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EDEXCEL INTERNATIONAL GCSE MATHS: QUESTIONS BY TOPIC

Ratio & Proportion (R1)

International GCSE Mathematics A (4MA1) · Higher tier

39 questions · 155 marks · Mark schemes included

Past papers June 2018 - June 2025 · 3 sub-topics

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HOW TO USE THIS BOOKLET

Questions are grouped by sub-topic and run from the lowest to the highest mark tariff, then oldest paper first.

Click any row below to jump straight to that sub-topic or question.

On every question page, click ANSWER in the top-right corner to jump to its mark scheme; < QUESTION brings you back.

A gold bar in the left margin marks exactly where the question sits on the original page.

Diagrams, graphs, grids and tables are printed exactly as they appear in the original papers.

Each question is filed under its main topic; longer questions may also test skills from other topics.

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R1a RATIO		20 Qs · 75 marks	3
1. Q4	IGCSE Paper 1HR June 2018	3	4
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R1c BEST BUYS, RECIPES & SCALING		1 Qs · 4 marks	44
39. Q12	IGCSE Paper 2H January 2020	4	45



QUESTIONS

39 questions · 155 marks · 3 sub-topics

SUB-TOPIC R1a

RATIO

Sub-topic R1a · 20 questions · 75 marks · lowest tariff first



- 4 Anna and Lionel share \$675 in the ratio 4 : 5

Lionel gives $\frac{3}{5}$ of his share of the money to his mother.

How much money does Lionel give to his mother?

\$.....

(Total for Question 4 is 3 marks)

- 5 $E = n^2 + n + 5$

Ali thinks that the value of E will be a prime number for any whole number value of n .

Is Ali correct?

You must give a reason for your answer.

.....
.....

(Total for Question 5 is 2 marks)



- 2 Work out the difference between the largest share and the smallest share when 3450 yen is divided in the ratios 2:6:7

..... yen

(Total for Question 2 is 3 marks)

- 3 Gopal is paid 20 000 rupees each month.
Jamuna is paid 19 200 rupees each month.

Gopal and Jamuna are both given an increase in their monthly pay.
After the increase, they are both paid the same amount each month.

Gopal was given an increase of 8%

Work out the percentage increase that Jamuna was given.

..... %

(Total for Question 3 is 4 marks)



- 10 Change 22 metres per second to a speed in kilometres per hour.
Show your working clearly.

.....km/h

(Total for Question 10 is 3 marks)

- 11 3 years ago, the ratio of Tom's age to Clemmie's age was 2 : 7
Tom is now 15 years old and Clemmie is now x years old.
Find the value of x .

$x =$

(Total for Question 11 is 3 marks)



- 6 There are some ice lollies in a freezer.

The flavour of each ice lolly is banana or strawberry or mint or chocolate.

Julius takes at random an ice lolly from the freezer.

The table shows the probabilities that the flavour of the ice lolly that Julius takes is banana or strawberry or chocolate.

Flavour	banana	strawberry	mint	chocolate
Probability	0.35	0.32		0.12

Work out the probability that the flavour of the ice lolly that Julius takes is either strawberry or mint.

(Total for Question 6 is 3 marks)

- 7 A football team played 55 games.
Each game was won, drawn or lost.

number of games won : number of games drawn : number of games lost = 6 : 3 : 2

Work out how many more games the team won than the team lost.

(Total for Question 7 is 3 marks)



Answer ALL TWENTY THREE questions.

Write your answers in the spaces provided.

You must write down all the stages in your working.

- 1** Brendon, Asha and Julie share some money in the ratios 3 : 2 : 6
The **total** amount of money that Asha and Julie receive is \$36

Work out the amount of money that Brendon receives.

\$.....

(Total for Question 1 is 3 marks)

- 2** Show that $3\frac{1}{5} \times 2\frac{5}{8} = 8\frac{2}{5}$

(Total for Question 2 is 3 marks)



- 4 On a farm there are chickens, ducks and pigs.

The ratio of the number of chickens to the number of ducks is $7:2$

The ratio of the number of ducks to the number of pigs is $5:9$

There are 36 pigs on the farm.

Work out the number of chickens on the farm.

.....
(Total for Question 4 is 3 marks)



- 2 Danil, Gabriel and Hadley share some money in the ratios $3:5:9$
The difference between the amount of money that Gabriel receives and the amount of money that Hadley receives is 196 euros.

Work out the amount of money that Danil receives.

..... euros

(Total for Question 2 is 3 marks)

- 3 The diagram shows triangle ABC

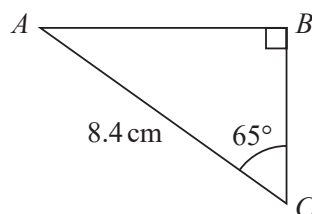


Diagram **NOT**
accurately drawn

Work out the length of the side AB
Give your answer correct to 3 significant figures.

..... cm

(Total for Question 3 is 3 marks)



- 5 In a box, there are only green sweets, orange sweets and yellow sweets.

There are 280 sweets in the box so that

the number of green sweets : the number of orange sweets = 2 : 3

and

the number of orange sweets : the number of yellow sweets = 1 : 5

Work out how many green sweets there are in the box.

(Total for Question 5 is 3 marks)



- 5 C grams of chocolate is shared in the ratios $2:5:8$
The difference between the largest share and the smallest share is 390 grams.

Work out the value of C

$C = \dots\dots\dots$

(Total for Question 5 is 3 marks)

- 6 Solve the simultaneous equations

$$\begin{aligned}x + 2y &= 15 \\ 4x - 6y &= 4\end{aligned}$$

Show clear algebraic working.

$x = \dots\dots\dots$

$y = \dots\dots\dots$

(Total for Question 6 is 3 marks)



Answer ALL TWENTY THREE questions.

Write your answers in the spaces provided.

You must write down all the stages in your working.

- 1** Last season, the number of goals scored by Arjun, by Simon and by Kath for their football team were in the ratios $2:5:8$

Simon scored 12 more goals than Arjun.

Work out the number of goals scored by Kath.

.....
(Total for Question 1 is 3 marks)



5 Avril bakes a cake.

She uses flour, butter and sugar such that

$$\begin{aligned}\text{weight of flour : weight of butter} &= 6 : 5 \\ \text{weight of butter : weight of sugar} &= 3 : 2\end{aligned}$$

Avril uses 120 grams of sugar.

Work out the weight of flour Avril uses.

..... grams

(Total for Question 5 is 3 marks)



- 4 Andreas, Isla and Paulo share some money in the ratios 3 : 2 : 5

The **total** amount of money that Isla and Paulo receive is £76 more than the amount of money that Andreas receives.

Andreas buys a video game for £48.50 with some of his share of the money.

Work out how much money Andreas has left from his share of the money when he has bought the video game.

£.....

(Total for Question 4 is 4 marks)



6 Mariana sells bags of bird food.

The bags that Mariana sold last week each contained 12 kg of seeds.

The bags that she is going to sell next week will each contain a mixture of nuts and seeds where for each bag

$$\text{weight of nuts : weight of seeds} = 4 : 5$$

The total weight of the nuts and the seeds in each bag will be 19.35 kg

The weight of seeds in each bag that Mariana sells next week will be less than the weight of seeds in each bag that Mariana sold last week.

Work out this decrease as a percentage of the weight of seeds in each bag that Mariana sold last week.

Give your answer correct to one decimal place.

..... %

(Total for Question 6 is 4 marks)



- 5 Nancy has some coins with a total value of 85 pence.
She has only 2 pence coins and 5 pence coins.
The ratio

$$\text{number of 2 pence coins} : \text{number of 5 pence coins} = 1 : 3$$

Nancy has more 5 pence coins than 2 pence coins.

How many more?

.....
(Total for Question 5 is 4 marks)

- 6 (a) Write 76000000 in standard form.

.....
(1)

- (b) Write 5.4×10^{-4} as an ordinary number.

.....
(1)

(Total for Question 6 is 2 marks)



6 Pau, Sam and Tia share £240 in the ratios 3 : 4 : 5

Sam and Tia each give £10 of their share to Pau.

Work out the ratios of the amounts of money that Pau, Sam and Tia now have.
Give your answer in its simplest form.

..... : :

(Total for Question 6 is 4 marks)



- 2 There are some people in a cinema.

$\frac{3}{5}$ of the people in the cinema are children.

For the children in the cinema,

$$\text{number of girls : number of boys} = 2 : 7$$

There are 170 girls in the cinema.

Work out the number of adults in the cinema.

(Total for Question 2 is 5 marks)



10 Alex makes 80 cakes to sell.

He makes chocolate cakes, lemon cakes and fruit cakes where

$$\begin{array}{ccccc} \text{number of} & : & \text{number of} & : & \text{number of} \\ \text{chocolate cakes} & & \text{lemon cakes} & & \text{fruit cakes} \end{array} = 3 : 2 : 5$$

Alex sells

all of the chocolate cakes

$\frac{3}{4}$ of the lemon cakes

$\frac{7}{8}$ of the fruit cakes

The profit he makes on each cake he sells is shown in the table.

Type of cake	Profit per cake he sells
chocolate	£2.00
lemon	£1.70
fruit	£2.40

Work out the total profit that Alex makes from the cakes he sells.

£.....

(Total for Question 10 is 5 marks)



8 Behnaz makes 300 celebration cards so that

number of birthday cards : number of anniversary cards : number of congratulations cards = 7:5:3

$\frac{2}{5}$ of the birthday cards have numbers on them.

36% of the anniversary cards have numbers on them.

None of the congratulations cards have numbers on them.

Work out what fraction of the 300 cards have numbers on them.

Give your answer in its simplest form.

(Total for Question 8 is 5 marks)



- 8 Ishir plants 600 bulbs in a garden.
He plants tulip bulbs, crocus bulbs and daffodil bulbs so that

number of tulip bulbs : number of crocus bulbs : number of daffodil bulbs = 9 : 4 : 2

45% of the tulip bulbs are for yellow flowers.

$\frac{5}{8}$ of the crocus bulbs are for yellow flowers.

All of the daffodil bulbs are for yellow flowers.

Work out the number of bulbs that are for yellow flowers.

(Total for Question 8 is 5 marks)



- 5 120 children go on an activity holiday.
The ratio of the number of girls to the number of boys is 3 : 5

On Sunday, all the children either go sailing or go climbing.

$\frac{16}{25}$ of the boys go climbing.

Twice as many girls go sailing as go climbing.

Work out how many children go sailing on Sunday.

.....
(Total for Question 5 is 6 marks)



SUB-TOPIC R1b

DIRECT & INVERSE PROPORTION

Sub-topic R1b · 18 questions · 76 marks · lowest tariff first



14 F is inversely proportional to the square of v .

Given that $F = 6.5$ when $v = 4$

find a formula for F in terms of v .

(Total for Question 14 is 3 marks)



15 A is inversely proportional to C^2

$A = 40$ when $C = 1.5$

Calculate the value of C when $A = 1000$

$C = \dots\dots\dots$

(Total for Question 15 is 3 marks)



..... cm

(Total for Question 16 is 5 marks)

17 y is inversely proportional to $\sqrt{x}$

$y = c^4$ when $x = c^2$ where c is a positive constant.

Find a formula for y in terms of x and c

Give your answer in its simplest form.

(Total for Question 17 is 3 marks)



One of the students is chosen at random.

Given that this student chose photography,

(b) find the probability that this student also chose knitting.

.....
(2)

(c) Find $n(P \cap K')$

.....
(1)

(d) Find $n([P \cup E] \cap K)$

.....
(1)

(Total for Question 16 is 7 marks)

17 Q is directly proportional to the square root of d

$Q = 4.5$ when $d = 324$

Find a formula for Q in terms of d

.....
(Total for Question 17 is 3 marks)



14 B is inversely proportional to the square of d

$$B = 0.25 \text{ when } d = 12$$

Find a formula for B in terms of d

(Total for Question 14 is 3 marks)

15 Write $3x(2x - 1)(5x + 4)$ in the form $ax^3 + bx^2 + cx$ where a , b and c are integers.

(Total for Question 15 is 3 marks)



14 T is directly proportional to the cube of r

$$T = 21.76 \text{ when } r = 4$$

(a) Find a formula for T in terms of r

(3)

(b) Work out the value of T when $r = 6$

(1)

(Total for Question 14 is 4 marks)



20 T is inversely proportional to m^2

$$T = 30 \text{ when } m = 0.5$$

(a) Find a formula for T in terms of m .

.....
(3)

(b) Work out the value of T when $m = 0.1$

.....
(1)

(Total for Question 20 is 4 marks)



- 20 y is inversely proportional to $\sqrt{x}$
 x is directly proportional to T^3

Given that $y = 8$ when $T = 25$

find the exact value of T when $y = 27$

$T = \dots\dots\dots$

(Total for Question 20 is 4 marks)



(b) Find

(i) $n(G)$

.....
(1)

(ii) $n([G \cup S]')$

.....
(1)

(iii) $n(G' \cap C)$

.....
(1)

One of the farmers who has chickens is chosen at random.

(c) Find the probability that this farmer also has goats.

.....
(2)

(Total for Question 16 is 8 marks)

17 M varies directly as the cube of h
 $M = 4$ when $h = 0.5$

Find the value of h when $M = 500$

.....
(Total for Question 17 is 4 marks)



16 Use algebra to show that $0.1\dot{7}\dot{6} = \frac{35}{198}$

(Total for Question 16 is 2 marks)

17 F is inversely proportional to the square of r

$$F = 36 \text{ when } r = 4$$

(a) Find a formula for F in terms of r

.....
(3)

(b) Work out the value of F when $r = 48$

.....
(1)

(Total for Question 17 is 4 marks)



18 y is inversely proportional to x^3

$$y = 4 \text{ when } x = 3$$

Work out the value of x when $y = 864$

$$x = \dots\dots\dots$$

(Total for Question 18 is 4 marks)

19 The equation of a curve is $y = f(x)$

There is only one minimum point on the curve.

The coordinates of this minimum point are $(8, -12)$

Write down the coordinates of the minimum point on the curve with equation

(i) $y = f(x) + 3$

$$(\dots\dots\dots, \dots\dots\dots)$$

(1)

(ii) $y = f(2x)$

$$(\dots\dots\dots, \dots\dots\dots)$$

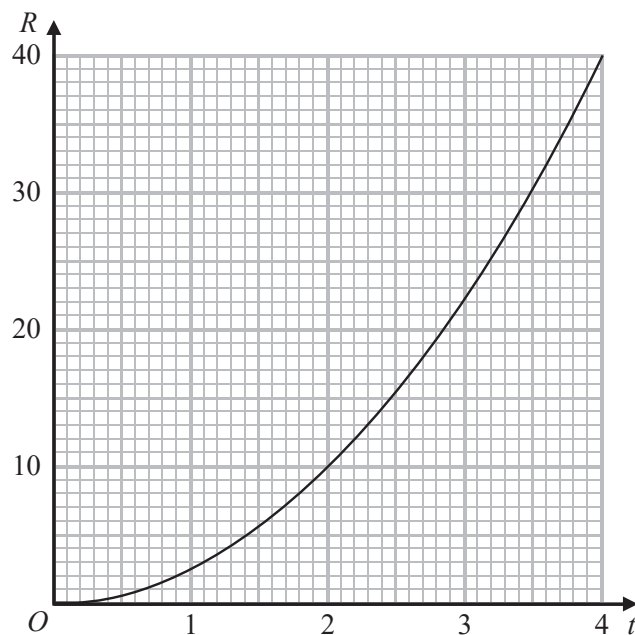
(1)

(Total for Question 19 is 2 marks)



16 R is proportional to t^2

The graph shows the relationship between R and t for $0 \leq t \leq 4$



(a) Find a formula for R in terms of t .

(3)



Given also that $R = \frac{8}{5x}$

(b) show that t is inversely proportional to $\sqrt{x}$ for $t > 0$

(2)

(Total for Question 16 is 5 marks)



17 y is directly proportional to the cube of x
 $y = 20h$ when $x = h$ ($h \neq 0$)

(a) Find a formula for y in terms of x and h

$$y = \dots\dots\dots (3)$$

(b) Find x in terms of h when $y = 67.5h$
Give your answer in its simplest form.

$$x = \dots\dots\dots (2)$$

(Total for Question 17 is 5 marks)



- 16 The following table gives values of x and y where y is inversely proportional to the square of x .

x	1.5	2	3	4
y	16	9	4	2.25

- (a) Find a formula for y in terms of x .

.....
(3)

Given that $x > 0$

- (b) find the value of x when $y = 144$

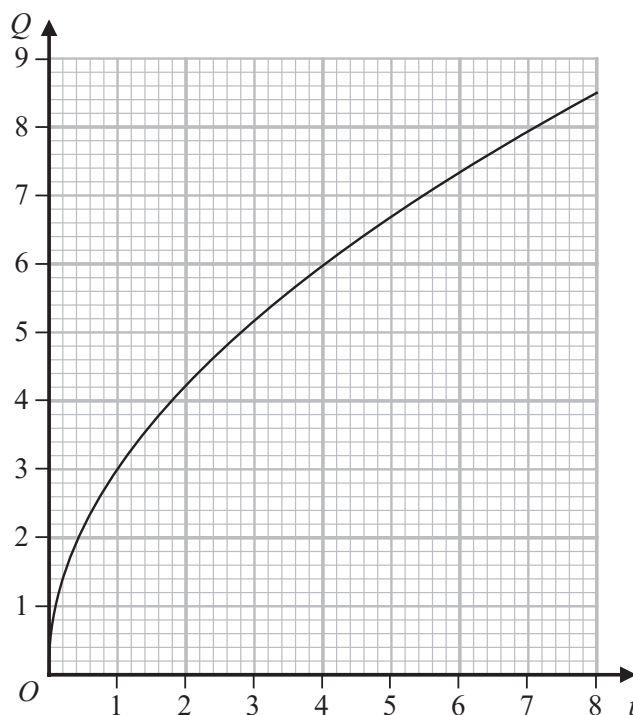
.....
(2)

(Total for Question 16 is 5 marks)



16 Q is directly proportional to $\sqrt{t}$

The graph shows the relationship between Q and t for $0 < t < 8$



(a) Find a formula for Q in terms of t

.....
(3)

Q is increased by 20%

(b) Find the percentage increase in t

..... %
(2)

(Total for Question 16 is 5 marks)



18 F is inversely proportional to the cube of r

$$F = 6 \text{ when } r = 2$$

(a) Find a formula for F in terms of r

.....
(3)

(b) Find the value of r when $F = 3072$

$r =$
(2)

(Total for Question 18 is 5 marks)



16 A is inversely proportional to the square of r

$$A = 5 \text{ when } r = 0.3$$

(a) Find a formula for A in terms of r

.....
(3)

(b) Find the value of A when $r = 7.5$

$$A = \text{.....}$$

(3)

(Total for Question 16 is 6 marks)



19 P is inversely proportional to y^2

When $y = 4$, $P = a$

(a) Find a formula for P in terms of y and a

.....
(3)

Given also that y is directly proportional to $\sqrt{x}$
and when $x = a$, $P = 4a$

(b) find a formula for P in terms of x and a

.....
(3)

(Total for Question 19 is 6 marks)



SUB-TOPIC R1c

BEST BUYS, RECIPES & SCALING

Sub-topic R1c · 1 question · 4 marks · lowest tariff first



- 12 Astrid wants to buy some oil.
She can buy the oil from either Dane Oil or Arctic Oil.

Here is information about the price that each company will charge Astrid.

Dane Oil	Arctic Oil
(4.2×10^5) litres for 2 500 000 Krone	(8.6×10^5) litres for 770 000 Dollars

Astrid wants to get the better value for money for the oil.

$$1 \text{ Dollar} = 6.57 \text{ Krone}$$

From which company should she buy her oil, Dane Oil or Arctic Oil?
You must show your working.

(Total for Question 12 is 4 marks)



MARK SCHEMES

official mark schemes, in the same order as the questions



2	$1 \times 5 + 3 \times 9 + 5 \times 24 + 7 \times 40 + 9 \times 7 (= 495)$ or $5 + 27 + 120 + 280 + 63 (= 495)$	5.8	4	M2 for at least 4 correct products added (need not be evaluated) If not M2 then award M1 for consistent use of value within interval (including end points) for at least 4 products which must be added OR correct mid-points used for at least 4 products and not added
	"495" $\div 85$			M1 dep on at least M1 Allow division by their $\sum f$ provided addition or total under column seen
				A1 for 5.8 – 5.824
Total 4 marks				

3 (a)		Correct R (5,6), (3,6), (3,5)	2	B2 fully correct If not B2 then B1 for correct orientation of R but in wrong position
(b)		Correct T (2,-1), (2,-3), (1,-3)	1	B1
Total 3 marks				

4	$675 \div (5 + 4) \times 5 (= 375)$	225	3	M1	M2 $675 \div (5 + 4) \times 3$
	"375" $\div 5 \times 3$			M1 dep M1	
				A1	
Total 3 marks					

Question	Working	Answer	Mark	Notes
2	$\frac{3450}{2+6+7} (=230)$ or $\frac{2}{2+6+7} \times 3450 (=460)$ or $\frac{7}{2+6+7} \times 3450 (=1610)$ or $\frac{7-2}{2+6+7} \left(=\frac{1}{3} \right)$		3	M1
	$(7-2) \times "230"$ or $7 \times "230"$ or $2 \times "460"$ or "1610" – "460" or $"\frac{1}{3}" \times 3450$			M1
		1150		A1
				Total 3 marks

3	$\frac{8}{100} \times 20000 (=1600)$		4	M1oe	Award M2 for 20000×1.08 or 21600
	$20000 + \frac{8}{100} \times 20000 (=21600)$ or $(20\,000 - 19200) + \frac{8}{100} \times 20000 (=2400)$			M1	
	$\frac{"21600"-19200}{19200} (\times 100)$ or $\frac{"2400"}{19200} (\times 100)$ or "21600" ÷ 19200 (×100) oe			M1 or for 1.125 or $\frac{9}{8}$ or 112.5%	
		12.5		A1 oe	
					Total 4 marks



11	$15 - 3 : x - 3 = 2 : 7$ or $(15 - 3) \div 2 (= 6)$	$(n \Rightarrow) (15 - 3) \div \frac{2}{2+7} (= 54)$ where n is the total age 3 years ago		3	M1	M2 for $\frac{(15-3) \times 7}{2} (= 42)$
	$\frac{x-3}{15-3} = \frac{7}{2}$ oe or $7 \times "6" (= 42)$	$"54" \times \frac{7}{2+7} (= 42)$			M1	
			45		A1	
					Total 3 marks	

12	$105 \div (5 \times 4) (= 5.25)$ oe or $105 \div (4 \times 3) (= 8.75)$ oe or $105 \div (3 \times 5) (= 7)$		3	M1
	"8.75" – "5.25"			M1 dep on previous M1. If M1 gained and they have worked out 3 pressures, award M1 for their highest minus their lowest.
		3.5		A1 oe
				Total 3 marks



Question		Working	Answer	Mark	Notes	
3	(a)		-5, 5, 5, -5	2	B2	All 4 correct values If not B2 then B1 for 2 or 3 correct values
	(b)		Fully correct curve	2	M1 A1	Plotting at least 6 points correctly from their table dep on B1 in part(a) Do not accept horizontal line at top of curve or straight line segments
Total 4 marks						
4	(a)	$40 \div 16 \times 12$ oe	30	2	M1 A1	$40 \times \frac{12}{16}$ oe
	(b)	$525 \div 100^2$	0.0525 oe	2	M1 A1	$\frac{525}{100^2}$ Accept 5.25×10^{-2}
Total 4 marks						
5			$(x + 4)(x - 9)$	2	M1 A1	For $(x + a)(x + b)$ where $ab = -36$ and a and b are integers Ignore extension to roots $x = -4$ & 9
						Total 2 marks
6		P(mint =) $1 - (0.35 + 0.32 + 0.12)$ (= 0.21) P(strawberry or mint =) $0.32 + "0.21"$	0.53 oe	3	M1 M1 A1	Or a correct equation summing to 1 Dep Allow 0.53/1
						Total 3 marks
7		$55 \div (6 + 3 + 2)$ (= 5) $(6 \times "5") - (2 \times "5")$	20	3	M1 M1 A1	Or $\frac{4}{11} \times 55$ (= 30) or $\frac{2}{11} \times 55$ (= 10) Or M2 for Won = 30 and Lost = 10 (can be seen in a ratio 30 : 15: 10)
						Total 3 marks

International GCSE Maths				
Apart from questions 2, 6, 10, 13a, 18ai (where the mark scheme states otherwise) the correct answer, unless clearly obtained by an incorrect method, should be taken to imply a correct method				
Q	Working	Answer	Mark	Notes
1	e.g. $36 \div (2 + 6) (= 4.5)$ or $36 \div \frac{2+6}{3+2+6} (= 49.5)$ oe or Asha = £9 OR Julie = £27			M1
	e.g. $3 \times "4.5"$ or $"49.5" \times \frac{3}{3+2+6}$ or $"9" \times \frac{3}{2}$ or $"27" \times \frac{3}{6}$			M1 or an answer of $\frac{27}{2}$
		13.5(0)	3	A1 SCB1 for $36/5 \times 6 (=43.2)$ or $36/9 \times 2 (=8)$
Total 3 marks				

2	e.g. $\frac{16}{5}$ and $\frac{21}{8}$ oe			M1 both fractions expressed as improper fractions
	e.g. $\frac{16^2}{5} \times \frac{21}{8^1}$ OR $\frac{336}{40}$ oe			M1 correct cancelling OR multiplication of numerators and denominators without cancelling
	e.g. $\frac{16}{5} \times \frac{21}{8} = \frac{336}{40} = \frac{42}{5} = 8\frac{2}{5}$ or $\frac{16}{5} \times \frac{21}{8} = \frac{336}{40} = 8\frac{16}{40} = 8\frac{2}{5}$ or $\frac{16^2}{5} \times \frac{21}{8^1} = \frac{42}{5} = 8\frac{2}{5}$ or candidate clearly shows that in the question, the result of $8\frac{2}{5} = \frac{42}{5}$ and that their answer becomes $\frac{42}{5}$	shown	3	A1 Dep on M2 for conclusion to $8\frac{2}{5}$ from correct working – either sight of the result of the multiplication e.g. $\frac{336}{40}$ must be seen or correct cancelling prior to the multiplication to $\frac{42}{5}$ NB: use of decimals scores no marks
Total 3 marks				



4		eg $(36 \div 9) \times 5$ or 20 [ducks] or 20 : 36 or for writing the 3 parts of the ratio correctly eg 35 : 10 : 18 oe		3	M1	For a fully correct calculation for the number of ducks or stating 20 ducks – may be shown in a ratio – does not need to be labelled if it is clear that the number or calculation refers to the number of ducks
		“20” $\div 2 = 10$ and 10×7 oe or $\frac{36}{18} \times 35$ oe			M1	For a correct calculation to find the number of chickens. (award the M2 for 70 : 20 : 36 or a different order if intention is clear eg by labels)
		<i>Working not required, so correct answer scores full marks (unless from obvious incorrect working)</i>	70		A1	
					Total 3 marks	



International GCSE Maths				
Apart from questions 18, 19, 22 and 24, the correct answer, unless clearly obtained by an incorrect method, should be taken to imply a correct method.				
Q	Working	Answer	Mark	Notes
1 (a)		a^{11}	1	B1
(b)		w^{12}	1	B1
(c)		$64x^{10}y^6$	2	B2 if not B2 then award B1 for 2 correct parts as part of a product eg $kx^{10}y^6$ where $k \neq 64$ or $64x^ky^6$ where $k \neq 10$ or $64x^{10}y^k$ where $k \neq 6$
(d)	$c + 8v = t^3$		2	M1
		$t = \sqrt[3]{c+8v}$		A1 oe
				SCB1 for an answer of $t = \frac{c+8v}{3}$ oe
				Total 6 marks
2	$196 \div (9 - 5) (= 49)$ oe		3	M1
	$3 \times \text{“}49\text{”}$			M1
		147		A1 SCB1 for an answer from 34.5 – 34.6 or an answer of 42
				Total 3 marks



4	$3 \times 180 (= 540)$ or $360 - [(180 - 90) + (180 - 135) + (180 - 67) + (180 - 119)] (= 51)$ or $360 - (90 + 45 + 113 + 61) (= 51)$		3	M1
	$90 + 135 + 67 + 119 + x = "540"$ oe $411 + x = "540"$ oe or $"540" - (90 + 135 + 67 + 119)$ or $3 \times 180 - (90 + 135 + 67 + 119)$ oe or $540 - 411$ or $180 - "51"$ oe			M1
	Correct answer scores full marks (unless from obvious incorrect working)	129		A1
				Total 3 marks

5	$2 : 3 : 15$ oe or 20 or $(1 : 5) \times 3$ or $(1 : 5 \Rightarrow) 3 : 15$ or $2n : 3n : 15n$ e.g. $4 : 6 : 30$ or $G(\text{reen}) = 2, O(\text{range}) = 3, Y(\text{ellow}) = 15$		3	M1
	$\frac{2}{"20"}$, 280 oe or 14×2 or $\frac{2}{"2"+ "3"+ "15"}$, 280 oe or $\frac{2n}{"2n"+ "3n"+ "15n"}$, 280 oe			M1
	Correct answer scores full marks (unless from obvious incorrect working)	28		A1 or $28 : 42 : 210$ or $28, 42, 210$ If not in this order must be labelled correctly
				Total 3 marks



5	$390 \div (8 - 2) (= 65)$ or $\frac{8}{15} - \frac{2}{15} = 390$ or $\frac{8}{15}x - \frac{2}{15}x = 390$ or $\frac{6}{15} = 390$ or $\frac{6}{15}x = 390$ oe		3	M1	M2 for $\frac{390 \times 15}{6}$ oe
	“65” $\times (2 + 5 + 8)$ oe or $\frac{1}{15} = 65$ or $\frac{1}{15}x = 65$ or $\frac{1}{5} = 195$ or $\frac{1}{5}x = 195$			M1 or for 975 seen with further work and a different answer	
	Correct answer scores full marks (unless from obvious incorrect working)	975		A1	SCB1 for 52, 130, 208 or 390, 975, 1560 (or 2925) or 97.5, 243.75, 390 (or 731.25)
Total 3 marks					



International GCSE Maths					
Apart from questions 8ab, 9, 11b, 15a, 19b, 20 the correct answer, unless clearly obtained by an incorrect method, should be taken to imply a correct method					
Q	Working	Answer	Mark	Notes	
1	$12 \div (5 - 2) (= 4)$ or $2 : 5 = 8 : 20$ or $A = 8$ or $S = 20$ or eg $\frac{5}{15}x - \frac{2}{15}x = 12$ or $x = 60$		3	M1 for method to find the value of one share or working with the ratio for Arjun or Simon or setting up an equation or for finding the total number of goals (= 60)	M2 for $\frac{8}{5-2} \times 12$ oe
	eg $8 \times "4"$ or $8 \times \frac{8}{2}$ or $8 + 12 + 12$ or $8 \times \frac{20}{5}$ or $20 + 12$ or $"60" \times \frac{8}{15}$			M1 for a complete method	
	Correct answer scores full marks (unless from obvious incorrect working)	32		A1 SCB1 for $\frac{8}{15} \times 12 (= 6.4)$	
				Total 3 marks	
2	$15 \times 5 + 45 \times 6 + 75 \times 8 + 105 \times 9 + 135 \times 2$ or $75 + 270 + 600 + 945 + 270$ [lower bound products are: 0, 180, 480, 810, 240] [upper bound products are: 150, 360, 720, 1080, 300]		3	M2 for correct products using midpoints (allow one error or omission) with attempt to add (M1 for products using a consistent value within range and attempt to add or for at least 4 correct products without addition)	
	Correct answer scores full marks (unless from obvious incorrect working)	2160		A1 (an answer of 72 loses the final A mark but gains M2)	
				Total 3 marks	



Question	Working	Answer	Mark	Notes
4 (a)	$2x + 5 = 6(2x - 5)$ or $2x + 5 = 12x - 30$ or $\frac{2}{6}x + \frac{5}{6} = 2x - 5$ oe (allow $0.33x + 0.83 = 2x - 5$)		3	M1 For multiplying both sides by 6 or separating values in fraction correctly in an equation. (decimals 2 dp or better)
	$2x - 12x = -30 - 5$ or $-10x = -35$ or $5 + 30 = 12x - 2x$ or $35 = 10x$ oe or $\frac{5}{6} + 5 = 2x - \frac{1}{3}x$ oe or $1\frac{2}{3}x = 5\frac{5}{6}$ oe			M1 ft For collecting the terms in x on one side and the number terms on the other side. ft from incorrect expansion dep on a number term and a term in x on both sides.
	Working required	3.5		A1 dep on M1 oe eg $\frac{7}{2}$ or $3\frac{1}{2}$
(b)		h^{12}	1	B1 Allow x^{12} or another letter to the power 12 but do not allow just 12
(c)	Working not required, so correct answer scores full marks (unless from obvious incorrect working)	$16g^{12}k^{30}$	2	B2 B1 for 2 terms correct in a product [must be 16 and not 2^4]
(d)	eg $\frac{y^n}{y^2} = y^{12}$ or $y^{-2} \times y^n = y^{12}$ or $y^5 \times y^{n-7} = y^{12}$ or $\frac{y^{5+n}}{y^7} = y^{12}$ $y^5 \times y^n = y^{19}$ or $y^{5+n-7} = y^{12}$ or $\frac{y^5}{y^{7-n}} = y^{12}$ or $y^{5+n} = y^{12+7}$ or $5 + n - 7 = 12$ oe		2	M1 for one correct application of an index rule (must be seen in powers of y) this could be after an initial mistake – working will need to be clearly seen or for a correct equation in n (no mistakes allowed)
	Working not required, so correct answer scores full marks (unless from obvious incorrect working)	14		A1 Allow y^{14}
				Total 8 marks



3	$ADC = 180 - 58 (= 122)$ or $EDF = 122$ or $CDE = 58$ or $ADF = 58$			M1 may be seen marked on the diagram
	e.g. $DEF = 58 \div 2$ or $DEF = (180 - 122) \div 2$			M1 complete method to find angle DEF
		29		A1
			5	B2 dep on M2 for fully correct reasons for their method (B1 dep on M1 for one correct reason stated and used) e.g. <u>Allied angles</u> , <u>co-interior angles</u> , <u>Alternate angles</u> , <u>Corresponding angles</u> , <u>Vertically opposite angles</u> are equal (or <u>Vertically opposite angles</u> are equal), <u>Angles</u> on a straight line add up to 180° (or angles on a straight line add to 180°), Sum of <u>two angles</u> in a triangle are equal to <u>opposite exterior angle</u> , <u>Angles</u> in a triangle add up to 180° (or Angles in a triangle add up to 180°), Base angles in an <u>isosceles triangle</u> , <u>Angles</u> in a <u>quadrilateral</u> add up to 360. (accept "4-sided shape" or parallelogram) <u>Opposite angles</u> of a <u>parallelogram</u> are equal
Total 5 marks				
4	eg $76 \div (5 + 2 - 3)$ oe (= 19) or $5x + 2x - 3x = 76$ and $x = 76 \div (5 + 2 - 3)$ (=19) oe			M1 For a correct method to find the value of 1 share
	$3 \times "19" (= 57)$			M1
	"57" - 48.5(0)			M1
		8.5(0)	4	A1
Total 4 marks				

Question	Working	Answer	Mark	Notes	
6	$19.35 \div (4 + 5) (= 2.15)$		4	M1	M2 for $\frac{5}{9} \times 19.35 (= 10.75)$
	$"2.15" \times 5 (= 10.75)$			M1	
	$\frac{12 - "10.75"}{12} \times 100 \text{ oe}$ or $100 - \frac{10.75 \times 100}{12} \text{ oe}$			M1	
	<i>Working not required, so correct answer scores full marks (unless from obvious incorrect working)</i>	10.4		A1	accept 10.4 – 10.42 SCB1 for $\frac{5}{9} \times 12 (= 6.66\dots)$ oe
				Total 4 marks	



5	2 and 15 seen or $1 \times 2 (+) 3 \times 5 (= 17)$	$2x + 15x (= 85)$ or $\frac{2}{3}y + 5y (= 85)$ or $0.25t \times 2 + 0.75t \times 5 (= 85)$		4	M1 For 2 and 15 oe seen or 17 or a correct equation in one unknown for number of 2p coins (x) or number of 5p coins (y) or total number of coins (t)
	$85 \div (2 + 15) (= 5)$ or at least two pairs of multiples of the values of 2 and 15 (eg 4, 30; 6, 45.....) or 10(p) (and) 75(p) or 10 : 75 or 5×2 and 15×5 $2 \times 5 + 5 \times 3 \times 5$ or 20 coins	$17x = 85$ ($x = 5$) or $\frac{17}{3}y = 85$ ($y = 15$) or $4.25t = 85$ ($t = 20$)			M1 Assumes previous M1 for number of 2p coins or number of 5p coins or total number of coins or value of 2p coins and value of 5p coins may be clearly listed eg 2 555 2 555 2 555 2 555 2 555 with no ambiguity
	5 (2p coins) and 15 (5p coins) or 5 : 15 (if clearly identified (or used) as the key ratio eg not just part of a list) or $(3 - 1) \times 5$	eg 15 – 5 oe			M1 Correct number of 2p coins and 5p coins or a sum to find the difference in number of coins
	Correct answer scores full marks (unless from obvious incorrect working)		10		A1 SCB1 if no other marks awarded for 21.25 in working or on answer line
					Total 4 marks



Question	Working	Answer	Mark	Notes
6*	$240 \div (3 + 4 + 5) (= 20)$ or $240 \times \frac{3}{3+4+5} (= 60)$ oe or $240 \times \frac{4}{3+4+5} (= 80)$ oe or $240 \times \frac{5}{3+4+5} (= 100)$ oe		4	M1 for a correct method to find the value of one share NB $(240 \div 3 =) 80$, $(240 \div 4 =) 60$ and $(240 \div 5 =) 48$ scores M0
	For two of (Pau:) $3 \times "20" + 10 + 10 (= 80)$ or $"60" + 10 + 10 (= 80)$ (Sam:) $4 \times "20" - 10 (= 70)$ or $"80" - 10 (= 70)$ (Tia:) $5 \times "20" - 10 (= 90)$ or $"100" - 10 (= 90)$			M1 for the correct values for 2 of the people after S and T give P £10
	80, 70 and 90 or eg $9 : 7 : 8$ oe or eg $4 : 3.5 : 4.5$ oe			M1 for all 3 of 80, 70, and 90 correct (ignore units) or for the correct values for the final ratio in the wrong order (ignore units) or for the correct values for the final ratio unsimplified (ignore units)
	Working not required, so correct answer scores full marks (unless from obvious incorrect working)	8 : 7 : 9		A1 other orders are acceptable if labelled correctly
Total 4 marks				



Question	Working	Answer	Mark	Notes
2	$170 \div 2 (=85)$ or $170 \div 2 \times 7 (=595)$ or $7 \div 2 (=3.5)$ $7 \times "85" + 170 (=765)$ or $9 \times "85" (=765)$ or $"595" + 170 (=765)$ or $170 \times "3.5" + 170 (=765)$ $"765" \div 3 (=255)$ or $"765" \div 3 \times 5 (=1275)$ $"255" \times 2$ or $"1275" - "765"$ or $"1275" \div 5 \times 2$	510	5	M1 M1 award of this mark implies the first M1 M1 dep on M2 M1 A1
	Alternative scheme			
2	(girls =) $\frac{2}{9}$ (of children) (girls =) $\frac{2}{9} \times \frac{3}{5} \left(= \frac{2}{15} \right)$ (of total) or $G : C : A = \frac{2}{9} \times \frac{3}{5} : \frac{3}{5} : \frac{2}{5} \left(= \frac{2}{3} : 3 : 2 \right)$ $"\frac{15}{2}" \times 170 (=1275)$ or $G : A = 2 : 6$ oe $"1275" \div 5 \times 2$ or 3×170	510	5	M1 M1 award of this mark implies the first M1 M1 dep on M2 M1 A1



9	e.g. $1.5 \times 1.5 (= 2.25 \text{ oe})$		3	M1 for calculating the area of the square, may be seen embedded within a calculation
	e.g. $34.8 \times "2.25"$			M1 for a complete method to find the force
		78.3		A1 oe
Total 3 marks				

10	e.g. $\frac{3}{10} \times 80 (= 24)$ or $\frac{2}{10} \times 80 (= 16)$ or $\frac{5}{10} \times 80 (= 40)$		5	M2 for a complete method to find the number of chocolate cakes or lemon cakes or fruit cakes "10" comes from $3 + 2 + 5$ (M1 for correct use of the ratio e.g. $80 \div "10" (= 8)$)
	e.g. $"16" \times \frac{3}{4} \times 1.7(0) (= 20.4(0))$ or $"40" \times \frac{7}{8} \times 2.4(0) (= 84)$			M1 for a method to find the profit for lemon cakes or fruit cakes
	e.g. $"24" \times 2 (= 48)$ and $"16" \times \frac{3}{4} \times 1.7(0) (= 20.4(0))$ and $"40" \times \frac{7}{8} \times 2.4(0) (= 84)$			M1 for a method to find the profit for all 3 cakes
		152.4(0)		A1
Total 5 marks				



8	$300 \div (7 + 5 + 3) (= 20)$ clear correct use of $7 + 5 + 3 (= 15)$ eg division at the end by 15 $\left(\frac{"2.8"+"1.8"}{15} \right)$ or correct use of 15 in a fraction eg $\frac{2}{5} \times \frac{7}{15}$		5	M1 (no mark for "15" unless it is used correctly) use of 7×20 or 140 or 5×20 or 100 in further work assumes this mark
	$\frac{2}{5} \times (7 \times "20") (= 56)$ oe eg $0.4 \times "140" (= 56)$ or $\frac{2}{5} \times 7 \left(= \frac{14}{5} = 2.8 \right)$ eg $\frac{2}{5} \times \frac{7}{15} \left(= \frac{14}{75} = 0.186... \right)$			M1 finding $\frac{2}{5}$ of the number of birthday cards or $\frac{2}{5}$ of the share of 7 or $\frac{2}{5}$ of fraction of amount
	$0.36 \times (5 \times "20") (= 36)$ [from working] or $0.36 \times 5 (= 1.8)$ eg $\frac{36}{100} \times \frac{5}{15} \left(= \frac{180}{1500} = 0.12 \right)$ oe			M1 finding 36% of anniversary cards Or 36% of the share of 5 or 36% of fraction of amount
	$\frac{"56"+"36"}{300} \left(= \frac{92}{300} \right)$ or eg $\left(\frac{"2.8"+"1.8"}{15} \right)$ or $\frac{14}{5} + \frac{9}{15}$ $\frac{"14"}{75} + \frac{180}{1500}$			M1 for any fraction from correct working that isn't simplified or 30.66..% or 0.3066...
		$\frac{23}{75}$		A1
				Total 5 marks



8	600 ÷ (9 + 4 + 2) (= 40) or tulip: 0.45 × 600 (= 270) or crocus: $\frac{5}{8} \times 600$ (= 375)	Tulips: 0.45 × 9 (= 4.05) or $0.45 \times \frac{9}{15} \left(= \frac{27}{100} (= 0.27) \right)$ oe	5	M1 A correct method to find one share or 45% of 600 or $\frac{5}{8}$ of 600 or the fraction of the share that is for tulips
	Daffodils: “40” × 2 (= 80) $\frac{2}{15} \times 600 (= 80)$ (implies 1 st M1)	Crocus: $\frac{5}{8} \times 4 (= 2.5)$ or $\frac{5}{8} \times \frac{4}{15} \left(= \frac{1}{6} (= 0.16) \right)$ oe		M1 A correct method to find number of daffodils or the fraction of the share that is for crocus
	Tulip: 0.45 × (9 × “40”)(=162) or $0.45 \times 600 \times \frac{9}{15} (= 162)$ (implies 1 st M1)	Total of parts 4.05 + 2.5 + 2 (= 8.55) or $\frac{27}{100} + \frac{1}{6} + \frac{2}{15} \left(= \frac{57}{100} \right)$ oe (implies 1 st and 2 nd M marks)		M1 A correct method to find number of yellow tulips or the total of the parts that are yellow
	Crocus: $\frac{5}{8} \times (4 \times “40”) (= 100)$ or $\frac{5}{8} \times 600 \times \frac{4}{15} (= 100)$ (implies 1 st M1)	$\frac{8.55}{9 + 4 + 2} \times 600$ oe or $\frac{57}{100} \times 600$ oe (implies all previous M marks)		M1 A correct method to find number of yellow crocuses or multiplying the total of the correct shares by 600
	Correct answer scores full marks (unless from obvious incorrect working)		342	A1
				Total 5 marks



5		$120 \div (3 + 5) (= 15)$ '15' $\times 3 (= 45)$ or '15' $\times 5 (= 75)$		6	M1 M1	M2 for $\frac{3}{8} \times 120 (= 45)$ or $\frac{5}{8} \times 120 (= 75)$ oe
		'45' $\div 3 (= 15)$ or '45' $\div 3 \times 2 (= 30)$			M1	
		'75' $\times \frac{16}{25} (= 48)$ or '75' $\times \frac{9}{25} (= 27)$			M1	
		E.g. ('45' $\div 3 \times 2$) + ('75' $\times \frac{9}{25}$) oe or '27' + '30' or ('75' – '48') + ('45' – '15')			M1 for a complete method	
			57		A1	
					Total 6 marks	

6	(a)		0.000 78	1	B1
	(b)	22 500 000 oe e.g. 22.5×10^6 or 2.25×10^n $n \neq 7$		2	M1
			2.25×10^7		A1
					Total 3 marks



13	$8000 \times \left(\frac{100+x}{100}\right)^6 = 8877.62$ oe or $8000 \times \left(1 + \frac{x}{100}\right)^6 = 8877.62$ oe or $8000 \times (1+x\%)^6 = 8877.62$ or $8000 \times y^6 = 8877.62$ oe		3	M1
	$\left(\frac{8877.62}{8000}\right)^{\frac{1}{6}} (=1.0175\dots)$ or $(1.1097\dots)^{\frac{1}{6}} (=1.0175\dots)$			M1
		1.75		A1
Total 3 marks				

14	$F = \frac{k}{v^2}$ or $Fv^2 = k$ oe		3	M1 (NB. Not for $F = \frac{1}{v^2}$) Constant of proportionality must be a symbol such as k M2 for $6.5 = \frac{k}{4^2}$ oe
	$6.5 = \frac{k}{4^2}$ or $k = 6.5 \times 4^2$ or $k = 104$			M1 For substitution of F and v into a correct formula
		$F = \frac{104}{v^2}$		A1 Award 3 marks if $F = \frac{k}{v^2}$ is on the answer line and the value of $k = 104$ is found
Total 3 marks				



15	eg $40 = \frac{k}{1.5^2}$ or $k = 90$ or $\frac{C^2}{1.5^2} = \frac{40}{1000}$ ($= 0.04$) or $(C^2 =) 1.5^2 \times \frac{40}{1000}$ ($= 0.09$) or $\frac{1.5^2}{C^2} = \frac{1000}{40}$ ($= 25$) or $(C^2 =) 1.5^2 \div \frac{1000}{40}$ ($= 0.09$)		3	M1
	eg $(C =) \sqrt{\frac{90}{1000}}$ oe or $(C =) \sqrt{1.5^2 \times 0.04}$ or $(C =) \sqrt{1.5^2 \div 25}$ or $(C =) \sqrt{0.09}$			M1
		0.3		A1 oe , allow ± 0.3 oe or -0.3 oe
Total 3 marks				
16	eg $\frac{55}{360} \times \pi \times d = 5$ or $\frac{55}{360} \times \pi \times 2 \times r = 5$ oe OR $\frac{360}{55} \times 5 (= 32.7...)$ oe		4	M1 for a correct equation for the diameter or radius OR for a method to find the circumference of the circle
	eg $d = \frac{5 \times 360}{55\pi}$ ($= 10.4...$) or $r = \frac{5 \times 360}{55 \times 2 \times \pi}$ ($= 5.2...$) OR $d = \frac{32.7...}{\pi}$ ($= 10.4...$) or $r = \frac{32.7...}{2 \times \pi}$ ($= 5.2...$)			M1 for a method to work out the diameter or radius
	(area =) eg $\pi \times \left(\frac{10.4...}{2}\right)^2$ or $\pi \times (5.2...)^2$			M1
		85.2		A1 allow 84.9 – 85.4
Total 4 marks				



17	$y = \frac{k}{\sqrt{x}}$ or $ky = \frac{1}{\sqrt{x}}$ or $\sqrt{x} = \frac{k}{y}$ oe		3	M1 (NB. Not for $y = \frac{1}{\sqrt{x}}$) Constant of proportionality must be a symbol such as k (Allow c for k for this mark only)	M2 for $c^4 = \frac{k}{\sqrt{c^2}}$ oe
	$c^4 = \frac{k}{\sqrt{c^2}}$ oe or $k = c^4 \times \sqrt{c^2}$ oe			M1 for substitution of x and y into a correct formula	
	Correct answer scores full marks (unless from obvious incorrect working)	$y = \frac{c^5}{\sqrt{x}}$		A1 oe e.g $y = c^5 \times \frac{1}{\sqrt{x}}$ Award 3 marks if answer is $y = \frac{k}{\sqrt{x}}$ on the answer line and $k = c^5$ clearly given in the body of working of the script	
				Total 3 marks	

18	(a)		$\frac{k}{x}$	1	B1 allow kx^{-1}
	(b)(i)		-46	1	B1 cao
	(ii)	$\frac{3(2-3x^4)}{2-(2-3x^4)}$ or $\frac{6-9x^4}{2-2+3x^4}$ oe or $\frac{6-9x^4}{3x^4}$ oe		2	M1
	Correct answer scores full marks (unless from obvious incorrect working)	$\frac{2-3x^4}{x^4}$			A1 allow $\frac{2}{x^4} - 3$ oe
					Total 4 marks



17	$Q = k\sqrt{d}$ oe or $kQ = \sqrt{d}$ or $Q = \sqrt{kd}$		3	M1 $k \neq 1$
	eg $4.5 = k \times \sqrt{324}$ or $k = 0.25$ oe			M1 Allow this for M2 if $Q = k\sqrt{d}$ is not seen Condone use of ∞ for method marks
	<i>Correct answer scores full marks (unless from obvious incorrect working)</i>	$Q = 0.25\sqrt{d}$		A1 oe but must be $Q = \dots$ eg $Q = \frac{\sqrt{d}}{4}$ or $Q = \sqrt{\frac{d}{16}}$ oe
				Total 3 marks



14	$B = \frac{k}{d^2}$ oe	$Bk = \frac{1}{d^2}$ oe		3	M1 (NB Not for $B = \frac{1}{d^2}$) Constant of proportionality must be a symbol such as k Allow D or b	M2 for $0.25 = \frac{k}{12^2}$ oe or $0.25 \times k = \frac{1}{12^2}$ oe or
	$0.25 = \frac{k}{12^2}$ oe or $0.25 = \frac{k}{144}$ oe or $k = 36$	$0.25 \times k = \frac{1}{12^2}$ oe or $0.25 \times k = \frac{1}{144}$ oe or $k = \frac{1}{36}$			M1 for substitution of B and d into a correct formula	
	Correct answer scores full marks (unless from obvious incorrect working)		$B = \frac{36}{d^2}$		A1 e.g $B = 36 \times \frac{1}{d^2}$ or $B = 36 \times d^{-2}$ Award 3 marks if answer is $B = \frac{k}{d^2}$ on the answer line and $k = 36$ clearly given in the body of working of the script M2A0 for $Bd^2 = 36$ or $d = \frac{6}{\sqrt{B}}$ or $d^2 = \frac{36}{B}$	
					Total 3 marks	



Question	Working	Answer	Mark	Notes
14 (a)	$T = kr^3$ $21.76 = k \times 4^3$ oe or $k = 0.34$	$T = 0.34r^3$ oe	3	M1 Allow $r^3 = mT$ Do not allow $T = r^3$ M1 for correct substitution into a correct equation; implies first M1 Award M2 if $k = 0.34$ stated unambiguously ($m = 2.94$) Condone use of proportional sign in place of equals sign A1 Only award if T is the subject Award M2A1 if $T = kr^3$ on answer line and k given as 0.34oe in working space.
(b)		73.44	1	B1ft for their value of k if $T = kr^3$

19	$\pi \times 12^2 \times \frac{AOC}{360} (=100)$		4	M1	oe for setting up a correct expression for the area of the sector (or equation)
	$(AOC =) \frac{100 \times 360}{\pi \times 12^2} \left(= \frac{250}{\pi} \right)$			M1	for correctly rearranging for AOC
	$(\text{Angle } ABC =) "79.57747" \div 2 (= 39.7887... \text{ or } \frac{125}{\pi})$			M1	ft dep 1 st M1 and 'x' less than 360 for dividing their 'AOC' by 2
		39.8		A1	for awrt 39.8 accept $\frac{125}{\pi}$
Total 4 marks					

20 (a)	$T = \frac{k}{m^2}$ or $Tm^2 = k$		3	M1	for a correct equation with a constant Do not allow constant = 1
	$30 \times 0.5^2 = k$ or $30 = \frac{k}{0.5^2}$ or $k = 7.5$ or $k = \frac{15}{2}$			M1	dep on M1 for correct substitution in a correct equation
		$T = \frac{7.5}{m^2}$		A1	for $T = \frac{7.5}{m^2}$ or $T = \frac{15}{2m^2}$ SCB2 for $Tm^2 = 7.5$ or $Tm^2 = \frac{15}{2}$ or $m^2 = \frac{7.5}{T}$ or $m^2 = \frac{15}{2T}$
(b)		750	1	B1	cao
Total 4 marks					

20	$y = \frac{k}{\sqrt{x}}$ or $ky = \frac{1}{\sqrt{x}}$ or $x = pT^3$ or $y = \frac{k}{\sqrt{pT^3}}$ or $y = \frac{c}{\sqrt{T^3}}$ oe	Alternative $y^2T^3 = n$ oe		4	M1 Constant of proportionality must be a symbol such as k or p or c or n $k \neq 1$, $p \neq 1$ and $c \neq 1$ and $n \neq 1$
	$c = 8 \times \sqrt{25^3} (=1000)$ oe	$n = 8^2 \times 25^3 (=1000000)$ oe			M1 dep M1 for rearranging for c or n with ($y =$) 8 and ($T =$) 25 substituted correctly into their equation
	$27 = \frac{'1000'}{\sqrt{T^3}}$ and $T^3 = \left(\frac{'1000'}{27}\right)^2$ oe $27 = \frac{'1000'}{\sqrt{T^3}}$ and $T^{\frac{1}{2}} = \left(\frac{'1000'}{27}\right)^{\frac{1}{3}}$ oe	$T^3 = \frac{'1000000'}{27^2}$ oe			M1 for substitution of y and a correct rearrangement for T^3 or $T^{\frac{1}{2}}$ or T .
			$\frac{100}{9}$		A1 oe eg $11\frac{1}{9}$ or 11.1' or 11.111(...)
					Total 4 marks

17	$M = kh^3$ oe or $4 = k \times 0.5^3$ oe		4	M1 $k \neq 1$ and where k could be any letter	M2 for $\frac{500}{4} = \frac{h^3}{0.5^3}$ oe or $125 \times 0.5^3 (= 15.625)$ oe
	$k = \frac{4}{0.5^3}$ or $k = \frac{4}{0.125}$ or $k = 32$			M1 Allow this for M2 if $M = kh^3$ is not written	
	$h = \sqrt[3]{\frac{500}{32}}$ or $\sqrt[3]{\frac{500 \times 0.5^3}{4}}$ or $\sqrt[3]{15.625}$ or $h = 5 \times 0.5$			M1 for a correct expression for h using correct values or a value of k from a completely correct method	
		2.5		A1 oe	
				Total 4 marks	

18	7.45, 7.55, 3.415, 3.425, 1.5, 2.5		3	B1 For one correct upper or one correct lower bound Allow 7.549 for 7.55, 3.4249 for 3.425, 2.49 for 2.5	
	$(X \Rightarrow) \frac{2 \times 7.55 - 3.415}{1.5}$ oe eg $\frac{11.685}{1.5}$			M1 $\frac{2 \times UB_o - LB_o}{LB_f}$ where $7.5 < UB_o \leq 7.55$, $3.415 \leq LB_o < 3.42$, $1.5 \leq LB_f < 2$ (also award this mark for $\frac{7.55 - 3.415}{1.5}$ or $\frac{2(7.55 - 3.415)}{1.5}$)	
		7.79		A1 must be from correct working	
				Total 3 marks	



17	(a)	$F = \frac{k}{r^2}$ or $kF = \frac{1}{r^2}$		3	M1 (NB. Not for $F = \frac{1}{r^2}$) Constant of proportionality must be a symbol such as k	M2 for $36 = \frac{k}{4^2}$ oe
		$36 = \frac{k}{4^2}$ oe or $k = 36 \times 4^2$ or $k = 576$			M1 for substitution of F and r into a correct formula	
		Correct answer scores full marks (unless from obvious incorrect working)	$F = \frac{576}{r^2}$		A1 oe e.g. $F = 576(\times) \frac{1}{r^2}$ Award 3 marks if answer is $F = \frac{k}{r^2}$ on the answer line and $k = 576$ clearly given in the body of working of the script	
	(b)		0.25	1	A1ft oe dep on M1 in part (a) and for their value of k if $F = \frac{k}{r^2}$	
Total 4 marks						

18	$y = \frac{k}{x^3}$	$hy = \frac{1}{x^3}$		4	M1 do not award for $y = \frac{1}{x^3}$ Constant of proportionality must be a symbol such as k Condone use of $\propto$ for method marks
	$4 = \frac{k}{3^3}$ or $k = 4 \times 3^3 (= 108)$	$h \times 4 = \frac{1}{3^3}$ or $h = \frac{1}{4 \times 3^3} (= \frac{1}{108})$			M1 for substitution of x and y into a correct formula Condone use of $\propto$ for method marks
	eg $(x^3 =) \frac{4 \times 3^3}{864} (= \frac{1}{8})$ or $(x^3 =) \frac{108}{864} (= \frac{1}{8})$ oe				M1 for method to find x^3 Condone use of $\propto$ for method marks
	Correct answer scores full marks (unless from obvious incorrect working)		0.5		A1 oe
					Total 4 marks

19	(i)		8, -9	1	B1 cao
	(ii)		4, -12	1	B1 cao
					Total 2 marks



Question	Working	Answer	Mark	Notes
16 (a)	$R = kt^2$ oe		3	M1 Equation consistent with $R \propto t^2$
	eg $10 = k \times 2^2$ or $40 = k \times 4^2$ or $k = 2\frac{1}{2}$			M1 Substitute values at any point on the graph or find the value of k . (Implies first M1.) Allow readings from graph for $t \pm 0.1$ and $R \pm 1$
		$R = \frac{5}{2}t^2$		A1 Award for $R = kt^2$ if the value of k is shown clearly in (a) or (b).
(b)	$\frac{8}{5x} = \frac{5}{2}t^2$ "		2	M1 ft dep on answer of the form $R = kt^2$
		$t = \frac{0.8}{\sqrt{x}}$		A1 ft dep on answer of the form $R = kt^2$ Simplification of constant is not required. eg accept $t = \sqrt{\frac{16}{25} \times \frac{1}{x}}$ [allow other clear arguments that clearly shows t is inversely proportional to $\sqrt{x}$]
				Total 5 marks

17	(a)	$y = kx^3$ or $ky = x^3$			M1 (NB. Not for $y = x^3$) Constant of proportionality must be a symbol such as k	M2 for $20h = k \times h^3$ oe
		$20h = k \times h^3$ oe			M1 substitution of x and y into a correct formula	
			$y = \frac{20x^3}{h^2}$	3	A1 for $y = \frac{20x^3}{h^2}$ oe Award 3 marks if answer is $y = kx^3$ and $k = \frac{20}{h^2}$ oe is seen in part (a) or in part (b)	
	(b)	$\sqrt[3]{67.5h \div \frac{20}{h^2}}$ oe			M1 ft, dep on at least M1 in part (a), complete method to find x	
			$1.5h$	2	A1 accept $\frac{3}{2}h$ or $\frac{3h}{2}$	
					Total 5 marks	



Question	Working	Answer	Mark	Notes
15	$ABD = 98^\circ \div 2 (= 49^\circ)$ or $ABC = 90^\circ$ <u>Angle at centre / middle is twice angle at circumference</u> <u>Angle in a semicircle / from a diameter is 90° / right angle</u> $DBC = (90 - 49) = 41$	41°	4	M1 Correct angle stated or seen on diagram B1 Dep M1 B1 Dep M1 A1 Correct answer + no reasons = M1A1
	Alt: $180 - 98 (= 82^\circ)$ $OAD = 82 \div 2 (= 41^\circ)$ Base / bottom angles in an <u>isosceles triangle</u> are equal $DBC = 41^\circ$ <u>Angles in the same segment / from the same chord (DC) are equal</u>	41°		M1 Correct angle stated or seen on diagram B1 Dep M1 B1 Dep M1 A1 Correct answer + no reasons = M1A1
	Alt: <u>$DOC = 180 - 98 (= 82^\circ)$</u> <u>Angles on a straight line = 180°</u> $DBC = 41^\circ$ <u>Angle at centre / middle is twice angle at circumference</u>	41°		M1 Correct angle stated or seen on diagram B1 Dep M1 B1 Dep M1 A1 Correct answer + no reasons = M1A1
				Total 4 marks

16	(a)	$y = \frac{k}{x^2}$ condone proportion symbol in place of = $16 = \frac{k}{1.5^2}$ or $9 = \frac{k}{2^2}$ or $4 = \frac{k}{3^2}$ or $2.25 = \frac{k}{4^2}$		3	M1 Setting up a correct equation " k " $\neq 1$ M1 Using the values from the table to find the value of the constant or " k " = 36
			$y = \frac{36}{x^2}$	A1	$\frac{36}{x^2} = M2 A0$
	(b)	$x^2 = \frac{36}{144}$ or $x = \sqrt{\frac{36}{144}}$			M1 Substituting $y = 144$ into the correct equation and making x^2 or x the subject.
			0.5 oe	2	A1 cao
					Total 5 marks



16	(a)	$Q = k\sqrt{t}$		3	M1	for linking Q and t correctly (must have constant eg k) (allow $Q \propto k\sqrt{t}$)
		eg $6 = k\sqrt{4}$ or $3 = k\sqrt{1}$ or $k = 3$			M1	for substituting a suitable pair of values or finding $k = 3$ (allow $\propto$ sign)
		Correct answer scores full marks (unless from obvious incorrect working)	$Q = 3\sqrt{t}$		A1	oe allow q for Q (must have $=$) allow 2.95 – 3.05 for k if method clearly shown and readings correct ± 0.5 small square allow an answer of $Q = k\sqrt{t}$ with $k = 3$ clearly stated
	(b)	1.2 ² or 1.44 or 144 could be within a calculation eg $\left(\frac{3 \times 1.2}{3}\right)^2 (=1.44)$ or $\left(\frac{6 \times 1.2}{3}\right)^2 (=5.76)$ eg $\left(\frac{6 \times 1.2}{"3"}\right)^2 \div 4 (=1.44)$ or $\left(\frac{6 \times 1.2}{3}\right)^2 - 4 (=1.76)$ eg $6 \times 1.2 = 7.2$ and reading from $Q = 7.2$ to t axis and calculates t value $\div 4$ (or 0.04)		2	M1ft	ft for an equation in the correct form Stating the multiplier 1.2 ² or 1.44 or 144 or showing the multiplier within a calculation or for using a pair of values and showing a correct calculation for the increase in t , ft their k from (a) or correct calculation and use of graph
		Correct answer scores full marks (unless from obvious incorrect working)	44		A1	allow 43 – 45 as long as not from incorrect working
Total 5 marks						

18	(a)	$F = \frac{k}{r^3}$ or $Fr^3 = k$ or $kF = \frac{1}{r^3}$		3	M1	oe k can be any letter (must be a letter and not 1)
		$6 = \frac{k}{2^3}$ oe or $k = 48$ or $6k = \frac{1}{2^3}$ oe or $k = \frac{1}{48}$			M1	For substitution of F and r into a correct formula, implies the first M1 if you see this stage Condone use of $\propto$ for method marks
		<i>Correct answer scores full marks (unless from obvious incorrect working)</i>	$F = \frac{48}{r^3}$		A1	oe with F the subject eg $F = 48 \times \frac{1}{r^3}$ or $F = 48 \times r^{-3}$ Award 3 marks if answer is $F = \frac{k}{r^3}$ and $k = 48$ clearly given in the body of the script M2A0 for $Fr^3 = 48$ or $r = \sqrt[3]{\frac{48}{F}}$ or $r^3 = \frac{48}{F}$
	(b)	$(r^3 =) \frac{"48"}{3072}$ oe eg $\frac{1}{64}$ or (0.01(5625)) rounded or truncated		2	M1ft	allow use of their “48” as long as M2 gained in (a)
		<i>Correct answer scores full marks (unless from obvious incorrect working)</i>	$\frac{1}{4}$		A1	oe
Total 5 marks						

Question	Working	Answer	Mark	Notes
16 (a)	$A = \frac{k}{r^2}$		3	M1 oe k can be any letter (must be a letter and not 1)
	$5 = \frac{k}{0.3^2}$ oe or $k = 0.45$ oe			M1 implies first M1 if you see this stage
	<i>Working not required, so correct answer scores full marks (unless from obvious incorrect working)</i>	$A = \frac{0.45}{r^2}$		A1 oe with A as the subject eg $A = \frac{9}{20r^2}$ (allow $A = \frac{k}{r^2}$ where $k = 0.45$ oe) (SC if M0 scored then award B2 for $A \propto \frac{0.45}{r^2}$ oe)
(b)	$[A =] \frac{0.45}{(7.5A)^2}$ oe or $\frac{0.45}{56.25A^2}$ or $\frac{9}{20(7.5A)^2}$ oe		3	M1 ft from (a) dep on M2 in (a) ([A =] $\frac{0.45}{7.5A^2}$ is zero marks unless recovered later)
	$A^3 = \frac{0.45}{56.25}$ ($A^3 = \frac{1}{125}$ or 0.008 oe) or $125 A^3 = 1$ oe			M1 ft their 0.45 dep on M2 in (a) Must include A^3
	<i>Working not required, so correct answer scores full marks (unless from obvious incorrect working)</i>	0.2		A1 oe
Total 6 marks				

19 (a)	$P = \frac{k}{y^2}$		3	M1 oe (the constant term, k , can be any other letter apart from a or P or y)
	eg $a = \frac{k}{4^2}$ or $k = 16a$			M1 oe
	Correct answer scores full marks (unless from obvious incorrect working)	$P = \frac{16a}{y^2}$		A1 oe eg $P = 16ay^{-2}$ or $P = \frac{4^2 a}{y^2}$
(b)	$\sqrt{\frac{16a}{4a}} = c\sqrt{a}$ oe eg $\frac{16a}{4a} = c^2a$ or $4a = \frac{16a}{c^2a}$ or $4a \times c^2a = 16a$ oe or (when $P = 4a$) $y^2 = \frac{16a}{4a}$ or $y^2 = 4$ or $y = \sqrt{\frac{16a}{4a}} (= 2)$ oe		3	M1 ft a correct formula involving the constant term (c used here) and a or ft for an expression or value of y^2 or y given for when $P = 4a$
	$c = \sqrt{\frac{4}{a}}$ or $c = \frac{\pm 2}{\sqrt{a}}$ or $c = \frac{\pm 2\sqrt{a}}{a}$ oe allow the constant term squared eg $c^2 = \frac{16a}{4a^2} (= \frac{4}{a})$			M1 (implies previous M1) a correct value, in terms of a , for the constant term or the constant term squared – need not be simplified
	Correct answer scores full marks (unless from obvious incorrect working)	$P = \frac{4a^2}{x}$		A1 oe eg $P = \frac{16a}{4x}$ or $P = \frac{16a^2}{4x a}$
				Total 6 marks

12	Litres per amount of money and then conversion			
	$\frac{8.6 \times 10^5}{770000}$ (= 1.1168) l/\$			M1 Number of litres per \$ for D
	$\frac{4.2 \times 10^5}{2500000}$ (= 0.168) l/k			M1 Number of litres per Krone for A
	A: l/\$ to l/k '1.1168' $\div$ 6.57 (= 0.1699..)or D: l/k to l/\$ '0.168' $\times$ 6.57 (= 1.103..)			M1 l/\$ to l/k for A or l/k to l/\$ for D
		Arctic Oil and relevant figures		A1 for Arctic Oil with 1.1168... and 1.10376... or 0.168 and 0.1699..
	Conversion then litres per amount of money			
	$\frac{2500000}{6.57}$ (=380517.5..) or 770 000 $\times$ 6.57(= 505 8900)			M1 Changing Krone to \$ or \$ to Krone
	$\frac{4.2 \times 10^5}{2500000}$ (=0.168) or $\frac{4.2 \times 10^5}{380517.5}$ (=1.103..)			M1 Litres per Krone or litres per \$ for D
	$\frac{8.6 \times 10^5}{770000}$ (= 1.1168) or $\frac{8.6 \times 10^5}{5058900}$ (= 0.1699..)			M1 Litres per Krone or litres per \$ for A
		Arctic Oil and relevant figures		A1 for Arctic Oil with 1.1168... and 1.10376... or 0.168 and 0.1699..
	Cost per litre then conversion			
	$\frac{2500000}{4.2 \times 10^5}$ (= 5.952..)			M1 Price per litre in Krone for D
	$\frac{770000}{8.6 \times 10^5}$ (0.895..)			M1 Price per litre in \$ for A
	'5.952' $\div$ 6.57(=0.9059..) or '0.895' $\times$ 6.57(= 5.882..)			M1 Conversion of Krone to \$ or \$ to Krone

		Arctic Oil and relevant figures		A1 For Arctic Oil with 5.952 and 5.882 or 0.895 and 0.9059
	Conversion then cost per litre			
	$\frac{2500000}{6.57}$ (=380517.5..) or $770\,000 \times 6.57$ (= 505 8900)			M1 Changing Krone to \$ or \$ to Krone
	$\frac{2500000}{4.2 \times 10^5}$ (= 5.952) or $\frac{'380517.5..'}{4.2 \times 10^5}$ (=0.9059..)			M1 Cost per litre in Krone or cost per litre in \$ for D
	$\frac{770000}{8.6 \times 10^5}$ (= 0.895) or $\frac{'5058900'}{8.6 \times 10^5}$ (= 5.882..)			M1 Cost per litre in \$ or cost per litre in Krone for A
		Arctic Oil and relevant figures		A1 For Arctic Oil with 5.952 and 5.882 or 0.895 and 0.9059
	Comparing equal amounts			
	$\frac{8.6 \times 10^5}{4.2 \times 10^5}$ (= $\frac{43}{21}$ = 2.047..) or $\frac{4.2 \times 10^5}{8.6 \times 10^5}$ (= $\frac{21}{43}$ = 0.488..)			M1 Multiplier for same amount of D as A or same amount of A as D
	'2.047..' $\times$ 2500 000 K (=5119047.619..)K	'0.488..' $\times$ 770 000 \$ (=376046.511..)S		M1 Cost of equal amount of D as A or A as D
	'5119047.619' $\div$ 6.57 = 779154.88...\$ or 770 000 $\times$ 6.57 = 5058900 K	'376046.511..' $\times$ 6.57 = 2470625.58..K or 2500 000 $\div$ 6.57 = 380517...\$		M1 Converts so can compare costs – either K to \$ or original A to K or \$ to K or original D to \$
		Arctic Oil and relevant figures		A1 Arctic Oil and 779154.. or with 2470625..(figures may be rounded) Or Arctic Oil with 5119047... and 5058900 or with 376046.. and 380517
Students may compare other equal amounts – please use the scheme that best fits their method and award marks appropriately.				
				Total 4 marks