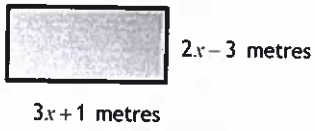
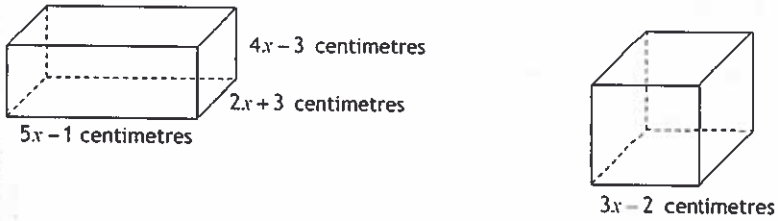
Bearsden Academy

S3 Block 1, 2 & 3 Revision Booklet

Topics:

- Removing Brackets
- Factorising
- Completing the Square
- Percentages
- Straight Line
- Volume & Surface Area
- Right-Angled Trig
- Angles in Circles
- Pythagoras
- Arcs & Sectors
- Similarity
- Statistics

Q	Questions	Marks
1 ◆ NC	Expand the brackets of the following expressions, simplifying where appropriate. (a) $r(4r-3t)$ (b) $2c(5a+3c)$ (c) $(p+2)(p+6)$ (d) $(h+4)(h-8)$	 1 1 2 2
2 ◆ NC	Expand and simplify the expression $(3x-1)(x+4)$	2
3 ◆ NC	Expand and simplify the expression $(2y+1)^2$	2
4 ◆ NC	Expand and simplify the expression $x(x-1)^2$	3
5 ◆ NC	Expand and simplify the expression $(2x+3)^2-3(x^2-6)$	3
6 ◆ * NC	Opposite is a rectangle with height $2x-3$ metres and breadth $3x+1$ metres. Find an expression for the area of this rectangle. Expand and simplify this expression.  $2x-3$ metres $3x+1$ metres	3
7 ◆ NC	A car is moving speed of $5x-1$ kilometres per hour for $x-7$ hours. Find an expression for the distance the car travels. Expand and simplify this expression.	3
8 ➢ NC	Expand and simplify $(x+2)(x^2+5x+4)$	3
9 ➢ NC	Expand and simplify $(2x-3)(5x^2-x-4)$	3

10 NC	**Extra Challenge:** Find an expanded expression for the difference between this cuboid and cube, given the cuboid is larger.  $4x-3$ centimetres $2x+3$ centimetres $5x-1$ centimetres $3x-2$ centimetres	
11 ◆ NC	Factorise the following (a) e^2+4e (b) $12af-18af^2$ (c) m^2-16 (d) $49-36g^2$ (e) $w^2+9w+14$ (f) $q^2-2q-15$ (g) $d^2-10d+24$	 1 1 1 1 2 2 2
12 ◆ # NC	(a) Factorise a^2-b^2 (b) Hence or otherwise, evaluate $9\cdot7^2-0\cdot3^2$	1 2
13 ◆ # NC	(a) Factorise $p^2+2pq+q^2$ (b) Hence or otherwise, evaluate $94^2+2\times94\times6+6^2$	1 2
14 ➢ NC	Fully factorise $2m^2-18$	2
15 ➢ NC	Fully factorise $5x^2-20y^2$	2
16 ➢ NC	Fully factorise $2x^2-6x-20$	3

17 NC	Fully factorise (a) $2x^2-5x-3$ (b) $3x^2-7x+2$ (c) $4x^2-5x-6$	 2 2 2
18 ◆ NC	Express the following in the form $(x+a)^2+b$ (a) $x^2+8x+10$ (b) $x^2+12x-3$ (c) x^2-4x-1	 2 2 2
19 ◆ NC	Given that $x^2-10x+18=(x+a)^2+b$ Find the values of a and b	 3
20 ◆ NC	Express x^2-3x+5 in the form $(x+p)^2+q$	 2
21 NC	**Extra Challenge:** Express $2x^2-12x+3$ in the form $2(x+a)^2+b$, stating the values of a and b.	
22 NC	**Extra Challenge:** Express $3x^2-4x-2$ in the form $3(x+a)^2+b$.	

[END OF REVISION QUESTIONS]

[Go to next page for the Marking Scheme]

Where suitable, you should always follow through an error as you may still gain partial credit. If you are unsure how to do this ask your teacher.

Q		Marking Scheme		
1 ◆ NC	(a)	•1 expand	•1	$4r^2-3rt$
	(b)	•2 expand	•2	$10ac+6c^2$
	(c)	•3 Expand brackets	•3	$p^2+2p+6p+12$
		•4 collect terms	•4	$p^2+8p+12$
	(d)	•5 Expand brackets	•5	$h^2+4h-8h-32$
		•6 collect terms	•6	$h^2-4h-32$
		Notes: 1. To gain •4 and •6, a squared term must appear in the expression		
2 ◆ NC		•1 Expand brackets	•1	$3x^2+12x-x-4$
		•2 collect terms	•2	$3x^2+11x-4$
		Notes: 1. To gain •2, a squared term must appear in the expression		
3 ◆ NC		•1 Expand brackets	•1	$(2y+1)(2y+1)=4y^2+2y+2y+1$
		•2 collect terms	•2	$4y^2+4y+1$
		Notes: 1. To gain •2, a squared term must appear in the expression		
4 ◆ NC		•1 Expand brackets	•1	$x(x-1)(x-1)=x(x^2-x-x+1)$
		•2 collect terms	•2	$x(x^2-2x+1)$
		•3 Final expansion	•3	x^3-2x^2+x
		Notes: 1. To gain •3, a cubed term must appear in the expression		
5 ◆ NC		•1 Expand first bracket	•1	$(2x+3)(2x+3)=4x^2+6x+6x+9$
		•2 Expand second bracket	•2	$-3x^2+18$
		•3 Collect like terms	•3	$x^2+12x+27$
		Notes: 1. For final answer $x^2+12x-9$ award 2/3		
6 ◆ NC		•1 State expression of the area	•1	$(3x+1)(2x-3)$
		•2 Expand expression	•2	$6x^2+2x-9x-3$
		•3 Collect like terms	•3	$6x^2-7x-3$
		Notes: 1. This question uses the formula for the area of a rectangle $A=lb$.		

7 ◆ NC		•1	State expression for the distance	•1	$(5x-1)(x-7)$
		•2	Expand expression	•2	$5x^2-x-7x+7$
		•3	Collect like terms	•3	$5x^2-8x+7$
		Notes: 1. This question uses the formula for distance $D=ST$			
8 ➢ NC		•1	Expand with at least three terms	•1	Eg $x^3+5x^2+4x\ldots$
		•2	Expand rest of the terms	•2	$\ldots 2x^2+10x+8$
		•3	Collect like terms	•3	$x^3+7x^2+14x+8$
		Notes: 1. For •1, any three of the six correct terms will gain this mark 2. For •3, The expression must contain a cubic term.			
9 ➢ NC		•1	Expand with at least three terms	•1	Eg $10x^3-2x^2-8x\ldots$
		•2	Expand rest of the terms	•2	$\ldots -15x^2-3x+12$
		•3	Collect like terms	•3	$10x^3-17x^2-11x+12$
		Notes: 1. For •1, any three of the six correct terms will gain this mark 2. For •3, The expression must contain a cubic term.			
10 NC	Extra Challenge $V_{difference}=(5x-1)(2x+3)(4x-3)-(3x-2)^3=13x^3+76x^2-47x+17$				
11 ◆ NC	(a)	•1	Factorise	•1	$e(e+4)$
	(b)	•2	Factorise	•2	$6af(2-3f)$
	(c)	•3	Factorise	•3	$(m-4)(m+4)$
	(d)	•4	Factorise	•4	$(7-6g)(7+6g)$
	(e)	•5	One factor correct	•5	$(w+7)$ or $(w+2)$ or $(w\ldots 7)(w\ldots 2)$
		•6	Fully factorised	•6	$(w+7)(w+2)$
	(f)	•7	One factor correct	•7	$(q+3)$ or $(q-5)$ or $(q\ldots 3)(q\ldots 5)$
		•8	Fully factorised	•8	$(q+3)(q-5)$
	(g)	•9	One factor correct	•9	$(d-6)$ or $(d-4)$ or $(d\ldots 6)(d\ldots 4)$
		•10	Fully factorised	•10	$(d-6)(d-4)$
		Notes: 1.			

12 ◆ # NC	(a)	•1	Factorise	•1	$(a+b)(a-b)$
	(b)	•2	Substitute	•2	$(9\cdot 7+0\cdot 3)(9\cdot 7-0\cdot 3)$
		•3	Evaluate (without a calculator)	•3	$(10)(9\cdot 4)=94$
		Notes: 1. Other methods are valid but we encourage the link between (a) and (b) as it is the most efficient method.			
13 ◆ # NC	(a)	•1	Factorise	•1	$(p+q)(p+q)$
	(b)	•2	Substitute	•2	$(94+6)(94+6)$
		•3	Evaluate (without a calculator)	•3	$(100)(100)=10000$
		Notes: 1. Other methods are valid but we encourage the link between (a) and (b) as it is the most efficient method.			
14 ➢ NC		•1	Common factor	•1	$2(m^2-9)$
		•2	Fully factorise	•2	$2(m+3)(m-3)$
		Notes: 1.			
15 ➢ NC		•1	Common factor	•1	$5(x^2-4y^2)$
		•2	Fully factorise	•2	$5(x+2y)(x-2y)$
		Notes: 1.			
16 ➢ NC		•1	Common factor	•1	$2(x^2-3x-10)$
		•2	First linear factor	•2	$(x+2)$ or $(x-5)$ or $(x\ldots 5)(x\ldots 2)$
		•3	Fully factorised	•3	$2(x-5)(x+2)$
		Notes: 1.			
17 ➢ NC	(a)	•1	One factor	•1	$(2x+1)$ or $(x-3)$ or $(2x\ldots 1)(x\ldots 3)$
		•2	Fully factorised	•2	$(2x+1)(x-3)$
	(b)	•3	One factor	•3	$(3x-1)$ or $(x-2)$ or $(3x\ldots 1)(x\ldots 2)$
		•4	Fully factorised	•4	$(3x-1)(x-2)$
	(c)	•5	One factor	•5	$(4x+3)$ or $(x-2)$ or $(4x\ldots 3)(x\ldots 2)$
		•6	Fully factorised	•6	$(4x+3)(x-2)$
		Notes: 1.			

18 ◆ NC	*(a)*	$\bullet^1$ Start process	$\bullet^1$	$(x+4)^2\ldots$
		$\bullet^2$ Complete the square	$\bullet^2$	$(x+4)^2-6$
	(b)	$\bullet^3$ Start process	$\bullet^3$	$(x+6)^2\ldots$
		$\bullet^4$ Complete the square	$\bullet^4$	$(x+6)^2-39$
	(c)	$\bullet^5$ Start process	$\bullet^5$	$(x-2)^2\ldots$
		$\bullet^6$ Complete the square	$\bullet^6$	$(x-2)^2-5$
		Notes: 1.		
19 ◆ NC		$\bullet^1$ Start process	$\bullet^1$	$(x-5)^2\ldots$
		$\bullet^2$ Complete square	$\bullet^2$	$(x-5)^2-7$
		$\bullet^3$ State values of a and b	$\bullet^3$	$a=-5,\ b=-7$
		Notes: 1.		
20 ◆ NC		$\bullet^1$ Start process	$\bullet^1$	$\left(x+\frac{3}{2}\right)^2\ldots$
		$\bullet^2$ Start to find q	$\bullet^2$	Eg $\ldots\frac{20}{4}-\frac{9}{4}$
		$\bullet^3$ Express answer	$\bullet^3$	$\left(x+\frac{3}{2}\right)^2+\frac{11}{4}$
		Notes: 1.		
21 NC	**Extra Challenge:** $2x^2-12x+3=2(x-3)^2-15.\ a=-3,\ b=-15$			
22 NC	**Extra Challenge:** $3x^2-4x-2=3\left(x-\frac{2}{3}\right)^2-\frac{22}{9}$			

[END OF MARKING SCHEME]

Corbett maths

Completing the Square
Video 10 on www.corbettmaths.com

Examples

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Workout

Question 1: Write the following expressions in the form $(x + a)^2 + b$

(a) $x^2 + 8x + 1$ (b) $x^2 + 10x + 3$ (c) $x^2 + 2x - 1$

(d) $x^2 - 6x - 10$ (e) $x^2 - 4x - 13$ (f) $x^2 - 12x + 3$

(g) $x^2 + 14x + 3$ (h) $x^2 - 2x - 15$ (i) $x^2 + 4x - 11$

(j) $x^2 + x - 8$ (k) $x^2 + 3x + 1$ (l) $x^2 - 7x - 2$

(m) $x^2 - 9x - 1$ (n) $x^2 + 11x + 3$ (o) $x^2 - 100x - 25$

Question 2: Solve the following equations (use completing the square).

(a) $x^2 + 4x + 1 = 0$ (b) $x^2 + 8x - 10 = 0$ (c) $x^2 + 14x - 4 = 0$

(d) $x^2 - 8x - 2 = 0$ (e) $x^2 - 10x + 10 = 0$ (f) $x^2 + 18x + 7 = 0$

(g) $x^2 + 12x + 3 = 19$ (h) $x^2 = 2x + 10$ (i) $x^2 - 7x - 3 = 0$

(j) $x^2 + x - 7 = 0$ (k) $x^2 + 3x + 8 = 0$ (l) $2x^2 - 10x - 30 = x^2 - 4x$

Question 3: Write the following expressions in the form $a(x + b)^2 + c$

(a) $2x^2 + 8x + 2$ (b) $2x^2 + 12x - 3$ (c) $3x^2 - 12x + 2$

(d) $4x^2 + 12x - 5$ (e) $2x^2 - 3x - 5$ (f) $5x^2 - 20x + 30$

Question 4: Solve the following equations (use completing the square).

(a) $3x^2 + 12x + 3 = 0$ (b) $2x^2 + 16x - 20 = 0$ (c) $3x^2 - 6x + 1 = 0$

(d) $5x^2 + 10x - 9 = 0$ (e) $2x^2 - 5x - 3 = 0$ (f) $2x^2 - 7x + 1 = 0$

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Apply

Question 1: Write $(x + 3)^2 - 4$ in the form $x^2 + bx + c$

Question 2: Write $(x - 2)^2 - 9$ in the form $x^2 + bx + c$

Question 3: Write $(x - 7)^2 + 11$ in the form $x^2 + bx + c$

Question 4: Use completing the square to find the minimum point for each graph below

(a) $y = x^2 + 10x + 12$ (b) $y = x^2 + 4x + 1$ (c) $y = x^2 + 6x + 8$

(d) $y = x^2 - 2x + 3$ (e) $y = x^2 - 6x - 3$ (f) $y = x^2 - x - 4$

(g) $y = x^2 + 9x + 1$ (h) $y = x^2 - 6x - 2$ (i) $y = x^2 + 22x + 100$

Question 5: By using completing the square to solve $ax^2 + bx + c = 0$, prove the quadratic formula.

Question 6: Can you spot any mistakes?

Solve $x^2 + 10x + 2 = 0$

$(x + 5)^2 - 10 + 2 = 0$

$(x + 5)^2 - 12 = 0$

$(x + 5)^2 = 12$

$x + 5 = \sqrt{12}$

$x = -5 + \sqrt{12}$

Answers

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Workout

Question 1

(a) $(x + 4)^2 - 15$ (b) $(x + 5)^2 - 22$ (c) $(x + 1)^2 - 2$

(d) $(x - 3)^2 - 19$ (e) $(x - 2)^2 - 17$ (f) $(x - 6)^2 - 33$

(g) $(x + 7)^2 - 46$ (h) $(x - 1)^2 - 16$ (i) $(x + 2)^2 - 15$

(j) $(x + 0.5)^2 - 8.25$ (k) $(x + 1.5)^2 - 1.25$ (l) $(x - 3.5)^2 - 14.25$

(m) $(x - 4.5)^2 - 21.25$ (n) $(x + 5.5)^2 - 27.25$ (o) $(x - 50)^2 - 2525$

Question 2

(a) $x = -2 + \sqrt{3}$ or $x = -2 - \sqrt{3}$

(b) $x = -4 + \sqrt{26}$ or $x = -4 - \sqrt{26}$

(c) $x = -7 + \sqrt{53}$ or $x = -7 - \sqrt{53}$

(d) $x = 4 + 3\sqrt{2}$ or $x = 4 - 3\sqrt{2}$

(e) $x = 5 + \sqrt{15}$ or $x = 5 - \sqrt{15}$

(f) $x = -9 + \sqrt{74}$ or $x = -9 - \sqrt{74}$

(g) $x = -6 + 2\sqrt{13}$ or $x = -6 - 2\sqrt{13}$

(h) $x = 1 + \sqrt{11}$ or $x = 1 - \sqrt{11}$

(i) $x = 1/2\,(7 + \sqrt{61})$ or $x = 1/2\,(7 - \sqrt{61})$

(j) $x = 1/2\,(-1 + \sqrt{29})$ or $x = 1/2\,(-1 - \sqrt{29})$

(k) No real roots

(l) $x = 3 + \sqrt{39}$ or $x = 3 - \sqrt{39}$

Question 3:

(a) $2(x + 2)^2 - 6$ (b) $2(x + 3)^2 - 21$ (c) $3(x - 2)^2 - 10$

(d) $4(x + 1.5)^2 - 14$ (e) $2(x - 0.75)^2 - 6.125$ (f) $5(x - 2)^2 + 10$

Question 4:

(a) $x = -2 + \sqrt{3}$ or $x = -2 - \sqrt{3}$

(b) $x = -4 + \sqrt{26}$ or $x = -4 - \sqrt{26}$

(c) $x = 1/3\,(3 + \sqrt{6})$ or $x = 1/3\,(3 - \sqrt{6})$

(d) $x = 1/5\,(-5 + \sqrt{70})$ or $x = 1/5\,(-5 - \sqrt{70})$

(e) $x = 3$ or $x = -1/2$

(f) $x = 1/4\,(7 + \sqrt{41})$ or $x = 1/4(7 - \sqrt{41})$

Apply

Question 1: $x^2 + 6x + 5$

Question 2: $x^2 - 4x - 5$

Question 3: $x^2 - 14x + 60$

Question 4

(a) (-5, -13) (b) (-2, -3) (c) (-3, -1) (d) (1, 2)

(e) (3, -12) (f) (0.5, -4.25) (g) (-4.5, -19.25)

(h) (3, -11) (i) (-11, -21)

Question 5: https://www.youtube.com/watch?v=A-JRFcexB78

Question 6:

Mistake 1 – it should be -25, not -10

Mistake 2 – if they added 2 to -10, it should be -8, not -12. It should be $-25 + 2 = 23$

Mistake 3 – they forgot the +/- in front of the $\sqrt{12}$, but it should be $\sqrt{23}$ anyway.

The correct answers should be: $x = -5 + \sqrt{23}$ or $x = -5 - \sqrt{23}$

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Compound Interest

Video 236 on www.corbettmaths.com

Examples

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Workout

Question 1: Paul leaves £4000 in the bank for two years.
It earns compound interest of 5% per year.
Calculate the total amount Paul has in the bank at the end of the two years.

Question 2: The population of birds on an island is estimated to increase by 10% every year.
The population of birds on the island is 20000.
Calculate an estimate for the population of birds in three years time.

Question 3: The value of a car decreases by 5% each year.
Sophie bought a car two years ago for £10000
Work out the value now.

Question 4: Sam invests £1800 in the bank for four years.
It earns compound interest of 4% each year.
Calculate the total amount Sam has in the bank at the end of four years.

Question 5: A full water tank holds 500 litres.
The tank begins to leak water and is losing 14% of its contents every hour.
Find how much water is left in the tank after 8 hours.

Question 6: The height of a tree increases by 60% each year.
When planted the tree was 40cm tall.
How tall will the tree be in 5 years time.

Question 7: Carrie invests £800 for 4 years at 3% interest per year.
How much interest does she earn?

Question 8: A house was bought for £100,000
Its value appreciates by 7.5% each year for the first three years.
What was its value at the end of the three years?

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Compound Interest

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Question 9: The number of people living on a remote island decreases by 9% every 10 years.
In 1950 there were 18000 living on the island.
Calculate how many less people will be living on the island in 2020.

Question 10: A car was bought for £20,000.
Its value depreciates by 31% each year for the first four years.
What is its values at the end of the four years?

Question 11: A tree is 80cm when planted.
Each year the height of the tree increases by 22%.
After how many complete years will the height of tree be at least 3m?

Question 12: The number of polar bears in a region is decreasing by 5% per year.
There are 3000 polar bears in the region in 2017.
What year will be the first year with less than 1000 polar bears in the region?

Question 13: Michael has started working for a company on a salary of £15000.
Each year he will be given a 6% pay rise.
How many years will it take for Michael's salary to exceed £30000?

Question 14: The value of a car decreases by 7.2% each year.
When bought the car cost £6200.
How many years will it take the car to have a value less than £1000?

Question 15: A full water tank has sprung a leak.
4% of the water is lost every minute.
What percentage of water is left in the tank after twenty minutes?

Question 16: A fish tank, that is full of water, has sprung a leak.
12% of the water is lost every hour.
What percentage of the water is lost after three hours?

Apply

Question 1: Florence invests £200 for two years at 5% compound interest, paid yearly.
Liam says that the interest that Florence will receive will be £20.
Is Liam right?

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Compound Interest

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Question 2: The value of a motorcycle was £14000 on 1st April 2014.
Every three months the value of the motorcycle decreases by 2% of its value at the start of that three months.
What was the value of the motorcycle on 1st April 2016?

Question 3: When a ball is dropped, it bounces and then rises.
The ball rises to 90% of the height from which it is dropped.
The ball is dropped from a height of 4m.

(a) Calculate the height of the rise after the first bounce.
(b) Calculate the height of the rise after the second bounce.

The ball carries on bouncing, each time rising to 90% of the last rise.
(c) For how many bounces does it rise to height greater than 1m?

Question 4: The population of a country is increasing by 5% a year.
How many years will it take the population of the country to double?

Question 5: Raheem and Ben invest money in 2010.

Raheem invests £1000 at Banks'R'us, who pay 3% interest per year.
Ben invests £1400 at Bank World, who pay 1% interest per year

In which year will Raheem's investment be worth more than Ben's?

Question 6: The population of a country increases by x% each year.
In 2014 the population of the country was 24,000,000.
Three years later, the population was 26,996,736.
Find x.

Question 7: Charlotte invests £5000.
The bank pays 10% interest for the first year and then y% every year after that.
After three years, Charlotte has £5610.55
Calculate y.

Answers

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Workout

Question 1: £4410

Question 2: 26620

Question 3: £9025

Question 4: £2105.74 or £2105.75

Question 5: 149.609 litres

Question 6: 419.4 cm or 4.194 m

Question 7: £100.40 or £100.41

Question 8: £124229.69

Question 9: 8698

Question 10: £4533.42

Question 11: 7 years

Question 12: 2039

Question 13: 12 years

Question 14: 25 years

Question 15: 44.2%

Question 16: 31.85%

Apply

Question 1: No, she will receive £20.50

Question 2: £11910.68

Question 3: (a) 3.6m (b) 3.24m (c) 14 bounces

Question 4: 15 years

Question 5: 2028

Question 6: 4%

Question 7: 1%

Corbett maths

Reverse Percentages

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Examples

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Workout

Question 1: 20% of all the children in a class are left handed.
4 children are left handed.
How many children are there in the class altogether?

Question 2: 30% of the members of a tennis club are pensioners.
36 members are pensioners.

(a) How many members are there in total?
(b) How many members are not pensioners?

Question 3: A group of people sit their driving theory test and 24 people passed.
80% of the people passed the driving theory test.
How many people sat the test altogether?

Question 4: An energy bar contains 2.1g of protein.
6% of the bar is protein.
What is the total mass of the bar?

Question 5: Swansea is a city in Wales.
The population of Swansea is 240,000
This population is 7.5% of the total population of Wales.
What is the total population of Wales?

Question 6: Heather invested money into a savers bank account.
Each year the money in the account earns 10% interest.
After one year, the total amount of money in the account was £2200
How much did Heather invest?

Question 7: A chair is on sale at a price of £20.80
This is a 20% reduction of the normal price.
What was the price of the chair before the reduction?

Question 8: The population of an island has decreased by 40% over 50 years.
The population in 2018 was 360
What was the population in 1968?

Question 9: Sinead buys a watch.
20% VAT is added to the price of the watch.
Sinead then has to pay a total of £60
What is the price of the watch with no VAT added?

Corbett maths

Reverse Percentages

Video 240 on www.corbettmaths.com

Question 10: Lucy has 68 books.
This number of books is 70% more than the number of books she had last year.
How many books did Lucy have last year?

Question 11: Henry invested money into a bank account.
Each year the money in the account earns 3% interest.
After one year, the total amount of money in the account was £169.95
How much did Henry invest?

Question 12: In a sale, the price of lawnmowers are decreased by 16%
Jude buys a lawnmower in the sale for £369.60
How much was the lawnmower before the sale?

Question 13: Evie is given a 22% pay rise.
Her new salary is £21960
What was Evie's salary before the pay rise?

Question 14: A limited edition bag of sugar contains 35% more than a standard bag.
The limited edition bag contains 702g of sugar.
How much sugar is in the standard bag?

Question 15: An oil tank has sprung a leak and loses 77.5% of its contents.
There is now 333 litres of oil in the oil tank.
How much oil was in the oil tank before the leak?

Question 16: Miss Jenkins buys a car costing £11895
This cost includes VAT at a rate of 20%
How much is the VAT?

Apply

Question 1: In a sale, a shop reduces all its prices by 10%.
On the last day of the sale, the shop reduces the sale prices by 20%

On the last day of the sale, a mobile phone costs £432

How much was the mobile phone before the sale?

Corbett maths

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Question 2: In 2008, Evan bought a car.

In 2010, Evan sold the car to Grace.
Evan made a loss of 25%

In 2018, Grace sold the car for £15225
Grace made a profit of 45%

Work out how much Evan bought the car for in 2008.

Question 3: There are 1500 people at an ice hockey match.
The announcer says that this is exactly 30% more people than the previous match.
Explain why the announcer is wrong.

Question 4: Gerard and Martin were both given a pay rise.
Gerard was given a 25% pay rise and Martin a 5% pay rise.
The ratio of Gerard's salary to Martin's salary is now 12:7
Martin is now paid £21000
Work out Gerard's pay before the pay rise.

Question 5: Michael bought a hat and a coat.
The hat cost £10
He sold both items for a total of £90
Michael made 200% profit on the hat and 80% profit on the total cost.
Work out the percentage profit on the cost of the coat.

Question 6: Leonie bought a hat and a coat.
The hat cost £6
She sold both items for a total of £45
Leonie made 300% profit on the hat and 125% profit on the total cost.
Work out her percentage profit on the cost of the coat.

Question 7: Trevor is a car salesman.
He bought a car for £5000
Currently he is holding a sale with 35% off the price of all cars.
Trevor wants to sell the car so that he makes a 10% profit on the price he paid.
How much should Trevor advertise the car for?

Answers

Click here

Reverse Percentages

Workout

Question 1:
20

Question 2:
(a) 120
(b) 84

Question 3:
30

Question 4:
35g

Question 5:
320, 0000

Question 6:
£2000

Question 7:
£26

Question 8:
600

Question 9:
£50

Question 10:
40

Question 11:
£165

Question 12:
£440

Question 13:
£18,000

Question 14:
520g

Question 15:
1480litres

Question 16:
£1982.50

Apply

Question 1:
£600

Question 2:
£14000

Question 3:
That would mean at the previous match there were 1153.846... people, which is not possible.

Question 4:
£28,800

Question 5:
50%

Question 6:
50%

Question 7:
£8461.54

Using Percentages

1. Bacteria in a test tube increase at the rate of 0.9% per hour.
At 12 noon there are 4500 bacteria.
At 3 pm, how many bacteria will be present?
Give your answer **to 3 significant figures.**

4 KU

2. In January 2001, it was estimated that the number of flamingos in a colony was 7000.
The number of flamingos is decreasing at the rate of 14% per year.
How many flamingos are expected to be in this colony in January 2005 ?
Give your answer **to the nearest 10.**

4 KU

3. In 1999, a house was valued at £70,000 and the contents were valued at £45,000.
The value of the house **appreciates** by 7% each year.
The value of the contents **depreciates** by 9% each year.
What will be the **total** value of the house **and** contents in 2002 ?

3 KU

4. A factory was put on the market in January 2001.

The site was in an excellent location so the value of the building has appreciated since then by 5.3% per year.

Unfortunately the plant & machinery were poorly maintained and have depreciated by 8·5% per year.

The value of the building was £435 000 and the value of the plant & machinery was £156 000 in January 2001.

What would be the expected value of the complete factory in January 2003 ?

4 KU

5. How much would the Strachans pay for a new iron, priced £16.50 at Watsons ?

WATSON'S SALE
$66\frac{2}{3}$ % off everything

3 KU

6. In 1995, the price of 1 litre of a certain kind of petrol was 54.9 pence

By 1996, the price of 1 litre of the same kind of petrol had risen to 56.3 pence.

The percentage increase for each of the next four years is expected to be the same as the percentage increase between 1995 and 1996.

What is the price of 1 litre of petrol expected to be in the year 2000?

4 RE

Reversing the change

7. A computer is sold for £695. This price includes VAT at 17.5%
Calculate the price of the computer **without** VAT.

3 KU

8. During the Christmas Sales a shopkeeper sold 60% of his "Santa Claus Dolls"
He then found he was left with 50 dolls.
How many dolls had he in stock to begin with ?

3 KU

9. Kerry bought a new car in 1996. When she sold it four years later, she found that it had reduced in value by 60% and she received only £4640.
How much had Kerry paid for the car in 1996 ?

3 KU

10. James bought a car last year. It has lost 12½ % of its value since then.
It is now valued at £14 875.
How much did James pay for his car.

2 KU

Solutions 1
Decimals, Fractions, Percentage & Standard Form.

Decimals

1. $8.1 - 4.85 = \mathbf{3.25}$
2. $43 - 22.4 = \mathbf{20.6}$
3. $5.7 + 15.6 = \mathbf{21.3}$
4. $31.4 - 9.03 = \mathbf{22.37}$

Fractions

5. $6 + \frac{25}{30} + \frac{18}{30} = 6 + \frac{43}{30} = 7\frac{13}{30}$
6. $3 + \frac{6}{15} - \frac{10}{15} = 3 - \frac{4}{15} = 2\frac{11}{15}$
7. $\frac{11}{\cancel{4}^{1}} \times \frac{\cancel{4}^{1}}{3} = \frac{11}{3} = 3\frac{2}{3}$
8. $\frac{11}{2} \div \frac{11}{3} = \frac{\cancel{11}^{1}}{2} \times \frac{3}{\cancel{11}^{1}} = \frac{3}{2} = 1\frac{1}{2}$
9. $\frac{3}{8} \times \left(\frac{5}{3} - \frac{4}{7}\right) = \frac{3}{8} \times \left(\frac{35}{21} - \frac{12}{21}\right) = \frac{\cancel{3}^{1}}{8} \times \frac{23}{\cancel{21}^{7}} = \frac{23}{56}$
10. $\frac{3}{7} \times \left(\frac{11}{6} + \frac{3}{4}\right) = \frac{3}{7} \times \left(\frac{22}{12} + \frac{9}{12}\right)$
    $= \frac{\cancel{3}^{1}}{7} \times \frac{31}{\cancel{12}^{4}} = \frac{31}{28} = 1\frac{3}{28}$

Various

11. $23 + 36 \times \frac{3}{4} = 23 + \frac{\cancel{36}^{9}}{1} \times \frac{3}{\cancel{4}^{1}} = 23 + 27 = 50$
12. 10% is £85 × 3 = £255
    1% = £8.50 × 2 = £ 17
    32% is £272
13. $\frac{1}{8}$ of 544 is 68, so $\frac{3}{8}$ is $68 \times 3 = 204$

Using Percentages

1. $4500 \times 1.009^{3} = 4622.59678\ldots$ **4620 (3 sf)**
2. $7000 \times 0.86^{4} = 3829.0571\ldots$ **3830 (nst 10)**
3. House: £ 70 000 × 1.07^{3} = £ 85 753.01
   Contents: £ 45 000 × 0.91^{3} = £ 33 910.70
   Total value: = **£ 119 663.71**
4. Factory: £ 435 000 × 1.053^{2} = £ 482 331.92
   Plant & Mcy: £ 156 000 × 0.915^{3} = £ 130 607.10
   Total value: = **£ 612 939.02**
5. $66\frac{2}{3}\% = \frac{2}{3}$ So, $\frac{2}{3}$ off means you pay $\frac{1}{3}$
   They pay $\frac{1}{3}$ of £ 16.50 = £ 5.50
6. Percentage Increase = $\frac{1.4}{54.9} \times 100 = 2.55\%$
   Price in 2000 = 56.3×1.0255^{4} = 62.3 p per litre

Reversing the change

7. Ex-VAT Price × 1.175 = £695
   Ex-VAT Price = £695 ÷ 1.175 = **£ 591.49**
8. Stock × 0.4 = 50 (60% sold = 40% left)
   Stock = 50 ÷ 0.4 = 125
9. Original Price × 0.4 = £ 4640
   Original Price = £ 4640 ÷ 0.4 = £ 11 600
10. Original Price × 0.875 = £ 14 875
    Original Price = £ 14 875 ÷ 0.875 = £ 17 000

Standard Form

1. $8 \times 4.80 \times 10^{8} = 3.84 \times 10^{9}$
2. $7.1 \times 10^{7} \div 300 = 2.4 \times 10^{5}$
3. Time = Distance ÷ Speed
   Time = $2.3 \times 10^{8} \div 3.0 \times 10^{5}$
   Time = 766.67 sec = 13 minutes.
4. Distance = circumference = $2\pi r$
   Distance = $2\pi \times 0.6 \times 10^{7}$
   Speed = Distance ÷ Time
   Time = 88 × 24 = 2112 hours
   Speed = $2\pi \times 0.6 \times 10^{7} \div 2112$
   Speed = 17 849. 95… = 18 000 kph (2 sf)
5. $1.8 \times 10^{3} \times 9.11 \times 10^{-31} = 1.6398 \times 10^{-27}$
   $= 1.6 \times 10^{-27}$ kg (2 sf)
6. $5 \times 10^{6} \times 9.46 \times 10^{12}$ km
   $= 4.73 \times 10^{19}$ km
7. 1 year (not leap year) = 365 × 24 × 60 × 60
   = 31536000 seconds
   Profit = £ $3.2 \times 10^{9} \div 31536000$ = £101.47133….
   = £ 101 per second.
8. No. of days = 26 (J) + 31(J) + 31(A) + 20 (S)
   = 108
   $2.925 \times 10^{7} \div 108 = 270\,833.333$
   = 270 833 visitors per day
9. $5.97 \times 10^{24} \div 2.2 \times 10^{30} \times 100$
   = 0.0002713…… %
   = 2.71×10^{-4} % (3 sf)

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Equation of a Line

Videos 191, 194, 195 on www.corbettmaths.com

Examples

Workout

Click here

Scan here

Question 1: Write down the gradient of each of these lines.

(a) $y = 3x + 1$ (b) $y = 2x - 5$ (c) $y = 7x + 4$ (d) $y = 10x + 5$

(e) $y = x - 2$ (f) $y = 6x$ (g) $y = -4x + 3$ (h) $y = -3x - 7$

(i) $y = \frac{1}{2}x + 3$ (j) $y = -\frac{4}{5}x - 9$

Question 2: Write down where each of these lines cross the y-axis (y-intercept)

(a) $y = 2x + 3$ (b) $y = 7x + 1$ (c) $y = 3x - 2$ (d) $y = x - 5$

(e) $y = 2x$ (f) $y = -4x + 6$ (g) $y = -5x - 3$ (h) $y = -3x$

(i) $y = \frac{4}{3}x + \frac{2}{5}$ (j) $y = -\frac{2}{3}x - \frac{1}{2}$

Question 3: Write down the equation of the lines below

(a) gradient of 3 and y–intercept of 6

(b) gradient of 2 and y–intercept of –1

(c) gradient of –4 and y–intercept of 3

(d) gradient of 8 and y–intercept of 4

(e) gradient of 1 and passing though (0, 4)

(f) passing through (0, –2) with gradient 4

(g) gradient of –5 and passing through the origin.

Question 4:

(a) Does the point (2, 5) lie on the line $y = 3x - 1$?

(b) Does the point (4, 1) lie on the line $y = 3x + 1$?

(c) Does the point (3, 1) lie on the line $y = x - 3$?

(d) Does the point (5, 7) lie on the line $y = -3x + 22$?

(e) Does the point (–4, –8) lie on the line $y = -2x$?

(f) Does the point (–1, 8) lie on the line $y = 2x + 11$?

(g) Does the point (12, 60) lie on the line $y = 7x - 18$?

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Equation of a Line

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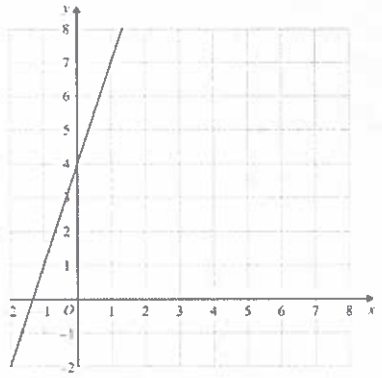
Question 5: Find the equation of each line

(a)



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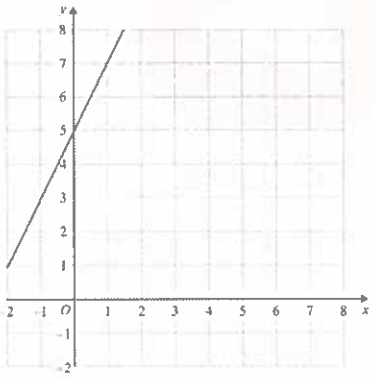

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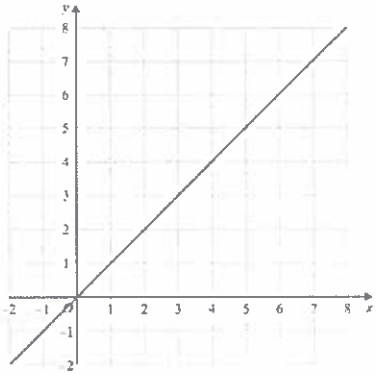

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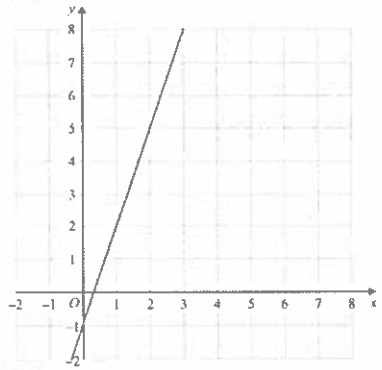

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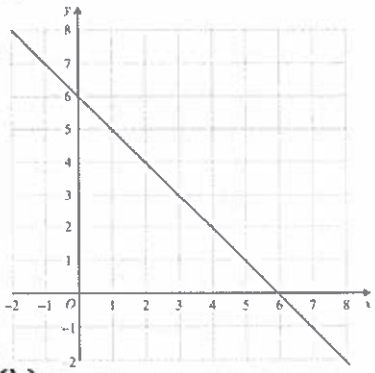
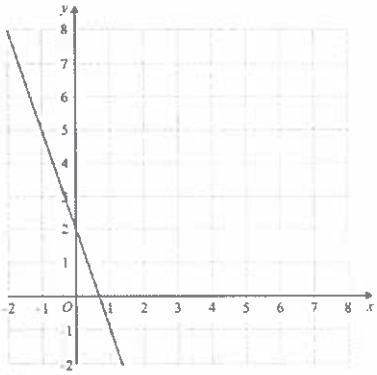
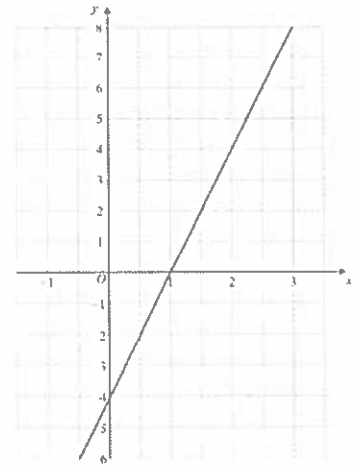


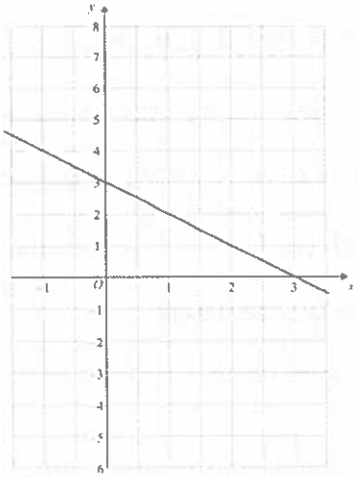
(f)



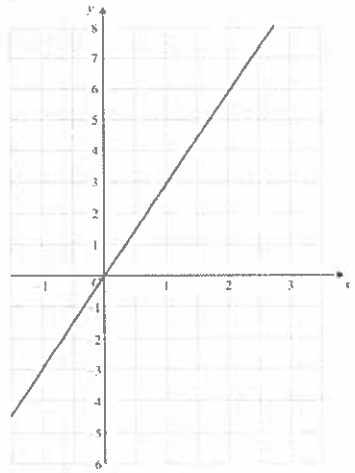
(g)



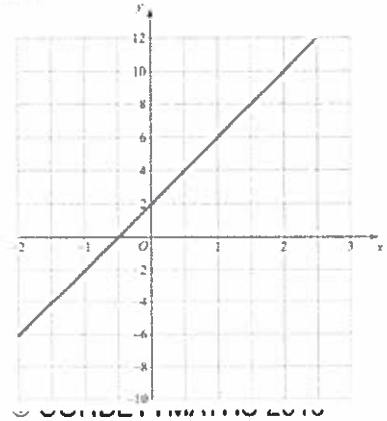
(h)



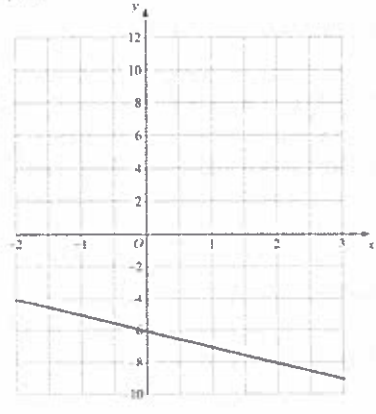
(i)



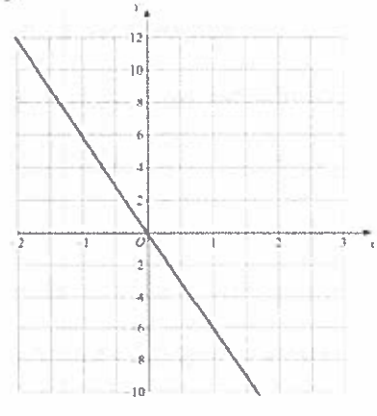
(j)



(k)



(l)



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Equation of a Line

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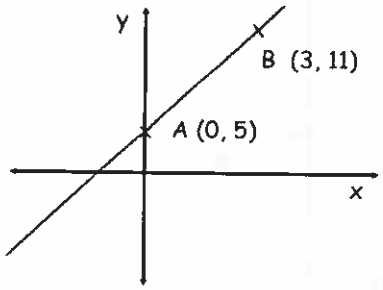
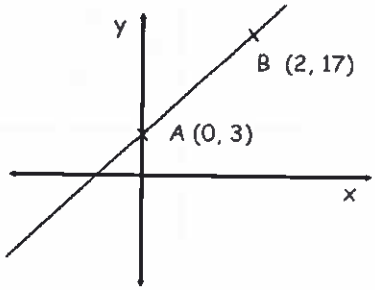
Question 6: Find the equation of each line below.

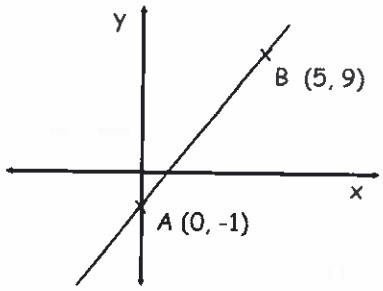
(a)



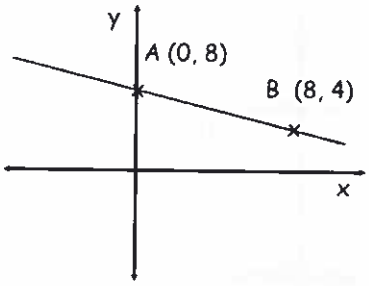
(b)



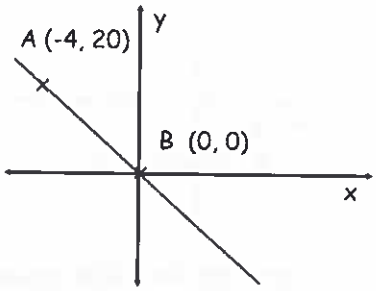
(c)



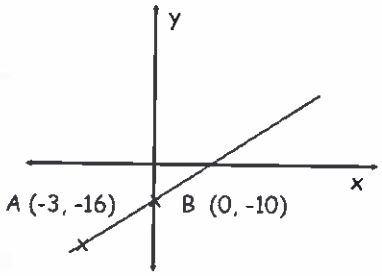
(d)



(e)



(f)



Question 7: Find the equation of the straight line that passes through the points

(a) (0, 3) and (4, 19)

(b) (0, 2) and (6, 20)

(c) (0, 0) and (1, 4)

(d) (0, −9) and (9, 0)

(e) (0, −6) and (7, 8)

(f) (−8, −10) and (0, 14)

(g) (0, 2) and (10, 7)

(h) (−4, 1) and (0, 7)

(i) (−4, 0) and (0, 18)

Question 8: Find the equation of the straight line that:

(a) has a gradient of 4 and passes through the point (1, 10)

(b) has a gradient of 2 and passes through the point (−3, 3)

(c) has a gradient of 1 and passes through the point (5, 2)

(d) has a gradient of −3 and passes through the point (−2, 8)

(e) has a gradient of −5 and passes through the point (3, −1)

(f) has a gradient of ½ and passes through the point (4, 5)

(g) has a gradient of ⅖ and passes through the point (−5, −5)

(h) has a gradient of −⅔ and passes through the point (9, 15)

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Equation of a Line

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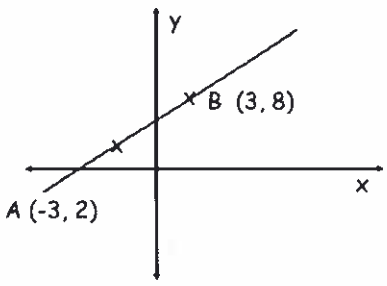
Question 9: Find the equations of the lines below

(a)



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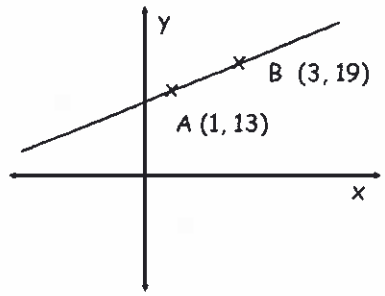
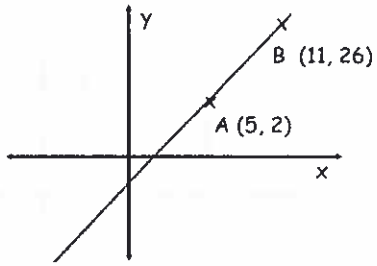
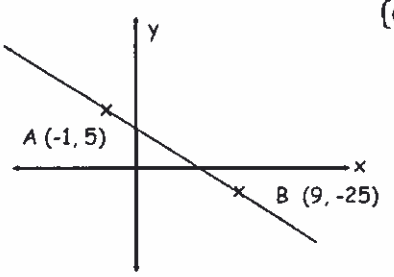


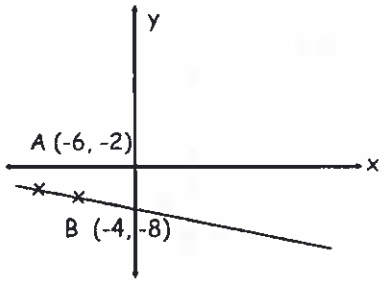
(c)



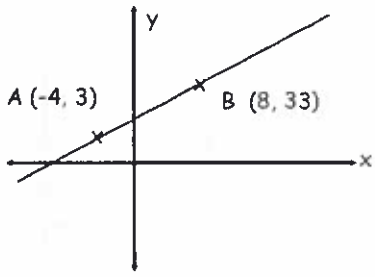
(d)



(e)



(f)



Question 10: Find the equation of the straight line that passes through these pairs of points

(a) (2, 5) and (4, 11) (b) (−4, 2) and (1, 7) (c) (−5, −8) and (−4, −4)

(d) (−1, −2) and (−6, 3) (e) (−6, −4) and (−3, 2) (f) (3, 5) and (4, 1)

(g) (−5, 4) and (5, 2) (h) (1, 6) and (5, 4) (i) (−10, −5) and (−7, 4)

Question 11: Find the coordinates where the following lines cross the x-axis

(a) $y = 2x + 6$ (b) $y = -x + 4$ (c) $y = 3x + 9$

(d) $y = x - 5$ (e) $y = 4x + 1$ (f) $y = -2x + 10$

(g) $y = -4x - 10$ (h) $y = 5x + 3$ (i) $y = \frac{1}{2}x + 3$

(j) $x + y = 8$ (k) $4x + 2y + 7 = 0$ (l) $3x + 2y - 8 = 0$

Question 12: Find the gradients and the y-intercepts of each of these lines

(a) $x + y = 10$ (b) $x - y = 4$ (c) $2x + y = 6$

(d) $3x - y = -1$ (e) $8x + 2y + 9 = 0$ (f) $5x - 2y - 4 = 0$

(g) $7x = 1 - 2y$ (h) $15y - 6x = 8$ (i) $\frac{2}{3}x + 2y = 5$

(j) $\frac{1}{5}y - \frac{1}{2}x = 1$ (k) $\frac{2}{3}x + \frac{3}{4}y = 1\frac{1}{2}$

Equation of a Line

Workout

Question 1:

(a) 3 (b) 2 (c) 7 (d) 10

(e) 1 (f) 6 (g) -4 (h) -3

(i) $\frac{1}{2}$ (j) $-\frac{4}{5}$

Question 2:

(a) (0,3) (b) (0,1) (c) (0,-2) (d) (0,-5)

(e) (0,0) (f) (0,6) (g) (0,-3) (h) (0,0)

(i) $(0, \frac{2}{5})$ (j) $(0, -\frac{1}{2})$

Question 3:

(a) $y = 3x + 6$ (b) $y = 2x - 1$

(c) $y = -4x + 3$ (d) $y = 8x + 4$

(e) $y = x + 4$ (f) $y = 4x - 2$

(g) $y = -5x$

Question 4:

(a) Yes (b) No (c) No (d) Yes

(e) No (f) No (g) No

Question 5:

(a) $y = 3x + 4$ (b) $y = 2x + 5$ (c) $y = x$

(d) $y = 3x - 1$ (e) $y = -x + 6$ (f) $y = -3x + 2$

(g) $y = 4x - 4$ (h) $y = -x + 3$ (i) $y = 3x$

(j) $y = 4x + 2$ (k) $y = -x - 6$ (l) $y = -6x$

Question 6:

(a) $y = 2x + 5$ (b) $y = 7x + 3$ (c) $y = 2x - 1$

(d) $y = -\frac{1}{2}x + 8$ (e) $y = -5x$ (f) $y = 2x - 10$

Question 7:

(a) $y = 4x + 3$ (b) $y = 3x + 2$ (c) $y = 4x$

(d) $y = x - 9$ (e) $y = 2x - 6$ (f) $y = 3x + 14$

(g) $y = \frac{1}{2}x + 2$ (h) $y = 1.5x + 7$ (i) $y = 4.5x + 18$

Question 8:

(a) $y = 4x + 6$ (b) $y = 2x + 9$ (c) $y = x - 3$

(d) $y = -3x + 2$ (e) $y = -5x + 14$ (f) $y = \frac{1}{2}x + 3$

(g) $y = \frac{2}{5}x + 3$ (h) $y = -\frac{2}{3}x + 21$

Question 9:

(a) $y = x + 5$ (b) $y = 3x + 10$ (c) $y = 4x - 18$

(d) $y = -3x + 2$ (e) $y = -3x - 20$ (f) $y = 2.5x + 13$

Question 10:

(a) $y = 3x - 1$ (b) $y = x + 6$ (c) $y = 4x + 12$

(d) $y = -x - 3$ (e) $y = 2x + 8$ (f) $y = -4x + 17$

(g) $y = -\frac{1}{5}x + 3$ (h) $y = -\frac{1}{2}x + 6\frac{1}{2}$ (i) $y = 3x + 25$

Question 11:

(a) (-3,0) (b) (4,0) (c) (-3,0)

(d) (5,0) (e) $(-\frac{1}{4}, 0)$ (f) (5,0)

(g) $(-\frac{5}{2}, 0)$ (h) $(-\frac{3}{5}, 0)$ (i) (-6,0)

(j) (8,0) (k) $(-\frac{7}{4},0)$ (l) $(\frac{8}{3},0)$

Question 12:

(a) gradient = -1 y-intercept = 10 (b) gradient = 1 y-intercept = 4

(c) gradient = -2 y-intercept = 6 (d) gradient = 3 y-intercept = 1

(e) gradient = -4 y-intercept = $-\frac{9}{2}$ (f) gradient = $\frac{5}{2}$ y-intercept = -2

(g) gradient = $-\frac{7}{2}$ y-intercept = $\frac{1}{2}$ (h) gradient = $\frac{6}{15}$ y-intercept = $\frac{8}{15}$

(i) gradient = $-\frac{1}{3}$ y-intercept = $\frac{5}{2}$ (j) gradient = $\frac{5}{2}$ y-intercept = 5

(k) gradient = $-\frac{4}{3}$ y-intercept = 2

Apply

Question 1: Line B $y = -3x + 13$

Question 2: Yes

Question 3: (a) (-3,0) (b) (0,6) (c) $y = 2x + 6$

Question 4: No – one has a gradient of 3 and the other has a gradient of 2.

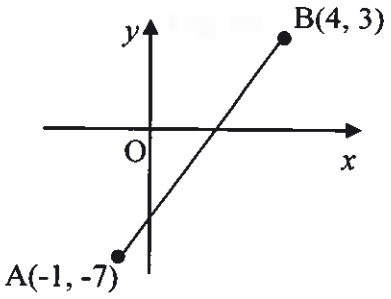
Question 5: (a) (10,6) (b) $y = -3x + 18$

Question 6: She has noticed that the gradient should be negative, but she has used the co-ordinates of the x-intercept. The equation should be $y = -4x + 8$

10. Gradients & The Straight Line

Finding Equations

1. In the diagram, A is the point (-1, 7) and B is the point (4, 3).



a) Find the gradient of the line AB. 1 KU

b) AB cuts the y-axis at the point (0, -5). Write down the equation of the line AB 1 KU

c) The point $(3k, k)$ lies on AB Find the value of k. 2 RE

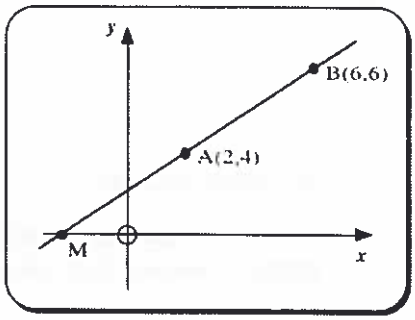
2. A is the point (a^2, a)

T is the point (t^2, t) $a \neq t$

Find the gradient of the line AT

Give your answer in its simplest form. 3 KU

3. The straight line through the points A(2, 4) and B(6, 6) is shown in the diagram.

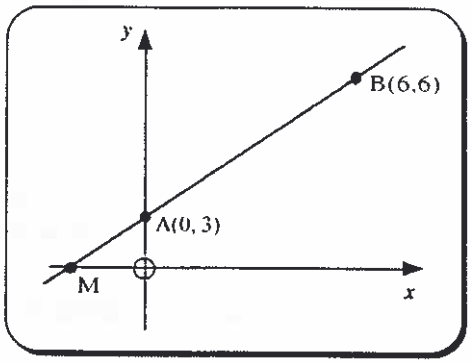


The point M is where the line AB cuts the x-axis.

a) Find the equation of the straight line AB. 4 KU

b) Use this equation to find the coordinates of the point M. 2 RE

4. The straight line through the points A(0, 3) and B(6, 6) is shown in the diagram.

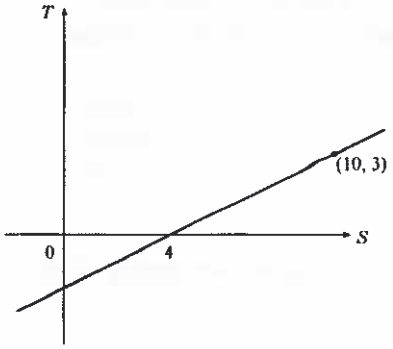


The point M is where the line AB cuts the x-axis.

a) Find the equation of the straight line AB. 4 KU

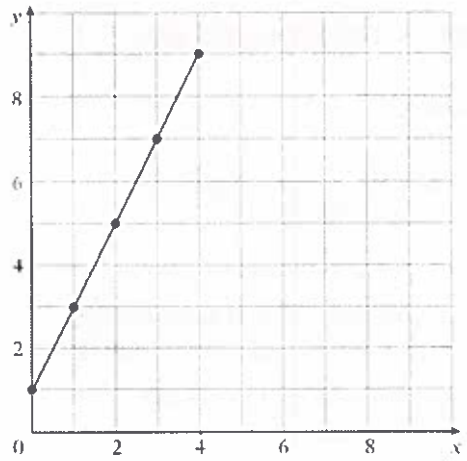
b) Use this equation to find the coordinates of the point M. 2 RE

5. Find the equation of the given straight line in terms of S and T.

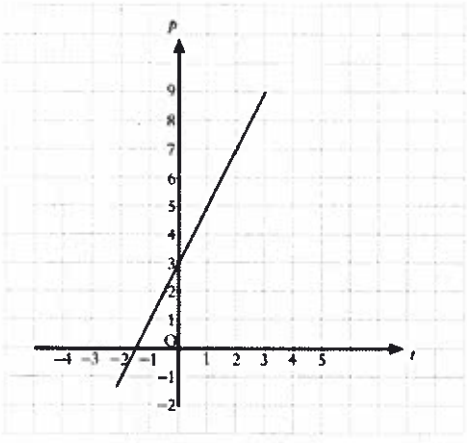


4 KU

6. Find the equation of the straight line. 3 KU



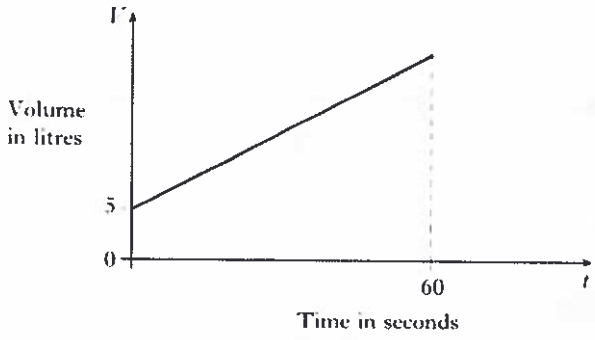
7.



Find the equation of the straight line in terms of p and t. 4 KU

8. The tank of a car contains 5 litres of petrol.

The graph below shows how the volume of petrol in this tank changes as a further 45 litres of petrol is pumped in at a steady rate for 60 seconds.



Find the equation of the straight line in terms of V and t. 4 KU

9. A tank contains 10 litres of water.

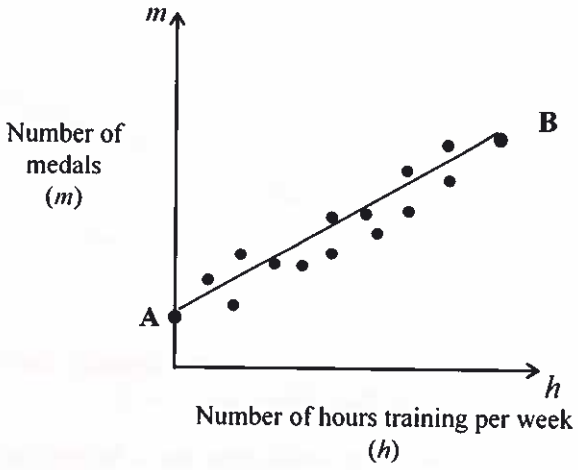
A further 30 litres of water is poured into the tank at a steady rate of 5 litres per minute.

a) On the 2mm square ruled graph paper provided, draw a graph of the volume, V litres, of water in the tank against the time, t minutes. 4 KU

b) Write down an equation connecting V and t. 2 KU

Applications of the Equation of a Straight Line

1. The graph shows the relationship between the number of hours (h) an athlete trains per week and the number of Championship medals (m) they have won.



A best fitting straight line AB has been drawn.

Athlete A does not train but has won 4 medals this year.

Athlete B who trains for 12 hours per week has won 40 medals this year.

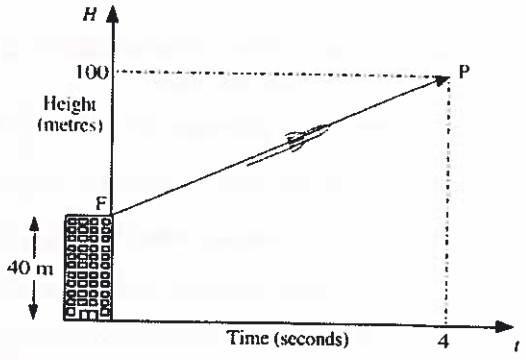
(a) Find the equation of the straight line AB in terms of m and h. 4 RE

(b) How many medals would you expect an athlete who trains 8 hours per week to have won ? 1 KU

2. A boy sets of a rocket from the top of a 40 metre high block of flats.

The diagram shows the path of the rocket over the first 4 seconds.

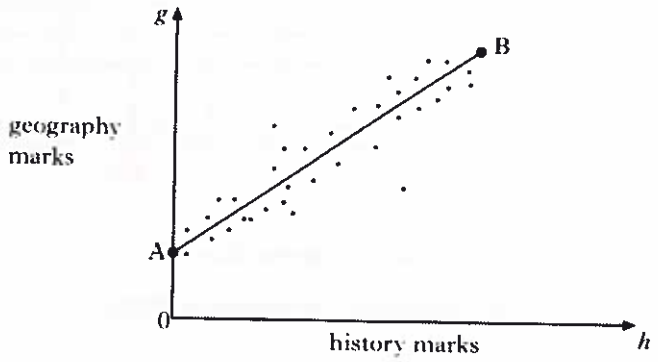
It is represented by the straight line in the graph.



After 4 seconds, the rocket has reached a point 100 metres above the ground.

Find the equation of the straight line FP in terms of H and t. 4 RE

3. The graph below shows the relationship between the history and geography marks of a class of students



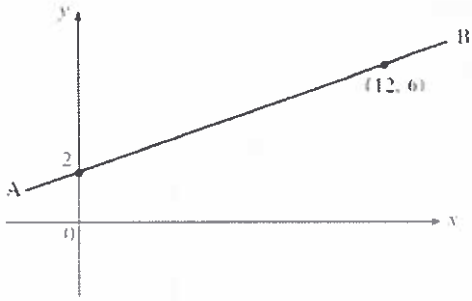
A best fitting straight line, AB has been drawn.

Point A represents 0 marks for history and 12 marks for geography.

Point B represents 90 marks for history and 82 marks for geography.

Find the equation of the straight line AB in terms of h and g. 4 RE

4. A water pipe runs between two buildings.
These are represented by the points A and B in the diagram below.



a) Using the information in the diagram, show that the equation of the line AB is $3y - x = 6$. 3 KU

b) An emergency outlet pipe has to be built across the main pipe.
The line representing this outlet pipe has equation $4y + 5x = 46$

Calculate the coordinates of the point on the diagram at which the outlet pipe will cut across the main water pipe. 4 RE

5. When a patient's blood pressue (B.P.), is taken, two measurements are made.

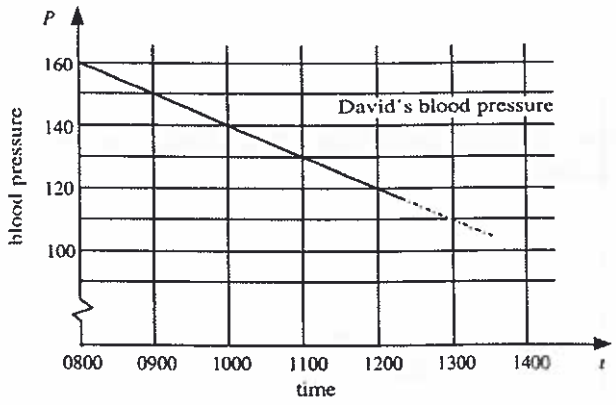
For example, in **"160 over 70"** (or $\frac{160}{70}$),

$\Rightarrow$ the 160 is the reading when the heart is pumping.

$\Rightarrow$ the 70 is the reading when the heart is at rest.

David has a heart problem, and has his blood pressure taken every hour.

The first number of these two measurements is monitored very carefully and the nurse plots a graph, showing the changes from 8 am.



a) Find the gradient of the line shown above. 2 KU

b) Write down the equation of the line in the form

$P =$ ..... 2 KU

c) It is known that if the blood pressure drops below 70, the patient will be in danger of losing consciousness.

If David's blood pressure continues to drop in the way indicated, when might he be expected to become unconscious. 3 RE

Solutions

10 Gradient and Straight Line

1. a) Gradient AB $= \frac{3-(-7)}{4-(-1)} \rightarrow \frac{10}{5} \rightarrow 2$

   b) Use $y = mx + c$ Eqn is: $y = 2x - 5$

   c) (3k, k) lies on AB, so it will satisfy the equation

   Hence, $k = 2(3k) - 5$ $k = 6k - 5$ $5 = 5k$ $k = 1$

---

2. Gradient $= \frac{a-t}{a^2-t^2} = \frac{\cancel{a-t}}{(a+t)\cancel{(a-t)}} = \frac{1}{a+t}$

---

3. a) Gradient AB $= \frac{6-4}{6-2} \rightarrow \frac{2}{4} \rightarrow \frac{1}{2}$

   Use $y = mx + c$, so $y = \frac{1}{2}x + c$

   Need to find c, so use point (2, 4)

   $4 = \frac{1}{2}(2) + c$ $4 = 1 + c$ $c = 3$

   Equation is $y = \frac{1}{2}x + 3$

   b) To find M, we know that $y = 0$

   Hence $0 = \frac{1}{2}x + 3$ solving gives $x = -6$

---

4. This is a simplified version of Question 3.

---

5. Gradient $= \frac{3-0}{10-4} \rightarrow \frac{3}{6} \rightarrow \frac{1}{2}$

   So, $T = \frac{1}{2}S + c$

   Find c using (4, 0) in the equation

   $0 = \frac{1}{2}(4) + c$ $0 = 2 + c$ $c = -2$

   Equation is: $T = \frac{1}{2}S - 2$

---

6. Gradient $= \frac{9-1}{4-0} \rightarrow \frac{8}{4} \rightarrow 2$

   y-intercept = 1 Equation is: $y = 2x + 1$

---

7. Gradient $= \frac{9-3}{3-0} \rightarrow \frac{6}{3} \rightarrow 2$

   y-intercept = 3 Equation is: $y = 2x + 3$

---

8. Gradient $= \frac{50-5}{60-0} \rightarrow \frac{45}{60} \rightarrow \frac{3}{4}$

   y-intercept = 5 Equation is: $y = \frac{3}{4}x + 5$

---

9. a) Draw graph - plot points (0, 10) – initial state and (6, 40) - 6 mins to add 30 litres at 5 litres/min and 40 litres (30 litres added to existing 10)

   b) Gradient $= \frac{40-10}{6-0} \rightarrow \frac{30}{6} \rightarrow 5$

   y-intercept = 10

   Equation is: $V = 5x + 10$

Applications of straight line

1. B is (12, 40) and A is (0, 4)

   Gradient $= \frac{40-4}{12-0} \rightarrow \frac{36}{12} \rightarrow 3$, y-intercept = 4

   Equation is: $m = h + 4$

---

2. Gradient $= \frac{100-40}{4-0} \rightarrow \frac{60}{4} \rightarrow 15$, y-intercept = 40

   Equation is: $H = 15t + 40$

---

3. B is (90, 82) and A is (0, 12)

   Gradient $= \frac{82-12}{90-0} \rightarrow \frac{70}{90} \rightarrow \frac{7}{9}$, y-intercept = 12

   Equation is: $g = \frac{7}{9}h + 12$

---

4. a) Gradient $= \frac{6-2}{12-0} \rightarrow \frac{4}{12} \rightarrow \frac{1}{3}$, y-intercept = 2

   Equation is: $y = \frac{1}{3}x + 2 \rightarrow 3y = x + 6$

   which can be re-arranged to: $3y - x = 6$

   b) Solve simultaneously: $3y - x = 6$ .....(1)
   $4y + 5x = 46$ .....(2)

   multiply (1) by 5 and add giving $y = 4$

   substitute into (1) giving $x = 6$

   Co-ordinates are: (6, 4)

---

5. a) Gradient $= \frac{120-160}{12-8} \rightarrow \frac{-40}{4} \rightarrow -10$

   Equation is: $P = -10t + 160$ or $P = 160 - 10t$

   b) Put $P = 70$

   $70 = 160 - 10t$ and solve for t

   $10t = 160 - 70$ $10t = 90$ $t = 9$

   Expected to be unconscious at 1700 hrs

---

6. Draw graph – plot points (0, 240) and (12, 0)

   Gradient $= \frac{0-240}{12-0} \rightarrow \frac{-240}{12} \rightarrow -20$

   y-intercept = 240

   Hence equation is: $V = -20t + 240$ or $V = 240 - 20t$

---

7. Gradient $= \frac{162-138}{80-0} \rightarrow \frac{24}{80} \rightarrow \frac{3}{10}$

   y-intercept = 138

   Hence equation is: $s = \frac{3}{10}t + 138$

Corbett maths

Surface Area: Cubes/Cuboids

Video 310 on www.corbettmaths.com

Examples

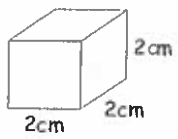
Click here

Scan here

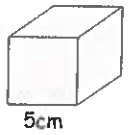
Workout

Question 1: Work out the surface area of each of the following cubes.

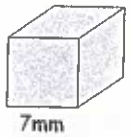
(a)



(b)

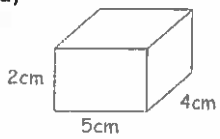


(c)

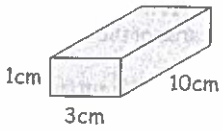


Question 2: Work out the surface area of each of the following cuboids.

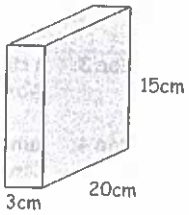
(a)



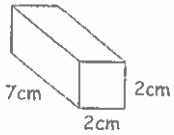
(b)



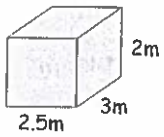
(c)



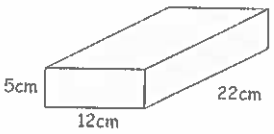
(d)



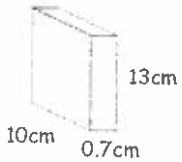
(e)



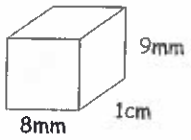
(f)



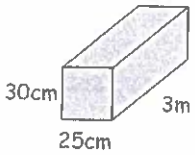
(g)



(h)



(i)



Question 3: Calculate the surface area of a cube with side length 12cm

Question 4: Calculate the surface area of a cube with side length ½ cm

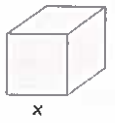
Corbett maths

Surface Area: Cubes/Cuboids

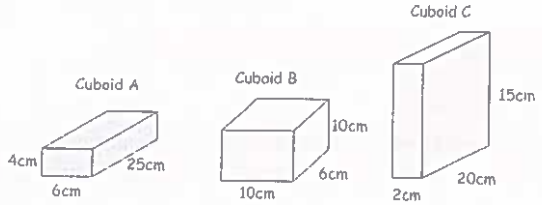
Video 310 on www.corbettmaths.com

Apply

Question 1: A cube has a surface area of $54cm^2$
Find the side length, x, of the cube



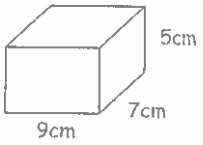
Question 2: A company is designing a new box to hold coffee.
They have 3 designs, cuboids A, B and C.
All 3 designs have the same volume of $600cm^3$
The company want to choose the design with the smallest surface area.
Which cuboid should they choose?



Question 3: A cube has a volume of $1000cm^3$.
Work out the surface area of the cube.

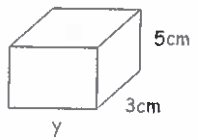
Question 4: Jamie is trying to work out the surface area of the cuboid below.
Can you spot any mistakes?

$$9 \times 5 = 45$$
$$7 \times 5 = 35$$
$$9 \times 7 = 63$$
$$45 + 35 + 63 = 143cm^3$$

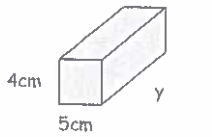


Question 5: Find y for each of the cuboids below

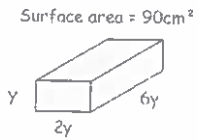
(a)



(b)



(c)



Answers

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Workout

Question 1:

(a) 24cm² (b) 150cm² (c) 294mm²

Question 2:

(a) 76cm² (b) 86cm² (c) 810cm²

(d) 64cm² (e) 37cm² (f) 868cm²

(g) 292.2cm² (h) 484mm² (i) 17250cm²

Question 3: 864cm²

Question 4: 1.5cm²

Apply

Question 1: x = 3cm

Question 2: Cuboid B has the lowest surface area (440cm²)

Question 3: 600cm²

Question 4: He has only considered the top, front and right hand side, not the bottom, back and left hand side. So he needs to multiply his answer by 2. Also the units should be cm²

Question 5: (a) 8cm (b) 17cm (c) 1.5cm

Corbett maths

Surface Area: Cylinders

Video 315 on www.corbettmaths.com

Examples

Workout

Click here

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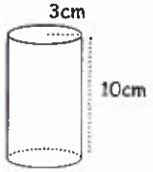
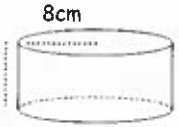
Question 1: Work out the surface area of each of the following cylinders.
Give each answer to 2 decimal places.

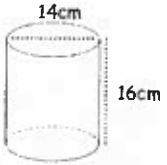
(a)



(b)

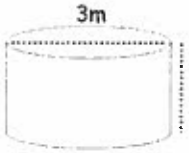


(c)

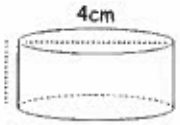


(d)

(e)



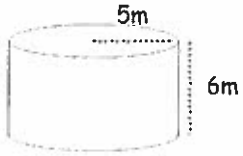
(f)



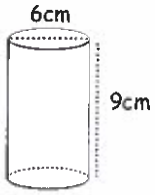
Question 2: Work out the surface area of each of the following cylinders.
Leave your answers in terms of π

(a)

(b)

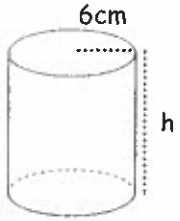


(c)



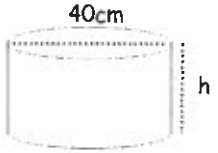
Question 3: Work out the height of each cylinder below

(a)



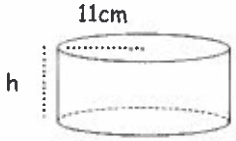
Surface area = 980.18cm²

(b)



Surface area = 4715cm²

(c)



Surface area = 850cm²

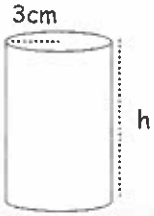
Corbett maths

Surface Area: Cylinders

Video 315 on www.corbettmaths.com

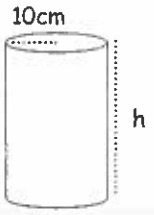
Question 4: Work out the height of each cylinder below

(a)



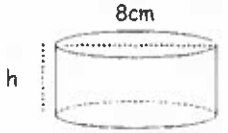
Surface area = 84π cm²

(b)



Surface area = 900π cm²

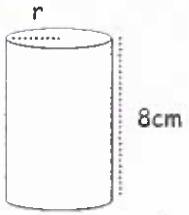
(c)



Surface area = 56π cm²

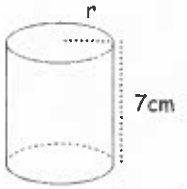
Question 5: Work out the radius of each cylinder below

(a)



Surface area = 18π cm²

(b)



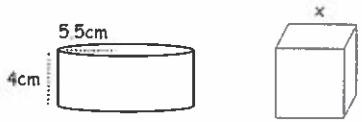
Surface area = 36π cm²

(c)

Surface area = 1040π cm²

Apply

Question 1: The cylinder and cube below have the same surface area.
Find the side length of the cube, x.



Question 2: A can of baked beans has a paper label wrapped around the outside.
The can has a height of 11cm and radius of 4.5cm.
The label covers the entire height of the can.
The label has a 1cm overlap vertically so that it can be stuck together
Calculate the area of the label.

Workout

Question 1:

(a) 245.04cm²

(b) 653.45cm²

(c) 1011.59cm²

(d) 14.7cm² (14.70cm²)

(e) 32.99m²

(f) 70.37cm²

Question 2:

(a) 28π cm²

(b) 110π m²

(c) 72π cm²

Question 3:

(a) 20cm

(b) 17.52cm

(c) 1.3cm (1.30cm)

Question 4

(a) 11cm

(b) 35cm

(c) 3cm

Question 5:

(a) 1cm

(b) 2cm

(c) 20cm

Apply

Question 1: 7.397cm

Question 2: 322.02cm²

Question 3: x = 9cm

Question 4: 813.39cm²

Question 5: 450π cm² or 1413.72 cm²

Question 6: 3114.336 cm²

Corbett maths

Area: Sectors

Video 46 on www.corbettmaths.com

Examples

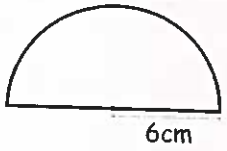
Workout

Click here

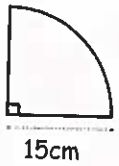
Scan here

Question 1: Calculate the area of each of the following sectors.
Give each answer to one decimal place and include units.

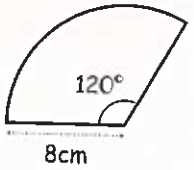
(a)



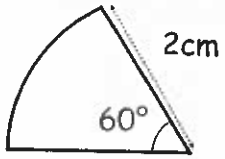
(b)



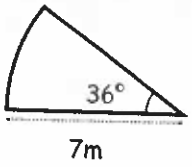
(c)



(d)

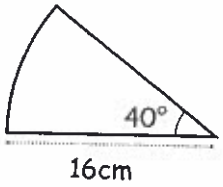


(e)

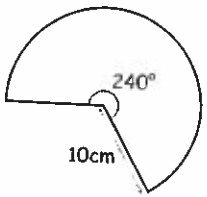


(f)

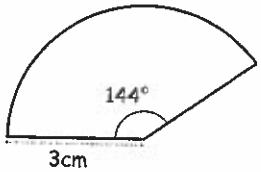
(g)



(h)

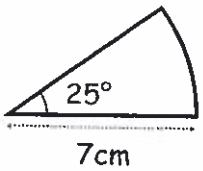


(i)

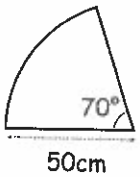


Question 2: Calculate the area of each of these sectors.
Give each answer to 2 decimal places and include suitable units.

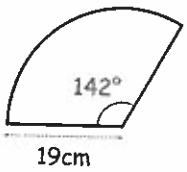
(a)



(b)



(c)



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Area: Sectors

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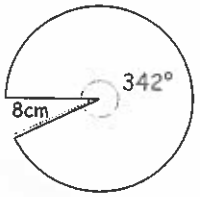
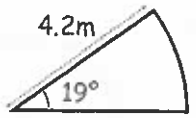
(d)

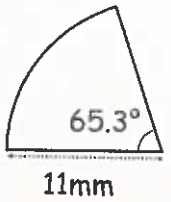


(e)

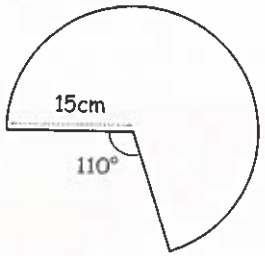


(f)

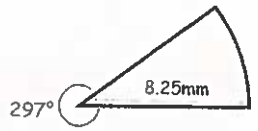
(g)



(h)

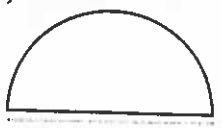


(i)

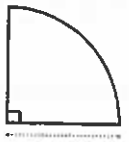


Question 3: Find the area of these sectors.
Leave your answer in terms of π

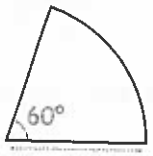
(a)



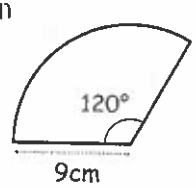
(b)



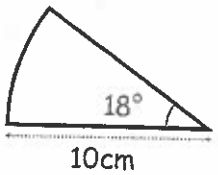
(c)



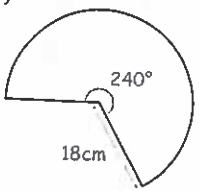
(d)



(e)



(f)

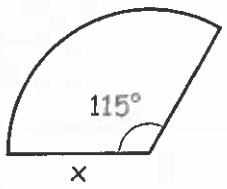


Area: Sectors

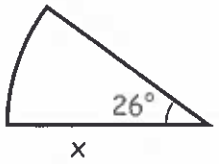
Video 46 on www.corbettmaths.com

Question 4: The areas of these sectors have been given.
Calculate x.

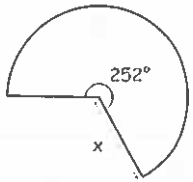
(a) Area = 20cm²



(b) Area = 98cm²

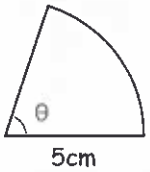


(c) Area = 1m²

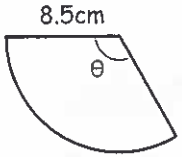


Question 5: The areas of these sectors have been given.
Calculate the missing angles.

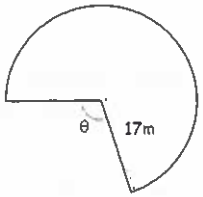
(a) Area = 17.45cm²



(b) Area = 62cm²

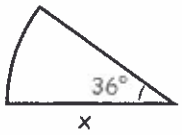


(c) Area = 625m²

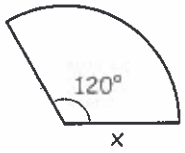


Question 6: The areas these sectors have been given in terms of π.
Work out x

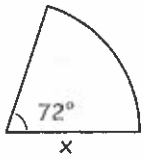
(a) Area = 40π cm²



(b) Area = 75π cm²

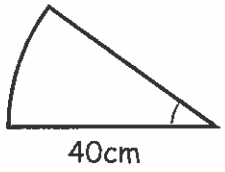


(c) Area = 245π cm²



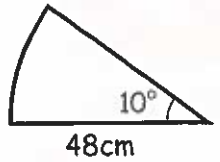
Apply

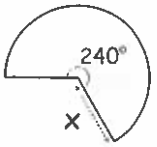
Question 1: The perimeter of the sector below is 103cm
Find the area of the sector



Area: Sectors
Video 46 on www.corbettmaths.com

Question 2: These two sectors have the same area.
James says x is 2cm.
Is he correct?





Answers

Click here

Scan here

Corbett maths

Area: Sectors

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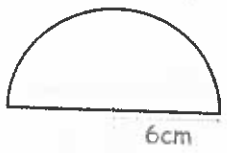
Workout

Question 1: Calculate the area of each of the following sectors.
Give each answer to one decimal place and include units.

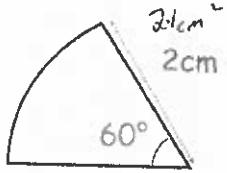
(a) 56.5cm²



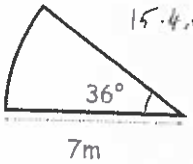
(b) 176.7cm²

(c) 67cm²

(d) 2.1cm²

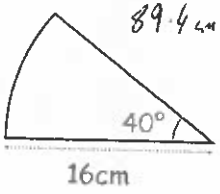


(e) 15.4cm²

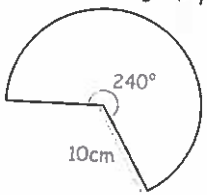


(f) 769.7cm²

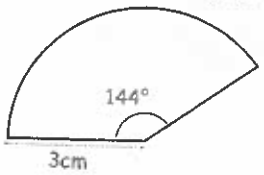
(g) 89.4cm²



(h) 209.4cm²

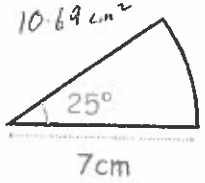


(i) 11.3cm²

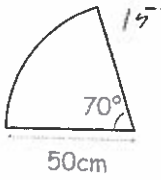


Question 2: Calculate the area of each of these sectors.
Give each answer to 2 decimal places and include suitable units.

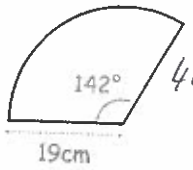
(a) 10.69cm²



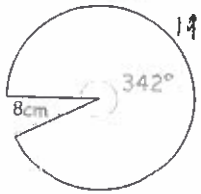
(b) 1527.16cm²



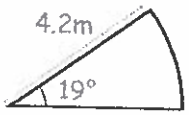
(c) 447.35cm²



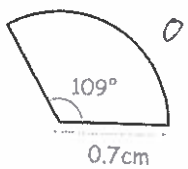
(d) 191.09cm²



(e) 2.92m²



(f) 0.47cm²



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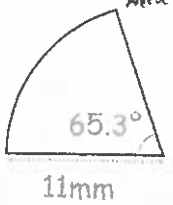
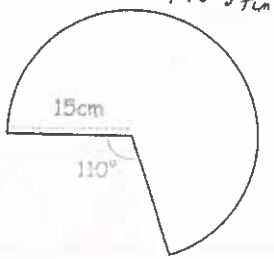
(g) 68.95mm²



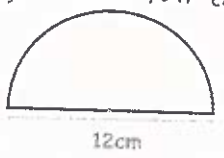
(h) 490.87cm²



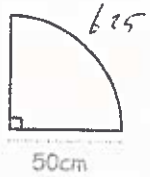
(i) 37.42mm²

Question 3: Find the area of these sectors.
Leave your answer in terms of π

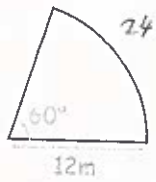
(a) 18π cm²



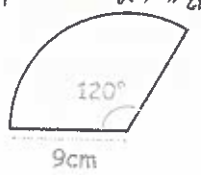
(b) 625π cm²



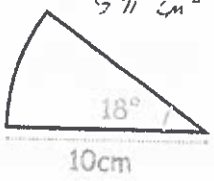
(c) 24π cm²



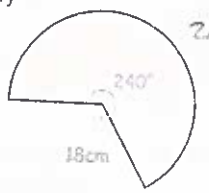
(d) 27π cm²



(e) 5π cm²

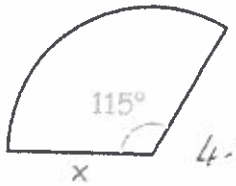


(f) 216π cm²

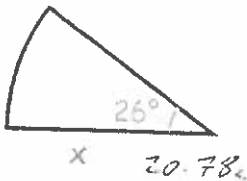


Question 4: The areas of these sectors have been given.
Calculate x.

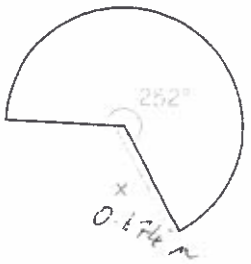
(a) Area = 20cm²



(b) Area = 98cm²



(c) Area = 1m²



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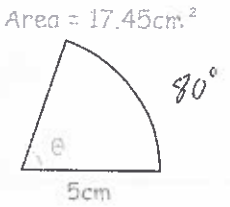
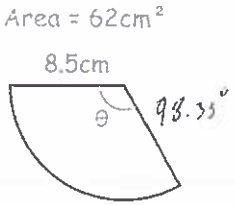
Question 5: The areas of these sectors have been given.
Calculate the missing angles.

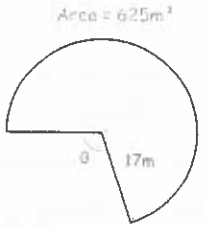
(a)



(b)

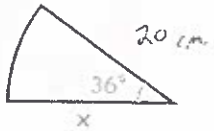


(c)

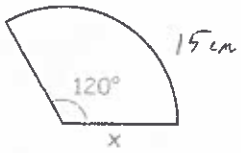


Question 6: The areas these sectors have been given in terms of π.
Work out x

(a)



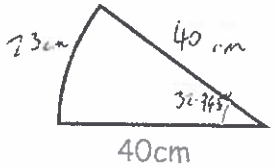
(b)



(c)

Apply

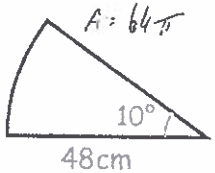
Question 1: The perimeter of the sector below is 103cm
Find the area of the sector

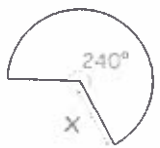


460 cm²

Question 2: These two sectors have the same area.
James says x is 2cm.
Is he correct?

No





x = 9.798cm

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Arc Length

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Examples

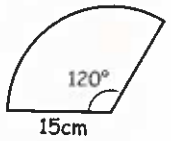
Workout

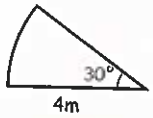
Click here

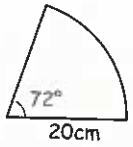
Scan here

Question 1: For each sector below, calculate the length of the arc.
Give your answers to one decimal place and include suitable units.

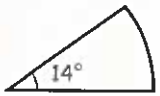
(a) 

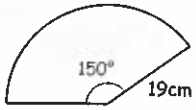
(b) 

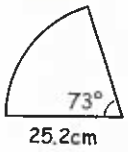
(c) 

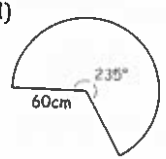
(d) 

Question 2: For each sector below, calculate the length of the arc.
Give your answers to one decimal place and include suitable units.

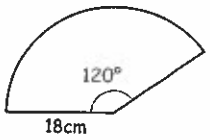
(a) 

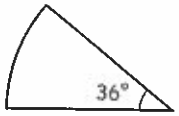
(b) 

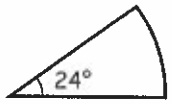
(c) 

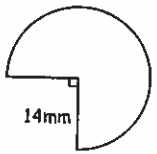
(d) 

Question 3: For each sector below, calculate the length of the arc.
Leave your answer in terms of π

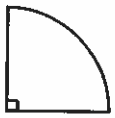
(a) 

(b) 

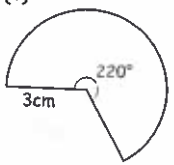
(c) 

(d) 

Question 4: Calculate the perimeter of each sector below
Give your answers to one decimal place and include suitable units.

(a) 

(b) 

(c) 

(d) 

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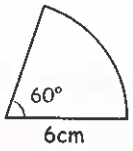
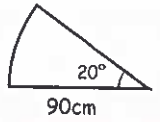
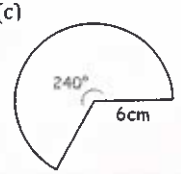
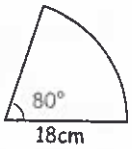
Question 5: Calculate the perimeter of each sector below
Leave your answer in terms of π

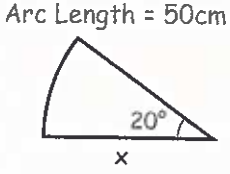
(a) 

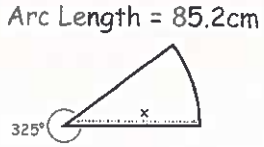
(b) 

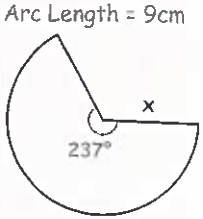
(c) 

(d) 

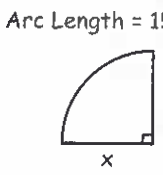
Question 6: The arc length of each sector has been given.
Calculate x
Give your answers to one decimal place and include suitable units.

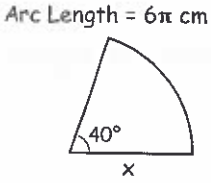
(a) 

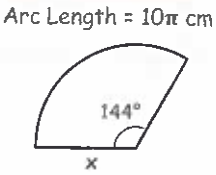
(b) 

(c) 

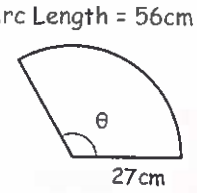
Question 7: The arc length of each sector has been given.
Calculate x

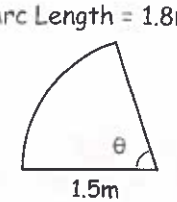
(a) 

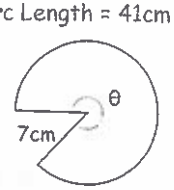
(b) 

(c) 

Question 8: The arc length of each sector has been given.
Calculate the size of the angle
Give your answers to one decimal place.

(a) 

(b) 

(c) 

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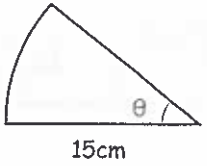
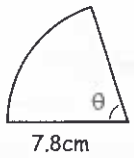
Question 9: The perimeter of each sector has been given.
Calculate the size of the angle
Give your answers to one decimal place.

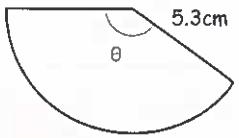
(a) Perimeter = 36cm



(b) Perimeter = 26.63cm

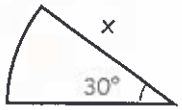


(c) Perimeter = 22.81cm

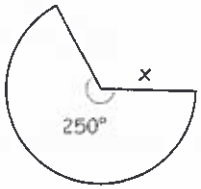


Question 10: The perimeter of each sector has been given.
Calculate x
Give your answers to one decimal place.

(a) Perimeter = 210cm

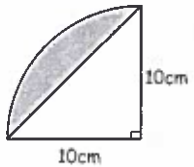


(b) Perimeter = 40cm

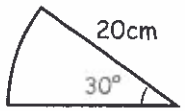


Apply

Question 1: Calculate the perimeter of the segment.



Question 2: James is calculating the perimeter of the sector.
Can you spot any mistakes?



$$\text{Perimeter} = \frac{30}{360} \times \pi \times 20$$
$$= 5.236cm$$

Answers

Click here

Scan here

Corbett maths

Arc Length

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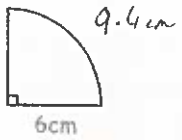
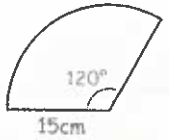
Workout

Question 1: For each sector below, calculate the length of the arc.
Give your answers to one decimal place and include suitable units.

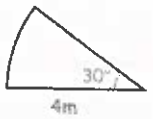
(a) 9.4cm



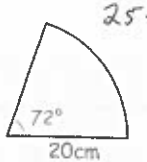
(b) 31.4cm



(c) 2.1m

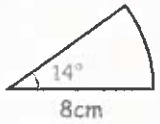


(d) 25.1cm



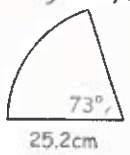
Question 2: For each sector below, calculate the length of the arc.
Give your answers to one decimal place and include suitable units.

(a) 2cm



(b) 44.7cm

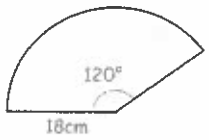
(c) 32.1cm



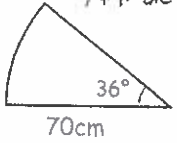
(d) 246.1cm

Question 3: For each sector below, calculate the length of the arc.
Leave your answer in terms of π

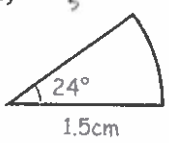
(a) 12π cm



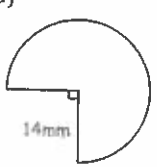
(b) 14π cm



(c) $\frac{1}{5}\pi$ cm

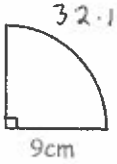


(d) 21π mm

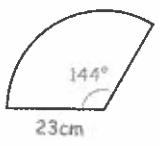


Question 4: Calculate the perimeter of each sector below
Give your answers to one decimal place and include suitable units.

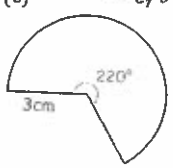
(a) 32.1cm



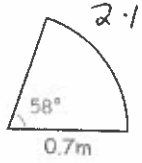
(b) 103.8cm



(c) 17.5cm



(d) 2.1m



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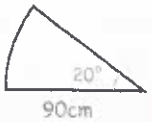
Arc Length

Video 58 on www.corbettmaths.com

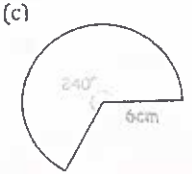
Question 5: Calculate the perimeter of each sector below
Leave your answer in terms of π

(a) 12 + 2π cm

(b) 180 + 10π cm



(c) 12 + 3π cm



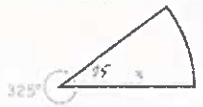
(d) 36 + 8π cm

Question 6: The arc length of each sector has been given.
Calculate x
Give your answers to one decimal place and include suitable units.

(a) Arc Length = 50cm

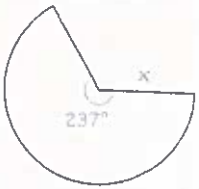
143.2cm

(b) Arc Length = 85.2cm



134.5cm

(c) Arc Length = 9cm



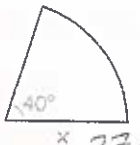
2.2cm

Question 7: The arc length of each sector has been given.
Calculate x

(a) Arc Length = 15π cm

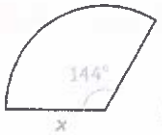
30cm

(b) Arc Length = 6π cm



27cm

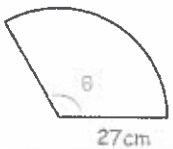
(c) Arc Length = 10π cm



12.5cm

Question 8: The arc length of each sector has been given.
Calculate the size of the angle
Give your answers to one decimal place.

(a) Arc Length = 56cm



118.8°

(b) Arc Length = 1.8m

68.8°

(c) Arc Length = 41cm

335°

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Arc Length

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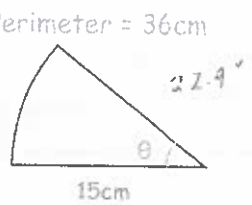
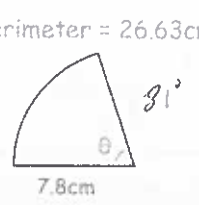
Question 9: The perimeter of each sector has been given.
Calculate the size of the angle
Give your answers to one decimal place.

(a)



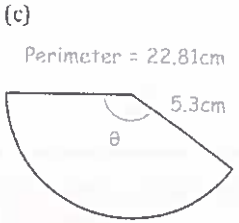
22.9°

(b)



81°

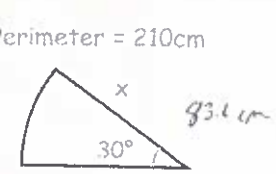
(c)



132°

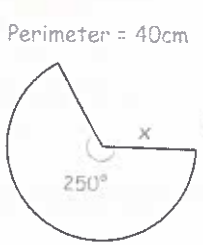
Question 10: The perimeter of each sector has been given.
Calculate x
Give your answers to one decimal place.

(a)



93.4 cm

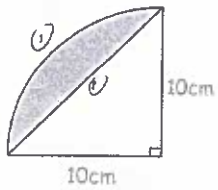
(b)



6.5cm

Apply

Question 1: Calculate the perimeter of the segment.

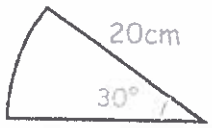


① = 15.7079...

② = 14.142 cm

Perimeter = 29.85cm

Question 2: James is calculating the perimeter of the sector.
Can you spot any mistakes?

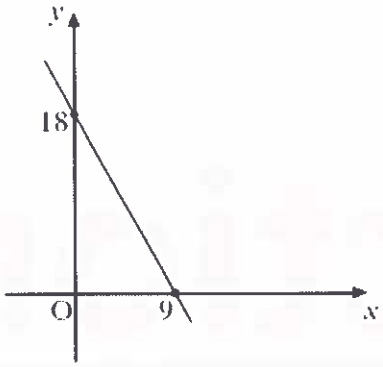
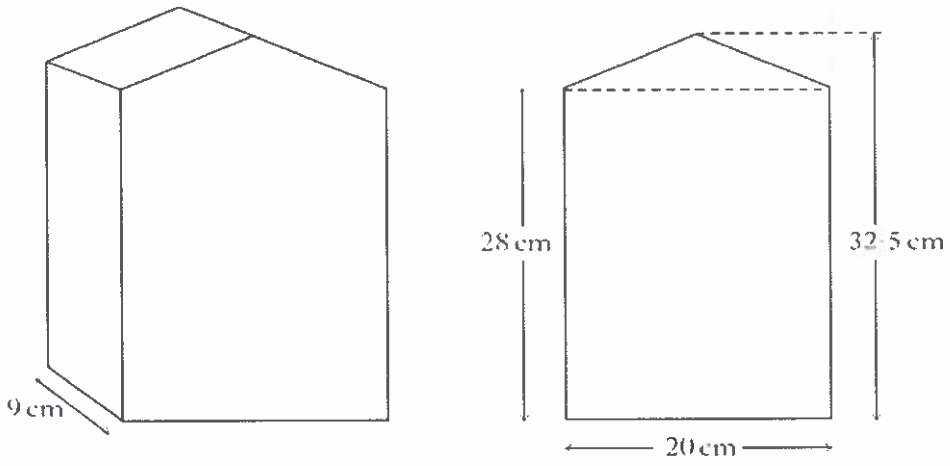


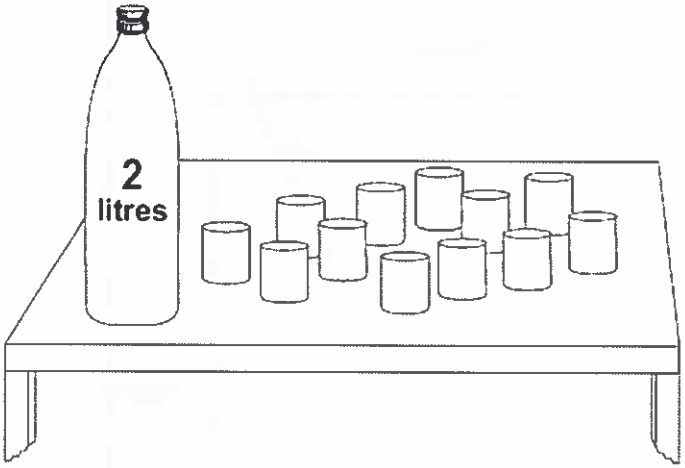
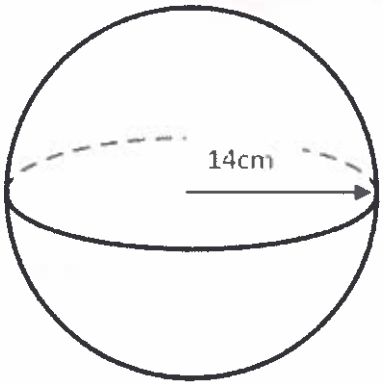
$$\text{Perimeter} = \frac{30}{360} \times \pi \times 40$$

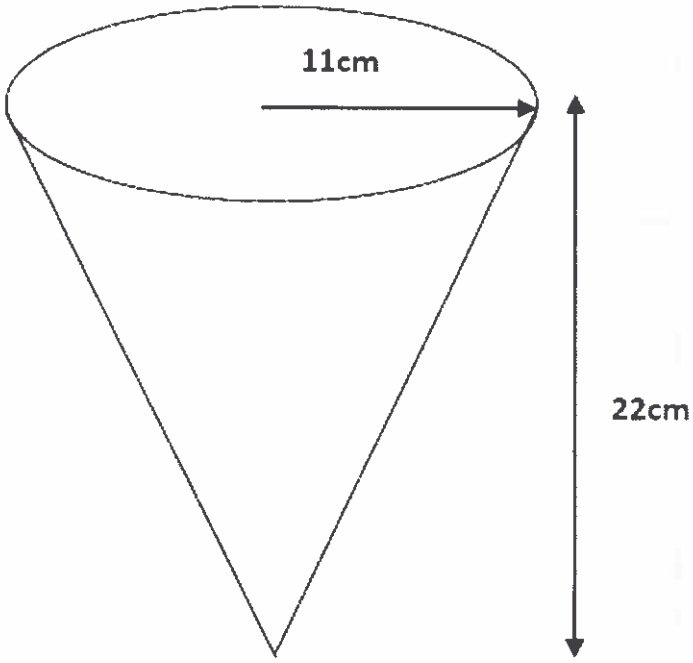
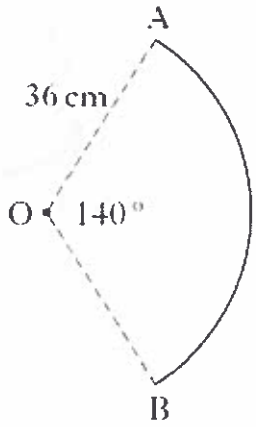
$$= 5.236\text{cm}$$

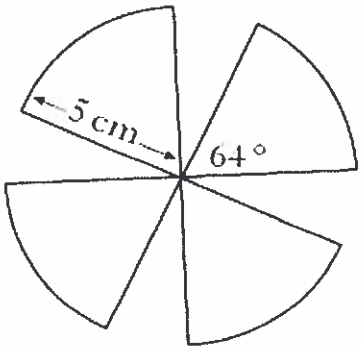
Section A

MIX OF STRAIGHT LINE
VOLUME
ARCS + SECTORS

Q		Marks
1 P1	4. A straight line cuts the x-axis at the point $(9, 0)$ and the y-axis at the point $(0, 18)$ as shown.  Find the gradient of this line.	1
2 P2	3. A container for oil is in the shape of a prism. The width of the container is 9 centimetres. The uniform cross section of the container consists of a rectangle and a triangle with dimensions as shown.  Calculate the volume of the container, **correct to the nearest litre.**	4

3 **P2**	2. Lemonade is to be poured from a 2 litre bottle into glasses. Each glass is in the shape of a cylinder of radius 3 centimetres and height 8 centimetres.  How many full glasses can be poured from the bottle?	4 (2.1) (2.2)
4 **P2**	1. Calculate the volume of a sphere with radius 14 cm, giving your answer correct to **two significant figures**.  	3

5 P2	**2.** Calculate the volume of the cone:  	2
6 P2	**6.** A circle, centre O, has radius 36 centimetres. Part of this circle is shown. Angle AOB = 140°.  Calculate the length of arc AB.	3

7 **P2**	7. A fan has four identical plastic blades.  Each blade is a sector of a circle of radius 5 centimetres. The angle at the centre of each sector is 64°. Calculate the **total** area of plastic required to make the blades.	3

Section A

MARKING SCHEME

Section A - Marking Scheme

1 4.
Gradient = -2 — 1

2

3	Ans: 5 litres **Method 1** • strategy (area of cross section) • strategy (volume of prism) • all calculations correct • correct rounding	• $(28\times 20)-\left(\frac{1}{2}\times 20\times 4\cdot 5\right)$ (605) • $\left[(28\times 20)-\left(\frac{1}{2}\times 20\times 4\cdot 5\right)\right]\times 9$ • 5445 • 5 4KU	
	Method 2 • strategy (volume of cuboid) • strategy (volume of triangular prism) • all calculations correct • correct rounding	• $9\times 20\times 28$ (5040) • $9\times\left[\frac{1}{2}\times 20\times 4\cdot 5\right]$ (405) • 5445 • 5 4KU	
	Method 3 • strategy (volume of extended cuboid) • strategy (volume of triangular prism) • all calculations correct • correct rounding	• $9\times 20\times 32\cdot 5$ (5850) • $9\times\left[\frac{1}{2}\times 20\times 4\cdot 5\right]$ (405) • 5445 • 5 4KU	
NOTES (i) for candidates who calculate $28\times 9\times 20\times 32\cdot 5$, only the final mark is available			

3		2	Ans: 8 • valid strategy • processing • processing a division • solution	• knows to use $\pi r^2 h$ • $\pi \times 3^2 \times 8 (= 226.19)$ • $\frac{2000}{72\pi} (= 8.84)$ • 8 (rounding down) **4RE**		
		NOTES: (i) the second mark is available only for a calculation involving π and h (ii) the 3rd mark is available for either: explicit evidence of division of 2000 or: implicit evidence (unrounded consistent value) (iii) the final mark is available for an answer consistent with the division (unrounded answer need not be stated) (iv) if no rounding is required, the final mark cannot be awarded				
4	•1	substitute and start calculation	• $\frac{4}{3} \times \pi \times 14^3$ $\frac{4}{3} \times \pi \times 2744$			
	•2	complete calculation	• $= 11494 \cdot 04032$ *or equivalent*			
	•3	round calculation to 2 significant figures	• $11000 cm^3$			
5	•1	substitute and start calculation	• $\frac{1}{3} \times \pi \times 11^2 \times 22$ $\frac{1}{3} \times \pi \times 121 \times 22$			
	•2	complete calculation	• $= 2787 \cdot 639881$ *or equivalent*			

6

6	Ans: 88·0 cm	
	• fraction of circumference	• $\frac{140}{360}$
	• use of formula	• $\frac{140}{360} \times \pi \times 72$
	• all calculations correct	• 87·96
		3KU

NOTES

(i) for 87·96 with or without working — award 3/3

(ii) for 1583·36 from $\frac{140}{360} \times \pi \times 36^2$ — award 2/3

(iii) the 3rd mark is available only for a calculation involving π

7

Question No	Give 1 mark for each •	Illustrations of evidence for awarding each mark
7	Ans: 55·84 cm^2	
	• fraction of area	• $\frac{64}{360}$
	• use of formula	• $\frac{64}{360} \times \pi \times 5^2$
	• all calculations correct	• $13{\cdot}96 \times 4 = 55{\cdot}84$
		3KU

Notes:

(i) for 55·84 with or without working — award $\frac{3}{3}$

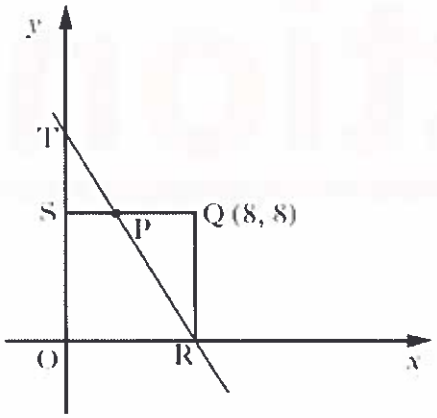
(ii) the 3rd mark is available only for a calculation involving π

Section A

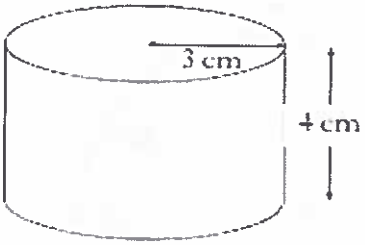
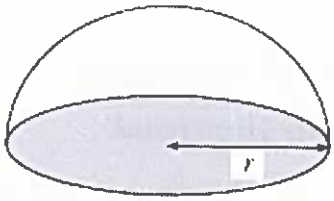
Section B

Section B

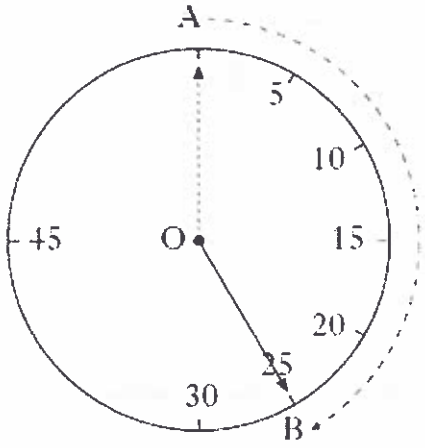
Paper 1 Questions

Q		Marks
1	8. A square, OSQR, is shown below. Q is the point (8, 8).  The straight line TR cuts the y-axis at T (0, 12) and the x-axis at R. (*a*) Find the equation of the line TR. The line TR also cuts SQ at P. (*b*) Find the coordinates of P.	4 3

Paper 2 Questions

Q		Marks
2	12. (*a*) A cylindrical paperweight of radius 3 centimetres and height 4 centimetres is filled with sand.  Calculate the volume of sand in the paperweight.	2
	(*b*) Another paperweight, in the shape of a hemisphere, is filled with sand.  It contains the same volume of sand as the first paperweight. Calculate the radius of the hemisphere. [The volume of a hemisphere with radius r is given by the formula, $V = \frac{2}{3}\pi r^3$].	3

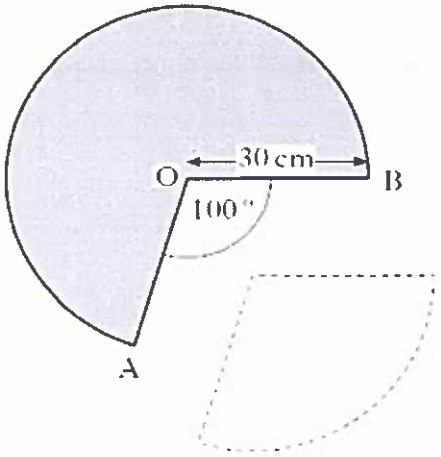
3 9. Contestants in a quiz have 25 seconds to answer a question.
This time is indicated on the clock.
The tip of the clock hand moves through the arc AB as shown.



(*a*) Calculate the size of angle AOB. 1

(*b*) The length of arc AB is 120 centimetres.
Calculate the length of the clock hand. 4

4 11. A cone is formed from a paper circle with a sector removed as shown.
The radius of the paper circle is 30 cm.
Angle AOB is 100°.



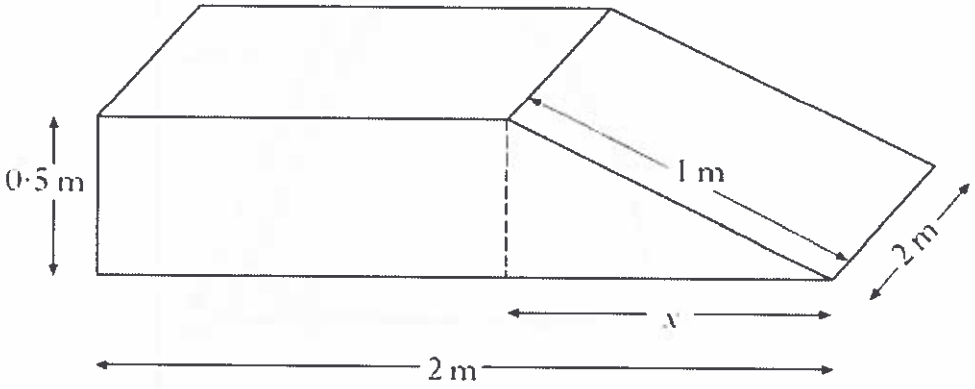
(*a*) Calculate the area of paper used to make the cone. 3

(*b*) Calculate the circumference of the base of the cone. 3

5

5. A concrete ramp is to be built.

The ramp is in the shape of a cuboid and a triangular prism with dimensions as shown.

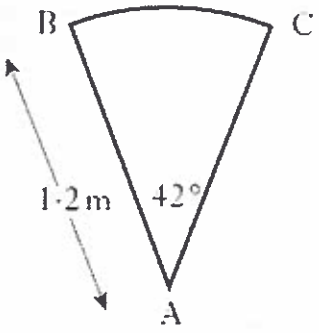


(*a*) Calculate the value of x. 2 (2.1)

(*b*) Calculate the volume of concrete required to build the ramp. 3 (2.2)

6

5. A spiral staircase is being designed. 4 (2.1) (2.2)



Each step is made from a sector of a circle as shown.

The radius is 1·2 metres.

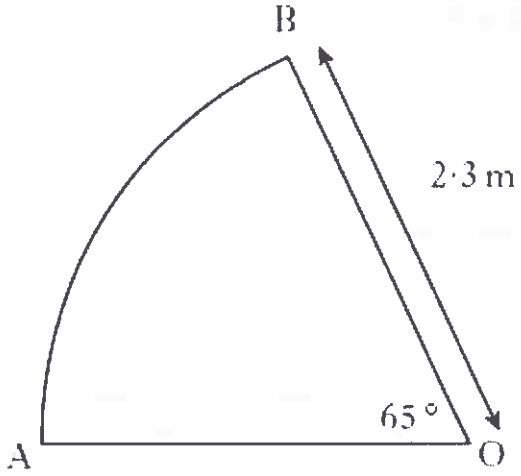
Angle BAC is 42°.

For the staircase to pass safety regulations, the arc BC must be at least 0·9 metres.

Will the staircase pass safety regulations?

7

4. A sector of a circle, centre O, is shown below.



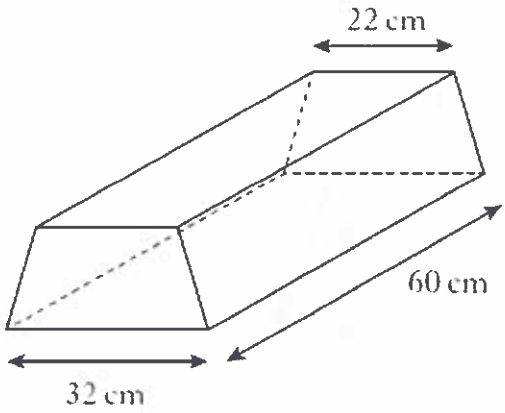
The radius of the circle is 2·3 metres.

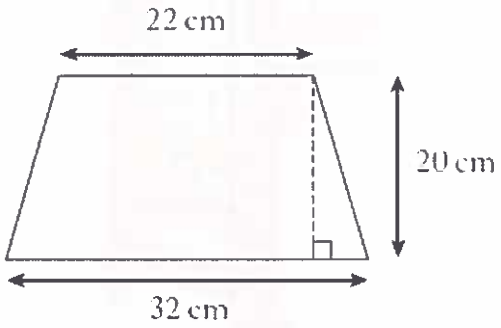
Angle AOB is 65°.

Find the length of the arc AB. 3

8

3. A concrete block is in the shape of a prism.





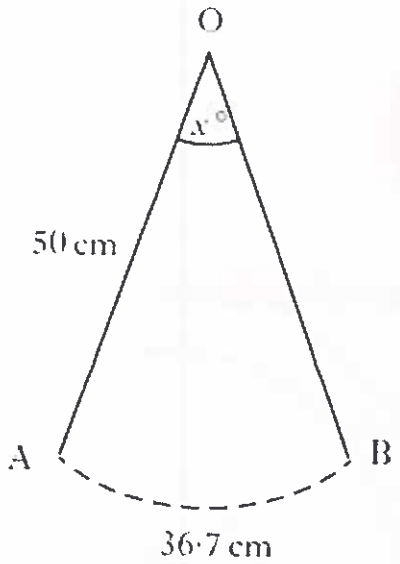
The cross section of the prism is a trapezium with dimensions as shown.

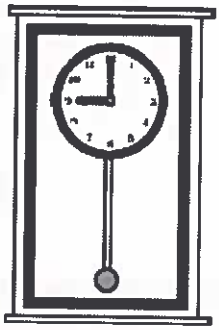
(*a*) Calculate the area of the cross section. 3

(*b*) Calculate the volume of the concrete block. 1

9

8. As the pendulum of a clock swings, its tip moves through an arc of a circle. 3





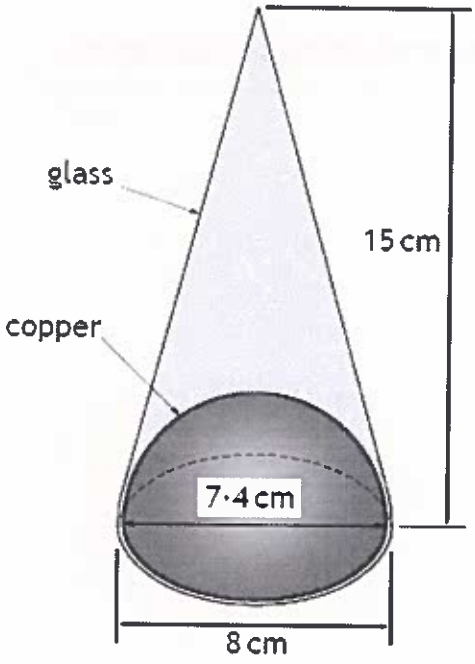
The length of the pendulum is 50 centimetres.
The length of the arc is 36·7 centimetres.

Calculate $x°$, the angle through which the pendulum swings.

10

7. An ornament is in the shape of a cone with diameter 8 centimetres and height 15 centimetres. 5

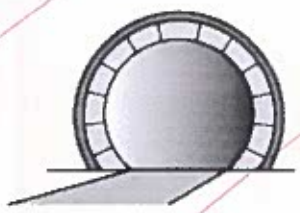
The bottom contains a hemisphere made of copper with diameter 7·4 centimetres. The rest is made of glass, as shown in the diagram below.



Calculate the volume of the glass part of the ornament.

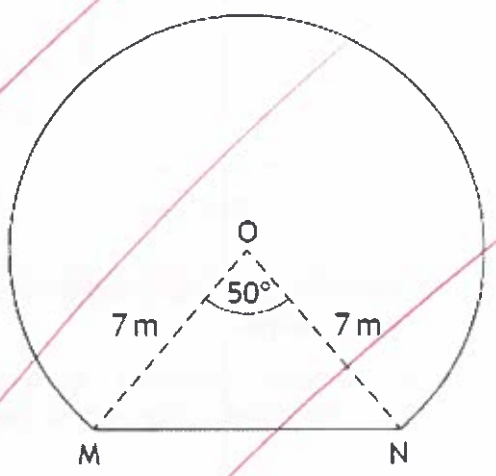
Give your answer correct to 2 significant figures.

11 13. The picture shows the entrance to a tunnel which is in the shape of part of a circle. 5



The diagram below represents the cross-section of the tunnel.

- The centre of the circle is O.
- MN is a chord of the circle.
- Angle MON is 50°.
- The radius of the circle is 7 metres.



Calculate the area of the cross-section of the tunnel.

Section B

MARKING SCHEME

Section B – Marking Scheme

Marking Scheme

Paper 1

Q		Marks
1	8 (a) Ans: $y = -\frac{3}{2}x + 12$ • gradient • y-intercept • equation • $m = -\frac{12}{8}$ • $c = 12$ • $y = -\frac{3}{2}x + 12$ 3KU NOTES: (i) for a correct equation without working award 3/3 (ii) where the gradient and/or y-intercept are wrong, but explicitly stated, the 3rd mark is still available	
	(b) Ans: $\left(\frac{8}{3}, 8\right)$ • method • substitution • solving equation • solution • recognising $y_p = 8$ • $8 = -\frac{3}{2}x + 12$ • $x = \frac{8}{3}$ • $\left(\frac{8}{3}, 8\right)$ 4RE NOTES: (i) for the 4th mark, both coordinates must be consistent with the candidate's response for 1st and 3rd marks	

Paper 2

Q				Marks
2	12 (a)	Ans: $113{\cdot}1\ \text{cm}^3$ • formula • solution	 • $V = \pi \times 3^2 \times 4$ • 113·1 2KU	
	Notes: (i) 452·4 (using $\pi d^2 h$) may be awarded the 2nd mark (ii) 75·4 (using πdh) may be awarded the 2nd mark (ii) for the use of any other wrong formula award $\frac{0}{2}$			
	(b)	Ans: 3·78 cm • forming equation • rearranging • solution	 • $\frac{2}{3}\pi \times r^3 = 113{\cdot}1$ • $r^3 = 54$ • 3·78 3RE	
	Notes: (i) for 452·4 → 216 → 6·0 award $\frac{3}{3}$ (ii) for 75·4 → 36 → 3·3 award $\frac{3}{3}$ (iii) the third mark is available only for the cube root of a number			

3	9 (a)	Ans: 150° • solution	• 150° 1KU	
	(b)	Ans: 45.8 cm • correct ratio • processing • processing • solution	• $\frac{150}{360}$ or $\frac{5}{12}$ • $\frac{150}{360}=\frac{120}{2\pi r}$ or $\frac{120}{5/12}=288$ • $r=\frac{360}{150}\times\frac{120}{2\pi}$ or $r=\frac{288}{2\pi}$ • 45.8 or 45.8 4RE	
	Notes: (i) a calculation using πr^2 (which leads to $r=9.57$) cannot be awarded the 2nd mark			

4	11(a)	Ans: $2042\ cm^2$ • strategy • processing • solution	• $\frac{260}{360}$ • $\frac{260}{360} \times \pi \times 30^2$ • 2042 **3KU**		
	Notes: (i) $\frac{100}{360}$ can be awarded the 1st mark only within the strategy $\pi r^2 - \frac{100}{360}\pi r^2$				
	(b)	Ans: 136.1 cm • strategy • process • process	• circumference of base = length of arc • $C = \frac{260}{360} \times \pi \times 60$ • 136.1 **3RE**		
	Notes: (i) calculating only $C = \pi \times 60$		award 0/3		

5	**5 (a)**	**Ans: 0·866 m** • method • solution	• $1^2 = x^2 + 0{\cdot}5^2$ • $x = 0{\cdot}866\cdots$ **2RE**		
	NOTES:				
	(b)	**Ans: 1·57 m³** • process – area of cross section • process – volume of prism • all calculations correct **OR** • process – volume of cuboid • process – volume of prism added to volume of cuboid • all calculations correct	• $0{\cdot}5\times0{\cdot}5\times0{\cdot}866+0{\cdot}5\times(2-0{\cdot}866)$ • $0{\cdot}7835\times2$ • 1·567 • $0{\cdot}5\times1{\cdot}134\times2=1{\cdot}134$ • $0{\cdot}5\times0{\cdot}5\times0{\cdot}866\times2+1{\cdot}134$ • 1·567 **3RE**		

6

5	**Ans: no, plus justification**	
	• strategy	• $\frac{42}{360}$
	• processing	• $\frac{42}{360} \times \pi \times 2{\cdot}4$
	• processing	• 0·879
	• communication	• no, as $0{\cdot}879 < 0{\cdot}9$
		4RE

NOTES:

(i) $\frac{42}{360} \times \pi \times 1{\cdot}2 = 0{\cdot}439$ → no etc — award 3/4

(ii) $\frac{42}{360} \times \pi \times 1{\cdot}2^2 = 0{\cdot}527$ → no etc — award 2/4

(iii) $\frac{42}{360} \times \pi \times 2{\cdot}4^2 = 2{\cdot}11$ → yes etc — award 2/4

(iv) the communication must include reference to both values, the difference between them or the use of comparative language

7

4	**Ans: 2·61m**	
	• ratio	• $\frac{65}{360}$ or $\frac{360}{65}$
	• strategy	• $\frac{65}{360} \times \pi \times 4{\cdot}6$ or $\pi \times 4{\cdot}6 \div \frac{360}{65}$
	• all calculations correct	• 2·609
		3KU

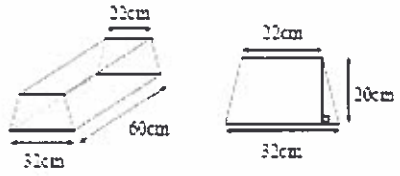
NOTES:

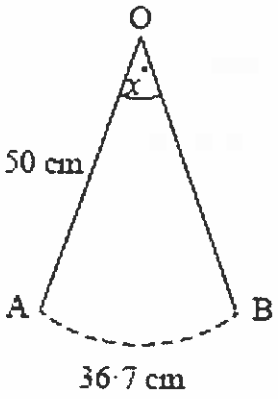
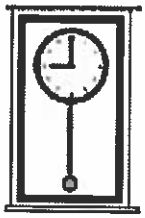
(i) for 2·61 with or without working — award 3/3

(ii) for 1·3 ($\times \pi \times 2{\cdot}3$) — award 2/3

(iii) for 3·0 ($\times \pi \times 2{\cdot}3^2$) — award 1/3

(iv) the 3rd mark is available only for a calculation involving π

8		3			A concrete block is in the shape of a prism.  The cross section of the prism is a trapezium with dimensions as shown.		
			a		Calculate the area of the cross section. Ans: **540 cm²**	3	
				$\bullet^1$	beginning process		$\bullet^1$ $2\times\frac{1}{2}\times 5\times 20+(22\times 20)$ or $\frac{1}{2}\times 20\times(22+32)$
				$\bullet^2$	processing		$\bullet^2$ $100+440$ or 10×54
				$\bullet^3$	calculation	(KU)	$\bullet^2$ 540
		3	b		Calculate the volume of the concrete block. Ans: **32 400 cm³**	1	
				$\bullet^1$	calculation	(KU)	$\bullet^1$ 32 400

9		8			As the pendulum of a clock swings, its tip moves through an arc of a circle.   The length of the pendulum is 50 centimetres. The length of the arc is 36·7 centimetres. Calculate $x°$, the angle through which the pendulum swings. Ans: 42°	3	$\bullet^1$ $\frac{x}{360}$ $\bullet^2$ $\frac{36{\cdot}7}{100\pi}$ $\bullet^3$ 42°	
					$\bullet^1$ strategy $\bullet^2$ strategy $\bullet^3$ solution	(RE)		

Notes:

(i) for use of $C = \pi r^2$, the 1st and 3rd marks are still available

10				Give one mark for each •		Mark	Awarding a mark at each •	
	7.			Ans: 150 cm^3		5		
				•^{1} substitute correctly into formula for volume of cone			•^{1} $\frac{1}{3}\times\pi\times4.7^2\times15$ (=251.32...)	
				•^{2} substitute correctly into formula for volume of sphere or hemisphere			•^{2} $\frac{4}{3}\times\pi\times3.7^3$ (=212.17....) or $\frac{1}{2}\times\frac{4}{3}\times\pi\times3.7^3$ (=106.08....)	
				•^{3} know to subtract volume of hemisphere from volume of cone			•^{3} evidence	
				•^{4} carry out all calculations correctly (must involve difference or sum of two volume calculations)			•^{4} 145.24...	
				•^{5} round final answer to 2 significant figures			•^{5} 150 (cm^3)	
				Notes:				
				1. Accept variations in π.				
				2. Some common answers (working must be shown):				
				(i) $39\ (\frac{1}{3}\times\pi\times4.7^2\times15-\frac{4}{3}\times\pi\times3.7^3)$	award 4/5	✓✓×✓✓		
				(ii) $120\ (\frac{1}{3}\times\pi\times4.7^2\times15-\frac{1}{2}\times\frac{4}{3}\times\pi\times4.7^3)$	award 4/5	✓×✓✓✓		
				(iii) $110\ (\frac{1}{3}\times\pi\times3.7^2\times15-\frac{1}{2}\times\frac{4}{3}\times\pi\times3.7^3)$	award 4/5	×✓✓✓✓		
				(iv) $160\ (\frac{1}{3}\times\pi\times8.4^2\times15-\frac{1}{2}\times\frac{4}{3}\times\pi\times7.4^3)$	award 4/5	×✓✓✓✓		
				(v) $360\ (\frac{1}{3}\times\pi\times4.7^2\times15-\frac{1}{2}\times\frac{4}{3}\times\pi\times3.7^3)$	award 4/5	✓✓×✓✓		
				(vi) $460\ (\frac{1}{3}\times\pi\times4.7^2\times15+\frac{4}{3}\times\pi\times3.7^3)$	award 4/5	✓✓×✓✓		
				(vii) $80\ (\frac{1}{3}\times\pi\times3.7^2\times15-\frac{1}{2}\times\frac{4}{3}\times\pi\times4.7^3)$	award 3/5	××✓✓✓		
				(viii) $250\ (\frac{1}{3}\times\pi\times4.7^2\times15)$	award 2/5	✓×××✓		
				3. The final mark is only available where answers to all intermediate steps involve at least three significant figures. eg $251.32-106.08=250-110=140$	award 4/5	✓✓✓✓×		

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Examples

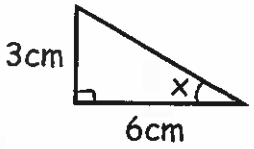
Workout

Click here

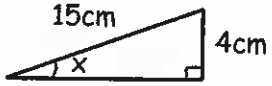
Scan here

Question 1: Find the size of the missing angles in the triangles below.

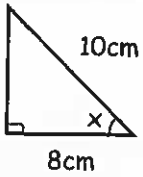
(a)



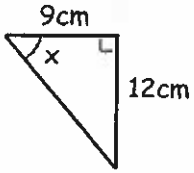
(b)



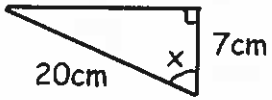
(c)



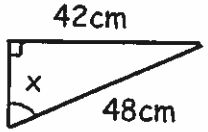
(d)



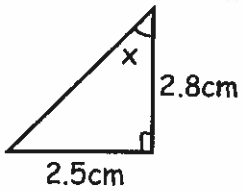
(e)



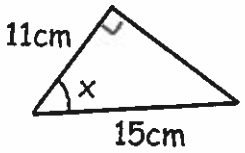
(f)



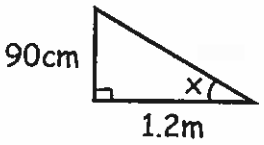
(g)



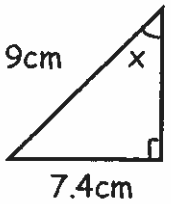
(h)



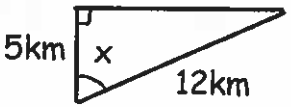
(i)



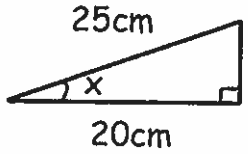
(j)



(k)



(l)



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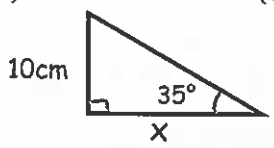
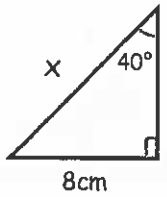
Question 2: Find the lengths of the sides labelled x below.

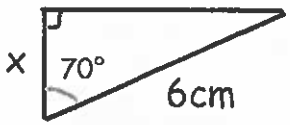
(a)



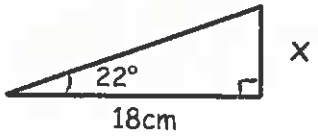
(b)



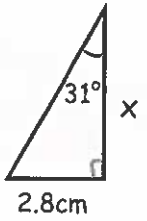
(c)



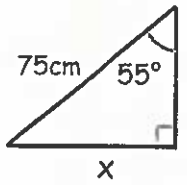
(d)



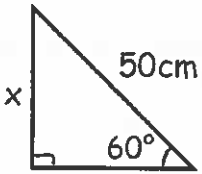
(e)



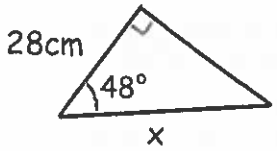
(f)



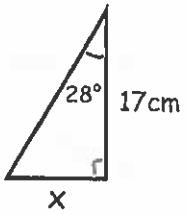
(g)



(h)



(i)



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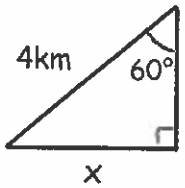
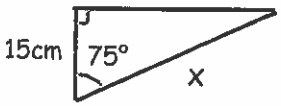
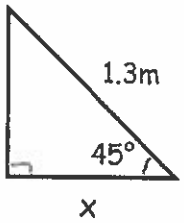


(k)



(l)



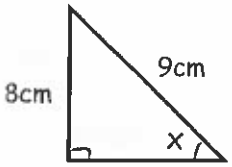
Corbett maths

Trigonometry

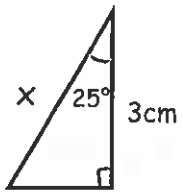
Video 329, 330, 331 on www.corbettmaths.com

Question 3: Find the size of the missing angles/sides labelled x below.

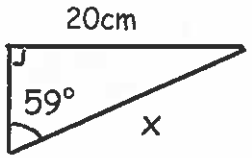
(a)



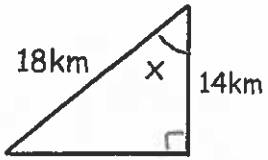
(b)



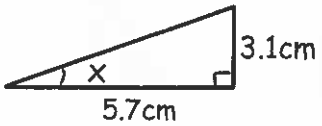
(c)



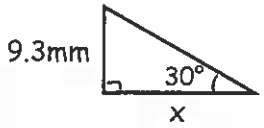
(d)



(e)



(f)



Apply

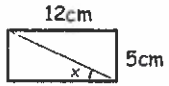
In each question, draw a diagram unless it has been given.

Question 1: A 4 metre long ladder is placed against a wall. The angle between the ladder and the ground is 75°. How far up the wall does the ladder reach?

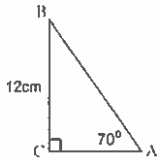
Question 2: A 5 metre long ladder is placed against a wall. It reaches 4.3 metres up the wall. What is the angle between the ladder and the ground?

Question 3: A ladder is placed against a wall. The base of the ladder is 4 foot from the bottom of the ladder. The angle between the ladder and the ground is 80°.
What is the length of the ladder?

Question 4: A rectangle is 12cm long and 5cm wide. Find the size of the angle marked x.



Question 5: (a) Find the length of AC.
(b) Find the length of AB.
(c) Find the perimeter of triangle ABC.
(d) Find the area of triangle ABC.



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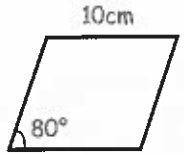
Question 6: A helicopter leaves A and flies 40 miles due east. Then the helicopter flies 10 miles due south and arrives at B. Work out the bearing of B from A.

Question 7: A boat leaves a port and sails 55km due west and then 30km due north and arrives at an oil rig. What is the bearing of the oil rig from the port?

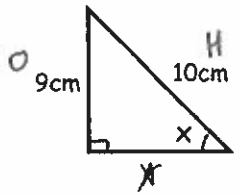
Question 8: Shown is an isosceles triangle. Calculate its area.

Question 9: Shown is a rhombus of side length 10cm.
Calculate its area.



Question 10: Can you spot any mistakes in the question below?

Find the size of the angle x.



$\sin x = \frac{9}{10}$

$\sin x = 0.9$

$x = \sin 0.9$

$x = 0.016°$

Answers

Click here

Scan here

Trigonometry

Workout

Question 1

(a) 26.57° (b) 15.47° (c) 36.87° (d) 53.13° (e) 69.51° (f) 61.04°

(g) 41.76° (h) 42.83° (i) 36.87° (j) 55.31° (k) 67.38° (l) 36.87°

Question 2

(a) 14.28cm (b) 12.45cm (c) 2.05cm (d) 7.27cm (e) 4.66cm (f) 61.44cm

(g) 43.30cm (h) 41.85cm (i) 9.04cm (j) 3.46km (k) 57.96cm (l) 0.92m

Question 3

(a) 62.73° (b) 3.31cm (c) 23.33cm (d) 38.94° (e) 28.54° (f) 16.11mm

Apply

Question 1

3.86m

Question 2

59.32°

Question 3:

23.04 foot

Question 4

22.62°

Question 5

(a) 4.37cm
(b) 12.77cm
(c) 29.14cm
(d) 26.22cm²

Question 6

104.04°

Question 7

298.61°

Question 8

A=54.54cm²

Question9

98.48cm²

Question 10

Did not take the inverse of sine – answer: $x=\sin^{-1}(0.9)$ therefore x = 64.16°

8. Trigonometry 1 – SOH-CAH-TOA

NB There is some overlap between these questions and those on Pythagoras and the Circle.

1. In the diagram

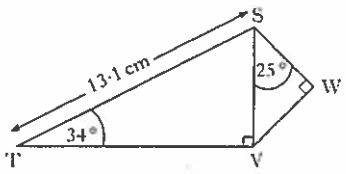
Angle STV = 34°

Angle VSW = 25°

Angle SVT = Angle SWV = 90°

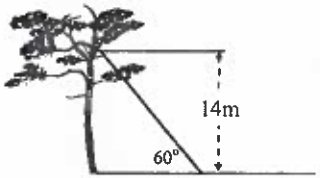
ST = 13·1 centimetres

Calculate the length of SW

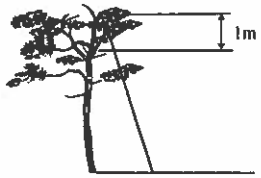


4 KU

2. A cat is trapped in a tree and a ladder is placed against the tree in an attempt to rescue it.



The ladder rests against the tree making an angle of 60° with the horizontal and reaching 14 metres up the tree, allowing the rescuer to reach the cat.



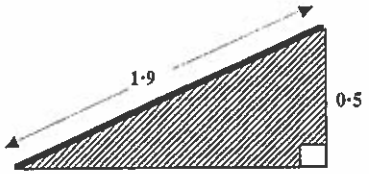
Just as the cat is about to be rescued, it jumps to a branch 1 metre above its original resting place.

Calculate the size of the angle, to the nearest degree, that the ladder now has to make with the horizontal to allow the rescuer to reach the cat.

5 RE

3. The owners of Stately Hall Manor erected an entrance ramp for disabled people at the main front entrance.

Local building regulations state that ramps must be built at an angle of **not more than** 15° to the horizontal ground.



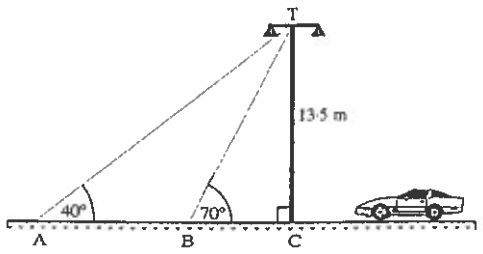
A side view of the ramp which was actually erected is shown above.

Does this ramp satisfy the local building regulations ?

You must explain your answer with mathematical reasoning.

4 RE

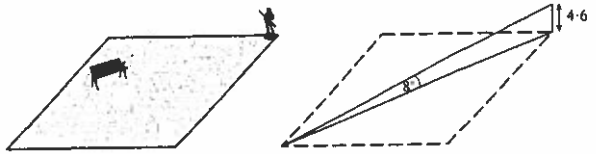
4. Two support cables, from the top (T) of a motorway light, are attached to a pair of points, A and B, on the ground, as shown in the diagram.



a) Calculate the distance from B to C. 2 KU

b) Calculate the distance from A to B. 3 RE

5. A statue stands at the corner of a square courtyard.



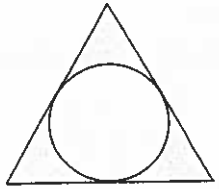
The statue is 4.6 metres high.

The angle of elevation from the opposite corner of the courtyard to the top of the statue is 8°.

a) Find the distance from the base of the statue to the opposite corner of the courtyard. 2 RE

b) Show that the length of the side of the courtyard is approximately 23 metres. 2 RE

6. The diagram shows the design of an earring.



The earring consists of a circle inside an equilateral triangle.

The sides of the triangle are tangents to the circle.

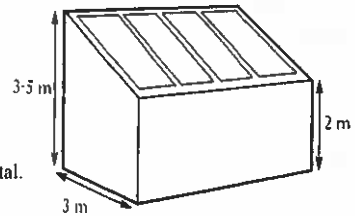
The radius of the circle is 8 mm

The distance from the centre of the circle to each vertex of the triangle is 17mm.

Calculate the perimeter of the triangle.

4 RE

7. The Scott family want to build a conservatory as shown in the diagram.



The conservatory is to be 3 metres wide.
The height of the conservatory at the lower end is to be 2 metres and at the higher end 3.5 metres.

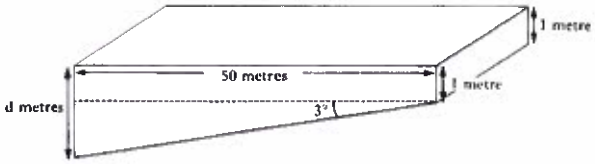
To obtain planning permission, the roof must slope at an angle of (25 ± 2) degrees to the horizontal.

Should planning permission be granted.

Justify your answer.

4 RE

8. The diagram shows the design of a swimming pool 50 metres in length.



The pool is 1 metre deep at one end and its base slopes downwards at an angle of 3° to the horizontal.

Calculate the depth, *d* metres, of the other end of the pool, giving your answer to 2 significant figures.

Do not use a scale drawing.

5 KU

Solutions

8 Trigonometry – SOH-CAH-TOA

1. Find SV and then SW

$$\sin 34 = \frac{SV}{13.1} \quad \text{hence SV} = 7.33 \text{ cms}$$

$$\cos 25 = \frac{SW}{SV} = \frac{SW}{7.33} \quad \text{so SW} = 6.6 \text{ cms (2 sf)}$$

---

2. Let Length of ladder = l

$$\sin 60 = \frac{14}{l} \quad l = 16.17 \text{ m}$$

Look at second triangle, cat is 15 m up the tree.

Let angle of ladder be θ

$$\sin\theta = \frac{15}{16.17} \quad \sin\theta = 0.9276 \quad \theta = 68°$$

---

3. Let angle of ramp be θ

$$\tan\theta = \frac{0.5}{1.9} \rightarrow \theta = \tan^{-1}\left(\frac{0.5}{1.9}\right) \quad \theta = 14.7°$$

Yes, the ramp satisfies local building regulations.

---

4. a) B to C: $\tan 70 = \frac{13.5}{BC}$ BC = 4.9 m

b) A to B is AC – BC

$$\tan 40 = \frac{13.5}{AC} \quad AC = 16.1 \text{ m}$$

Hence AB is: 16.1 – 4.9 = 11.2 metres.

---

5. a) Let diagonal of courtyard = d metres

$$\tan 8° = \frac{4.6}{d} \rightarrow d = \frac{4.6}{\tan 8°} = 32.7 \text{ metres}$$

b) Let length of side of courtyard = l metres.

Then by Pythagoras:

$$l^2 + l^2 = 32.7^2 \rightarrow 2l^2 = 1069.29$$

$$l = \sqrt{534.65} = 23.12.. \text{ metres}$$

This is approx 23 metres.

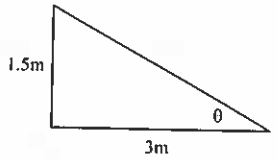
---

6. See Pythagoras Section 6
For the solution – misplaced in wrong section.

7.

$$\tan\theta = \frac{1.5}{3}$$

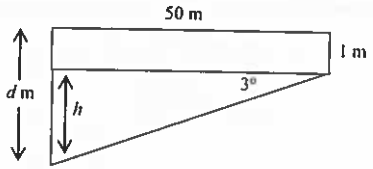
$$\theta = \tan^{-1}\frac{1.5}{3}$$



θ = 26.565.. °

Yes Planning permission should be granted, since angle is between 23° and 27°

8.



$$\tan 3° = \frac{h}{50} \quad \text{hence h} = 50 \tan 3° = 2.62 \text{ metres}$$

Hence d = 1 + 2.62 = 3.62

Hence depth of pool = 3.6 metres (2 sf)

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Examples

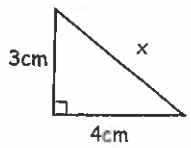
Workout

Click here

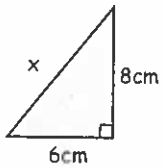
Scan here

Question 1: For each right angle triangle below, work out x

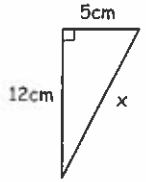
(a)



(b)

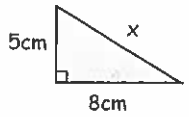


(c)

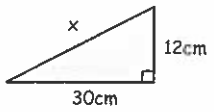


Question 2: Calculate x
Give each answer to 2 decimal places.

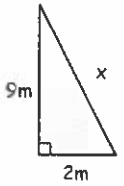
(a)



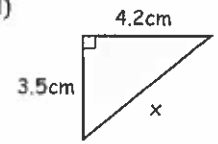
(b)



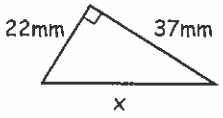
(c)



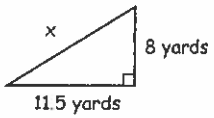
(d)



(e)

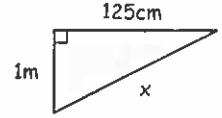


(f)

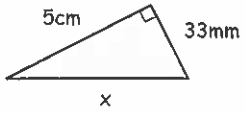


Question 3: Calculate x
Include suitable units and give each answer to 1 decimal place.

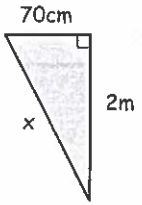
(a)



(b)

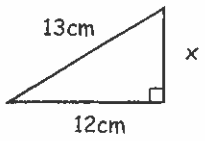


(c)

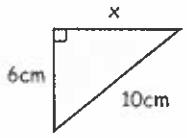


Question 4: For each right angle triangle below, work out x

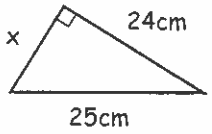
(a)



(b)



(c)



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Pythagoras

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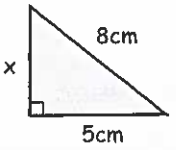
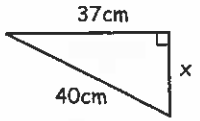
Question 5: Calculate x
Give each answer to 2 decimal places.

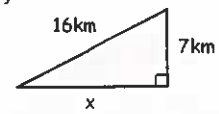
(a)



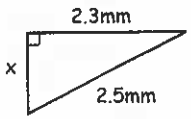
(b)



(c)



(d)



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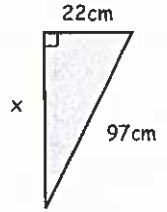
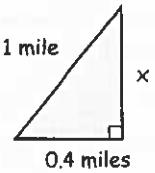
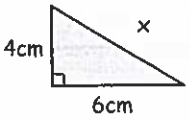


(f)

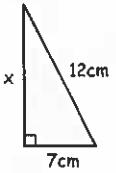


Question 6: Calculate x for each right angle triangle.
Give each answer to 2 decimal places.

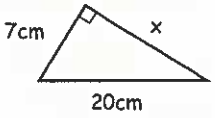
(a)



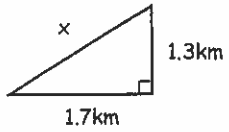
(b)



(c)



(d)



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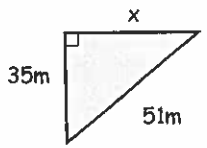
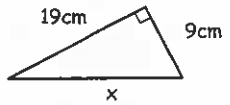
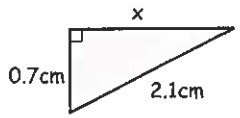


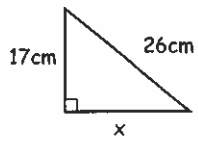
(f)



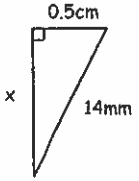
(g)



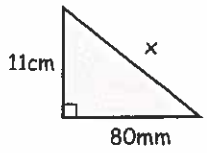
(h)



(i)

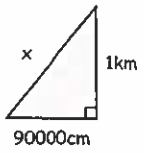


(j)



(k)

(l)



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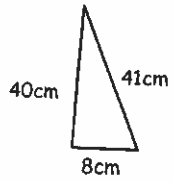
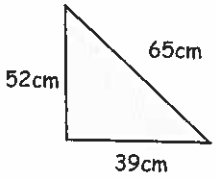
Question 7: Work out if each triangle below is right angled or not.
The triangles are not drawn accurately.

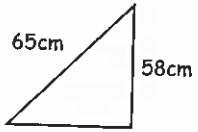
(a)



(b)

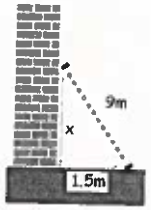


(c)

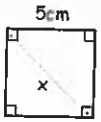


Apply

Question 1: A 9m ladder is placed against a wall.
The foot of the ladder is 1.5m from the foot of the wall.
How far up the wall does the ladder reach?

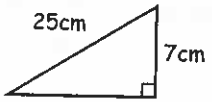


Question 2: Shown is a square with side length 5cm.
Find the length of the diagonal, x.



Question 3: Shown is a right angle triangle.
Calculate:

(a) the perimeter of the triangle.
(b) the area of the triangle.

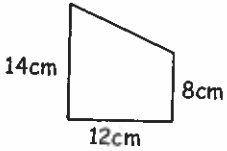


Question 4: A rectangle is 20cm long and 8cm wide.
Find the length of the diagonal of the rectangle.

Question 5: An airplane is flying from Redville to Leek.
The airplane flies 50 miles East and then 180 miles South.
How far is Leek from Redville directly?

Question 6: A frame is made from wire.
The frame is a trapezium
Calculate the total amount of wire needed to make the frame.

Give your answer to 1 decimal place.



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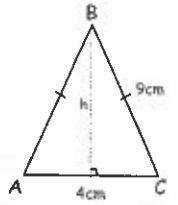
Question 7: ABC is an isosceles triangle.

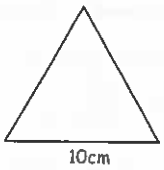
(a) Find h.

(b) Find the area of the triangle.



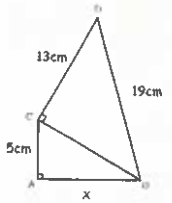
Question 8: Shown is an equilateral triangle.

Find the area of the equilateral triangle.



Question 9: Stanley has drawn a right angle triangle.
One side is 14cm and another is 18cm.
There are two possible lengths for the third side.
What are they?

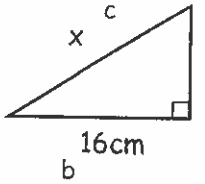
Question 10: ABC and BCD are right angle triangles.
Find the length of AB



Question 11: A wooden flagpole is 25 foot tall.
In a storm, the flagpole is broken and its top touches the ground 5 foot from the base.

Find the lengths of the segments of the flagpole.

Question 12: Benjamin has completed this question.
Can you spot any mistakes?



$a^2 + b^2 = c^2$

$12^2 + 16^2 = x^2$

$144 + 256 = x^2$

$400 = x^2$

$x^2 = 400$

$x = 200\text{cm}$

Pythagoras

Workout

Question 1:

(a) 5cm (b) 10cm (c) 13cm

Question 2:

(a) 9.43cm (b) 32.31cm (c) 9.22m

(d) 5.47cm (e) 43.05mm (f) 14.01 yards

Question 3:

(a) 1.6m/160cm (b) 59.9mm/6.0cm (c) 211.9cm/2.1m

Question 4:

(a) 5cm (b) 8cm (c) 7cm

Question 5:

(a) 6.24cm (b) 15.20cm (c) 14.39km

(d) 0.96mm (e) 94.47cm (f) 0.92 miles

Question 6:

(a) 7.21cm (b) 9.75 cm (c) 18.73cm

(d) 2.14km (e) 37.09m (f) 21.02cm

(g) 1.98cm (h) 19.67cm (i) 13.08mm

(j) 13.6cm (k) 3.38m (l) 1.35km

Question 7:

(a) No - $40^2 + 8^2 = 1664$ and $41^2 = 1681$ so it is not right-angled

(b) Yes - $52^2 + 39^2 = 4225$ and $65^2 = 4225$ so it is right-angled

(c) No - $58^2 + 28^2 = 4148$ and $65^2 = 4225$ so it is not right-angled

Apply

Question 1: 8.87m

Question 2: 7.07cm

Question 3: (a) 56cm (b) $84cm^2$

Question 4: 21.54cm

Question 5: 186.82 miles

Question 6: 47.4 cm

Question 7: (a) 8.77cm (b) $17.55cm^2$

Question 8: $43.3cm^2$

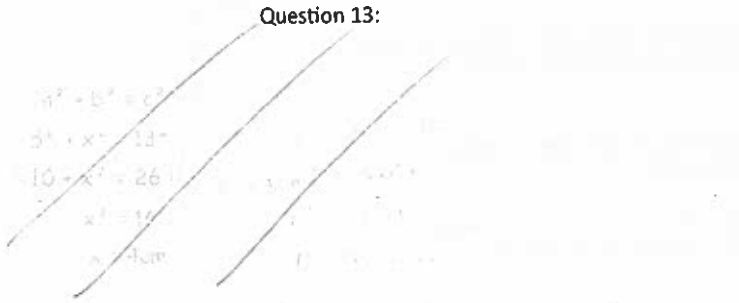
Question 9: 22.80cm or 11.31cm

Question 10: 12.93cm

Question 11: 12 foot and 13 foot

Question 12:

Question 13:



Question 14:

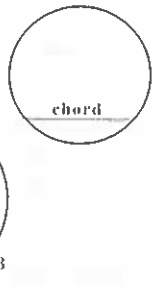
Angles formed inside Circles - Isosceles Triangles

Any line joining two points on the circumference of a circle is call a **chord**.

A **diameter** is a special chord.

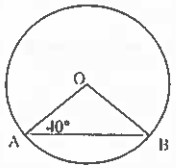
If the two points, A and B, are joined by a chord AB, then the triangle formed must be an isosceles triangle.

$\angle OAB = \angle OBA$



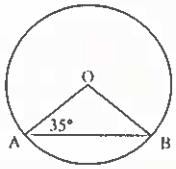
Exercise 10·6

1. Calculate the sizes of the angles in triangle OAB shown opposite.

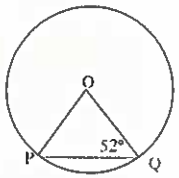


2. Find the missing angles in each of these :–

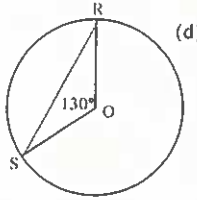
(a)



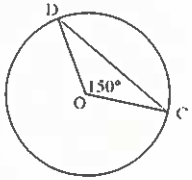
(b)



(c)

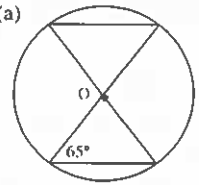


(d)

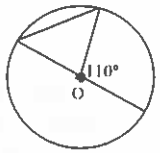


3. Use a coin to sketch each of these circles and fill in all the missing angles :–

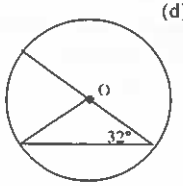
(a)



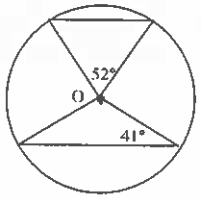
(b)



(c)

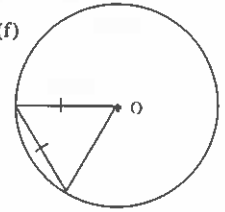


(d)

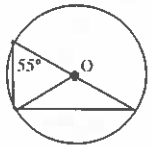


(e)

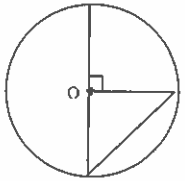
(f)



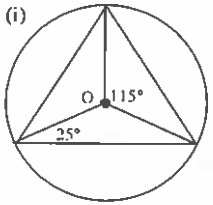
(g)



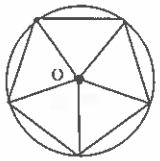
(h)



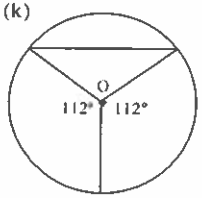
(i)



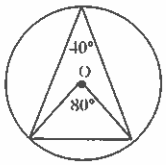
(j)



(k)



(l)



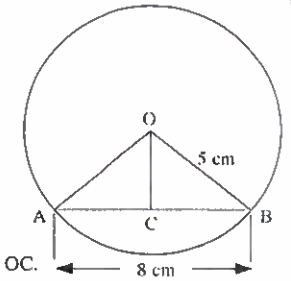
A **perpendicular bisector** is a line which cuts another line in half and does so at right angles to the first line.

For the diagram shown, the chord AB is now cut into two parts AC and CB, (both 4 cm long), by the line OC.

OC is the **perpendicular bisector** of the chord AB.

Can you see that triangle OCB is a right angled triangle ?

This means that you can use **Pythagoras' Theorem** to find the length of OC.



4. Use **Pythagoras' Theorem** to calculate the length of OC in the above diagram.

Copy and complete :-

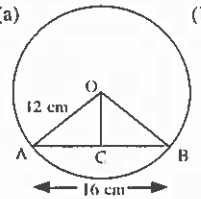
$OC^2 = OB^2 - CB^2$

$OC^2 = 5^2 - 4^2$

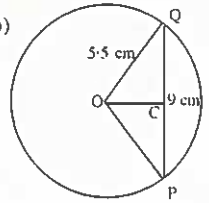
etc.

5. Use Pythagoras' Theorem to calculate the length of OC, to the nearest millimetre, in each diagram below :–

(a)

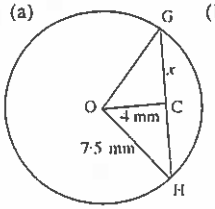


(b)

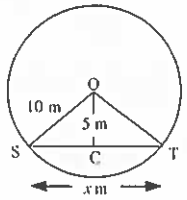


6. Calculate the value of x in each of these :–

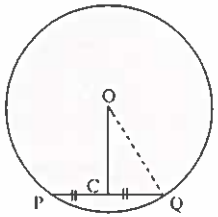
(a)



(b)



7.



In this circle, chord PQ is 10 cm and the line OC is 12 cm long.

Calculate the area of the circle.

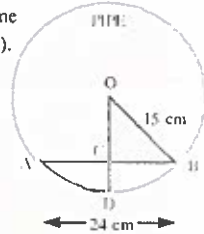
8. A horizontal pipe has some water in it to a depth (CD).

The surface AB is 24 cm.

The radius OB of the circle is 15 cm.

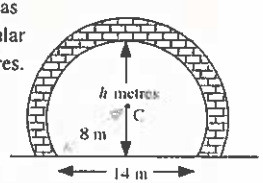
(a) Calculate the length of the line OC.

(b) Now write down the depth of the water CD.

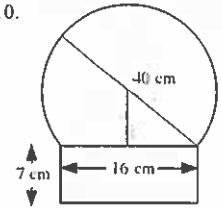


9. A tunnel entrance has centre C and a circular arc of radius 8 metres.

Calculate the height of the tunnel entrance.



10.



The picture shows a glass lamp, consisting of part of a spherical globe on top of a cylindrical base.

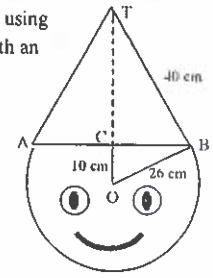
(a) Calculate the length of the red line.

(b) Calculate the total height of the lamp.

11. A clown's face is drawn using a segment of a circle, with an isosceles triangular hat.

- The Radius = 26 cm
- Line OC = 10 cm
- Side TB = 40 cm.

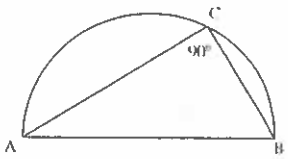
(a) Calculate the length of the base AB of triangle ATB.



(b) Calculate the total height of the face and hat.

Angles in a Semi-Circle

The diagram shows a semi-circle with diameter AB and a 3rd point C drawn somewhere on the circumference of the semi-circle.



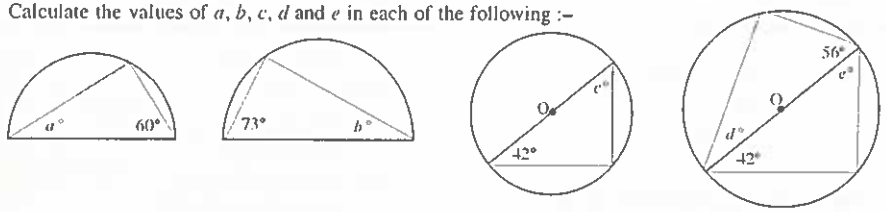
Two chords, AC and BC are drawn to create triangle ABC.

If you measure the size of ∠ACB, it always turns out to be 90°, *(as long as C is on the circumference)* !

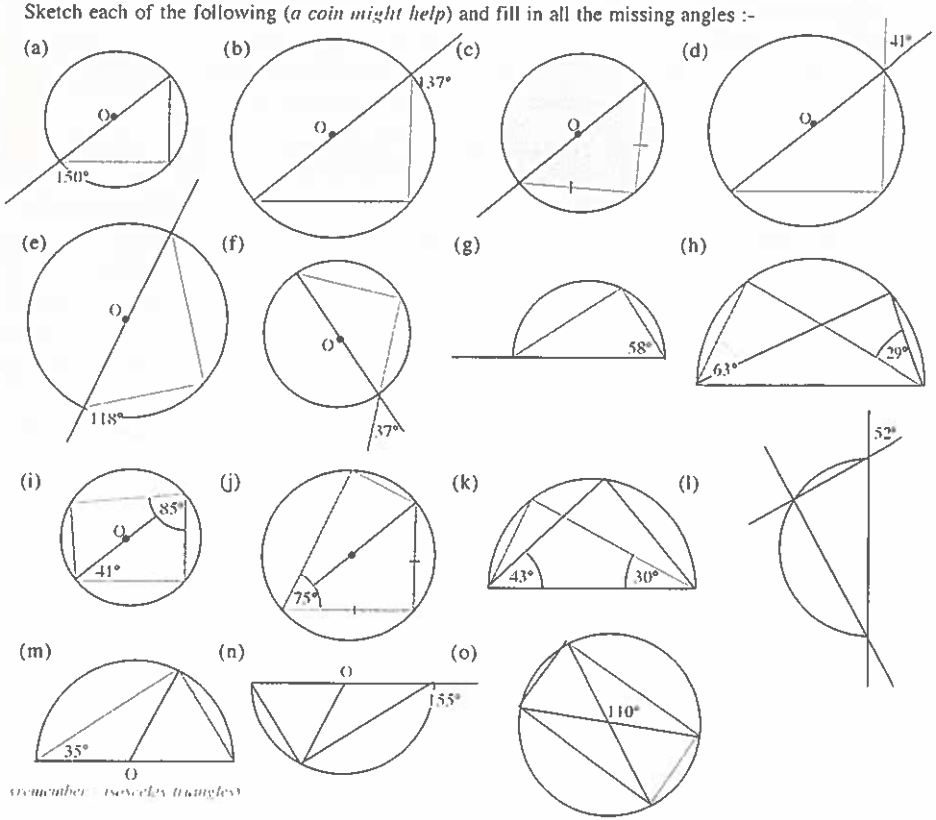
Every triangle in a semi-circle, formed like this, with the diameter as base, is a right angled triangle.

Exercise 10·7

1. Calculate the values of a, b, c, d and e in each of the following :–



2. Sketch each of the following (*a coin might help*) and fill in all the missing angles :-



(remember – isosceles triangles)

Because we have right angle triangles formed in semi-circles, we can once again use Pythagoras' Theorem to find a unknown lengths.

3. Calculate the length of the diameter AB shown in the semi-circle below :-

Copy and complete :–

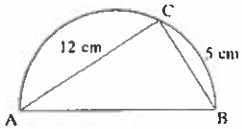
$ACB = 90°$

$AB^2 = 12^2 + 5^2$

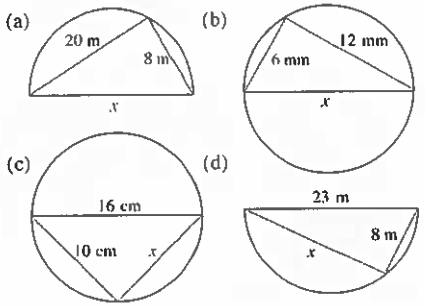
$= \ldots + \ldots$

$AB = \sqrt{\ldots\ldots}$

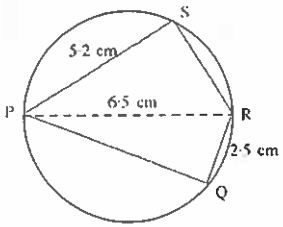
$AB = \ldots$



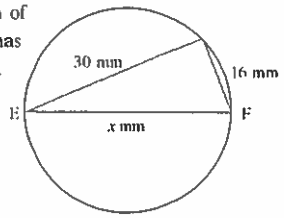
4. Calculate the value of x for each of these :–



5. Calculate the perimeter of quadrilateral PQRS, where PR is a diameter of the circle.

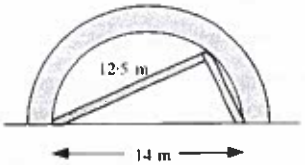


6. Calculate the area of this circle, which has EF as its diameter.



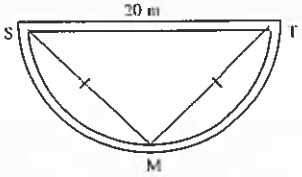
7. An entrance to a tunnel, through which water flows, is in the shape of a semi-circle.

Two wooden beams are used to support it while work is being carried out on the tunnel.



Calculate the length of the smaller beam.

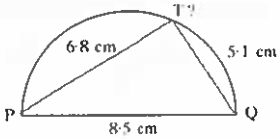
8. A semi-circular swimming pool has a diameter of 20 metres.



Lucy swims from T to M, then from M to S.
Josh walks directly from T to S.

How much further has Lucy travelled than Josh ?

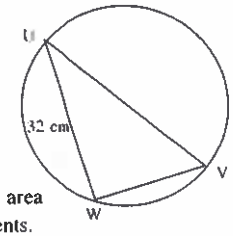
9. Ryan looks at this sketch of a semi-circle with diameter PQ.



He is not sure whether the point T actually lies on the circumference.

Use the Converse of Pythagoras' Theorem to decide if T lies on the circumference or not.

10. The circumference of this circle, with diameter UV, is 125·6 cm, and chord UW = 32 cm.



(a) Calculate the size of the circle's diameter.

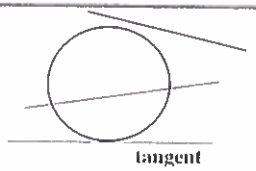
(b) Calculate the length of the chord VW.

(c) Calculate the total area of the pink segments.

Tangents to a Circle

A tangent is a line which, even if extended, would only ever touch a circle at one point.

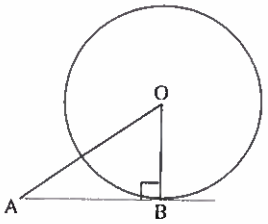
Only the red line shown opposite is a tangent.



A Special Property

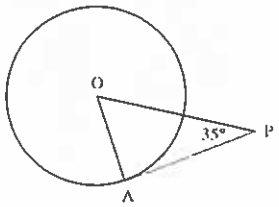
The diagram shows a tangent, AB, meeting the circle at point B.

If we draw a radius (OB) to this point of contact B, it is found that the radius and the tangent are at right angles. ($\angle ABO = 90°$)



Exercise 10·8

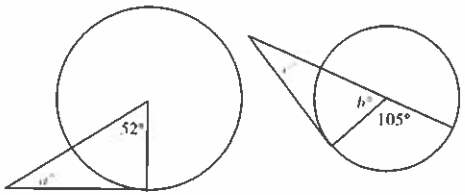
1. PA is a tangent to this circle, meeting it at the point A.

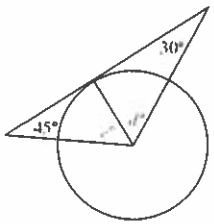


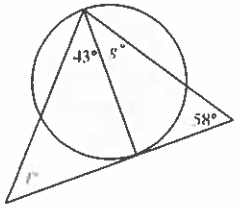
(a) What is the size of $\angle PAO$?

(b) Write down the size of $\angle POA$.

2. Write down the values of a, b, ... g.

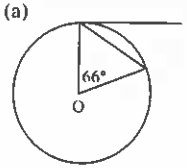




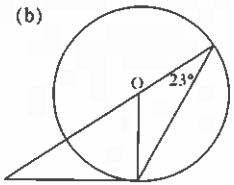


3. Sketch the following, (*a cm might help*), and fill in the sizes of all the missing angles.

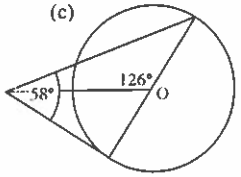
(a)



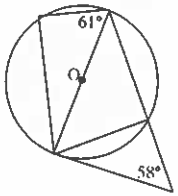
(b)



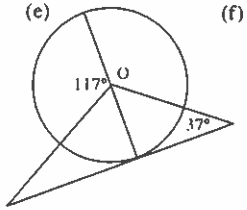
(c)



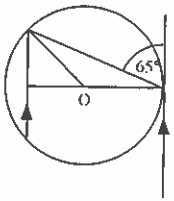
(d)



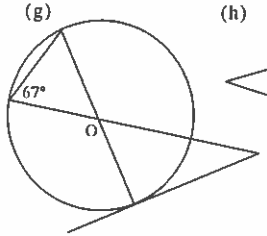
(e)



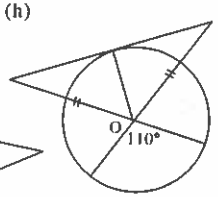
(f)



(g)



(h)

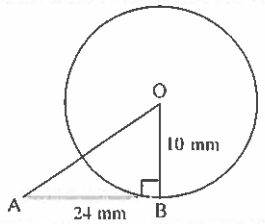


Pythagoras (again !)

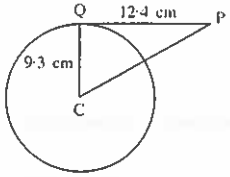
Again, because right angle triangles are formed, Pythagoras' Theorem can be used to find missing lengths.

The distance from O to A can be calculated as shown :-

$$OA^2 = 24^2 + 10^2$$
$$OA^2 = 576 + 100$$
$$OA^2 = 676$$
$$OA = \sqrt{676} = 26 \text{ mm}$$

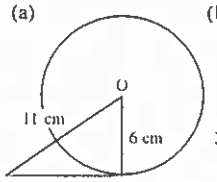


4. Calculate the distance from P to the centre of the circle C.

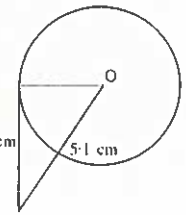


5. Determine the lengths of the red lines.

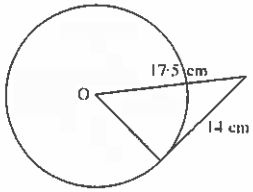
(a)



(b)

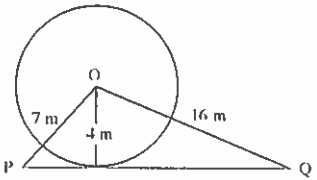


6.

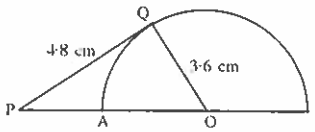


Calculate the area of this circle.

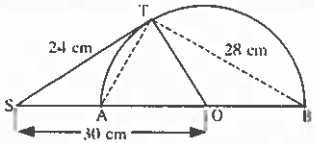
7. Determine the length of the tangent PQ.



8. Determine the length of the line PA.
(*Hint :- find the length of PO first*).



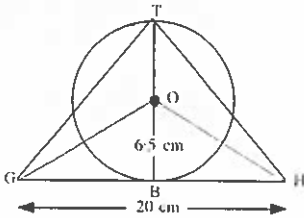
9. BA is a diameter of this semi-circle and is extended to point S.
ST is a tangent meeting the semi-circle at the point T.



(a) Calculate the size of radius OT.

(b) Now find the length of the chord AT.

10. The diagram shows a wheel, centre O, with a radius of 6·5 centimetres.

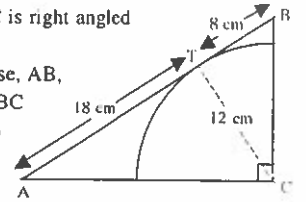


GH is a tangent and diameter BT is a line of symmetry for the whole figure.

A red wire is stretched from G to O to H.
A blue wire is stretched from G to T to H.

By how much is the blue wire longer than the red one ?

11. Triangle ABC is right angled at C.
The hypotenuse, AB, of triangle ABC is a tangent to the quarter circle at T.



Calculate the perimeter of triangle ABC.

e $4(q-2)(q+2)$ f $7(x-y)(x+y)$
g $6(v+5)(v-5)$ h $10(a-3b)(a+3b)$
i $19(x-y)(x+y)$ j $a(w-v)(w+v)$
k $n(m-n)(m+n)$ l $k(p-6q)(p+6q)$
m $k(p-3q)(p+3q)$ n $d(d+2)(d-2)$
o $3x(3x-4)(3x+4)$ p $(a^2-1)(a^2+1)$
q $(1-k^2)(1+k^2)$ r $(p^2-q^2)(p^2+q^2)$
s $(1-4y^2)(1+4y^2)$ t $3(d^2-4)(d^2+4)$

3. a Yellow area $= k^2 - s^2 = (k-s)(k+s)$
b 47·25cm²

Exercise 9·7

1. a $(x+1)(x+1)$ b $(a+2)(a+1)$
c $(k+5)(k+2)$ d $(d+7)(d+2)$
e $(x-1)(x-1)$ f $(b-3)(b-3)$
g $(c-6)(c-3)$ h $(w-3)(w-8)$
i $(x+4)(x-1)$ j $(n+3)(n-2)$
k $(p+5)(p-3)$ l $(q+6)(q-3)$
m $(x-4)(x+1)$ n $(r-7)(r+1)$
o $(y-6)(y+2)$ p $(h-10)(h+2)$
2. a $(x-6)(x+1)$ b $(x+3)(x+5)$
c $(x-5)(x+10)$ d $(x-9)(x-2)$
e $(y-5)(y+3)$ f $(y+8)(y-1)$
g $(y-7)(y-2)$ h $(y+6)(y+2)$
i $(a-7)(a+7)$ j $(a-11)(a+1)$
k $(a+6)(a-5)$ l $(a-4)(a-5)$
m $(c-5)(c-3)$ n $(c+7)(c-3)$
o $(c-9)(c+3)$ p $(c-8)(c-2)$
q $(k+10)(k-1)$ r $(k-9)(k+1)$
s $(k-7)(k+5)$ t $(k+6)(k-4)$
u $(v+4)(v-2)$ v $(v-3)(v-10)$
w $(v-4)(v+3)$ x $(v-8)(v-5)$
3. a $(2x+3)(x+1)$ b $(2a+1)(a+3)$
c $(3y+2)(2y+1)$ d $(3g+5)(g+3)$
e $(6k-1)(2k-1)$ f $(2b-1)(b-3)$
g $(4c-5)(2c-1)$ h $(3x+4)(x-2)$
i $(3a+1)(a-2)$ j $(5p-1)(p+1)$
k $(2m-1)(m+1)$ l $(3q+1)(q-1)$
m $(4c+3)(2c-1)$ n $(4n-1)(2n+3)$
o $(4w-5)(3w+1)$ p $(2c+3)(2c+3)$
q $(4k+1)(6k-1)$ r $-(6x+1)(3x-1)$
s $-(2y-3)(y+5)$ t $(x+6y)(x+2y)$
u $(p-12q)(p+2q)$ v $(b+2c)(b+c)$
w $(a-7b)(a+2b)$ x $(2u+v)(u-3v)$
y $(3g+4)(3g-2)$ z $(3\sin\theta-2)(3\sin\theta-2)$

Exercise 9·8

1. $6(x+6y)$ 2. $(p+7)(p-7)$
3. $(y+3)(y+3)$ 4. $k(k-1)$
5. $(v-3)(v+2)$ 6. $(1-a)(1+a)$
7. $d(e+h-j)$ 8. $3(c-2)(c+2)$
9. $m(m-8)$ 10. $(q-1)(q-1)$
11. $(b-1)(b+1)$ 12. $b(b-1)$
13. $(b-2)(b+1)$ 14. $2(t-3)(t+3)$
15. $2x(x-16)$ 16. $a^2(a-1)$
17. $(2p+5)(p-1)$ 18. $(3u+1)(3u+1)$
19. $(9-x)(9+x)$ 20. $2(5-c)(5+c)$
21. $6y(3-y)$ 22. $(9-2b)(9+2b)$
23. $(2k+1)(k-1)$ 24. $14(x^2+3y^2)$
25. $14(m-2n)(m+2n)$ 26. $(4x-1)(4x-1)$
27. $3pq(p-3q)$ 28. $(u-1)(u-1)$
29. $3x(x-3)(x+3)$ 30. $(3a-2)(2a+3)$
31. $4(x+2)(x-1)$ 32. $10w(1-2w)(1+2w)$
33. $a(k-m)(k+m)$ 34. $(2x+3)(x-5)$
35. $p^5(p^2-p-1)$ 36. $(x+3)(x-3)(x^2+9)$

Remember Remember 9

1. a $24x$ b g^2 c $32ab$ d $5p^2$
e $4m^2n$ f $3x^2q$ g 20 h $4x^2$
2. a $5a+10$ b $8-24r$ c $9a+a^2$
d $-6x^2+12xy$
3. a $3x+10$ b $y+36$ c $16-3q$
d $9w+14$ e $18-8d$ f $3q+2$
g $5-5u$ h $2k+6$ i $14m-2$
4. a $a^2+9x+14$ b $b^2-9b+18$
c $c^2+7c-18$ d $12d^2+20d+3$
e $6e^2-17e+5$ f $14y^2+19y-3$
g $4k^2-20k+25$ h m^2+4+4/m^2
i n^3+3n^2+3n+1 j $8s^3-36s^2+54s-27$
k $7x$ l $5x^2-12x+1$
m $6y^3+5y^2-10y+3$

5. a $4(a+6)$ b $7(3x-4b)$ c $e(d+g)$
d $2b(b-5)$ e $n^2(n-1)$ f $12kh(2k+3h)$
g $(r-10)(r+10)$ h $5(q-2)(q+2)$
i $(w-8)(w-2)$ j $(2m+3)(m+2)$
k $(5b-2)(b-5)$ l $(x-2y)(x+y)$
m $(3x-y)(2x+3y)$ n $(x-7y)(x-7y)$
o $(1-5a)(1+5a)$ p $(9n+9)(n-2)$
q $3p(p-16)$ r $7ab(a^2-3)$
s $17s(t-u)(t+u)$ t $(x^2-y^2)(x^2-y^2)$
6. a $2k+3$ b $k+2$
c $(2k+3)(k+2)=2k^2+7k+6$
d $2k^2+6k+14$

Turn off that Calculator - Non-calc 3

1. a 6575 b 837 c 360 d 27360
e 12500 f 6300000 g 880 h 7036
2. £2220
3. a 4·75 b 6·716 c 10·251 d 0·18
e 70 f 115·644 g 23·444 h 2·168
4. a 264 b 63 c 600
5. a $^2/_3$ b $^8/_9$ c $^2/_3$ d $^1/_4$
6. a $11^1/_4$ b $43^1/_4$ c 9 d $^1/_4$
7. 100 pupils
8. a £282 b £23·50 c £42·30
9. a £1·60 b £4·20 c 96p
d £9 e £75 f £30
10. £1632
11. a 7 b −29 c −17 d 40
e −60 f −45 g 121 h −5
i −45 j −6 k −18 l 35
12. 36°
13. 23rd May

Answers to Chapter 10 Page 101

Exercise 10·1

1. 5·5 cm
2. a 12·56 cm b 11·78 cm
c 6·98 cm d 18·84 cm
3. a 25·12 cm b 19·63
c 18·14 d 37·68 cm
4. a 18·84 mm b 54·95 cm
c 39·08 m d 52·33 cm
5. a 41·8 cm b 74·89 mm
6. 16·28 cm

Exercise 10·2

1. 39·25 cm²
2. a 26·17 cm² b 42·39 cm²
3. a 274·75 cm² b 52·33 cm²
4. a 43·96 cm² b 802·44 cm²
c 83·41 cm² d 54·51 cm²
e 128·22 cm² f 69·32 cm²
g 163·54 cm²

Exercise 10·3

1. a (i) 39·25 cm (ii) 1116·44 cm²
b (i) 12·95 mm (ii) 35·62 mm²
2. 1395·56 cm²
3. 157 cm²
4. 24·42 cm
5. a 115·13 m b 105·54 m
6. 11·6 m
7. a 29·34 cm b 53·22 cm²
8. a 113·04 cm² b 72 cm² c 41·04
9. 254·18

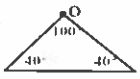
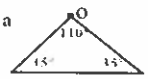
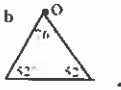
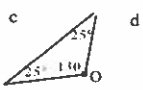
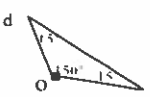
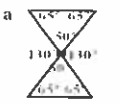
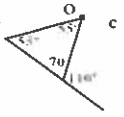
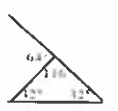
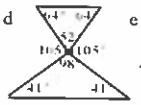
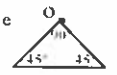
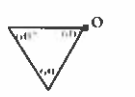
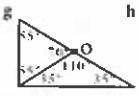
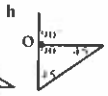
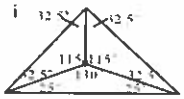
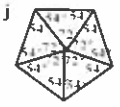
Exercise 10·4

1. 45°
2. a 120° b 240°
3. 180°
4. a 147·4° b 169·8° c 223° d 107·5°
5. a 330° b 5077·38 mm²

Exercise 10·5

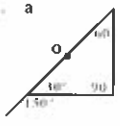
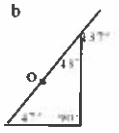
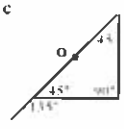
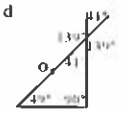
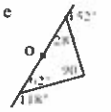
1. 45° 2. a 115·6° b 238·9°
3. 300·4°
4. a 120·0° b 156·0° c 107·5° d 301·0°
5. a 202·5° b 63·6 cm

Exercise 10·6

1. 
2. a 
2. b 
c 
d 
3. a 
b 
c 
d 
e 
f 
g 
h 
i 
j 
k 
l 

4. 3
5. a 89 mm b 32 mm
6. a 6·3 mm b 17·3 mm
7. 530·66 cm²
8. a 9 cm b 6 cm
9. 11·87 m
10. a 18·3 cm b 45·3 cm
11. a 48 cm b 68 cm

Exercise 10·7

1. a 30° b 17° c 48° d 34°
e 48°
2. a 
b 
c 
d 
e 
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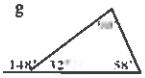
g 
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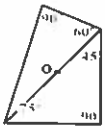
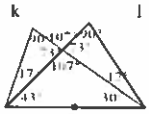
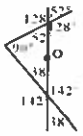
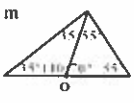
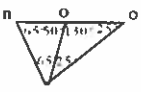
j 
k 
l 
m 
n 
o 

3. 13 cm

4. a 21·54 cm b 13·42 mm
c 12·49 cm d 21·56 cm

5. 17·6 cm 6. 907·46 mm²

7. 6·3 m 8. 8·28 m

9. (longest)² = (shortest)² = 72·25 by converse of Pythagoras T lies on circumference

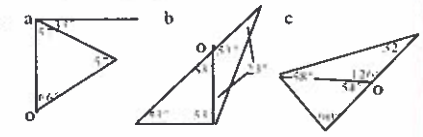
10. a 40 cm b 24 cm c 872 cm

Exercise 10·8

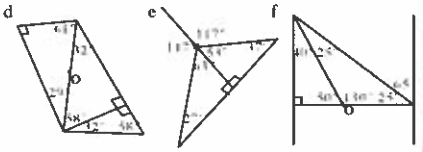
1. a 90° b 55°

2. a 38 b 75° c 15° d 60°
e 45° f 47° g 32°

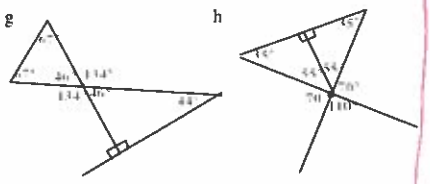
3. a b c



d e f



g h



4. 15·5 cm

5. a 9·2 cm b 3·4 cm

6. 346·185 cm² 7. 21·2 cm

8. 2·4 cm

9. a 18 cm b 22·6 cm

10. 8·9 cm 11. 62·1 cm

Exercise 10·9

1. a 125°

2. ∠AOB = 138° ∠CAO = 90° ∠CBO = 90°

3. a 24° b 132° c 66° d 24°

4. 22·4 cm

5. 706·5 cm²

6. a (i) 10 cm (ii) 28 cm b 26·2 cm

7. 60·9 cm

Remember Remember 10

1. a 11·8 m b 41·9 mm

2. a 88·3 m² b 209 mm²

3. a 135° b 100° c 300° d 160°

4. a x = 44° b y = 50°
c z = 50° d w = 37·5°

5. a 6 cm b 7·81 m c 20·6 mm

6. a 10·6 cm² b 19·39 m

7. 26·37 m b 40·03 m²

Maths 1 NAB Practice Page 114

Outcome 1

1. a £16 b £8·75 c 94p
d £1·50 e £560 f £80

2. 1·35 m

3. a 655·64 b £1255·83

4. £102960 5. £50494·25

6. £4050

7. a 4000 b 30000 c 40 d 700

8. a 4300 b 44000 c 530 d 860

9. a 8180 b 64700 c 6090 d 147000

10. a 6·86 b 19·3 c 0·235 d 0·0570

Outcome 2

11. a 120 cm³ b 42·5 cm³
c 495 cm³ d 150·5 cm³

12. a 960 cm³ b 98 cm³

13. a 804 cm³ b 4850 cm³

14. 43·96 litres

15. a 565·2 cm³ b 220·8 mm³

Outcome 3

16. a 523 cm³ b 56520 cm³

17. a $7/3$ b $2/3$

18. a $2/3$ b 2

19. a -2 b $-2/7$

20. a -1 b -4 c -3

21. a m = 2 (0, 3) b m = 3 (0, −1)
c m = 1 (0, −5) d m = 1/2 (0, 2)
e m = −2 (0, −1) f m = −4 (0, 1)

22. a m = 2 (0, 0) $y = 2x$
b m = 2 (0, −2) $y = 2x - 2$
c m = 1/2 (0, 2) $y = 1/2x + 2$
d m = −2 (0, 1) $y = -2x + 1$
e m = −2/3 (0, 3) $y = -2/3\,x + 3$
f m = −1 (0, 3) $y = -x + 3$

Outcome 4

23. a $8x + 40$ b $5p + 10$
c $3a - 18$ d $9w - 27$
e $18n - 12$ f $df + 6d$
g $4g^2 + 5gh$ h $31w - 3w^2$

24. a $4a + 4b - 12$ b $y^2 + 4y$
c $5e - 5f + 55$ d $3d - d^2$

25. a $x^2 + 8x + 15$ b $x^2 + 10x + 16$
c $x^2 + cx - 7$ d $h^2 + h - 12$
e $k^2 - 10k + 25$ f $q^2 - 4q - 21$

26. a $8x^2 - 14x - 15$ b $12e^2 + 8e - 15$
c $9e^2 + 9e - 10$ d $a^2 - 11a + 30$
e $-2w^2 + 17x + 30$ f $5r^2 - 16r + 3$

27. a $w^2 - 4w + 4$ b $e^2 + 20e + 100$
c $9x^2 + 6x + 1$ d $25a^2 - 20a + 100$
e $9x^2 + 6x + 1$ f $25a^2 - 20a + 4$
g $9a^2 + 12ab + 4b^2$ h $16t^2 - 8ts + s^2$

28. a $8(a + b)$ b $5(t + s)$
c $10(u - v)$ d $3(3d - 2e)$
e $5(2a + 3b)$ f $4(3m - 2n)$
g $b(e + u)$ h $x(n - m)$

29. a $(x - 5)(x + 5)$ b $(a - 9)(a + 9)$
c $(6 - w)(6 + w)$ d $(e - f)(e + f)$

30. a $(x + 5)(x + 2)$ b $(w + 8)(w + 2)$
c $(g + 9)(g + 2)$ d $(w - 2)(w - 2)$
e $(d - 4)(d - 4)$ f $(m - 6)(m - 2)$
g $(b - 4)(b - 9)$ h $(y - 1)(y - 1)$
i $(e - 10)(e - 5)$ j $(f + 15)(f + 1)$
k $(r - 5)(r + 2)$ l $(e - 6)(e + 2)$
m $(z + 5)(z - 4)$ n $(c + 7)(c - 2)$

31. a 4·99 cm b 42·52 cm

32. a 99·15 cm² b 181·1 cm²

33. a 31° 59° b 114° 24°

34. x = 4·5 cm

35. a m = 58° b n = 115°

36. 11·4 cm

37. 55°

Answers to Chapter 11 Page 120

Exercise 11·1

1. a 0·424 b 1·072 c 1·376 d 11·430
e 1·428 f 0·287 g 0·070 h 2·050
i 8·144 j 1·000 k 2·174 l 0·061

2. Yes, it is !

3. a 16 cm b 10 cm c 1·6 d 1·6

Exercise 11·2

1. 32·2 cm

2. a 10·0 b 7·4 c 5·7
d 78·6 e 7·7 f 20·8 (all cm)

3. 56 m 4. 8·1 m 5. 15·5 m

6. 125 m 7. 41·3 m 8. 51·2 ft

Exercise 11·3

1. a 25° b 56° c 14° d 6°
e 45° f 38° g 22° h 12°
i 66° j 85°

2. 21·8° 3. a 24·0° b 32·1°

4. a 38·7° b 45·0° c 71·6°
d 20·7° e 28·1° f 52·4°

5. 31·7° 6. 70·7° 7. 13·6°

8. a 10·3° b 100·3°

Exercise 11·4

1. a 0·766 b 0·500 c 0·866 d 0·995
e 0·122 f 0·477 g 0·339 h 0·951
i 0·99.. j 1·000

2. a 23·6° b 12·4° c 26·4° d 73·7°
e 7·2° f 10·5° g 30·0° h 14·5°
i 19·5° j 36·0°

3. a 17·8 b 8·8 c 105·0
d 207·4 e 2·4 f 17·8 (all cm)

4. 1·75 m 5. 0·92 m 6. 1·5 km 7. 6·3 m

8. a 60° b 8·7 m c 8·7 m same !

9. a 23·6° b 41·8° c 10·8°
d 56·4° e 58·8° f 38·7°

10. 53·1° 11. 13·7° 12. 15·5° 13. 14·9°

Exercise 11·5

1. a 0·766 b 0·174 c 0·500
d 0·866 e 0·996 f 0·609

2. a 36·9° b 69·1° c 83·6°
d 32·9° e 79·5° f 29·0°

3. a 4·2 cm b 5·7 cm c 4·2 cm

4. 22·3 cm 5. 2·71 m 6. 27·5 cm 7. 10·6 cm

8. 39·7° 9. a 33·6° b 56·4° 10. 81·1°

Exercise 11·6

1. a 6·7 b 50·5 c 172·9 (all cm)

2. 8·12 m

3. a 37·1cm b 8·1cm c 247·2 mm

4. 3·1 m

5. a 20·9cm b 19·9cm c 306·7 mm

6. 15·8 cm 7. 51·6 cm 8. 10·3 cm

Exercise 11·7

1. a 5·1 b 15·1 c 10·0
d 14·0 e 10·1 f 24·2 (all cm)

2. a 57·3° b 39·9° c 11·7°
d 35·7° e 64·6° f 30·0°

3. 39·4 m 4. 38·5° 5. 45·4 ft

6. a 7·8 m b 7·1 m 7. 13·5 m

8. 18·0 km 9. 12·8° Yes, ok

10. 118° 11. 108 cm² 12. 3·99 m

13. 36° - Yes, ok

Remember Remember 11

1. a 10·6 cm b 39·2° c 27·7 cm

2. 64·3° 3. 33 m

4. 302 m

5. a 149·8 m & 83·9 m b 66 m

6. 036° 7. 33·1 cm

Answers to Chapter 12 Page 136

Exercise 12·1

1. a x = 2 b x = 0 c x = 12

Similar Shapes: Sides 1

Video 292 on www.corbettmaths.com

Examples

Click here

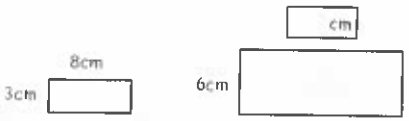
Scan here

Workout

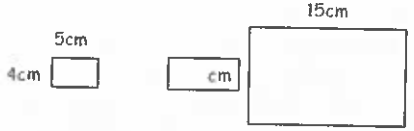
*The diagrams in this exercises are not drawn to scale.

Question 1: Below are pairs of similar shapes.
Find the missing lengths.

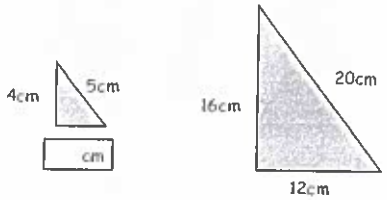
(a)



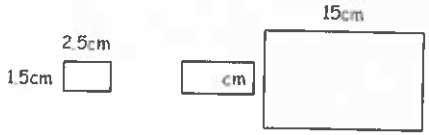
(b)



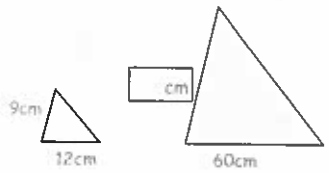
(c)



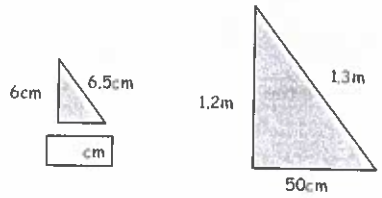
(d)



(e)

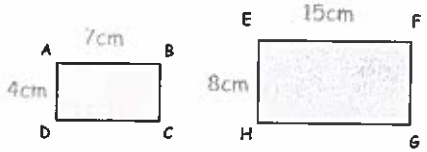


(f)

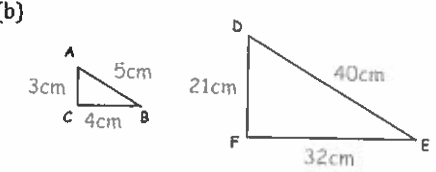


Question 2: These pairs of shapes are **not** similar.
Explain why.

(a)

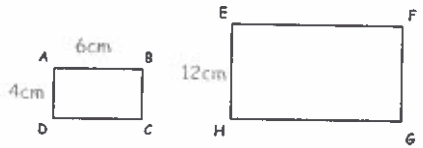


(b)



Question 3: Rectangles ABCD and EFGH are similar.

Work out the size of EF



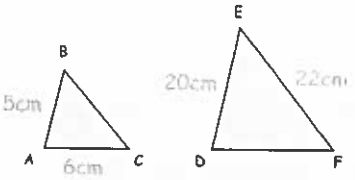
Similar Shapes: Sides 1

Video 292 on www.corbettmaths.com

Question 4: Triangles ABC and DEF are similar.

(a) Work out the length of DF

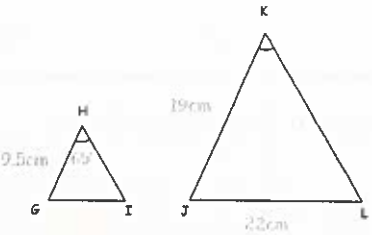
(b) Work out the length of BC



Question 5: Triangles GHI and JKL are similar.

(a) Write down the size of angle JKL

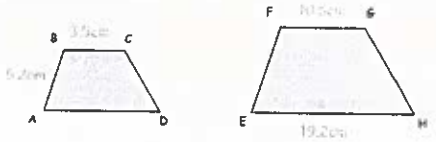
(b) Work out the length of GI



Question 6: Trapezium ABCD and trapezium EFGH are similar.

(a) Work out the length of EF

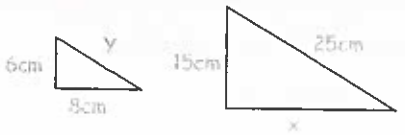
(b) Work out the length of AD



Question 7: The triangles below are similar

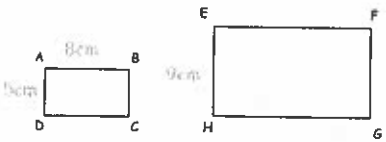
(a) Find the size of x

(b) Find the size of y



Question 8: Rectangles ABCD and EFGH are similar.

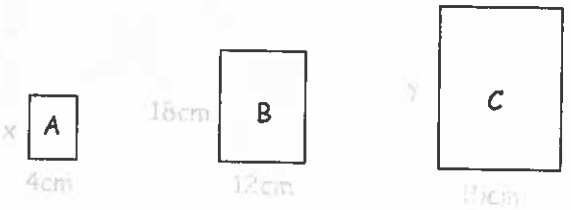
Work out the length of EF



Question 9: The diagram shows three similar rectangles.

(a) Work out the size of x

(b) Work out the size of y



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Similar Shapes: Sides 1

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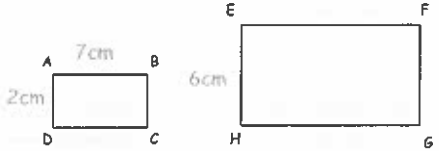
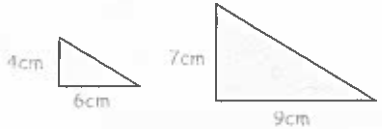
Apply

Question 1: Rectangles ABCD and EFGH are similar

Find the area of rectangle EFGH



Question 2: Here are two triangles



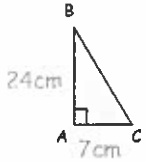
Finley says "the two triangles are similar because 3cm has been added to both the height and base of the smaller triangle."

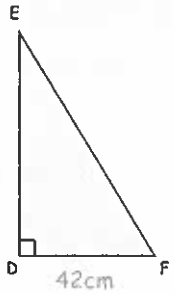
Explain why Finley is incorrect.

Question 3: ABC and DEF are similar right angled triangles.

AB = 24cm AC = 7cm DF = 42cm

Work out the length of EF.





Answers

Click here

Scan here

Video 292

1

a) 16cm b) 12cm c) 3cm d) 45cm

e) 45cm f) 2.5cm

2a) 4 x 2 = 8, but 7x2 does not make 15

b) AB and CB have been multiplied by 8, but AC has been multiplied by 7

3) 18cm

4a) 24cm b) 5.5cm

5a) 65° b) 11cm

6a) 15.6cm b) 6.4cm

7a) 20cm b) 10cm

8) 14.4cm

9) 22.5cm

Apply:

1) $126cm^2$

2) For shapes to be similar, corresponding sides must be multiplied by a common scale factor.

3) 150cm

5. Similar Shapes and Similar Triangles

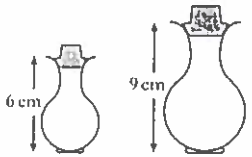
Similar Shapes – Area and Volume Scale Factors

1. Two perfume bottles are mathematically similar in shape.

   The smaller one is 6 centimetres high and holds 30 millilitres of perfume.

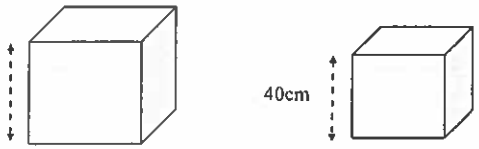
   The larger one is 9 centimetres high.

   What volume of perfume will the larger one hold.



3 KU

2. The two boxes below are mathematically similar and both have to be wrapped with decorative paper.



   If it requires 3.27 m^2 of paper to cover the large box, calculate the amount of paper needed to cover the smaller box. 3 KU

3. The diagram shows two bottles of Silvo Shampoo.

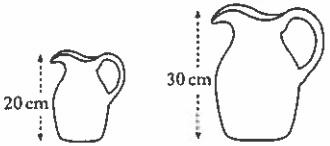
   The two bottles are **mathematically similar**, and the cost of the shampoo depends only on the volume of liquid in the bottle.

   If the small one costs 80p, what should the large one cost ? 3 KU

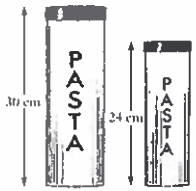
4. The diagram shows two jugs which are mathematically similar.

   The volume of the smaller jug is 0.8 litres.

   Find the volume of the larger jug.



3 KU

5. 

   The diagram shows two storage jars which are mathematically similar.

   The volume of the large jar is 1.2 litres.

   Find the volume of the smaller jar.

   Give your answer in litres correct to 2 significant figures. 4 KU

6. The diagram shows two tubes of toothpaste.

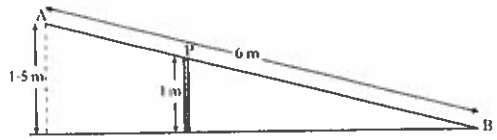
   Assuming that the tubes are mathematically similar, and that the price of toothpaste depends only on the volume of toothpaste in the tube, what would be the cost of the large tube when the small one costs £1.12?

3 KU

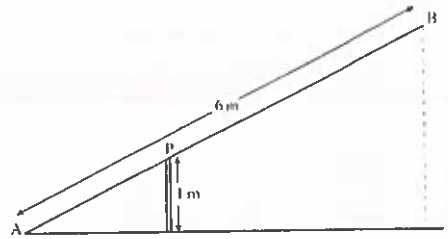
Similar Triangles

1. A metal beam, AB, is 6 metres long. It is hinged at the top, P, of a vertical post 1 metre high. When B touches the ground, A is 1.5 metres above the ground, as shown in Figure 1.

Figure 1



   When A comes down to the ground, B rises, as shown in Figure 2.



   By calculating the length of AP, or otherwise, find the height of B above the ground.

   Do not use a scale drawing. 5 RE

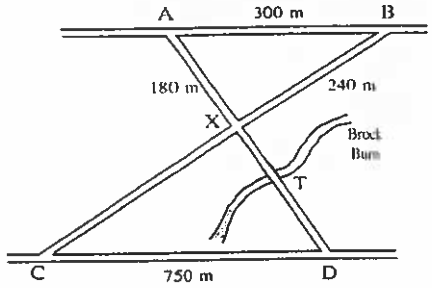
2. The road joining A to B is parallel to the road joining C to D in the diagram.

   AB = 300 metres,

   AX = 180 metres,

   BX = 240 metres

   and CD = 750 metres.



   a) Prove that the two roads AX and BX are at right angles to one another 3 RE

   b) The Brock Burn burst its banks at T and the road became impassable. An alternative route had to be found in order to travel from A to D.

   Calculate the length of the shortest route. 3 RE

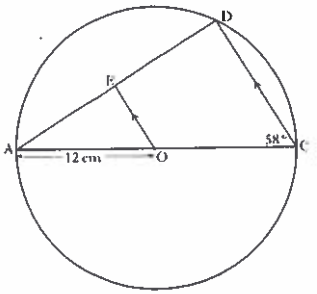
3. AC is the diameter of the circle, with centre O, and radius 12 centimetres

   AD is a chord of the circle.

   OE is parallel to CD

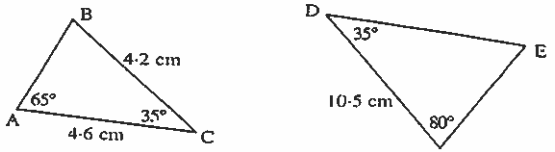
   Angle ACD is 58°

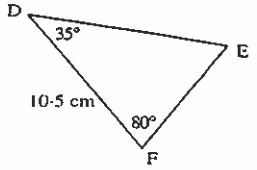
   Calculate the length of ED.



4 KU

4. Study the two triangles shown.





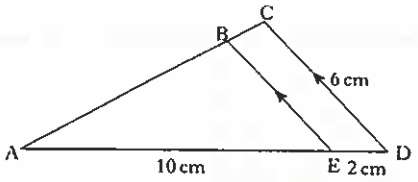
a) Explain clearly why the two triangles must be similar. 1 KU

b) Use the fact that the two triangles are similar to calculate the length of the line DE. 2 KU

5. Triangles ABE and ACD with some of their measurements are shown opposite.

Triangle ABE is similar to triangle ACD.
Calculate the length of BE.

Do not use a scale drawing.



3 KU

6. The brown family want to convert the roof space in their bungalow into an extra room.

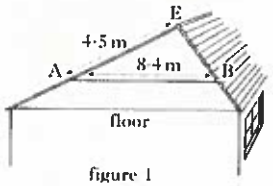


figure 1

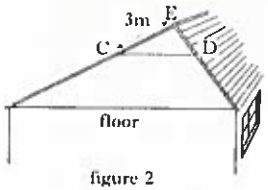


figure 2

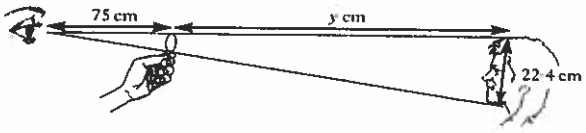
The position, AB, of the wooden beam must be changed to position CD, as shown in figure 2.

The wooden beam must always be parallel to the floor.

By considering the similar triangles EAB and ECD, calculate the length of the wooden beam in position CD.

Do not use a scale drawing. 3 KU

7. By holding a 10 pence coin at arms' length, it is possible to cover exactly the face of a person standing a distance away.



The diameter of the 10 pence coin is 2.8 cm and the length from the top to the bottom of the person's face is 22.4 cm.

If the distance from the observer's eye to the top of the coin is 75 cm, find the distance from the top of the 10 pence coin to the top of the person's head. 4 KU

Solutions
5 Similar Shapes

1. Linear scale factor $= \frac{9}{6} \rightarrow \frac{3}{2}$

   Volume: $= 30 \times \frac{3}{2} \times \frac{3}{2} \times \frac{3}{2} = 101.25\ mls$

---

2. Linear scale factor $= \frac{40}{50} \rightarrow \frac{4}{5}$

   Area: $= 3.27 \times \frac{4}{5} \times \frac{4}{5} = 2.0928\ m^2 \ = 2.09\ m^2$

---

3. Linear scale factor $= \frac{27}{18} \rightarrow \frac{3}{2}$

   Cost: $= 80 \times \frac{3}{2} \times \frac{3}{2} \times \frac{3}{2} = £2.70$

---

4. Linear scale factor $= \frac{30}{20} \rightarrow \frac{3}{2}$

   Volume: $= 0.8 \times \frac{3}{2} \times \frac{3}{2} \times \frac{3}{2} = 2.7\ litres$

---

5. Linear scale factor $= \frac{24}{30} \rightarrow \frac{4}{5}$

   Volume: $= 1.2 \times \frac{4}{5} \times \frac{4}{5} \times \frac{4}{5} = 0.6144\ litres$

   Volume = 0.61 litres (2 sig figs)

---

6. Linear scale factor $= \frac{200}{160} \rightarrow \frac{5}{4}$

   Cost: $= £1.12 \times \frac{5}{4} \times \frac{5}{4} \times \frac{5}{4} = £2.1875$

   Cost = £2.19

Similar Triangles

1. Due to parallel line, Triangles are similar

   $\frac{BP}{6} = \frac{1}{1.5} \rightarrow BP = \frac{6}{1.5} = 4$

   Hence AP = 6 – 4 = 2 metres

   In Figure 2 the triangles are similar:

   Let B be h metres above the ground

   $\frac{h}{1} = \frac{6}{AP}$ but $AP = 2$ $\frac{h}{1} = \frac{6}{2}$ $h = 3\ metres$

---

2. a) Use converse of Pythagoras in Δ ABX
   $AB^2 = 300^2 = 90000$
   $AX^2 + BX^2 = 180^2 + 240^2 = 90000$
   Since $AB^2 = AX^2 + BX^2$ then ∠ AXB is 90°
   So roads AX and BX are at right angles to one another

   b) Shortest route is AX → XC → CD
   Triangles ABX and XCD are similar
   ∠A = ∠D, ∠B = ∠C (alternate angles)
   So,
   $\frac{XC}{240} = \frac{750}{300} \rightarrow XC = \frac{750 \times 240}{300} = 600$
   Shortest distance = 180 + 600 + 750 m
   = 1530 metres = 1.53 km

---

3. AC = 24 cm (diameter) and ∠ACD = 58°
   Using SOH-CAH-TOA,
   $\sin 58 = \frac{AD}{24} \rightarrow AD = 24 \sin 58 = 20.35\ cm$

   Δ AEO and ΔADC are similar (parallel line)

   $\frac{AE}{20.35} = \frac{12}{24} \rightarrow AE = \frac{1}{2} \times 20.35 = 10.175$

   Hence ED = 20.35 – 10.175 = 10.175 cm

---

4. ∠B = 80° (angle sum triangle ABC)
   ∠E = 65° (angle sum triangle DEF)
   Triangles are equiangular, hence similar.

   $\frac{DE}{4.6} = \frac{10.5}{4.2} \rightarrow DE = \frac{10.5 \times 4.6}{4.2} = 11.5$
   Hence DE = 11.5 centimetres

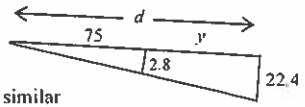
---

5. $\frac{BE}{6} = \frac{10}{12} \rightarrow BE = \frac{10 \times 6}{12} = 5$ cms

---

6. $\frac{CD}{8.4} = \frac{3}{4.5} \rightarrow CD = \frac{3 \times 8.4}{4.5} = 5.6$ m

---

7. 

   The triangles are similar (parallel line).

   $\frac{d}{75} = \frac{22.4}{2.8} \rightarrow d = \frac{22.4 \times 75}{2.8} = 600\ cms$

   Hence y = 600 – 75 = 525 centimetres

   So, distance from top of 10p coin to top of person's head is 525 centimetres.

N5 R1.4 Geometric Skills - Revision

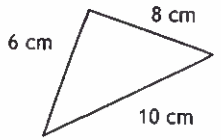
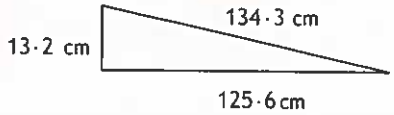
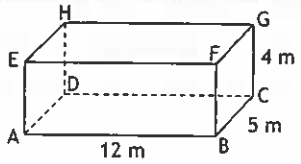
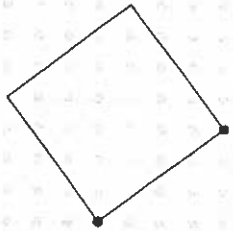
This revision pack covers the skills at Unit Assessment and exam level for Geometric Skills so you can evaluate your learning of this outcome. It is important that you prepare for Unit Assessments but you should also remember that the final exam is considerably more challenging, thus practice of exam content throughout the course is essential for success. The SQA does not currently allow for the creation of practice assessments that mirror the real assessments so you should make sure your knowledge covers the sub skills listed below in order to achieve success in assessments as these revision packs will not cover every possible question that could arise in an assessment.

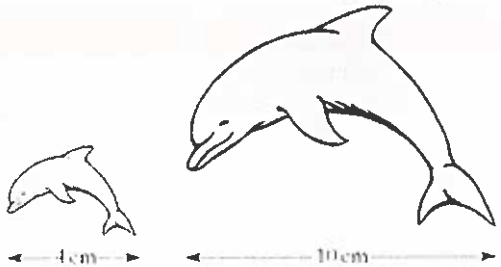
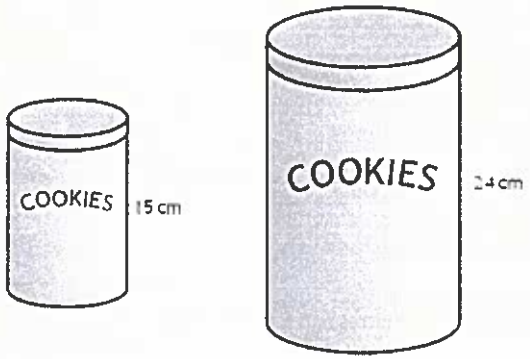
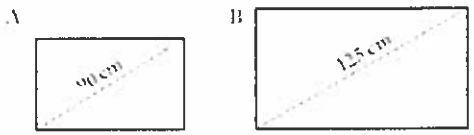
Topic	Unit	Sub skills	Questions
Pythagoras' Theorem	R1.4	◆ Using Pythagoras' theorem in complex situations, including converse and 3D.	1 - 5, 13
Similarity	R1.4	◆ Interrelationship of scale including linear, area and volume scale factors.	6 - 13
Angles	R1.4	◆ Angles in quadrilaterals, triangles, polygons and circles.	15 - 18
Circle geometry	-	➢ Use the relationship in a circle between the centre, chord and perpendicular bisector to evaluate missing sides or angles	20 - 23

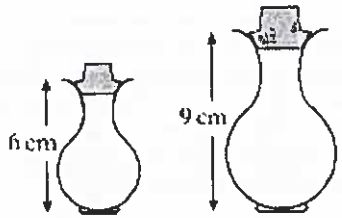
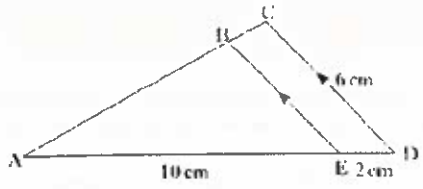
When attempting a question, this key will give you additional important information.

Key	Note
◆	Question is at unit assessment level, a similar question could appear in a unit assessment or an exam.
➢	Question is at exam level, a question of similar difficulty will only appear in an exam.
#	The question includes a reasoning element and typically makes a question more challenging. Both the Unit Assessment and exam will have reasoning questions.
*	If a star is placed beside one of the above symbols that indicates the question involves sub skills from previously learnt topics. If you struggle with this question you should go back and review that topic, reference to the topic will be in the marking scheme.
NC	Question should be completed without a calculator.
C	Question should be completed with a calculator.

Questions will be ordered by sub skill and typically will start of easier and then get more challenging. Some questions may also cover several sub skills from this outcome or even include sub skills from previously learnt topics (denoted with a *). Questions are gathered from multiple sources including ones we have created and from past papers. **Extra challenge** questions are for extension and are not essential for either Unit Assessment or exam preparation.

Q	Questions	Marks
1 ◆ NC	Determine whether the triangle opposite is right angled. 	3
2 ◆ # C	The diagram opposite shows the position of three towns. Lowtown is due west of Midtown The distance from • Lowtown to Midtown is 75 kilometres. • Midtown to Hightown is 110 kilometres. • Hightown to Lowtown is 85 kilometres. Is Hightown directly north of Lowtown? Justify your answer. 	4
3 ◆ # C	A wheel chair ramp must be righted angled to pass safety inspection. Opposite is the measurements that a safety inspector took of a ramp outside a shop.  Will this ramp pass the safety inspection?	4
4 ◆ # C	In the cuboid opposite, *(a)* Find the length of the face diagonal AC. *(b)* Find the length of the space diagonal HB. 	2 2
5 ◆ # NC	In the diagram opposite is a square with each vertex lying on a dot. The vertical distance and horizontal distance between each dot are equal at a length of 1 centimetre. Calculate the area of the square. 	3

6 ◆ C	Two fridge magnets are mathematically similar. One magnet is 4 centimetres long and the other is 10 centimetres long.  The area of the smaller magnet is 18 square centimetres. Calculate the area of the larger magnet.	3
7 ◆ C	A supermarket sells cylindrical cookie jars which are mathematically similar.  The smaller jar has a height of 15 centimetres and a volume of 750 cubic centimetres. The larger jar has a height of 24 centimetres. Calculate the volume of the larger jar.	3
8 ◆ # C	Two rectangular solar panels, A and B, are mathematically similar. Panel A has a diagonal of 90 centimetres and an area of 4020 square centimetres  A salesman claims that panel B, with a diagonal of 125 centimetres, will be double the area of panel A. Is this claim justified? **Show all your working.**	4

9 ◆ NC	Two drinks bottles are mathematically similar in shape. The smaller one is 6 centimetres high and holds 160 millilitres of juice.  The larger one is 9 centimetres high. What volume of juice will the larger one hold.	4
10 ➢ NC	Shampoo is available in travel size and salon size bottles. The two bottles are mathematically similar.  The travel size contains 200 millilitres and is 12 centimetres in height. The salon size contains 1600 millilitres. Calculate the height of the salon bottle.	3
11 ➢ NC	Triangle ABE and ACD with some measurements are shown opposite. Triangle ABE is mathematically similar to triangle ACD. Calculate the length of BE. **Do not use a scale drawing.**  	3

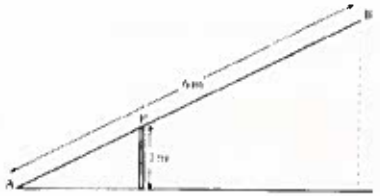
12 ➢ # NC

A metal beam, AB, is 6 metres long.

It is hinged at the top, P, of a vertical post 1 metre high.

When B touches the ground, A is 1·5 metres above the ground, as shown in Figure 1.

When A comes down to the ground, B rises, as shown in Figure 2.
By calculating the length of AP, or otherwise, find the height of B above the ground.



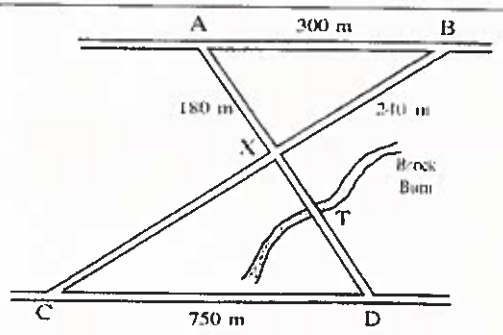
Do not use a scale drawing.

5

13 ➢ # C

The road joining A to B is parallel to the road joining C to D in the diagram opposite.

- AB = 300 metres
- AX = 180 metres
- BX = 240 metres
- CD = 750 metres



(a) Show that the roads AX and BX are perpendicular. 3

(b) The brook burn bursts its banks at T and the road becomes impassable.
An alternative route had to be found in order to travel from A to D.
Calculate the length of the shortest route. 4

14 C

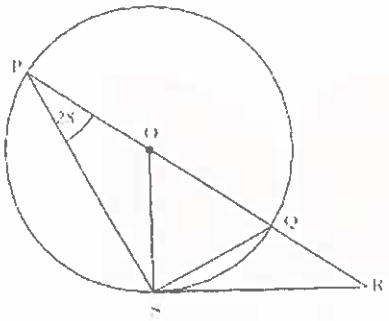
Extra Challenge:
Two shapes are mathematically similar. The volume of the larger shape is 400 cm³ and the volume of the smaller shape is 150 cm³. The area of the larger shape is 210 cm². Calculate the area of the smaller shape.

15 ◆ NC

In the diagram opposite,

- O is the centre of the circle
- PQ is a diameter of the circle
- PQR is a straight line
- RS is a tangent to the circle at S
- Angle OPS is 28°

Calculate the size of angle QRS.



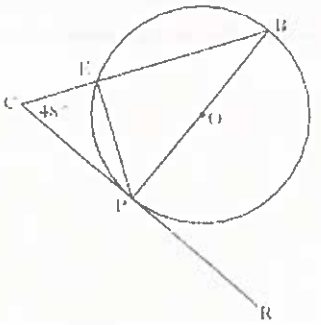
3

16 ◆ NC

In the circle

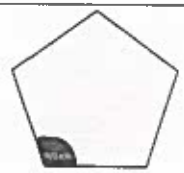
- PB is a diameter
- CR is a tangent to the circle at point P
- Angle BCP is 48°

Calculate the size of angle EPR.



17 ◆ # NC

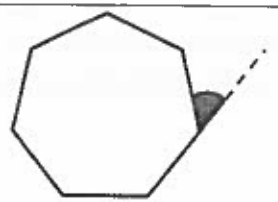
Calculate the size of the interior angle of the regular pentagon opposite.



2

18 ◆ # C

Calculate the size of the exterior angle of the regular heptagon (a seven sided polygon) opposite.



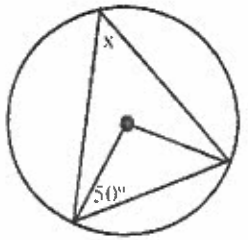
3

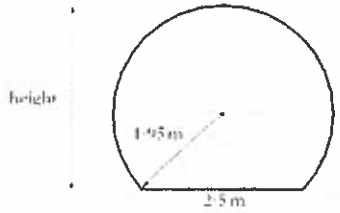
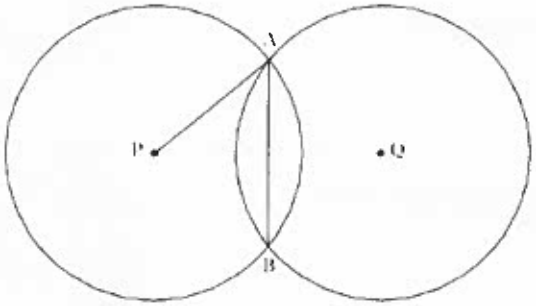
19 NC

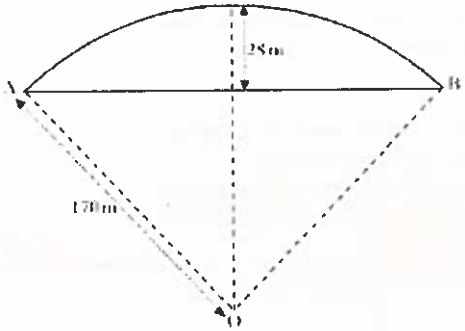
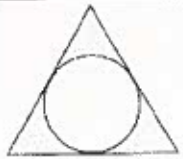
Extra Challenge:

In the diagram opposite, the dot is the centre of the circle.

Calculate the value of x.



20 ➢ # C	Ocean World has an underwater viewing tunnel. The diagram below shows the cross-section of the tunnel. It consists of part of a circle with a horizontal base.   The radius of the circle is 1·95 metres and the width of the base is 2·5 metres. Calculate the height of the tunnel.	4
21 ➢ # C	Two identical circles, with centres P and Q, intersect at A and B as shown in the diagram.  The radius of each circle is 10 centimetres. The length of the common chord, AB is 12 centimetres. Calculate PQ, the distance between the centres of the two circles.	5

22 ➢ # C	Opposite is a picture of a road bridge.  The curved part of the bridge is formed from the arc of a circle, centre O, as shown opposite. • OA and OB are radii of length 170 metres. • The height of the middle of the bridge above its ends is 28 metres  Calculate the horizontal distance, AB.	4
23 ➢ # C	The diagram opposite shows the design of an earring. The earring consists of a circle inside an equilateral triangle. The sides of the triangle are tangents to the circle. The radius of the circle is 8 mm.  The distance from the centre of the circle to each vertex of the triangle is 17 mm. Calculate the perimeter of the triangle.	4

[END OF REVISION QUESTIONS]

[Go to next page for the Marking Scheme]

Where suitable, you should always follow through an error as you may still gain partial credit. If you are unsure how to do this ask your teacher.

Q		Marking Scheme		
1 ◆ NC		•1 Valid strategy	•1	10^2 and 6^2+8^2
		•2 Calculation	•2	100 and 100
		•3 Statement	•3	$10^2=6^2+8^2$ so by the converse of Pythagoras the triangle is right angled
		Notes: 1. Final mark is only available if a comparison is made with all three sides and a reference to triangle being right angled. "yes" is not acceptable.		
2 ◆ # C		•1 Valid strategy	•1	110^2 and 85^2+75^2
		•2 Evaluation	•2	12 100 and 12 850
		•3 comparison	•3	$110^2 \neq 85^2+75^2$
		•4 Valid conclusion	•4	Therefore Hightown is not directly north from Lowtown since the triangle is not right angled.
		Notes: 1. •3 is only available if there is a direct numerical comparison between the longer side and shorter sides. 2. •4 is only available for a reference in the context of the question (eg "not directly North"). "no" or "not right angled" is not enough to gain this mark.		
3 ◆ # C		•1 Valid strategy	•1	$134\cdot3^2$ and $125\cdot6^2+13\cdot2^2$
		•2 Evaluation	•2	$18036\cdot49$ and $15949\cdot6$
		•3 comparison	•3	$134\cdot3^2 \neq 125\cdot6^2+13\cdot2^2$
		•4 Valid conclusion	•4	Therefore the ramp will not pass the safety inspection as the triangle is not right angled
		Notes: 1. •3 is only available if there is a direct numerical comparison between the longer side and shorter sides. 2. •4 is only available for a reference in the context of the question (eg "not pass safety inspection"). "no" or "not right angled" is not enough to gain this mark.		
4 ◆ # C	(a)	•1 Marshall facts and start Pythagoras	•1	$AC^2(=AB^2+BC^2)=12^2+5^2$
		•2 Complete Pythagoras	•2	$AC=13$ (m)
	(b)	•3 Know that DB (or HF) = AC	•3	$HB^2(=HD^2+DB^2)=4^2+13^2$
		•4 Complete Pythagoras	•4	$HB=13\cdot6$ (m)
		Notes: 1. Units not required		

5 ◆ # NC		•1 Know to use Pythagoras to find distance between two vertices	•1	$D^2=4^2+3^2$
		•2 Complete Pythagoras	•2	$D=5$
		•3 Find area of square	•3	Area = 25 m²
		Notes: 1. Units required for final mark		
6 ◆ C		•1 Linear scale factor	•1	$\frac{10}{4}$ or equivalent
		•2 Area scale factor	•2	$\left(\frac{10}{4}\right)^2$ or equivalent
		•3 Solution (using an area scale factor) with correct units	•3	$112\cdot5$ cm²
		Notes: 1. Units required for final mark 2. •3 is only available if an area scale factor is used. $\frac{10}{4}\times18=45$ cm² can only gain the first mark and no other		
7 ◆ C		•1 Linear scale factor	•1	$\frac{24}{15}$ or equivalent
		•2 Volume scale factor	•2	$\left(\frac{24}{15}\right)^3$ or equivalent
		•3 Solution (involving the use of the volume scale factor) with correct units	•3	3072 cm³
		Notes: 1. •3 is only available if a volume scale factor is used. $\frac{24}{15}\times750=1200$ cm³ can only gain the first mark and no other		

8 ◆ # C

$\bullet^1$	Linear scale factor	$\bullet^1$	$\frac{125}{90}$
$\bullet^2$	Area scale factor	$\bullet^2$	$\left(\frac{125}{90}\right)^2$
$\bullet^3$	Area of panel B (using an area scale factor)	$\bullet^3$	$\left(\frac{125}{90}\right)^2 \times 125 = 7754 \cdot 6$
$\bullet^4$	Conclusion with explanation.	$\bullet^4$	No, the salesman's claim is not correct as $7754 \cdot 6 \neq 8040$

Notes:

1. $\bullet^4$ is only available for a direct comparison between two numbers and reference to the context of the question. 8040 must appear in explanation and some reference to the claim not being correct.
2. $\bullet^3$ is only available if an area scale factor is used. $\frac{125}{90} \times 4020 = 5583 \cdot 3\,\text{cm}^2$ can only gain the first mark, however, $\bullet^4$ is still available if the conclusion has enough information detailed in note 1.
3. Units not required
4. An acceptable alternative is $\bullet^3 \left(\frac{125}{90}\right)^2 = 1 \cdot 929$ and $\bullet^4$ $1 \cdot 929 \neq 2$ so no ...

9 ◆ NC

$\bullet^1$	Linear scale factor	$\bullet^1$	$\frac{9}{6}$
$\bullet^2$	Volume scale factor	$\bullet^2$	$\left(\frac{9}{6}\right)^3$
$\bullet^3$	Evaluate volume scale factor without a calculator	$\bullet^3$	$\left(\frac{9}{6}\right)^3 = \left(\frac{3}{2}\right)^3 = \frac{3^3}{2^3} = \frac{27}{8}$ or equivalent
$\bullet^4$	Find larger volume	$\bullet^4$	$\frac{27}{8} \times 160 = 27 \times 20 = 540$ (ml)

Notes:

1. Some evidence of calculation is required for $\bullet^4$, at least one step of working.
2. For candidates who use linear scale factor, only $\bullet^1$ is available and no other mark (eg $\frac{9}{6} \times 160 = 240$ award 1/4)
3. Units not required

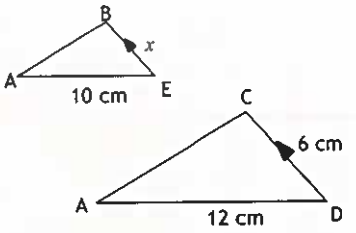
10 ➢ NC

$\bullet^1$	Volume scale factor	$\bullet^1$	$\frac{1600}{200}$
$\bullet^2$	Linear scale factor	$\bullet^2$	$\sqrt[3]{\frac{1600}{200}} = \sqrt[3]{8} = 2$
$\bullet^3$	Calculate height	$\bullet^3$	$12 \times 2 = 24$ cm

Notes:

1. Units not required

11 ➢ NC

$\bullet^1$	Marshall facts (eg AD = 12cm)	$\bullet^1$	
$\bullet^2$	Linear scale factor	$\bullet^2$	$\frac{10}{12}$
$\bullet^3$	Calculate BE	$\bullet^3$	$\frac{10}{12} \times 6 = 5$ (cm)

Notes:

1. Units not required
2. Minimum working for all 3 marks is $\frac{10}{12} \times 6 = 5$
3. Note, these triangles are not right angled and therefore any attempt to use Pythgoras to find missing sides will gain 0 marks.

12 ➢ # NC

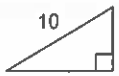
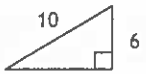
$\bullet^1$	Linear scale factor in Figure 1	$\bullet^1$	$\frac{1}{1 \cdot 5}$
$\bullet^2$	Calculate length of PB	$\bullet^2$	$\frac{1}{1 \cdot 5} \times 6 = 4$
$\bullet^3$	Calculate length of AP	$\bullet^3$	$6 - 4 = 2$
$\bullet^4$	Linear scale factor in Figure 2	$\bullet^4$	$\frac{6}{2}$
$\bullet^5$	Calculate height of B	$\bullet^5$	$\frac{6}{2} \times 1 = 3$ (m)

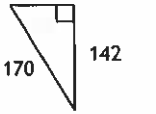
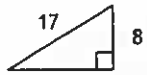
Notes:

1. Units not required

13 ➢ # C	*(a)*	$\bullet^1$ Valid strategy	$\bullet^1$	300^2 and 180^2+240^2
		$\bullet^2$ Calculation	$\bullet^2$	90 000 and 90 000
		$\bullet^3$ Statement	$\bullet^3$	$300^2 = 180^2+240^2$ so by the converse of Pythagoras the roads are perpendicular at X.
	(b)	$\bullet^4$ Know that triangles are mathematically similar	$\bullet^4$	$\frac{AB}{CD}=\frac{BX}{CX}$ stated or implied by $\bullet^5$
		$\bullet^5$ Linear scale factor	$\bullet^5$	$\frac{750}{300}$
		$\bullet^6$ Calculate CX	$\bullet^6$	$\frac{750}{300}\times 240 = 600$
		$\bullet^7$ Find shortest distance	$\bullet^7$	$180+600+750 = 1530$ (m)
		Notes: 1. $\bullet^3$ is only available if a comparison is made with all three sides and a reference to roads being perpendicular (or right angled). "yes" is not acceptable. 2. Units not required		
14 C		Volume scale factor $=\frac{150}{400}$, linear scale factor $=\sqrt[3]{\frac{3}{8}}$, area scale factor $=\left(\sqrt[3]{\frac{3}{8}}\right)^2$ Therefore area of smaller shape $=\left(\sqrt[3]{\frac{3}{8}}\right)^2\times 210 = 109\cdot 2\,\text{cm}^2$		
15 ◆ NC		$\bullet^1$ Angle OSR	$\bullet^1$	90°
		$\bullet^2$ Angle PSR	$\bullet^2$	118°
		$\bullet^3$ Angle QRS	$\bullet^3$	QRS = 34°
		Notes: 1. Answer must be clearly indicated either by being labelled or underlined. 2. For correct answer without working award 0/3 3. Alternatives: METHOD TWO (USING TRIANGLE ORS) $\bullet^1$ angle OSR is 90° $\bullet^2$ angle SOR is 56° $\bullet^3$ angle QRS is 34° METHOD THREE (USING TRIANGLE QRS) $\bullet^1$ angle OSR is 90° $\bullet^2$ angle QSR and SQR is 28° and 118° $\bullet^3$ angle QRS is 34°		

16 ◆ NC		$\bullet^1$ Angle BEP	$\bullet^1$	90°
		$\bullet^2$ Angle EPC or EPB	$\bullet^2$	42° or 48°
		$\bullet^3$ Angle EPR	$\bullet^3$	EPR = 138°
		Notes: 1. Answer must be clearly indicated either by being labelled or underlined. 2. For correct answer without working award 0/3 3. Before awarding 2nd mark, is should be clear that 42° and 48° refer to angles EPC and EPB respectively.		
17 ◆ # NC		$\bullet^1$ Valid strategy (eg splitting shape into triangles and working out centre angle)	$\bullet^1$	$\frac{360}{5}=72$
		$\bullet^2$ Calculate answer	$\bullet^2$	108°
		Notes: 1.		
18 ◆ # C		$\bullet^1$ Valid strategy (eg splitting shape into triangles and working out centre angle)	$\bullet^1$	$\frac{360}{7}=51\cdot 4\ldots$
		$\bullet^2$ Valid strategy (eg calculate interior angle	$\bullet^2$	$128\cdot 5\ldots$
		$\bullet^3$ Calculate answer	$\bullet^3$	$51\cdot 4°$
		Notes: 1. Ignore units and rounding 2. It should be clear that an attempt is made to work out exterior angle. For correct answer with no working, award 0/3		
19 C		x = 40° (look up "proof of angle at the centre theorem")		

20 ➢ # C		•1	Marshall facts and recognise right-angle	•1 
		•2	Use Pythagoras	•2 $x^2 = 1{\cdot}95^2 - 1{\cdot}25^2$
		•3	Calculate third side correctly	•3 $1{\cdot}496$
		•4	State height	•4 $1{\cdot}496 + 1{\cdot}95 = 3{\cdot}45$ (m)
		Notes: 1. Mark •4 is for adding $1{\cdot}95$ to a value which has been calculated using Pythagoras' Theorem. 2. SOME COMMON ANSWERS (with working): $\sqrt{1{\cdot}95^2 + 1{\cdot}25^2} + 1{\cdot}95 = 4{\cdot}27$ award 3/4 $\sqrt{1{\cdot}95^2 + 2{\cdot}5^2} + 1{\cdot}95 = 5{\cdot}12$ award 2/4 $\sqrt{2{\cdot}5^2 - 1{\cdot}95^2} + 1{\cdot}95 = 3{\cdot}51$ award 2/4 $\sqrt{3{\cdot}9^2 - 2{\cdot}5^2} = 2{\cdot}99$ award 1/4		
21 ➢ # C		•1	Marshall facts and know to use right angled triangle	•1 
		•2	Know that PQ bisects AB	•2 
		•3	Use Pythagoras' Theorem	•3 $x^2 = 10^2 - 6^2$
		•4	Calculate length of third side	•4 8
		•5	Calculate PQ	•5 16 (cm)
		Notes: 1. For correct answer without working award 0/5 2. SOME COMMON ANSWERS (with working): $2 \times \sqrt{10^2 + 6^2} = 23{\cdot}32$ award 4/5 $\sqrt{10^2 + 6^2} = 11{\cdot}66$ award 3/5 $2 \times \sqrt{12^2 - 10^2} = 13{\cdot}27$ award 3/5 $\sqrt{12^2 - 10^2} = 6{\cdot}33$ award 2/5 $\sqrt{12^2 + 10^2} = 15{\cdot}62$ award 2/5 $\sqrt{10^2 + 10^2} = 14{\cdot}14$ award 2/5		

22 ➢ # C		•1	Marshall facts and recognise right-angle	•1 
		•2	Use Pythagoras	•2 $x^2 = 170^2 - 142^2$
		•3	Calculate third side correctly	•3 $93{\cdot}466\ldots$
		•4	Find length AB	•4 $93{\cdot}466 \times 2 = 186{\cdot}9$ (m)
		Notes: 1. For correct answer without working award 0/4		
23 ➢ # C		•1	Marshall facts and recognise right-angle	•1 
		•2	Use Pythagoras	•2 $x^2 = 17^2 - 8^2$
		•3	Calculate third side correctly	•3 15
		•4	Find the perimeter	•4 $15 \times 6 = 90$ (mm)
		Notes: 1. For correct answer without working award 0/4		

[END OF MARKING SCHEME]

COMPARING DATA SETS

QUARTILES AND INTERQUARTILE RANGE

1. For each of the data sets below find the median, lower quartile, upper quartile, ~~and~~ interquartile range. and semi-interquartile range

(a)	2	4	4	6	7	8	10	14	15			
(b)	29	30	32	33	34	37	40					
(c)	17	19	20	22	23	25	26					
(d)	0	0	0	1	1	2	2	2	3	3	4	
(e)	1·8	1·8	2·8	2·9	4·0	4·0	4·0	4·7	5·1	5·2	5·3	
(f)	0·13	0·18	0·18	0·19	0·25	0·26	0·29	0·29	0·30	0·31	0·33	0·39
(g)	133	136	136	138	140	141	143	145				
(h)	371	375	376	379	380	384	385	387	389	390		
(i)	57	58	58	60	63	67	67	69	82	85	86	90
(j)	11	11	11	12	13	14	15	15	16	18	20	

2. For each of the data sets below find the median, lower quartile, upper quartile, ~~and~~ interquartile range. and semi-interquartile range

(a)	47	56	58	48	60	65	50	52	61	53	63	
(b)	12	20	27	15	35	16	26	34	38	24	26	
(c)	149	165	154	167	170	179	151	168	158			
(d)	1	8	3	1	2	5	3	1	4	3	2	
(e)	108	114	132	95	144	120	116	125	172	188	155	160
(f)	65	74	59	43	63	52	48	63	67	85	92	48
(g)	190	165	174	187	166	172	184	190	166	183	180	
(h)	325	363	347	359	314	329	364	372	301	317	346	
(i)	0·5	1·3	0·4	1·0	0·9	1·4	0·8	0·9	1·1	0·6		
(j)	10	13	11	11	20	10	10	14	50	10	11	10

COMPARING DATA SETS

STANDARD DEVIATION

1. Calculate the mean and standard deviation for the following sets of data.

(a)	20	21	19	22	21	20	19	20	21	20	
(b)	303	299	306	298	304	307	299	302	305	299	300
(c)	15·3	14·9	15·1	15·2	14·8	14·7	15·1	14·8	15·0	15·0	
(d)	87	89	84	88	89	87	86	87	86	87	
(e)	48	73	29	82	54	43	95	41	92	71	
(f)	4·4	4·6	4·8	4·0	4·2	4·3	4·5	4·7	4·9	4·1	
(g)	0·2	0·3	0·4	0·2	0·2	0·0	0·4	0·1	0·2	0·3	
(h)	40	40	39	38	38	40	40	42	40	39	

2. A third year pupil conducting an experiment with a die got the following results

6	1	1	4	4	2	2	6	5	6
1	1	1	5	1	4	2	3	4	6
1	4	4	1	5	4	4	3	6	2
5	3	5	6	3	2	6	5	5	2
3	1	4	5	2	4	1	4	4	3

(a) Show these results in a frequency table

(b) Use your table to calculate the mean and standard deviation.

3. A company that manufactures shoelaces spot checks the length (in cm) of the laces.

Here are the results for two different production lines.

Line A	26·8	27·2	26·5	27·0	27·3	27·5	26·1	26·4	27·9	27·3
Line B	26·8	26·7	27·1	27·0	26·9	27·0	27·3	26·9	27·0	27·3

Calculate the mean and standard deviation and comment on any differences between line A and line B.

4. The running times, in minutes, of films shown on television over a week are as follows.

110	95	135	70	100	125	140	105	95	105
95	95	110	90	110	100	125	105	90	120

Calculate the mean and standard deviation.

5. The temperatures, in °C, at a seaside resort were recorded at noon over a 10-day period.

19	20	19	17	21	18	19	24	25	28

Calculate the mean and standard deviation.

6. John James plays golf with his brother Joe each month. They keep a note of their scores.

John	74	73	74	73	71	73	72	75	73	73	72	73
Joe	68	74	70	67	80	81	69	68	79	67	70	71

Calculate the mean and standard deviation and comment on John's and Joe's performance over the year.

7. The weekly takings in small store, to the nearest £, for a week in December and March are shown below

December	2131	2893	2429	3519	4096	4810
March	1727	2148	1825	2397	2901	3114

Calculate the mean and standard deviation and comment on any differences.

8. Two sixth year classes take part in a Sponsored Fast for Famine Relief. The number of hours each pupil lasted are shown below.

6C1	20	22	21	20	22	20	22	20	20	24	21	22	23	22	22	23
6C2	15	20	24	23	22	24	18	24	22	23	24	17	20	24	24	20

Calculate the mean and standard deviation for each class and comment on how well each class did.

MIXED QUESTIONS on FRACTIONS

1. $2\frac{11}{12}$ kgs **2.** $3\frac{1}{4}$ km **3.** **(a)** $3\frac{23}{24}$ litres **(b)** $4\frac{1}{24}$ litres

4. **(a)** $36\frac{14}{15}$ metres **(b)** $83\frac{1}{5}$ m²

5. **(a)** 190 km **(b)** 297 km **(c)** 487 km

(d) $6\frac{1}{6}$ hours **(e)** $78\frac{36}{37}$ km/h

6. **(i)** 4 questions correct **(ii)** **(a)** $1\frac{11}{42}$ **(d)** $\frac{68}{75}$

COMPARING DATA SETS
QUARTILES and INTERQUARTILE RANGE

1.

	median	Q1	Q3	SIR
(a)	7	4	12	8
(b)	33	30	37	7
(c)	22	19	25	6
(d)	2	0	3	3
(e)	4·0	2·8	5·1	2·3
(f)	0·275	0·185	0·305	0·12
(g)	139	136	142	6
(h)	382	376	387	11
(i)	67	59	83·5	24·5
(j)	14	11	16	5

2.

	median	Q1	Q3	SIR
(a)	56	50	61	11
(b)	26	16	34	18
(c)	165	152·5	169	16·5
(d)	3	1	4	3
(e)	128·5	115	157·5	42.5
(f)	63	50	70·5	20.5
(g)	180	166	187	21
(h)	346	317	363	46
(i)	0·9	0·6	1·1	0·5
(j)	11	10	13·5	3·5

STANDARD DEVIATION

1.

	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)
mean	20·3	302	14·99	87	62·8	4·45	0·23	39·6
SD	0·95	3·19	0·19	1·49	22·9	0·30	0·13	1·17

2. 3·44, 1·72

3. line A 27, 0·55; line B 27,0·19; line B more consistent

4. 106, 16·7

5. 21, 3·6

6. John 73, 1·04 ; Joe 72, 5·20 — Joe has lower mean score but John has better overall performance (lower standard deviation)

7. Dec 3313, 1025; Mar 2352, 565 — December has higher mean takings but March has less variation in takings

8. 6C1 21·5,1·26 ; 6C2 21·5, 2·88 — Same average but 6C1 has lower SD so less spread out.

4.2 FORMING a LINEAR MODEL from a given SET of DATA

1. **(a)** no relation **(b)** positive **(c)** negative

2. **(a)** positive correlation (more rain – more people buy umbrellas)
(b) no relation
(c) negative correlation (the faster you go, the less time it takes)

3. **(a)** yes **(b)** yes, but not strong **(c)** yes **(d)** no

4. student's best fit lines

5. Answers will vary depending on where line is drawn
(a) $y = 1{\cdot}67x + 3.3$ **(b)** $y = 0{\cdot}4x + 1.5$ **(c)** $y = 1{\cdot}2x - 6$
(d) $y = -1{\cdot}5x + 9$ **(e)** $y = -1{\cdot}5x + 12$ **(f)** $y = -0{\cdot}25x + 7$

6. H = 0·6D + 0·7, 1·6 **7.** $y = 3{\cdot}8x + 6$

8. $l = 0{\cdot}9F + 2{\cdot}2$, 6·25 **9.** C = –2T + 67, 62°C

10. S = 7T, 70 mph **11.** C = 1·1m + 177, £215.50

12. R = –0·35V + 0·61, 0·3

Standard Deviation

1. Fiona checks out the price of a litre of milk in several shops.

   The prices in pence are:

   49 44 41 52 47 43

   a) Find the mean price of a litre of milk. 1 KU

   b) Find the standard deviation of the prices. 2 KU

   c) Fiona also checks out the price of a kilogram of sugar in the same shops and finds that the standard deviation of the prices is 2.6. Make one valid comparison between the two sets of prices. 1 RE

2. A group of fifth year students from Alloa High School were asked how many hours studying they did in the week prior to their exams.

   The results are shown below.

   14 7 9 12 19 10 16 15

   (a) Use an appropriate formula to calculate the mean and standard deviation of these times. 3 KU

   (b) A similar group of students from Alloa Academy were asked the same question The mean number of hours studied was 16 and the standard deviation was 2·2.

   How did the number of hours studied by students from Alloa High School compare with the number of hours studied by students from Alloa Academy ? 2 RE

3. The Mobile Phone Shop is advertising their five latest mobile phones on their website.

   Their prices are:

   £120 £135 £75 £235 £185

   Use an appropriate formula to calculate the mean and standard deviation of these prices.

   (Show all working) 4 KU

4. The price, in pence per litre, of petrol at 10 city garages is shown below:

84.2	84.4	85.1	83.9	81.0
84.2	85.6	85.2	84.9	84.8

   a) Calculate the mean and standard deviation of these prices. 3 KU

   b) In 10 rural garages, the petrol prices had a mean of 88.8 and a standard deviation of 2.4

   How do the rural prices compare with the city prices ? 2 RE

5. Jim typed six pages on his computer using his word processor.

   He did a "spell check" and discovered that he had made the following numbers of errors on the 6 pages.

   page one - 4 errors
   page two - 1 errors
   page three - 7 errors
   page four - 13 errors
   page five - 6 errors
   page six - 5 errors

   a) Calculate the mean number of errors 1 KU

   b) Calculate the standard deviation. 4 KU

6. After trying a new fertilizer on one of his tomato plants, a grower counted the number of tomatoes on each of its six bunches.

   The number of tomatoes was:

   8, 14, 9, 16, 13, 18

   a) Calculate the mean number of tomatoes. 1 KU

   b) Construct a table and use it to calculate the standard deviation. 4 KU

6. a) There are 50 scores, so the median lies between the 25th and 26th scores.
i.e. between 73 and 75. **Median = 74**

b) (UQ – LQ) ÷ 2 LQ is 13th item
UQ is 38th item
So **S.I.R.** = (83 – 69) ÷ 2 = 14 ÷ 2 = 7

c) Lo = 63, Hi = 98, Q_1=69, Q_2=74, Q_3=83

7. Put into order
6, 7, 9, 9, 12, 13, 16, 18, 18, 20, 22, 24, 28
↑ LQ ↑ Median ↑ UQ

13 items: **Median** is 7th item = **16**
LQ= 9 UQ = 21
Transfer onto sketch.

6 9 16 21 28

Standard Deviation

1. Use formula $s=\sqrt{\frac{\sum(x-\bar{x})^2}{n-1}}$

Use 3 columns: x, $(x-\bar{x})$ $(x-\bar{x})^2$

$\sum x = 276$, mean = $276 \div 6 = 46$

$\sum(x-\bar{x})^2 = 84$, SD = $\sqrt{\frac{84}{5}} = 4.098...$

Mean = 46p Standard Deviation = 4.1p

Sugar prices more consistent compared to milk or milk prices more variable than sugar prices.

2. Use formula $s=\sqrt{\frac{\sum(x-\bar{x})^2}{n-1}}$

Use 3 columns: x, $(x-\bar{x})$ $(x-\bar{x})^2$

$\sum x = 102$, mean = $102 \div 8 = 12.75$

$\sum(x-\bar{x})^2 = 111.5$, SD = $\sqrt{\frac{111.5}{7}} = 3.991...$

A better formula to use is $s=\sqrt{\frac{\sum x^2 - \frac{(\sum x)^2}{n}}{n-1}}$

to avoid a lot of decimal calculations

$\sum x = 102$, $\sum x^2 = 1412$, $(\sum x)^2 = 10404$

This also gives SD = 3.991..

Mean = 12.75 hrs Standard Deviation = 3.99 hours

Alloa High School were more variable in the hours they spent in study time than Alloa Academy.

3. Use formula $s=\sqrt{\frac{\sum(x-\bar{x})^2}{n-1}}$

Use 3 columns: x, $(x-\bar{x})$ $(x-\bar{x})^2$

$\sum x = 750$, mean = $750 \div 5 = £150$

$\sum(x-\bar{x})^2 = 15200$, SD = $\sqrt{\frac{15200}{4}} = £61.64$

Mean = £150 Standard Deviation = £61.64

4. A better formula to use is $s=\sqrt{\frac{\sum x^2 - \frac{(\sum x)^2}{n}}{n-1}}$

to avoid a lot of decimal calculations

Mean = 84.33 pence Standard Deviation = 1.28 pence

The rural garages had a higher average price and the prices were more variable.

5. Use formula $s=\sqrt{\frac{\sum(x-\bar{x})^2}{n-1}}$

Use 3 columns: x, $(x-\bar{x})$ $(x-\bar{x})^2$

$\sum x = 36$, mean = $36 \div 6 = 6$

$\sum(x-\bar{x})^2 = 84$, SD = $\sqrt{\frac{80}{5}} = 4$

Mean = 6 Standard Deviation = 4

6. Use formula $s=\sqrt{\frac{\sum(x-\bar{x})^2}{n-1}}$

Use 3 columns: x, $(x-\bar{x})$ $(x-\bar{x})^2$

$\sum x = 78$, mean = $78 \div 6 = 13$

$\sum(x-\bar{x})^2 = 76$, SD = $\sqrt{\frac{76}{5}} = 3.898...$

Mean = 13 Standard Deviation = 3.9
