Westie's Workshop

IGCSE Hit List

- Topics in this resource have been organised based on probability of come up. This should be taken with the pinch of salt all probability-based predictions come with.
- I have tried to pick questions types from each topic that I feel are likely to come up, but the style in which they will be asked is not certain. It could be similar to previous years or posed in a completely new way.
- To get more practice on topics, please use the links sent out on teams.

Certain to very likely: 100-80% topics

Differentiation (100%)

A particle P is moving along a straight line.
The fixed point O lies on the line.

At time t seconds ($t \geqslant 0$), the displacement of P from O is s metres where

$$s = t^3 - 9t^2 + 33t - 6$$

Find the minimum speed of P.

..... m/s

(Total for Question 20 is 5 marks)

The curve **C** has equation $y = 5x^3 - x^2 - 6x + 4$

(a) Find $\frac{dy}{dx}$

$\frac{dy}{dx} =$ .....

(2)

There are two points on the curve **C** at which the gradient of the curve is 2

(b) Find the x coordinate of each of these two points.
Show clear algebraic working.

.....

(4)

(Total for Question 13 is 6 marks)

Pythagoras (100%)

The diagram shows a quadrilateral $ABCD$

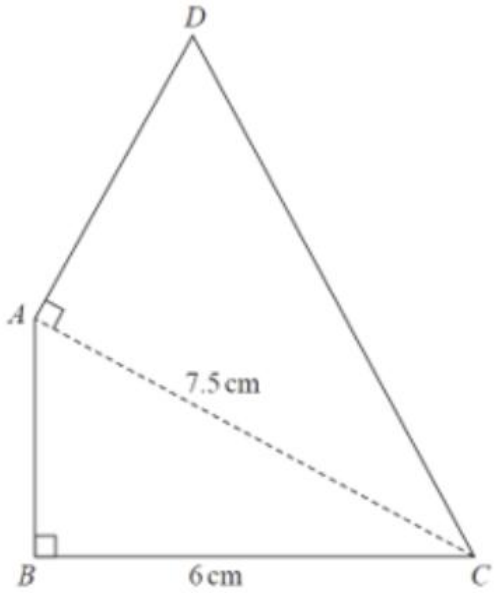


Diagram **NOT** accurately drawn

In the diagram, ABC and DAC are right-angled triangles.

$BC = 6\,\text{cm}$ $AC = 7.5\,\text{cm}$

The area of quadrilateral $ABCD$ is $31.5\,\text{cm}^2$

Work out the length of AD

..... cm

(Total for Question 11 is 6 marks)

The diagram shows a cube *ABCDEFGH* with sides of length 6 cm.

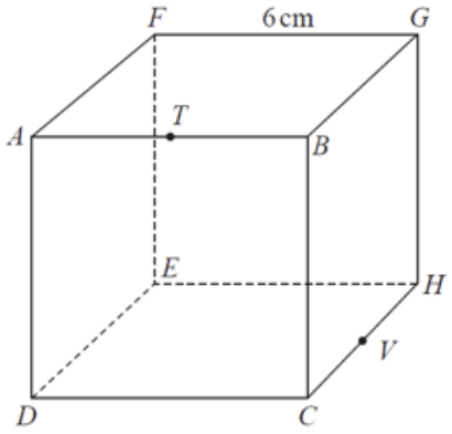


Diagram **NOT** accurately drawn

T is the midpoint of *AB* and *V* is the midpoint of *CH*

Work out the distance from *T* to *V* in a straight line through the cube.
Give your answer in the form $\sqrt{a}$ cm where *a* is an integer.

..... cm

(Total for Question 18 is 4 marks)

Cumulative Frequency (100%)

The table gives information about the ages, in years, of 80 people in a train carriage.

Age (a years)	Frequency
$0 < a \leqslant 20$	7
$20 < a \leqslant 30$	25
$30 < a \leqslant 40$	20
$40 < a \leqslant 50$	14
$50 < a \leqslant 60$	8
$60 < a \leqslant 70$	6

(a) Complete the cumulative frequency table.

Age (a years)	Cumulative frequency
$0 < a \leqslant 20$	
$0 < a \leqslant 30$	
$0 < a \leqslant 40$	
$0 < a \leqslant 50$	
$0 < a \leqslant 60$	
$0 < a \leqslant 70$	

(1)

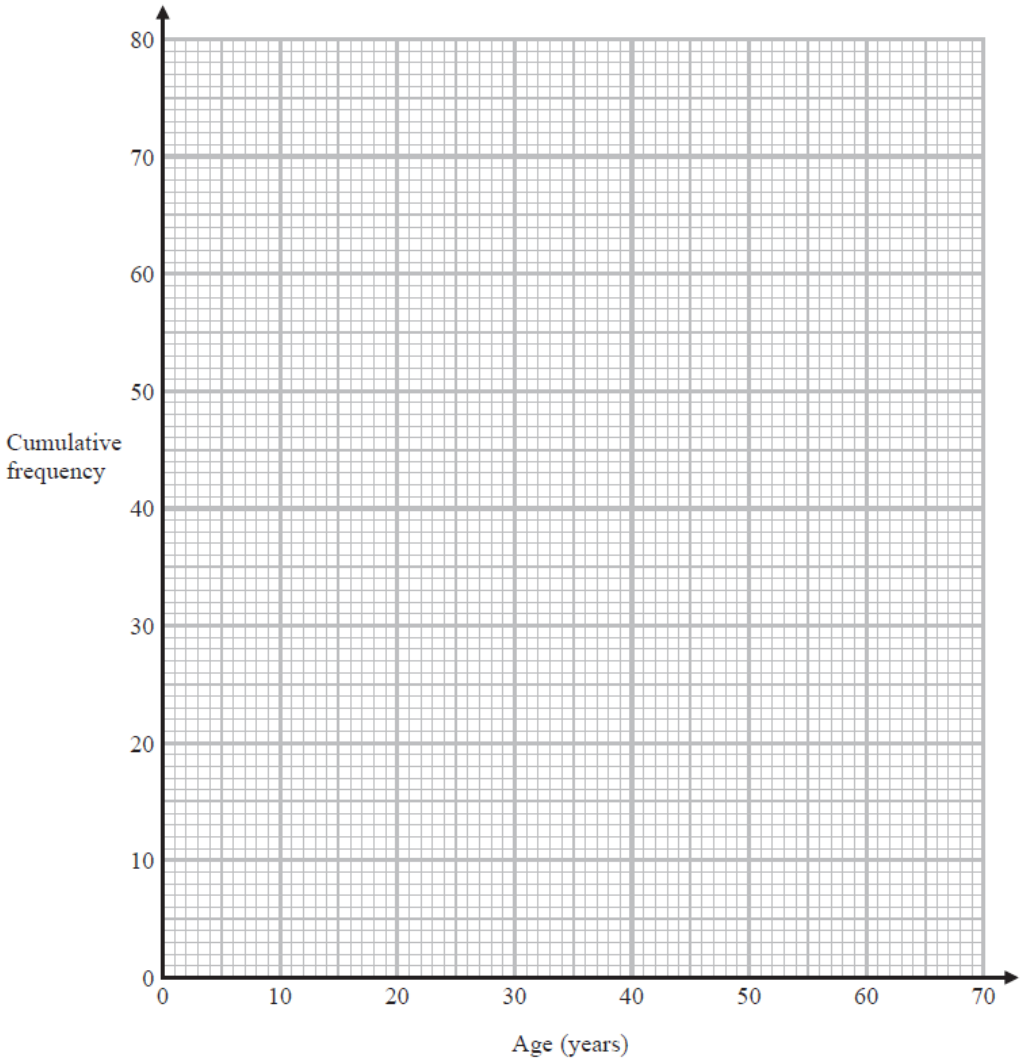
(b) On the grid opposite, draw a cumulative frequency graph for your table.

(2)

(c) Use your graph to find an estimate for the median age of the 80 people.

..... years

(1)



Of the people in the train carriage, 60% of those who are aged between 18 and 65 are going to work. None of the other people in the train carriage are going to work.

(d) Use your graph to find an estimate for the number of people in the train carriage who are going to work.

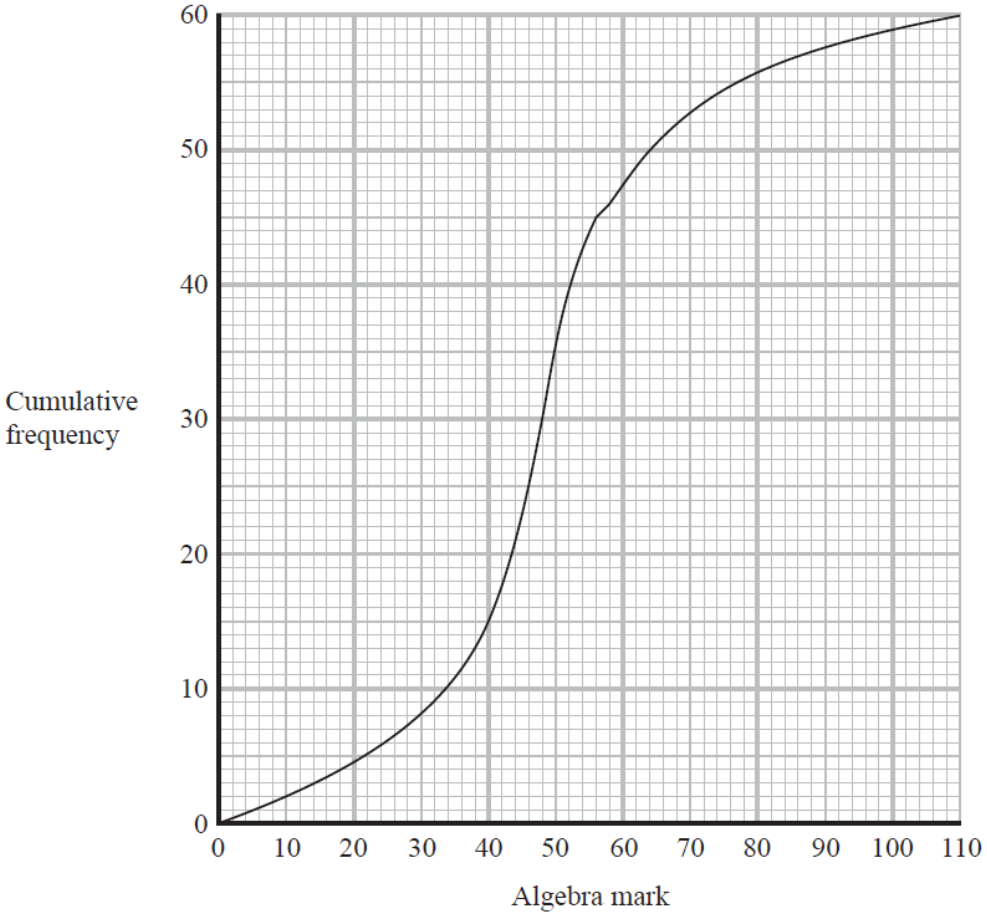
.....

(3)

(Total for Question 13 is 7 marks)

14 A group of 60 students each sat an algebra test and a geometry test.
Each test was marked out of 110

The cumulative frequency graph gives information about the marks gained by the 60 students in the algebra test.



(a) Use the graph to find an estimate for the median mark in the algebra test.

.....

(1)

(b) Use the graph to find an estimate for the number of students who gained 58 marks or less in the algebra test.

.....

(1)

(c) Use the graph to find an estimate for the interquartile range of the marks gained in the algebra test.

(2)

The interquartile range of the marks gained in the geometry test is 9

Luis says

"The students' marks are more spread out in the algebra test than in the geometry test."

(d) Is Luis correct?
Give a reason for your answer.

(1)

To be awarded a grade A in the algebra test, a student had to gain a mark greater than 64

Two students are to be selected at random from the 60 students in the group.

(e) Use the graph to find an estimate for the probability that both of these students were awarded a grade A in the algebra test.

(3)

(Total for Question 14 is 8 marks)

Changing the Subject (92.3%)

(a) Make a the subject of the formula $M = ac - bd$

(2)

(d) Make r the subject of $m = \sqrt{\frac{6a + r}{5r}}$

(4)

Given that $n > 0$

make n the subject of the formula $y = \dfrac{n^2 + d}{n^2}$

(Total for Question 17 is 4 marks)

Properties of Numbers (92.3%)

$P = 3^3 \times 5^2 \times 7$
$Q = 3^2 \times 5 \times 7^2$

(a) Write down the highest common factor (HCF) of P and Q

(1)

$P = 3^3 \times 5^2 \times 7$
$Q = 3^2 \times 5 \times 7^2$

(b) Work out the value of $P^3 \times Q$
Give your answer in the form $3^x \times 5^y \times 7^z$ where x, y and z are positive integers.

(2)

(Total for Question 12 is 3 marks)

(a) Write 720 as a product of its prime factors.
Show your working clearly.

(3)

(b) Find the smallest whole number that 720 can be multiplied by to give a square number.

(1)

(Total for Question 5 is 4 marks)

(a) Work out the lowest common multiple (LCM) of 36 and 120

(2)

$A = 5^2 \times 7^4 \times 11^p$
$B = 5^m \times 7^{n-5} \times 11$

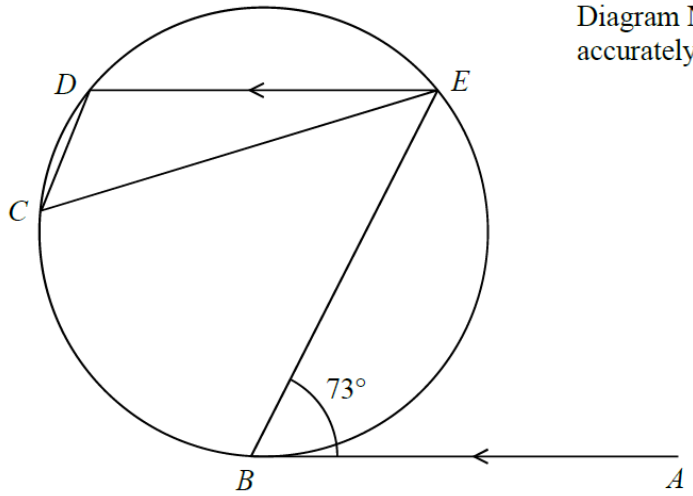
m, n and p are integers such that
$m > 2$
$n > 10$
$p > 1$

(b) Find the highest common factor (HCF) of A and B
Give your answer as a product of powers of its prime factors.

(2)

(Total for Question 6 is 4 marks)

Circle Theorems – Angles (92.3%)



B, *C*, *D* and *E* are points on a circle.

AB is the tangent at *B* to the circle.
AB is parallel to *ED*.
Angle *ABE* = 73°

Work out the size of angle *DCE*.
Give a reason for each stage of your working.

°

.....

(Total for Question 19 is 5 marks)

P, Q, R, S and T are points on a circle with centre O.

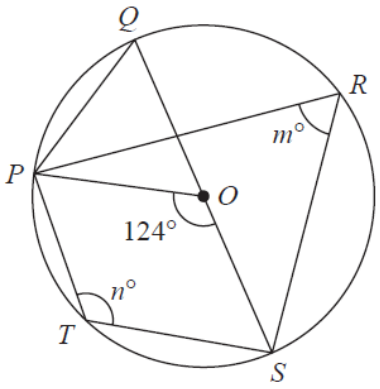


Diagram **NOT** accurately drawn

QOS is a diameter of the circle.

angle $POS = 124°$ angle $PRS = m°$ angle $PTS = n°$

(a) Find the value of

(i) m

.....

(ii) n

.....

(2)

(b) Find the size of angle QPO.

..... °

(1)

(Total for Question 13 is 3 marks)

Linear Simultaneous Equations (88.5%)

Solve the simultaneous equations

$$7x - 2y = 34$$
$$3x + 5y = -3$$

Show clear algebraic working.

$x =$ .....

$y =$ .....

(Total for Question 12 is 4 marks)

Alison buys 5 apples and 3 pears for a total cost of $1.96
Greg buys 3 apples and 2 pears for a total cost of $1.22

Michael buys 10 apples and 10 pears.

Work out how much Michael pays for his 10 apples and 10 pears.
Show your working clearly.

$ .....

(Total for Question 6 is 5 marks)

Compound Measures (88.5%)

Change a speed of 81 kilometres per hour to a speed in metres per second.

..... metres per second

(Total for Question 7 is 3 marks)

The density of gold is 19.3 g/cm^3
A gold bar has volume 150 cm^3

Work out the mass of the gold bar.

..... g

(Total for Question 9 is 2 marks)

Sets – Venn (88.5%)

Some students were asked the following question.

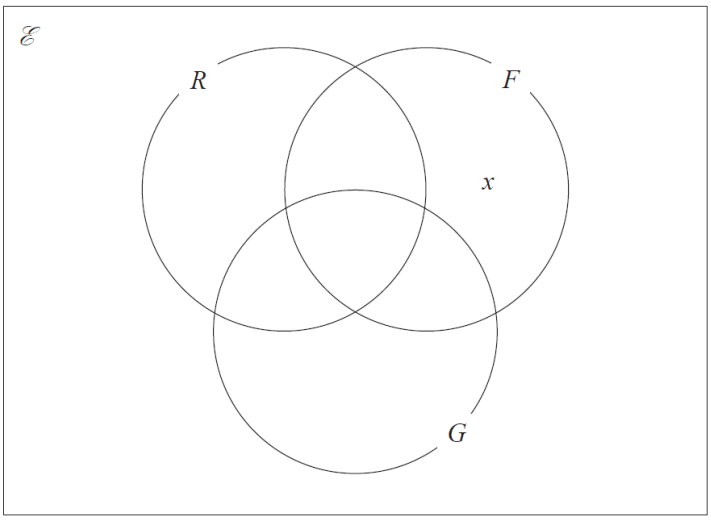
"Which of the subjects Russian (R), French (F) and German (G) do you study?"

Of these students

4 study all three of Russian, French and German
10 study Russian and French
13 study French and German
6 study Russian and German
24 study German
11 study none of the three subjects
the number who study Russian only is twice the number who study French only.

Let x be the number of students who study French only.

(a) Show all this information on the Venn diagram, giving the number of students in each appropriate subset, in terms of x where necessary.



(3)

Given that the number of students who were asked the question was 80

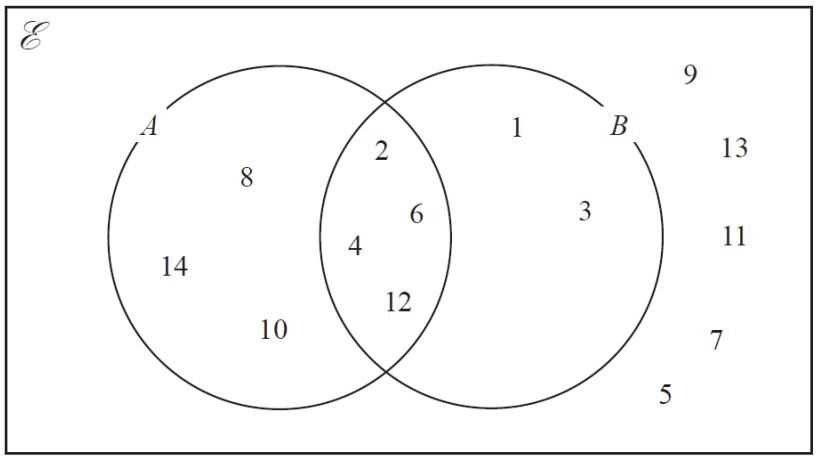
(b) work out the number of these students that study Russian.

.....

(3)

(Total for Question 16 is 6 marks)

The numbers from 1 to 14 are shown in the Venn diagram.



(a) List the members of the set $A \cap B$

.....

(1)

(b) List the members of the set B'

.....

(1)

A number is picked at random from the numbers in the Venn diagram.

(c) Find the probability that this number is in set A but is **not** in set B.

.....

(2)

(Total for Question 1 is 4 marks)

Completing the Square (84.6%)

Write $5 + 12x - 2x^2$ in the form $a + b(x + c)^2$ where a, b and c are integers.

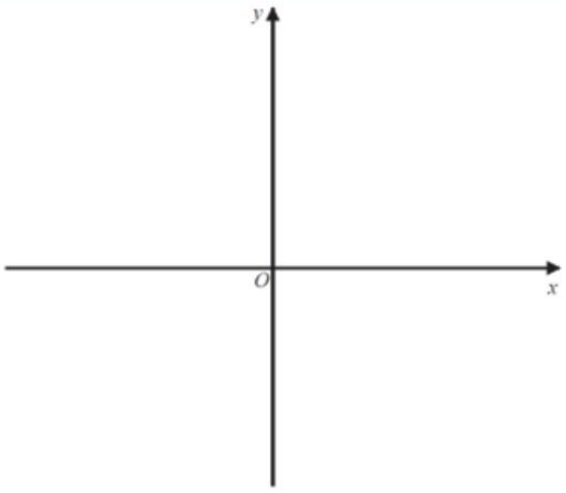
(Total for Question 22 is 4 marks)

The curve **C** has equation $y = 4(x - 1)^2 - a$ where $a > 4$

Using the axes below, sketch the curve **C**.
On your sketch show clearly, in terms of a,

(i) the coordinates of any points of intersection of **C** with the coordinate axes,

(ii) the coordinates of the turning point.



(Total for Question 20 is 4 marks)

The function g is such that $g(x) = 2x^2 - 20x + 9$ where $x \geqslant 5$

(b) Express the inverse function g^{-1} in the form $g^{-1}(x) = ...$

$g^{-1}(x) =$ .....

(4)

(Total for Question 24 is 5 marks)

Problem Solving with Averages (84.6%)

Yusuf sat 8 examinations.

Here are his marks for 5 of the examinations.

68 72 75 77 80

For his results in all 8 examinations

the mode of his marks is 80
the median of his marks is 74
the range of his marks is 16

Find Yusuf's marks for each of the other 3 examinations.

.....

.....

.....

(Total for Question 5 is 4 marks)

Jethro has sat 5 tests.
Each test was marked out of 100 and Jethro's mean mark for the 5 tests is 74

Jethro has to sit one more test that is also to be marked out of 100

Jethro wants his mean mark for all 6 tests to be at least 77

Work out the least mark that Jethro needs to get for the last test.

.....

(Total for Question 10 is 3 marks)

Indices – Negative and Fractional (80.8%)

$\frac{\sqrt{a} \times a}{a^{-2}}$ can be written in the form a^k

(c) Find the value of k.

$k =$ .....

(2)

(b) Given that $\left(\sqrt{\frac{y}{x}}\right)^{-5} = \frac{x^m}{y^m}$ where $x \neq y$

find the value of m.

$m =$ .....

(1)

Ratio (80.8%)

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)

The people working for a company work in Team A or in Team B.

number of people in Team A : number of people in Team B = 3 : 4

$\frac{4}{5}$ of Team A work full time.

24% of Team B work full time.

Work out what fraction of the people working for the company work full time.
Give your fraction in its simplest form.

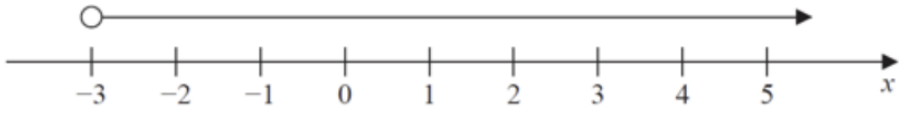
.....

(Total for Question 10 is 3 marks)

Very Likely to Likely (80%-60%)

Inequalities (76.9%)

(a)



Write down the inequality shown on the number line.

.....

(1)

(b) Solve the inequality $4y - 13 \leqslant y + 8$

.....

(2)

(b) Solve the inequality $7 < 4x - 1 \leqslant 17$

.....

(3)

3D Trigonometry/ Pythagoras (76.9%)

The diagram shows cuboid *ABCDEFGH*.

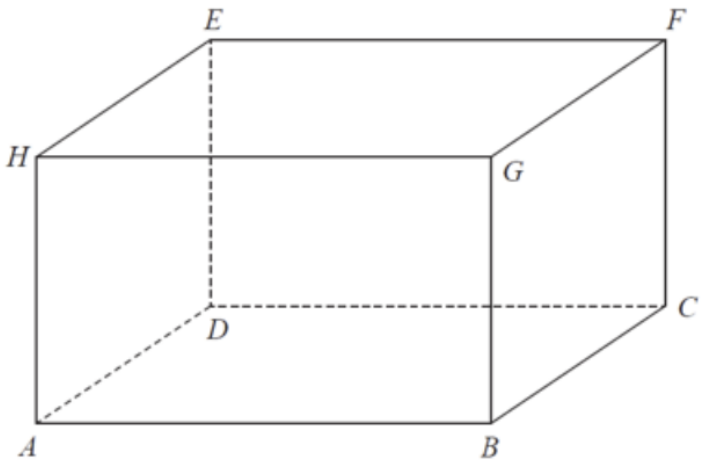


Diagram **NOT** accurately drawn

For this cuboid

the length of *AB* : the length of *BC* : the length of *CF* = 4 : 2 : 3

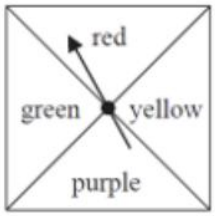
Calculate the size of the angle between *AF* and the plane *ABCD*.
Give your answer correct to one decimal place.

.....

(Total for Question 21 is 3 marks)

Basic Probability (76.9%)

Here is a biased spinner.



When the spinner is spun once, the probabilities that it lands on red or on yellow or on green are given in the table.

Colour	red	yellow	purple	green
Probability	0.25	0.2		0.2

(a) Work out the probability that the spinner lands on red or on yellow.

.....

(1)

Yang is going to spin the spinner 300 times.

(b) Work out an estimate for the number of times the spinner will land on purple.

.....

(3)

(Total for Question 1 is 4 marks)

A bag contains only pink sweets, white sweets, green sweets and red sweets.

The table gives each of the probabilities that, when a sweet is taken at random from the bag, the sweet will be green or the sweet will be red.

Sweet	pink	white	green	red
Probability			0.2	0.35

The ratio

number of pink sweets : number of white sweets = 2 : 1

There are 28 red sweets in the bag.

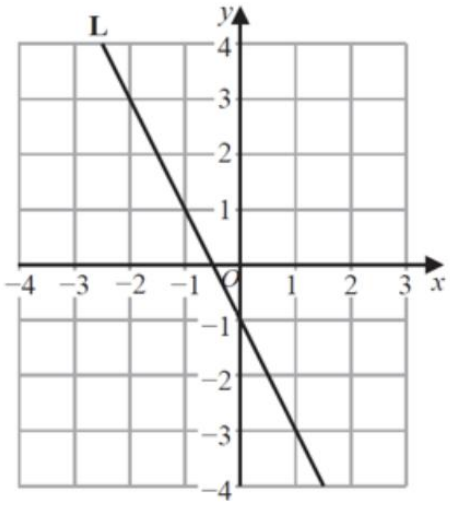
Work out the number of white sweets in the bag.

.....

(Total for Question 6 is 5 marks)

Linear Graphs – no Perpendicular Element (73.1%)

Line **L** is drawn on the grid.



Find an equation for **L**.

.....

(Total for Question 11 is 3 marks)

The point A has coordinates $(5, -4)$
The point B has coordinates $(13, 1)$

(a) Work out the coordinates of the midpoint of AB.

(.....,.....)

(2)

Line **L** has equation $y = 2 - 3x$

(b) Write down the gradient of line **L**.

.....

(1)

Line **L** has equation $y = 2 - 3x$

(c) Does the point with coordinates $(100, -302)$ lie on line **L**?
You must give a reason for your answer.

.....

.....

.....

(1)

(Total for Question 1 is 4 marks)

***also consider Q's asking for lengths of line segments (using Pythagoras)**

Expanding Brackets (73.1%) and Expanding Triple Brackets (73.1%)

(a) Expand and simplify $3(c - 7) + 2(3c + 4)$

.....

(2)

(b) Expand and simplify $(x + 7)(x - 2)$

.....

(2)

A rectangular lawn has a length of $3x$ metres and a width of $2x$ metres.
The lawn has a path of width 1 metre on three of its sides as shown in the diagram.

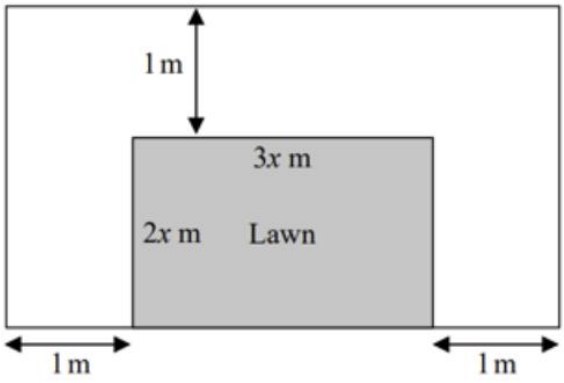


Diagram **NOT** accurately drawn

The total area of the lawn and the path is $100\,m^2$

(a) Show that $6x^2 + 7x - 98 = 0$

(2)

(b) Calculate the area of the lawn.
Show clear algebraic working.

..... m^2

(5)

(Total for Question 15 is 7 marks)

(a) Expand and simplify $(2x - 1)(x + 3)(x - 5)$

(3)

Fractions (73.1%)

Show that $2\frac{4}{7} \div 1\frac{1}{8} = 2\frac{2}{7}$

(Total for Question 2 is 3 marks)

Show that $5\frac{1}{3} - 2\frac{6}{7} = 2\frac{10}{21}$

(Total for Question 4 is 3 marks)

Basic Factorising (69.2%)

Factorise fully $18e^2f^3 - 12e^3f$

.....

(2)

(c) Factorise $4c^2 - 9d^2$

.....

(1)

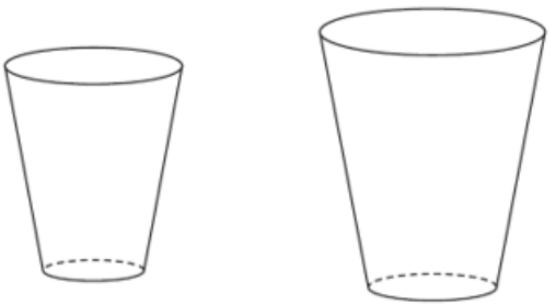
(d) Simplify fully $\dfrac{x^2 - 7x + 12}{4x - x^2}$

.....

(3)

Similar shapes – Area and Volume (69.2%)

The diagram shows two mathematically similar vases, **A** and **B**.



A **B**

Diagram **NOT** accurately drawn

A has a volume of 405 cm^3
B has a volume of 960 cm^3

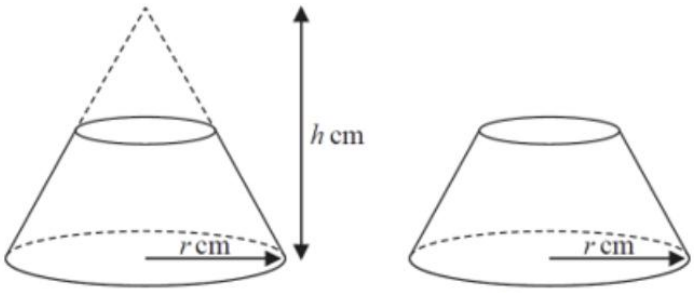
B has a surface area of 928 cm^2

Work out the surface area of **A**.

..... cm^2

(Total for Question 16 is 3 marks)

A frustum is made by removing a small cone from a large cone.
The cones are mathematically similar.



Frustum

Diagram **NOT** accurately drawn

The large cone has base radius r cm and height h cm.

Given that

$$\frac{\text{volume of frustum}}{\text{volume of large cone}} = \frac{98}{125}$$

find an expression, in terms of h, for the height of the frustum.

..... cm

(Total for Question 16 is 4 marks)

Volume & Surface Area (69.2%)

The total surface area of a solid hemisphere is equal to the curved surface area of a cylinder.

The radius of the hemisphere is r cm.
The radius of the cylinder is twice the radius of the hemisphere.

Given that

volume of hemisphere : volume of cylinder = $1 : m$

find the value of m.

$m =$ .....

(Total for Question 15 is 4 marks)

Here are a solid sphere and a solid cylinder.

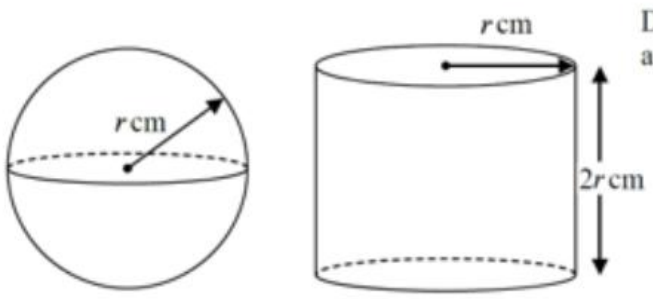


Diagram **NOT** accurately drawn

The radius of the sphere is r cm.
The radius of the cylinder is r cm.
The height of the cylinder is $2r$ cm.

The total surface area of the cylinder is $k\pi$ cm^2

(a) Find an expression for k in terms of r.

(2)

(b) Show that the ratio

total surface area of the cylinder : total surface area of the sphere

is the same as the ratio

volume of the cylinder : volume of the sphere

(3)

(Total for Question 17 is 5 marks)

***don't forget about cones too**

Circles and Sectors (68.2%) *I doubt there will be another sectors Q but maybe something like this

The diagram shows four identical circles drawn inside a square.

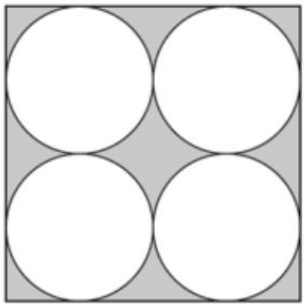


Diagram **NOT** accurately drawn

Each circle touches two other circles and two sides of the square.

The region inside the square that is outside the circles, shown shaded in the diagram, has a total area of 40 cm^2

Work out the perimeter of the square.
Give your answer correct to 3 significant figures.

..... cm

(Total for Question 20 is 4 marks)

Solving Quadratics by Factorising (68%)

The diagram shows a trapezium.

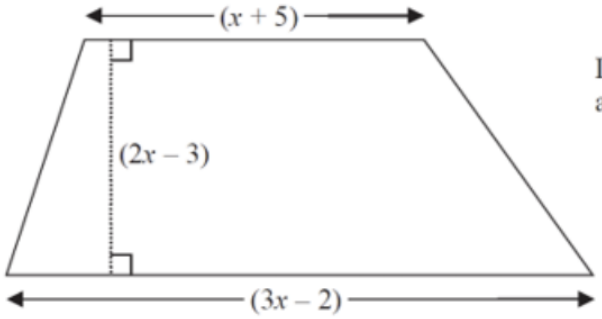


Diagram **NOT** accurately drawn

All measurements shown on the diagram are in centimetres.

The area of the trapezium is 133 cm²

(a) Show that $8x^2 - 6x - 275 = 0$

(3)

(b) Find the value of x.
Show your working clearly.

$x =$ .....

(3)

(Total for Question 15 is 6 marks)

The curve **C** has equation $y = 5x^3 - x^2 - 6x + 4$

(a) Find $\frac{dy}{dx}$

$\frac{dy}{dx} =$ .....

(2)

There are two points on the curve **C** at which the gradient of the curve is 2

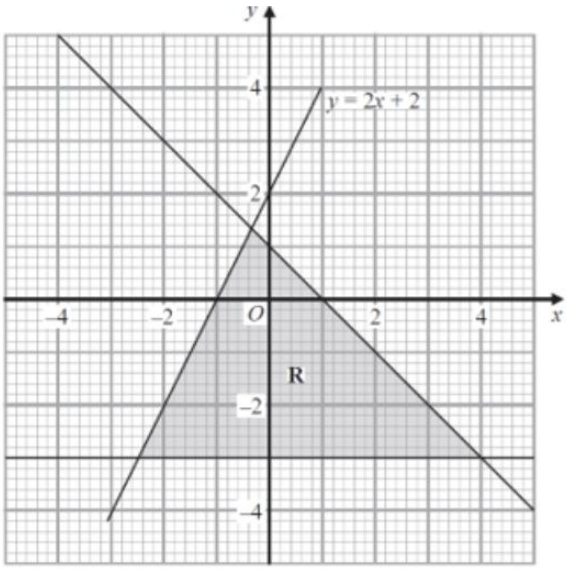
(b) Find the x coordinate of each of these two points.
Show clear algebraic working.

.....

(4)

(Total for Question 13 is 6 marks)

Graphical Inequalities (65.4%) *with linear graphs only coming up as a harder perpendicular question, I feel this has a good chance



The region **R**, shown shaded in the diagram, is bounded by three straight lines.

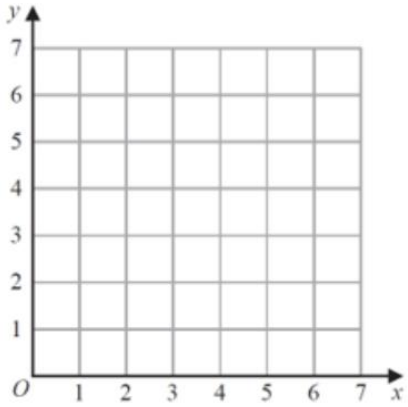
Write down the three inequalities that define **R**.

.....

.....

.....

(Total for Question 13 is 3 marks)



(a) On the grid, draw and **label** the straight line with equation

(i) $x = 1.5$

(ii) $y = x$

(iii) $x + y = 6$

(3)

(b) Show, by shading on the grid, the region that satisfies **all three** of the inequalities

$x \geqslant 1.5$ $y \geqslant x$ $x + y \leqslant 6$

Label the region **R**.

(1)

(Total for Question 4 is 4 marks)

Indices – Basic (61.5%) and rewriting bases (61.5%)

(a) Simplify $y^5 \times y^9$

.....

(1)

(b) Simplify $(2m^3)^4$

.....

(2)

$128 = 4^{2x} \times 2^x$

Work out the value of x.

$x =$ .....

(Total for Question 14 is 3 marks)

Given that $M = \dfrac{18^{4n} \times 2^{3(n^2-6n)} \times 3^{2(1-4n)}}{12^2}$

find the values of n for which $M = 2$

.....

(Total for Question 21 is 5 marks)

Likely to Unlikely: 60%-40%

Basic Trigonometry (57.7%)

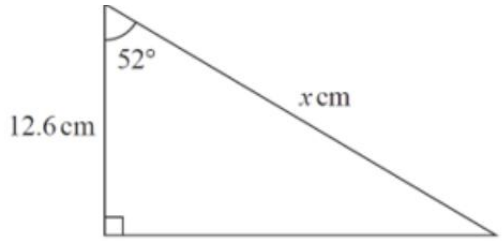


Diagram **NOT** accurately drawn

Work out the value of x.
Give your answer correct to 3 significant figures.

$x =$ .....

(Total for Question 8 is 3 marks)

Advanced Trigonometry (56%) *Probably Area formula if it does come up again

The diagram shows a kite $ABCD$

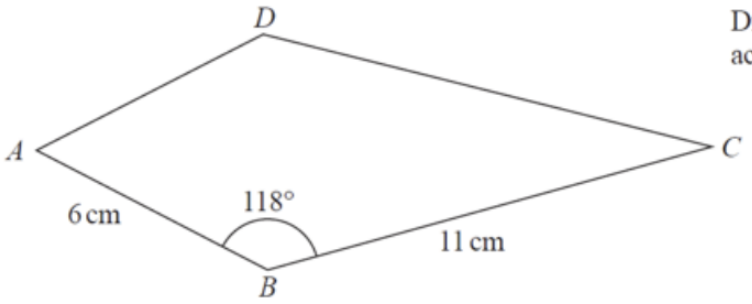


Diagram **NOT** accurately drawn

$AB = 6$ cm $BC = 11$ cm Angle $ABC = 118°$

Calculate the area of the kite.
Give your answer correct to 3 significant figures.

..... cm

(Total for Question 15 is 3 marks)

Recurring Decimals to Fractions (53.8%)

Use algebra to show that $0.3\dot{4}\dot{5} = \frac{19}{55}$

(Total for Question 17 is 2 marks)

IQR from Discrete Data (53.8%)

Here are the points that Carmelo scored in his last 11 basketball games.

23 20 14 23 17 24 24 18 16 22 21

(a) Find the interquartile range of these points.

.....

(3)

Kobe also plays basketball.
The median number of points Kobe has scored in his last 11 games is 18.5
The interquartile range of Kobe's points is 10

(b) Which of Carmelo or Kobe is the more consistent points scorer?
Give a reason for your answer.

.....

.....

(1)

(Total for Question 12 is 4 marks)

Sets – Notation (53.8%)

$\mathscr{E}$ = {positive integers less than 20}
$A = \{x : x < 12\}$
$B = \{x : 7 \leqslant x < 16\}$

(a) List the members of $A \cap B$

(2)

C is a set such that $C \subset A$ and $n(C) = 3$

Given that all members of C are even numbers,

(b) list the members of one possible set C.

(1)

(Total for Question 14 is 3 marks)

Quadratic Inequalities (50%)

Solve the inequality $4x^2 - 5x - 6 > 0$

(Total for Question 20 is 4 marks)

Algebraic Fractions (50%)

Express $\left(\frac{20}{x^2-36}-\frac{2}{x-6}\right)\times\frac{1}{4-x}$ as a single fraction in its simplest form.

(Total for Question 23 is 3 marks)

Proof (42.3%)

Using algebra, prove that, given any 3 consecutive whole numbers, the sum of the square of the smallest number and the square of the largest number is always 2 more than twice the square of the middle number.

(Total for Question 15 is 3 marks)

Percentage Change (41.7%)

On Saturday, Jacob walked 10 800 steps.
On Sunday, he walked 7% more steps than on Saturday.

Work out how many steps Jacob walked on Sunday.

.....

(Total for Question 4 is 3 marks)

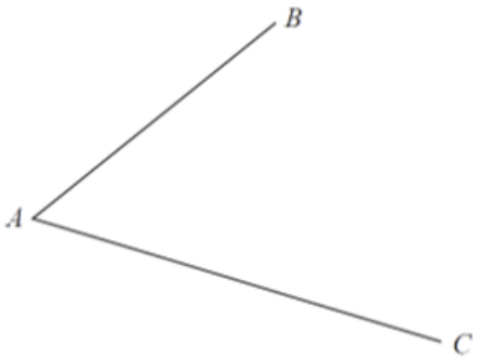
Unlikely to Very Unlikely: 40%-20%

Constructions (38.5%)

Use ruler and compasses to construct the perpendicular bisector of the line DE.
You must show all your construction lines.

(Total for Question 2 is 2 marks)

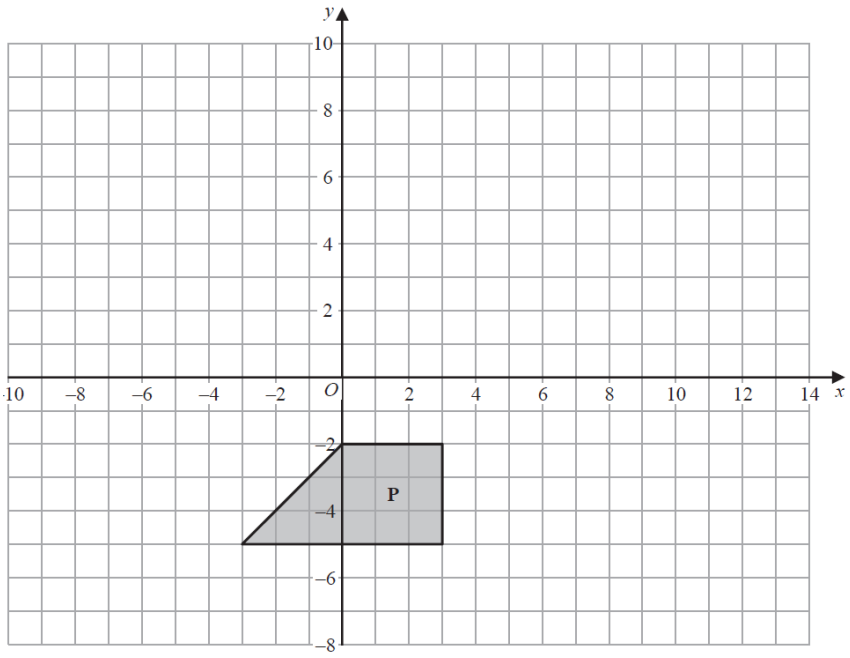
Use ruler and compasses to construct the bisector of angle BAC.
You must show all your construction lines.



(Total for Question 5 is 2 marks)

Transformations of Shapes (38.5%)

Here is a shape **P** drawn on a grid of squares.



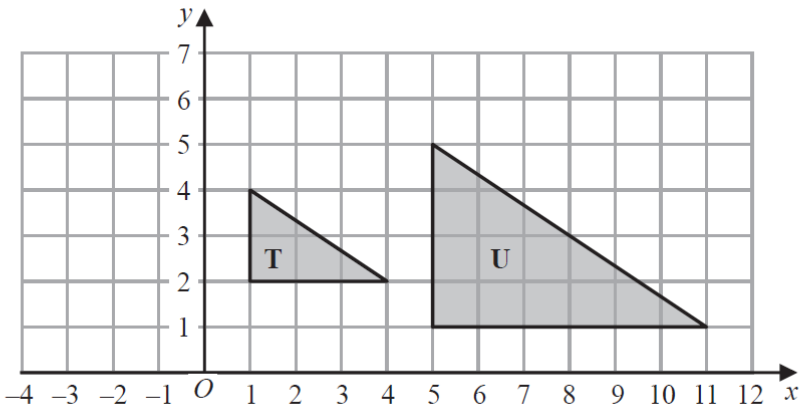
(a) On the grid, rotate shape **P** 180° about the point (–3, 2)
Label the new shape **Q**.

(2)

(b) On the grid, translate shape **P** by the vector $\begin{pmatrix} 10 \\ 8 \end{pmatrix}$
Label the new shape **R**.

(1)

Here are triangle **T** and triangle **U** drawn on a grid of squares.



(c) Describe fully the single transformation that maps triangle **T** onto triangle **U**.

.....

.....

(3)

(Total for Question 5 is 6 marks)

Similar Shapes – Linear (38.5%)

ABC and *DEF* are similar triangles.

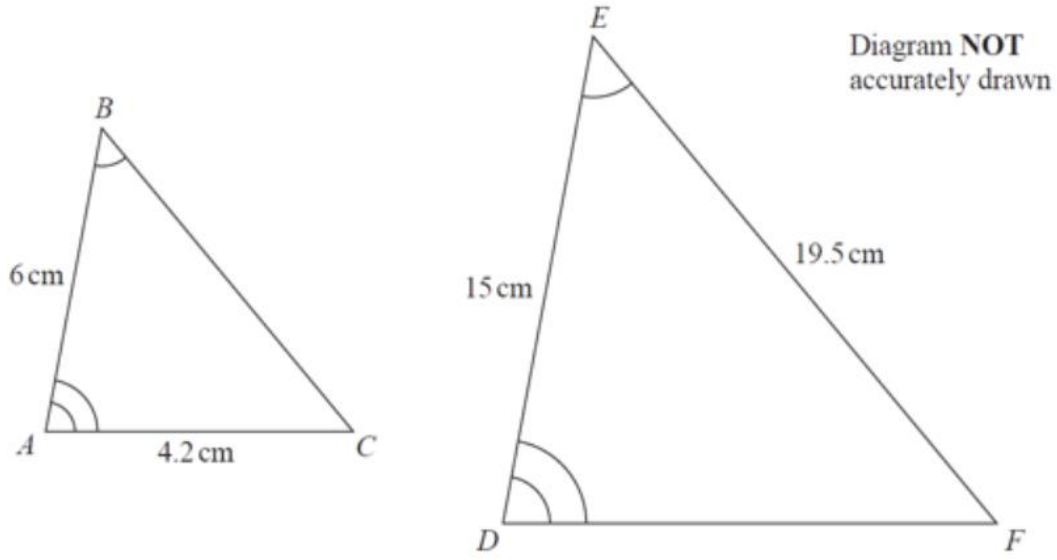


Diagram **NOT** accurately drawn

(a) Work out the length of *DF*.

..... cm

(2)

(b) Work out the length of *BC*.

..... cm

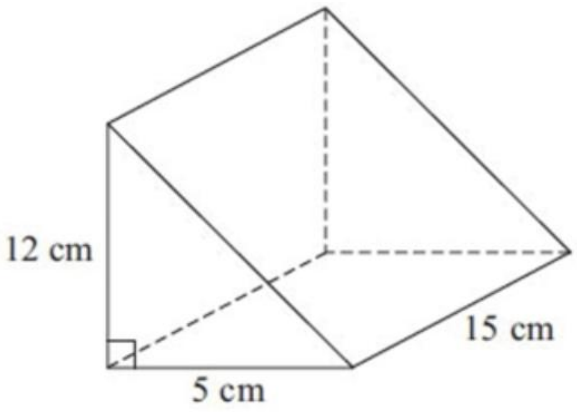
(2)

(Total for Question 6 is 4 marks)

Prisms and Cylinders (37.5%)

The diagram shows a solid triangular prism.

Diagram **NOT** accurately drawn



The prism is made from metal.
The density of the metal is 6.6 grams per cm^3.

Calculate the mass of the prism.

(Total 3 marks)

Solving Simple Equations (35%)

Angles in Parallel Lines (34.6%)

Arithmetic Sequences and Series (30.8%) *if this does come up again, it will probably be a fairly straightforward one at the start

Factorising Quadratics (27.3%)

Standard Form (26.9%)

Circle Theorems – Intersecting Chords (26.9%)

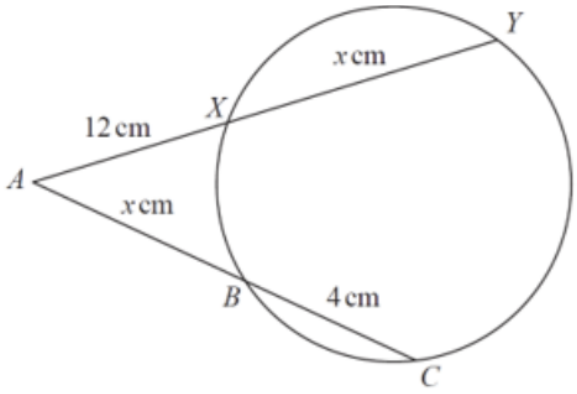


Diagram **NOT** accurately drawn

The points B, C, Y and X lie on a circle.

AXY and ABC are straight lines.

$AX = 12\,\text{cm}$ $XY = x\,\text{cm}$ $AB = x\,\text{cm}$ $BC = 4\,\text{cm}$

(a) Show that $x^2 - 8x - 144 = 0$

(3)

(b) Find the length of AC.
Show your working clearly.
Give your answer correct to 3 significant figures.

..... cm

(4)

(Total for Question 16 is 7 marks)

Area and Perimeter (25%) *Maybe with a circle?

Multiple event scenarios (23.8%) *Possibly algebraic fractions involved

Drawing and Using Graphs (23.5%) *Possibly a graphs to equation match up

Graphical Transformations (20.8%) *Not in function format, but possibly a graph that has already been drawn and in equation form – maybe completing the square form or a trig graph.

Angles in Polygons (20%)

<u>Unlikely to Impossible – 20%-0%</u> *I am only going to mention things I feel worthwhile here

Compound Percentages (19.2%) *As the Q in the first paper combined different changes and reverse percentages there may be a more standard question here that you can use powers on

Henri buys a yacht for 150 000 euros.

The yacht depreciates in value by 18% each year.

Work out the value of the yacht at the end of 3 years.
Give your answer correct to the nearest euro.

..... euros

(Total for Question 10 is 3 marks)

Upper and Lower Bounds (15.4%)

Functions (12%)

Quadratic Formula (11.5%)

Vectors (7.7%) *maybe a small one asking for magnitude using Pythag

Grouped Data (5.6%)

Non-Linear Simultaneous Equations (4.5%)

Surds (4.2%)

Time Series (3.8%)

Differentiation

20	$(v=)\ 3t^2-9\times 2t+33$			5	M1	for differentiating at least 2 terms correctly
	$(a=)\ 3\times 2t-$ '18' or $(t=)-\dfrac{-18}{2\times 3}\left(=\dfrac{18}{6}\right)$	$(v=)3\left[(t-3)^2-(3)^2\right](+33)$ **or** $(v=)3\left[(t-3)^2-(3)^2(+11)\right]$			M1	dep ft must be a two term linear equation **or** for the use of $(t=)-\dfrac{b}{2a}$ **or** for a **correct** first step for completing the square on at least a two term quadratic
	$6t-18=0$ **or** $t=3$	$(v=)3\left[(t-3)^2-(3)^2\right]+33$ **or** $(v=)3\left[(t-3)^2-(3)^2+11\right]$			M1	dep on at least M2 for equating their acceleration to 0 **or** for a **correct** method for completing the square on at least a two term quadratic
	$3\times$'3'$^2-18\times$'3'$+33$	$(v=)3(t-3)^2+6$ **or** $(v=)3\left[(t-3)^2+2\right]$			M1	dep on at least M2 for substituting their t into v **or** for a seeing a **correct** simplified expression after completing the square
			6		A1	
						Total 5 marks

13	(a)		$15x^2-2x-6$	2	B2	for correct differentiation
					(B1	for 2 of $15x^2$, $-2x$, -6 correct)
	(b)	e.g. "$15x^2-2x-6$" $=2$ oe		4	M1	ft, for equating their dy/dx to 2
		$15x^2-2x-8\ (=0)$			M1	(dep on M1) ft their three-term quadratic
		e.g. $(3x+2)(5x-4)\ (=0)$ $x=\dfrac{2\pm\sqrt{(-2)^2-(4\times 15\times -8)}}{2\times 15}$			M1	for solving their quadratic equation using any correct method - if factorising, allow brackets which expanded give 2 out of 3 terms correct (if using formula or completing the square allow one sign error and some simplification – allow as far as e.g. $\dfrac{2\pm\sqrt{4+480}}{30}$ oe)
			$-\dfrac{2}{3}$, $\dfrac{4}{5}$		A1	oe, dep on M2 (allow -0.66 or better). Both values – isw any attempt to find y coordinates
						Total 6 marks

Pythagoras

11	$(AB^2=)\ 7.5^2-6^2\ (=20.25)$ **or** eg $(BAC=)\sin^{-1}\left(\dfrac{6}{7.5}\right)(=53.1...)$ **or** $\cos(BCA)=\dfrac{6}{7.5}(=0.8)$		6	M1	for a correct first step to find AB **or** a complete method to find angle BAC **or** a correct first step to find angle BCA
	$(AB=)\ \sqrt{7.5^2-6^2}\ (=4.5)$ **or** $(AB=)\dfrac{6}{\tan"53.1"}(=4.5...)$ **or** $(AB=)7.5\cos"53.1"(=4.5...)$ **or** $(BCA=)\cos^{-1}\left(\dfrac{6}{7.5}\right)(=36.8...)$			M1	for a complete method to find AB **or** angle BCA
	(Area $ABC=$) $\dfrac{1}{2}\times 6\times$"4.5" $(=13.5)$ **or** (Area $ABC=$)$\dfrac{1}{2}\times 6\times 7.5\times\sin("36.8")(=13.47...$ or $13.5)$			M1	ft [their labelled AB] or [their labelled BCA] eg for $\dfrac{1}{2}\times 6\times$[their labelled AB] **or** $\dfrac{1}{2}\times 6\times 7.5\times\sin$[their labelled BCA]
	(Area $DAC=$) $31.5-$"13.5" $(=18)$ **or** "13.5" $+0.5\times 7.5\times AD=31.5$ oe			M1	ft (dep on previous M1) allow $31.5-$[their area]
	$(AD=)$ ("18" $\div 7.5)\div 0.5$ oe			M1	for a complete method to find AD, dependent on correct working
		4.8		A1	accept 4.78 – 4.81
					Total 6 marks

18	eg $(BV^2 =)3^2+6^2(=45)$ **or** $(CT^2 =)3^2+6^2(=45)$ **or** $(DH^2 =)6^2+6^2(=72)$ **or** $(MV^2 =)3^2+3^2(=18)$		4	M1	a correct expression for eg BV^2 **or** CT^2 **or** DH^2 **or** MV^2 where M is the midpoint of DC **or** a correct expression for [length]^2 for any length in the cube using Pythagoras	M3 for $(VT =)\sqrt{6^2+3^2+3^2}$ $(=3\sqrt{6}$ or 7.34...) (M2 for $(VT^2 =)$ $6^2+3^2+3^2(=54)$)
	eg $(BV =)\sqrt{3^2+6^2}\left(=\sqrt{45}\text{ or }3\sqrt{5}\text{ or }6.70...\right)$ **or** $(CT =)\sqrt{3^2+6^2}\left(=\sqrt{45}\text{ or }3\sqrt{5}\text{ or }6.70...\right)$ **or** $(DH =)\sqrt{6^2+6^2}\left(=\sqrt{72}\text{ or }6\sqrt{2}\text{ or }8.48...\right)$ **or** $(MV =)\sqrt{3^2+3^2}\left(=\sqrt{18}\text{ or }3\sqrt{2}\text{ or }4.24...\right)$			M1	for a complete method for eg BV **or** CT **or** DH **or** MV **or** any length in the cube using Pythagoras	
	$(VT =)\ \sqrt{"45"+3^2}$ **or** $\sqrt{\left(\frac{"\sqrt{72}"}{2}\right)^2+6^2}$ **or** $\sqrt{"18"+6^2}$ **or** $3\sqrt{6}$ **or** 7.34...			M1	for a correct expression for VT (condone missing brackets around $3\sqrt{5}$ or $3\sqrt{2}$ or $\frac{\sqrt{72}}{2}$)	
		$\sqrt{54}$		A1	if $\sqrt{54}$ seen and answer then given as $3\sqrt{6}$ isw and award full marks	
						Total 4 marks

C.Frequency

13	(a)		7, 32, 52, 66, 74, 80	1	B1	
	(b)	*If a graph is ascending you can ft for the marks in parts (c) and (d)*		2	B2	**(use overlay)** Fully correct cf graph – points at ends of intervals and joined with curve or line segments. If not B2 then B1(ft from a table with only one arithmetic error) for 5 or 6 of their points **either** plotted correctly at ends of intervals not joined **or** plotted consistently within each interval (not at upper ends of intervals) at their correct heights and joined with smooth curve or line segments. (ignore curve/line from 0 to first plotted point)
	(c)		32-34	1	B1	Any value in range (ft their CF graph reading across at 40 or 40.5)
	(d)			3	M1	For a correct method to take readings at 18 and 65 (eg 6 and 77) even if not given values or error reading the CF scale (ft a CF graph if method shown)
		eg $(77-6)\times 0.6$ oe			M1	ft dep on previous M1 for their **difference** (working must be shown if incorrect values used) ft finding 60% of their difference dep on previous M1
			42, 43, 44		A1	ft award full marks for an integer answer in the range if not from incorrect working and ft their CF graph if value outside range (but for this accuracy mark all readings must be correct) ft their graph but answer must be whole number (value rounded or truncated)
						Total 7 marks

14	(a)		48	1	B1 allow 47 – 49 Accept $\frac{n}{110}$ where n is in the range 47 – 49
	(b)		46	1	B1 allow 45.5 – 46.5
	(c)	40 **and** 56		2	M1 for both values. LQ of 40 – 41 and UQ in the range 56 – 58. **or** for use of 15 and 45 (eg indicated by marks on horizontal axis that correspond to 15 and 45 on the vertical axis.) **or** for use of 15.25 and 45.75 (eg indicated by marks on horizontal axis that correspond to 15.25 and 45.75 on the vertical axis.
			16 to 18		A1 accept 16 to 18
	(d)		Yes and correct reason	1	B1ft dep on M1 in (c) but ft their reading of the horizontal axis. For stating yes **and** the IQR for the Algebra test is greater than IQR for the Geometry test oe If using value in (c) less than 9, only accept 'no' and IQR for the Algebra test is less than the IQR for the Geometry test oe.
	(e)	60 – '50' (= 10)		3	M1 may be seen embedded as $\frac{10}{60}$ $(=\frac{1}{6})$ oe (eg reading of 50 from graph stated or indicated by marks on vertical axis that correspond to 64 on the horizontal axis). Allow 60 – '50' – 1 (= 9) oe
		$\frac{'10'}{60} \times \frac{'10'-1}{59}$			M1 for use of $\frac{n}{60} \times \frac{n-1}{59}$ with any integer n such that $2 \le n \le 59$
			$\frac{3}{118}$		A1 oe (accept 0.025 or better) Allow $\frac{6}{295}$ (= 0.02 or better) if using $\frac{9}{60} \times \frac{8}{59}$
					Total 8 marks

Changing the Subject

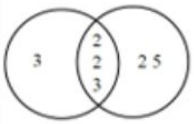
1	(a)	$ac=M+bd$ **or** $-ac=-M-bd$ **or** $\frac{M}{c}=a-\frac{bd}{c}$		2	M1	For a correct first stage
			$a=\frac{M+bd}{c}$		A1	oe, eg $a=\frac{M}{c}+\frac{bd}{c}$, $a=\frac{-M-bd}{-c}$ [must have been seen with a = to award accuracy mark]
	(b)	$5x<39+4$ oe		2	M1	Accept as equation or with the wrong inequality sign. Also award M1 for an answer of 8.6 or 8.6 with an = sign or the incorrect inequality sign.
	(d)	$m^2=\frac{6a+r}{5r}$ $m^2\times 5r=6a+r$ $5rm^2-r=6a$	$r=\frac{6a}{5m^2-1}$	4	M1 M1 M1 A1	or for $r=\frac{-6a}{1-5m^2}$ oe NB: to award A1 we must see $r=\frac{6a}{5m^2-1}$ in working if $\frac{6a}{5m^2-1}$ alone is given as answer

17	$ym^2=n^2+d$ **or** $y=1+\frac{d}{n^2}$		4	M1	
	$ym^2-n^2=d$ **or** $-d=n^2-ym^2$ **or** $y-1=\frac{d}{n^2}$			M1	
	$n^2(y-1)=d$ **or** $-d=(1-y)n^2$			M1	for factorising n^2 from a suitable expression. or $n^2=\frac{d}{y-1}$
		$n=\sqrt{\frac{d}{y-1}}$		A1	Accept $n=\sqrt{\frac{-d}{1-y}}$ Penalise $\pm\surd$
					Total 4 marks

Properties of Numbers

12	(a)		$3^2\times5\times7$	1	B1	accept $3\times3\times5\times7$ oe or 315
	(b)		$3^{11}\times5^7\times7^5$	2	B2	fully correct answer (allow $x=11$, $y=7$, $z=5$) (B1 for an answer in the form $3^p\times5^q\times7^r$ where one or two of p, q or r are correct)
						Total 3 marks

5	(a)	e.g. $720 = 2\times360 = 2\times2\times180$ or $720 = 3\times240 = 3\times3\times80$ etc		3	M1	At least 2 correct stages in prime factorisation
		2, 2, 2, 2, 3, 3, 5			M1	condone inclusion of 1 (may be a fully correct factor tree or ladder)
			$2\times2\times2\times2\times3\times3\times5$		A1	dep on M2, accept $2^4\times3^2\times5$
	(b)		5	1	B1	
						Total 4 marks

6	(a)	36, 72, 108, ... **and** 120, 240, 360, ... **or** 2, 2, 3, 3 **and** 2, 2, 2, 3, 5 **or**  **or** $\frac{36\times120}{12}$ **or** 2, 2, 2, 3, 3, 5 oe		2	M1for any correct valid method e.g. for starting to list at least **three** multiples of each number 2, 2, 3, 3 **and** 2, 2, 2, 3, 5 seen (may be in a factor tree or a ladder diagram and ignore 1) (Allow 2×2 as 4) **or** a fully correct "Venn" diagram
			360		A1 or $2^3\times3^2\times5$ oe (allow 2^3 . 3^2 . 5)
	(b)		$5^3\times7^4\times11$	2	B2 for $5^3\times7^4\times11$ (in any order) (B1 for 660 275 or correct unsimplified product or $5^a\times7^b\times11^c$ where 2 of a, b and c are correct)
					Total 4 marks

2	36	120
2	18	60
3	9	30
	3	10

Circle Theorems - Angles

19	Angle $BCE = 73°$	Angle $BDE = 73°$	34	5	M1	angles may be written on the diagram
	Angle $DEB = 73°$ **and** Angle $DCB =$ $180-73$ (=107°)	Angle $DEB = 73°$ **and** Angle $DBE =$ $180-73\times2$ (=34°)			M1	
	Angle $DCE = 34°$				A1	
	eg Alternate segment theorem Opposite angles of a cyclic quadrilateral sum to 180° Alternate angles are equal Angles in the Same segment are equal Angles in a triangle sum to 180				B2	for a full set of reasons relevant to their method (B1 for at least one relevant circle theorem)

13	(a) (i)		62	3	B1	
	(a) (ii)		118		B1ft	180 – their (a)(i)
	(b)		62		B1	
						Total 3 marks

Linear Simultaneous Equations

12	**Elimination** E.g. $21x-6y=102$ $21x+35y=-21$ $(-41y=123)$ or $35x-10y=170$ $6x+10y=-6$ $(41x=164)$	**Substitution** E.g. $3\left(\frac{34+2y}{7}\right)+5y=-3$ or $3x+5\left(\frac{7x-34}{2}\right)=-3$ or $7\left(\frac{-3-5y}{3}\right)-2y=34$ or $7x-2\left(\frac{-3-3x}{5}\right)=34$		4	M1	for a correct method to eliminate x or y: coefficients of x or y the same **and** correct operation to eliminate selected variable (condone 1 arithmetical error) **or** for correctly writing x or y in terms of the other variable and correctly substituting
					A1	dep on M1 for $x = 4$ or $y = -3$
	E.g. $7x-2\times-3=34$				M1	dep on M1 for substitution of found variable **or** repeating the steps in first M1 for the second variable
			$x=4$ $y=-3$		A1	cao A correct answer without working scores no marks
						Total 4 marks

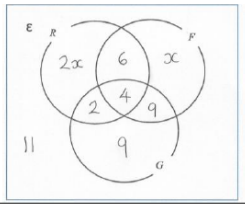
6	$5a+3p=1.96$ and $3a+2p=1.22$ oe **or** $5a+3p=196$ and $3a+2p=122$ oe		M2 for an arithmetical method (must see the calculation to find 0.22 or 0.26 or 0.74 and 0.48 oe) E.g. 6.1(0) – 5.88 (= 0.22) oe **or** 3.92 – 3.66 (= 0.26) oe **or** 1.96 – 1.22 (= 0.74) oe and 1.22 – "0.74" (= 0.48)		5	M1 for setting up both equations oe Allow the use of apples and pears oe throughout, e.g. 5 apples + 3 pears = 1.96 and 3 apples + 2 pears = 1.22
	E.g. $15a+9p=5.88$ $15a+10p=6.1\ 0$ Subtracting $(-p=-0.22)$	E.g. $10a+6p=3.92$ $9a+6p=3.66$ Subtracting $(a=0.26)$				M1 for a correct method to eliminate a or p: coefficients of a or p the same **and** correct operation to eliminate selected variable (condone any one arithmetic error) **or** to find the cost of 1 apple and 1 pear
	E.g. $5a+3p=1.96$ and $6a+4p=2.44$ oe Subtracting					
	E.g. $5a+3("0.22")=1.96$ or $3a+2("0.22")=1.22$	E.g. $5("0.26")+3p=196$ or $3("0.26")+2p=1.22$	E.g. 3 × 0.22 (= 0.66) 1.96 – "0.66" (= 1.3(0)) "1.3(0)" ÷ 5 (= 0.26) **or** 5 × 0.26 (= 1.3(0)) 1.96 – "1.3(0)" (= 0.66) "0.66" ÷ 3 (= 0.22) **or** Apple and pear is 0.48 oe			M1 (dep on M2) for substituting their value found (must be > 0) of one variable into one of the equations **or** for repeating above method to find second variable **or** for third working column allow $k(a+p)=k(0.48)$ **or** for a complete arithmetical method to find the other value
	E.g $a+p=0.48$ oe					
	$10\times"0.26"+10\times"0.22"$ or $(a+p=)\,0.48\times10$ oe or $k(a+p)=k(0.48)\times\frac{10}{k}$					M1 (dep on M3) can be implied by $10(a+p)$ provided a and p must be > 0
	Working required				4.8(0)	A1 dep M2
						Total 5 marks

Compound Measures

7	×1000 (÷60 ÷ 60) or ÷3600 or sight of 81 000 or 1350 or 0.0225		3	M1	For one of ×1000 (eg sight of 81 000) or (÷60 ÷ 60) or ÷3600 oe
	$\frac{81\times1000}{60\times60}$ oe eg $\frac{81}{3.6}$ or $81\times\frac{5}{18}$ oe			M1	For a fully correct method with correct use of brackets eg 81000 ÷ 60 × 60 is M1 only if not recovered
		22.5		A1	or $\frac{45}{2}$ or $22\frac{1}{2}$
					Total 3 marks

9	19.3 × 150		2	M1	for 19.3 × 150
		2895		A1	for 2895
					Total 2 marks

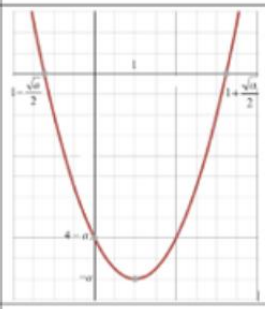
Sets – Venn

16	(a)			3	B3	For all sections completed correctly (B2 for 5 or 6 sections correct (excl x), B1 for 3 or 4 sections correct (excl x))
	(b)	$2x + 6 + x + 2 + 4 + 9 + 9 + 11 = 80$ $(80 - 6 - 2 - 4 - 9 - 9 - 11) \div 3$		3	M1ft	ft their Venn diagram A correct equation to find x or subtracting all numerical values from 80 and dividing by 3 or other fully correct method to find x with all sections completed
		$x = 13$			A1	correct value for x
			38		B1	their $2x + 12$
						Total 6 marks

1	(a)		2, 4, 6, 12	1	B1	
	(b)		5, 7, 8, 9, 10, 11, 13, 14	1	B1	
	(c)			2	M1	for $\frac{a}{14}$ with $a < 14$ **or** $\frac{3}{b}$ with $b > 3$ **or** for 3 and 14 used with incorrect notation e.g. 3 : 14
			$\frac{3}{14}$		A1	for $\frac{3}{14}$ oe **or** 0.214(…)
						Total 4 marks

Completing the Square

22		$-2(x^2 - 6x) + 5$ or $-2(x^2 - 6x - 2.5)$ $-2[(x-3)^2 - 9 - 2.5]$ or $-2[(x-3)^2 - 9] + 5$ $-2[(x-3)^2 - 11.5]$ or $-2(x-3)^2 + 18 + 5$ Alt: ~~$a + b(x^2 + 2cx + c^2)$~~	$23 - 2(x-3)^2$	4	M1 M1 M1 A1	Factorising by extracting -2 in a correct expression Correct expression equivalent to $5 + 12x - 2x^2$ Correct expression equivalent to $5 + 12x - 2x^2$ **Award full marks if a, b, and c are correctly stated and $23 - 2(x-3)^2$ is not stated anywhere.** SC B3 for $23 - 2(3-x)^2$ SC B2 for $-2(x-3)^2 +$ constant or $23 - 2(x +$ constant$)^2$ SC B1 for $-2(x+3)^2 +$constant
		~~Multiplying out expression correctly~~ $2bc = 12$ or $a + bc^2 = 5$ or $b = -2$ $2 \times -2 \times c = 12$ or $c = -3$ $a + -2 \times (-3)^2 = 5$ or $a = 23$ seen	$23 - 2(x-3)^2$		~~M1~~ M1 M1 M1	~~Multiplying out expression correctly~~ Equating coefficients or stating value of b Method to calculate c Method to calculate a SC B3 for $23 - 2(3-x)^2$
						Total 4 marks

20		graph drawn in shape of a quadratic with a minimum in any quadrant		4	M1 for a quadratic with a minimum
		$x = 1$, $y = 4(1-1)^2 - a$			M1 for finding the turning point (may be seen marked on the graph as $(1, -a)$)
		$x = 1 \pm \sqrt{\frac{a}{4}}$ oe **or** $y = 4 - a$			M1 for finding one of the intercepts (or award for any one correct coordinate shown on graph) $(0, 4-a)$ or $(1+\frac{\sqrt{a}}{2}, 0)$ or $(1-\frac{\sqrt{a}}{2}, 0)$ Note: The 0's can be ignored (as shown in the diagram)
			Correct graph		A1 for a fully correct graph • quadratic shape with minimum in the fourth quadrant and marked as $(1, -a)$ oe • x-axis intercepts marked as $(1+\frac{\sqrt{a}}{2}, 0)$ oe on the positive x-axis **and** $(1-\frac{\sqrt{a}}{2}, 0)$ oe on the negative x-axis • y-axis intercept marked as $(0, 4-a)$ oe Note: The 0's can be ignored (as shown in the diagram)
					Total 4 marks

	(b)	$y = 2(x^2 - 10x) + 9$ **or** $y = 2\left(x^2 - 10x + \frac{9}{2}\right)$			M1 for a correct equation for a first step in order to complete the square
		e.g. $y = 2\left((x-5)^2 - 5^2\right) + 9$ **or** $y = 2\left((x-5)^2 - 5^2 + \frac{9}{2}\right)$ **or** $y = 2(x-5)^2 - 41$ oe			M1 dep
		$(x-5)^2 = \frac{y+41}{2}$ oe			M1
			$5 + \sqrt{\frac{x+41}{2}}$	4	A1 oe
					Total 5 marks

Problem Solving with Algebra

5			4	B1 for 80
	for $\frac{a+75}{2} = 74$ oe **or** 73			M1 for setting up an equation using the median **or** for 73
	for 80 – 16 (= 64) oe			M1 for using the range correctly **or** for 64
		64, 73, 80		A1 answers can be in any order
				Total 4 marks

10	5×74 (= 370) **or** 6×77 (= 462) **or** 5×0.74 (= 3.7) **or** 6×0.77 (= 4.62)		3	M1	one correct product	M2 for $74 + (3 \times 6)$ oe **or** $77 + (3 \times 5)$ oe (where 3 = 77 – 74)
	$6 \times 77 - 5 \times 74$ **or** "462" – "370" **or** $(6 \times 0.77 - 5 \times 0.74) \times 100$ **or** ("4.62" – "3.7") × 100			M1	from correct working	
	Working not required, so correct answer scores full marks (unless from obvious incorrect working)	92		A1	allow 92/100 **or** 92% **or** 92 out of 100 (trial and error scores no marks unless correct – and then it gains full marks)	
						Total 3 marks

Indices - Negative and Fractional

	(c)	$a^{\frac{1}{2}} \times a = a^{\frac{3}{2}}$ or $\frac{a}{a^{-2}} = a^3$ or $\frac{a^{\frac{1}{2}}}{a^{-2}} = a^{\frac{5}{2}}$	$\frac{7}{2}$	2	M1 for one correct step
					A1 oe
	(b)		2.5 oe	1	B1

Ratio

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) × "230" **or** 7 × "230" – 2 × "230" **or** "1610" – "460" **or** "$\frac{1}{3}$"×3450			M1
		1150		A1
				Total 3 marks

10	eg $\frac{4}{5}\times\frac{3}{7}(=\frac{12}{35})$oe **or** $0.24\times\frac{4}{7}(=\frac{96}{700})$oe **or** eg $\frac{4}{5}\times 3(=\frac{12}{5}=2.4)$ **and** $0.24\times 4(=\frac{24}{25}=0.96)$ (or 3.36) **or** eg $\frac{4}{5}\times 300(=240)$ **and** $0.24\times 400(=96)$ (or 336)		3	M1	
	eg "$\frac{12}{35}$"+"$\frac{96}{700}$" $\left(=\frac{336}{700}\right)$ oe **or** $\frac{"2.4"+"0.96"}{3+4}\left(=\frac{3.36}{7}\right)$ oe **or** eg $\frac{"240"+"96"}{300+400}\left(=\frac{336}{700}\right)$ oe			M1	or 0.48 or 48% or correct unsimplified fraction eg $\frac{84}{175}$
		$\frac{12}{25}$		A1	cao
					Total 3 marks

Indices

1	(a)		$x > -3$	1	B1	Accept $-3 < x$
	(b)	$4y - y \le 8 + 13$		2	M1	Arranging y's on one side and the numbers on the other side. (allow $4y - y = 8 + 13$ oe or $4y - y < 8 + 13$ oe or $4y - y > 8 + 13$ oe or $4y - y \ge 8 + 13$ oe)
			$y \le 7$ oe		A1	Allow $y \le 21/3$
						Total 3 marks

(b)	$7 + 1 < 4x \le 17 + 1$ or $\frac{7}{4} < x - \frac{1}{4} \le \frac{17}{4}$ $(7+1)\div 4 < x \le (17+1)\div 4$ or $\frac{7}{4}+\frac{1}{4} < x \le \frac{17}{4}+\frac{1}{4}$	$2 < x \le 4.5$	3	M1 M1 A1	or one side of the inequality correct, e.g. 2 or 4.5 Accept $x > 2$, $x \le 4.5$

3D Trig/ Pythag

21	e.g. (*AC* =) $\sqrt{(4x)^2 + (2x)^2}$ (= $\sqrt{20}x$) **or** (*AC* =) $\sqrt{(4)^2 + (2)^2}$ (= $\sqrt{20}$) **or** (*AF* =) $\sqrt{(4)^2 + (2)^2 + (3)^2}$ (= $\sqrt{29}$) **or** (*AF* =) $\sqrt{(\sqrt{20})^2 + (3)^2}$ (= $\sqrt{29}$) **or**			M1 for a method to find an expression for length *AC* or length *AF* with or without *x* **or** *x* can represent any number e.g. *AB* : *BC* : *CF* = 2 : 1 : 1.5 $AC^2 = \sqrt{2^2 + 1^2}\left(=\sqrt{5}\right)$
	e.g. (*CAF* =) $\tan^{-1}\left(\frac{3x}{'\sqrt{20}x'}\right)$ (= 33.854...) or (*CAF* =) $\tan^{-1}\left(\frac{3}{'\sqrt{20}'}\right)$ (= 33.854...) or (*CAF* =) $\cos^{-1}\left(\frac{'\sqrt{20}'}{'\sqrt{29}'}\right)$ (= 33.854...) or (*CAF* =) $\sin^{-1}\left(\frac{3}{'\sqrt{29}'}\right)$ (= 33.854...)			M1 for a complete method to find angle *CAF* using length *AC* **or** for a complete method to find angle *CAF* using length *AF* with or without *x* or *x* can represent any number *AB* : *BC* : *CF* = 2 : 1 : 1.5 (*CAF* =) $\tan^{-1}\left(\frac{1.5}{'\sqrt{5}'}\right)$ (= 33.854...)
		33.9°	3	A1 answers in the range 33.85 – 33.9
				Total 3 marks

Basic Probability

1	(a)		0.45	1	B1	oe eg $\frac{9}{20}$, $\frac{45}{100}$, 45%
	(b)	eg 1 – (0.25 + 0.2 + 0.2) (= 0.35) **or** 1 – ("0.45" + 0.2) (= 0.35) **or** 300 × (0.25 + 0.2 + 0.2) (= 195)		3	M1	allow use of their "0.45" from part (a), check the table
		eg 300 × "0.35" **or** 300 – "195"			M1	for a complete method
			105		A1	cao (award $\frac{105}{300}$ M2 only)
						Total 4 marks

6	28 ÷ 0.35 (= 80) oe eg (28 ÷ 7) × 20 (= 80)		5	M1	indep for calculating total number of sweets
	1 – (0.2 + 0.35) (= 0.45) oe **or** (0.2 + 0.35) × "80" (= 44) or 28 + "16" (= 44)			M1	or for a correct equation for missing values eg $x + 2x + 0.2 + 0.35 = 1$ oe (can be implied by 2 probabilities that total 0.45 in table if not contradicted in working space)
	"0.45" ÷ 3 (= 0.15) oe **or** "0.45" × "80" (= 36) **or** "80" – "44" (= 36)			M1	(or 0.15 or 0.3 seen in table – either order)
	"80" × "0.15" **or** "80" × "0.3" (= 24) **or** "36" ÷ 3 or "36" ÷ $\frac{3}{2}$ (= 24)			M1	A correct calculation for the number of white sweets or the number of pink sweets
		12		A1	

Linear Graphs

11		Gradient = (–)4 ÷ 2 oe		3	M1	Correct method to work out the gradient (±) accept 4 ÷ 2 oe or "m" = 2
			$y = -2x - 1$ oe		A2	If not A2 then A1 for $L = -2x - 1$ or $-2x - 1$ or $y = -2x - 1$ or $y = -2x + c$
						Total 3 marks

1	(a)	$\frac{5+13}{2}$ or $\frac{-4+1}{2}$		2	M1 for a correct method to find one coordinate **or** for one coordinate correct **or** for (–1.5, 9)
			(9, –1.5)		A1 oe
	(b)		–3	1	B1
	(c)		No with reason	1	B1 No (oe) and e.g. line goes through (100, –298) or (101.3(3..), –302) or $\left(\frac{304}{3}, -302\right)$ or (3 × 100) – 302 = –2 not (+)2
					Total 4 marks

Expanding Brackets

4	(a)	$3c - 21 + 6c + 8$	$9c - 13$	2	M1 A1	For 3 or 4 terms correct
	(b)	$x^2 - 2x + 7x - 14$	$x^2 + 5x - 14$	2	M1 A1	For 3 correct terms or for 4 correct terms ignoring signs or for $x^2 + 5x + k$ for any non-zero value of k or for .... + 5x – 14

15	a	$(3x + 2)(2x + 1) = 100$			AO1, AO2	M1	or $(2x \times 3x) + 2(2x + 1) + 3x = 100$ oe or $(2x \times 3x) + (2 \times 2x (\times 1)) + 1) + 3x + 1 + 1 = 100$ oe other partitions are acceptable but partitioning must go on to form a correct equation.
			$6x^2 + 7x - 98 = 0$ *	2		A1	Accept $6x^2 + 7x + 2 = 100$ if M1 awarded * Answer given
	b	$(3x + 14)(2x - 7) (= 0)$			AO1	M2	or $(x =) \frac{-7 \pm \sqrt{49 + 2352}}{12}$ or $(x =) \frac{-7 \pm \sqrt{2401}}{12}$ If not M2 then M1 for $(3x \pm 14)(2x \pm 7)$ or $(x =) \frac{-7 \pm \sqrt{7^2 - 4 \times 6 \times -98}}{2 \times 6}$
		$x = 3.5$				A1	Dependent on at least M1 Ignore negative root
		(Area =) $6 \times '3.5'^2$ or $(3 \times '3.5') \times (2 \times '3.5')$				M1 ft	Dependent on at least M1 and x > 0
			73.5	5		A1	

11	a	$2x^2 - x + 6x - 3$ **or** $2x^2 + 5x - 3$ **or** $x^2 + 3x - 5x - 15$ **or** $x^2 - 2x - 15$ **or** $2x^2 - 10x - x + 5$ **or** $2x^2 - 11x + 5$ eg. $2x^3 + 5x^2 - 3x - 10x^2 - 25x + 15$ **or** $2x^3 - 4x^2 - 30x - x^2 + 2x + 15$ **or** $2x^3 - 11x^2 + 5x + 6x^2 - 33x + 15$	$2x^3 - 5x^2 - 28x + 15$	3	M1	for expansion of any 2 of the 3 brackets (at least 3 of 4 terms correct)
					M1	(dep) ft for at least half of their terms correct in second expansion (the correct number of terms **must** be present)
					A1	

Fractions

2	eg $\frac{18}{7}$ **and** $\frac{9}{8}$ oe		3	M1	both fractions expressed as improper fractions, no need for ÷ or × may be equivalent to those given eg $\frac{36}{14}$ or $\frac{27}{24}$ etc. A student could invert $\frac{9}{8}$ and show multiplication - as shown in the 2nd M1, this mark is then implied.
	eg $\frac{18}{7}\times\frac{8}{9}$ oe **or** oe $\frac{144}{56}\div\frac{63}{56}$			M1	**or** for both fractions expressed as equivalent fractions with denominators that are a common multiple of 7 and 8 eg $\frac{144}{56}\div\frac{63}{56}$
	eg $\frac{18}{7}\times\frac{8}{9}=\frac{144}{63}=\frac{16}{7}=2\frac{2}{7}$ **or** $\frac{18}{7}\times\frac{8}{9}=\frac{144}{63}=2\frac{18}{63}=2\frac{2}{7}$ **or** $\frac{\cancel{18}^{2}}{7}\times\frac{8}{\cancel{9}^{1}}=\frac{16}{7}=2\frac{2}{7}$ **or** $\frac{18}{7}\div\frac{9}{8}=\frac{144}{56}\div\frac{63}{56}=\frac{144}{63}=\frac{16}{7}=2\frac{2}{7}$ **or** correct working to $\frac{16}{7}$ **and** writing $2\frac{2}{7}=\frac{16}{7}$	shown		A1	Dep on M2 for conclusion to $2\frac{2}{7}$ from correct working – either sight of the result of the multiplication or division eg $\frac{144}{63}$ must be seen and then cancelled or correct cancelling prior to the multiplication to $\frac{16}{7}$ **or** writing $2\frac{2}{7}=\frac{16}{7}$ (maybe on first line of working) and correct working as far as LHS $=\frac{16}{7}$ **NB: use of decimals scores no marks**
					Total 3 marks

4	$\frac{16}{3}(-)\frac{20}{7}$ or $(5)\frac{7}{21}(-)(2)\frac{18}{21}$		3	M1	for correct improper fractions or fractional part of numbers written correctly over a common denominator (no need for minus sign)
	$\frac{112}{21}-\frac{60}{21}$ or $5\frac{7}{21}-2\frac{18}{21}=3-\frac{11}{21}$ oe or $5\frac{7}{21}-2\frac{18}{21}=4\frac{28}{21}-2\frac{18}{21}$			M1	for correct fractions with a common denominator with minus sign or mixed numbers to the stage shown
	$\frac{112}{21}-\frac{60}{21}=\frac{52}{21}=2\frac{10}{21}$ oe or $3-\frac{11}{21}=2\frac{10}{21}$ or $5\frac{7}{21}-2\frac{18}{21}=4\frac{28}{21}-2\frac{18}{21}=2\frac{10}{21}$	Shown		A1	Dep on M2 for a correct answer from fully correct working If all 3 fractions turned into improper fractions on the first line $\frac{16}{3}-\frac{20}{7}=\frac{52}{21}$ then the student **clearly** needs to show that the LHS $=\frac{52}{21}$
					Total 3 marks

Basic Factorising

eg $6e^2(3f^3-2ef)$, eg $2f(9e^2f^2-6e^3)$ eg $ef(18ef^2-12e^2)$		2	M1	Any correct partially factorised expression with at least 2 terms in the common factor **or** for the correct common factor and a 2 term expression inside the brackets with just one error
	$6e^2f(3f^2-2e)$		A1	
				Total 6 marks

(c)		$(2c-3d)(2c+3d)$	1	B1	
(d)	$\frac{(4-x)(3-x)}{x(4-x)}$ or $\frac{(x-4)(x-3)}{x(4-x)}$	$\frac{3-x}{x}$	3	M1	for either numerator or denominator factorised correctly
				M1	for both numerator and denominator factorised correctly
				A1	oe

Similar Shapes A&V

16	e.g. $\sqrt[3]{\frac{960}{405}}\left(=\frac{4}{3}\right)$ (=1.3...)or $\sqrt[3]{\frac{405}{960}}\left(=\frac{3}{4}\right)$(=0.75) $\left(\frac{3}{4}\right)^2\times 928$ **or** $928\div\left(\frac{4}{3}\right)^2$ oe	522	3	M1 M1 A1	for a correct linear scale factor for a complete method
16	$1-\frac{98}{125}\left(=\frac{27}{125}\right)$ **or** 0.216 **or** 125 – 98 (=27) $\sqrt[3]{"\frac{27}{125}"}\left(=\frac{3}{5}\right)$ **or** $\sqrt[3]{"\frac{125}{27}"}\left(=\frac{5}{3}\right)$ $1-"\frac{3}{5}"$ **or** $h-"\frac{3}{5}"h$ oe	$\frac{2}{5}h$ oe	4	M1 M1 M1 A1	for the length scale factor may be seen as a ratio E.g. 3 : 5 for $\frac{2}{5}h$ oe (may not be simplified)
	Alternative scheme $\frac{1}{3}\pi r^2h-\frac{1}{3}\pi(kr)^2kh=\frac{98}{125}\times\frac{1}{3}\pi r^2h$ oe $k=\frac{3}{5}$ $1-"\frac{3}{5}"$ **or** $h-"\frac{3}{5}"h$ oe	$\frac{2}{5}h$ oe	4	M1 M1 M1 A1	sets up an equation using scale factor for the length scale factor for $\frac{2}{5}h$ oe (may not be simplified)

Volume and Surface Area

15	Eg $\frac{4\pi r^2}{2}\left(+\pi r^2\right)=2\pi(2r)h$ oe $h=\frac{3}{4}r$ **or** $r=\frac{4}{3}h$ Eg $\frac{1}{2}\times\frac{4}{3}\times\pi\times r^3$ **and** $\pi\times(2r)^2\times"\frac{3}{4}r"$ **OR** $\frac{1}{2}\times\frac{4}{3}\times\pi\times\left("\frac{4}{3}h"\right)^3$ **and** $\pi\times(2\times"\frac{4}{3}h")^2\times h$	4.5 oe	4	M1 A1 M1 A1	for use of, for example, r and $2r$ in an equation condone omission of flat surface area for a correct expression for either r or h dep on award of first M1 ft for candidate's expression for r or h for correct expressions for volume of hemisphere and volume of cylinder ; both in terms of either r or h
17 (a)	$2\pi r^2+2\pi r\times 2r$	$6r^2$	2	M1 A1	
(b)	S.A. $6\pi r^2:4\pi r^2=3:2$ $V_c:V_s=2\pi r^3:\frac{4}{3}\pi r^3$ $=3\times 2:4=3:2$	Shown	3	M1 M1 A1	ft their answer from (a), must be in terms of r. Ratios could be seen as fractions throughout eg $\frac{3}{2}$ oe eg ratios could be $\frac{3}{2}:1$

Circles and Sectors

20	eg $2d \times 2d - 4 \times \pi \times (\frac{1}{2}d)^2 (= 40)$ oe or $4r \times 4r - 4 \times \pi \times r^2 (= 40)$ oe or $x^2 - 4\pi\left(\frac{1}{4}x\right)^2 (= 40)$ oe or $w^2 - \pi\left(\frac{1}{2}w\right)^2 (= 10)$ oe		4	M1	oe a **correct** expression or a correct equation for the shaded area (must be in one unknown only) where d = diameter r = radius x = side of large square w = side of square when shape divided into 4
	$d = \sqrt{\frac{40}{4-\pi}} (= 6.826...)$ or $2d = \sqrt{\frac{160}{4-\pi}} (= 13.652...)$ oe $r = \sqrt{\frac{40}{16-4\pi}} (3.413...)$ or $4r = \sqrt{\frac{640}{16-4\pi}} (= 13.652...)$ oe $x = \sqrt{\frac{40}{1-0.25\pi}} (13.652...)$ or $w = \sqrt{\frac{10}{1-0.25\pi}} (= 6.826...)$oe			M1	oe a correct expression for d or $2d$ or r or $4r$ or x or w
	(perimeter =) 8 × "6.826..." (8 × diameter(or side of small square when divided)) or 16 × "3.413..." (16 × radius) oe or 4 × "13.652..."(4 × side of square)			M1ft	dep on first M1 For substituting values into a calculation for the perimeter use of **their** r, d, x, w
		54.6		A1	54.4 - 54.7
					Total 4 marks

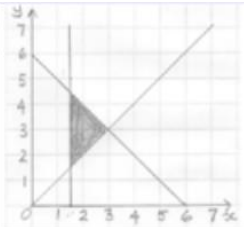
Solving Quadratics by Factorising

15	(a)	e.g. $\frac{1}{2} \times (x + 5 + 3x - 2) \times (2x - 3)$ or $0.5(4x + 3)(2x - 3)$ oe			M1	correct algebraic expression for area
		eg. $\frac{1}{2} \times (8x^2 - 12x + 6x - 9) = 133$ or $8x^2 - 12x + 6x - 9 = 266$			M1	for correct equation with brackets expanded
			shown	3	A1	for completion to given equation dep on M2
	(b)	$\frac{--6 \pm \sqrt{36 - -8800}}{2 \times 8}$ **or** $\frac{6 \pm \sqrt{36 + 8800}}{16}$ **or** $\frac{6 \pm \sqrt{8836}}{16}$ **or** $(4x - 25)(2x + 11) (=0)$			M2	If not M2 then award M1 for $\frac{--6 \pm \sqrt{(-6)^2 - 4 \times 8 \times -275}}{2 \times 8}$ Condone one sign error in substitution; allow evaluation of individual terms e.g. 36 in place of $(-6)^2$ [allow -6^2 or 6^2 in place of $(-6)^2$, throughout allow + rather than ±] **or** $(4x \pm 25)(2x \pm 11) (=0)$ (if student gains M1 and shows both answers the 2nd M1 can be awarded) ft from an incorrect 3 term quadratic equation
			6.25 oe	3	A1	dep on M1 **and** 6.25 oe alone given as final answer

13	(a)		$15x^2 - 2x - 6$	2	B2	for correct differentiation
					(B1	for 2 of $15x^2$, $-2x$, -6 correct)
	(b)	e.g. "$15x^2 - 2x - 6$" = 2 oe		4	M1	ft, for equating their dy/dx to 2
		$15x^2 - 2x - 8 (= 0)$			M1	(dep on M1) ft their three-term quadratic
		e.g. $(3x + 2)(5x - 4) (= 0)$ $x = \frac{2 \pm \sqrt{(-2)^2 - (4 \times 15 \times -8)}}{2 \times 15}$			M1	for solving their quadratic equation using any correct method - if factorising, allow brackets which expanded give 2 out of 3 terms correct (if using formula or completing the square allow one sign error and some simplification – allow as far as e.g. $\frac{2 \pm \sqrt{4 + 480}}{30}$ oe)
			$-\frac{2}{3}; \frac{4}{5}$		A1	oe, dep on M2 (allow −0.66 or better), Both values – isw any attempt to find y coordinates
						Total 6 marks

Graphical Inequalities

13		$y \geq -3$ oe $x + y \leq 1$ oe $y \leq 2x + 2$ oe	3		B3 for all 3 correct inequalities (B2 for 2 correct inequalities B1 for 1 correct inequality) Allow < instead of ≤ and > instead of ≥
					Total 3 marks

4	(a)(i)		Correct line	1	B1	For $x = 1.5$ drawn
	(ii)		Correct line	1	B1	For $y = x$ drawn
	(iii)		Correct line	1	B1	For $x + y = 6$ drawn
	(b)		Correct region	1	B1	dep on B3 for correctly indicating the region **R** accept unlabelled or unshaded if clear. Shading can be 'in' or 'out'.
						Total 4 marks

Indices

3	a		y^{14}	1	B1	
	b		$16m^{12}$	2	B2	if not B2 then B1 for am^{12} **or** $16m^{b}$ **or** $2^{4}m^{12}$ $b \neq 0, 12$ $a \neq 1, 16$

14	$2^7 = 4^{2x} \times 2^x$ or $128 = (2^2)^{2x} \times 2^x$	1.4	3	M1	Replacing 128 by 2^7 or 4 by 2^2
	$7 = 2(2x) + x$			M1	
				A1	oe
					Total 3 marks

21	$12^2 = 2^4 \times 3^2$ **or** $2 \times 12^2 = 2^5 \times 3^2$ oe **or** $\frac{2 \times 12^2}{3^2} (= 32) = 2^5$		5	M1	
	$18^{4n} = (2 \times 3^2)^{4n}$ **or** $2^{4n} \times 3^{2 \times 4n}$			M1	
	$3n^2 - 14n - 5 (= 0)$			A1	
	e.g. $(3n + 1)(n - 5)(= 0)$ $n = \frac{14 \pm \sqrt{(-14)^2 - (4 \times 3 \times -5)}}{2 \times 3}$			M1	for solving their 3 term quadratic equation using any correct method - if factorising, allow brackets which expanded give 2 out of 3 terms correct (if using formula or completing the square allow one sign error and some simplification – allow as far as e.g. $\frac{14 \pm \sqrt{196 + 60}}{6}$ oe)
		$-\frac{1}{3}$, 5		A1	Allow −0.33 or better for $-\frac{1}{3}$

Basic Trig

8	$\cos 52 = \frac{12.6}{x}$ **or** $\sin 38 = \frac{12.6}{x}$		3	M1	Or use of tan to find horizontal side 12.6 × tan 52 or $\frac{12.6}{\tan 38}$ (=16.12...) **and** a correct first stage to find x eg $x^2 = 12.6^2 + "16.12..."^2$ or $\sin 52 = \frac{"16.12..."}{x}$ oe Allow correct first stage of sine rule
	$(x =) \frac{12.6}{\cos 52}$ **or** $\frac{12.6}{\sin 38}$ $(= \frac{12.6}{0.61566...})$ **or**			M1	Accept decimal correct to at least 3SF Or $(x =) \sqrt{12.6^2 + "16.12..."^2}$ **or** $(x =) \frac{"16.12..."}{\sin 52}$ Allow fully rearranged sine rule
		20.5		A1	20.4 – 20.5
					Total 3 marks

Advanced Trig

15	$\frac{1}{2} \times 6 \times 11 \times \sin 118 (= 29.1...)$		3	M1	for the area of half of the kite
	eg $2 \times \frac{1}{2} \times 6 \times 11 \times \sin 118$			M1	for a complete method
		58.3		A1	accept 58.2 – 58.3
					Total 3 marks

Recurring Decimals to Fractions

17	eg $x = 0.34545....$ **and** $100x = 34.545....$ with intention to subtract **OR** $10x = 3.4545....$ **and** $1000x = 345.45....$ with intention to subtract Must include algebra as the question asked for 'using algebra'		2	M1	for 2 recurring decimals (they must identify or show the pair they are using) that when subtracted give a whole number or terminating decimal eg $100x = 34.545....$ and $x = 0.34545....$ **OR** $1000x = 345.45....$ and $10x = 3.4545....$ with intention to subtract. (If recurring dots not shown then showing at least the digits 34545, i.e. 5sf for **one** of the numbers that they are using) **OR** $0.3 + 0.0454545....$ and Eg $10x = 0.454545...$ and $1000x = 45.4545..$
	eg $100x - x = 34.545.... - 0.34545....$ **and** $99x = 34.2$ **and** $\frac{34.2}{99} = \frac{19}{55}$ oe **OR** $1000x - 10x = 345.45.... - 3.4545....$ **and** $990x = 342$ **and** $\frac{342}{990} = \frac{19}{55}$ oe **OR** $0.3 + ...$ and $(1000x - 100x = 990x = 45)$ and $0.3 + \frac{45}{990} = \frac{3 \times 99 + 45}{990} = \frac{19}{55}$ oe	shown		A1	for completion to $\frac{19}{55}$
					Total 2 marks

IQR from Discrete Data

12	a	14 16 17 18 20 21 22 23 23 24 24 (14 16 17 18 20 21 22 23 23 24 24) (14 16 17 18 20) and (22 23 23 24 24) 23 - 17	6	3	AO3	M1 M1 A1 cao	arrange in order **or** One of 21(median), 17(LQ), 23(UQ) identified Identify any **two** of 21, 17 and 23
	b		Carmelo **and** reason using IQR	1	AO3	B1	ft from (a) Carmelo - he has a lower IQR oe (IQR must be part of the statement)

Sets Notation

14	(a)		7, 8, 9, 10, 11	2	B2	completely correct. (B1 for 4 or 5 correct and no more than 1 incorrect **or** for all terms seen correctly placed in a Venn diagram or for a correct description of the numbers in the set but not listed, eg $7 \leq x < 12$)
	(b)		eg 2, 4, 6	1	B1	for any 3 of 2, 4, 6, 8, 10
						Total 3 marks

Quadratic Inequalities

20	eg $(4x + 3)(x - 2)$ or $(x =) \frac{-(-5)\pm\sqrt{(-5)^2-4\times4\times(-6)}}{2\times4}$		4	M1	first step to finding the critical values
	$(x =) -\frac{3}{4}$ and 2			A1	for two correct critical values
				M1	(dep on two critical values having been found) for a diagram showing the inequalities **OR** $x < a$ and $x > b$ where a is their lower critical value and b is their upper critical value **OR** $x > 2$ **OR** $x < \frac{-3}{4}$ **OR** $\frac{-3}{4} > x > 2$
		$x < -\frac{3}{4}$ $x > 2$		A1	for both correct inequalities
					Total 4 marks

Algebraic Fractions

23	eg $\frac{20}{x^2-36} - \frac{2(x+6)}{x^2-36}$ oe **or** $\frac{20}{(x-6)(x+6)} - \frac{2(x+6)}{(x-6)(x+6)}$ oe **or** $\frac{20(x-6)}{(x^2-36)(x-6)} - \frac{2(x+6)(x-6)}{(x^2-36)(x-6)}$ or $\frac{20-2(x+6)}{(x^2-36)(4-x)}$ oe		3	M1	for writing the first two fractions with a common denominator (may be a single denominator) or multiplying both fractions by $\frac{1}{4-x}$ and writing over a common denominator
	eg $\frac{8-2x}{x^2-36} \times \frac{1}{4-x}$ **or** $\frac{8-2x}{(x-6)(x+6)} \times \frac{1}{4-x}$ **or** $\frac{20x-2x^2-48}{(x^2-36)(x-6)} \times \frac{1}{4-x}$ oe $\frac{8-2x}{(x^2-36)(4-x)}$ oe			M1	for simplifying first 2 fractions to a single fraction and expanding and simplifying numerator – must be correct, and showing intention to multiply by $\frac{1}{4-x}$ or expanding the numerator of the full solution and writing as a single fraction
		$\frac{2}{x^2-36}$		A1	oe eg $\frac{2}{(x-6)(x+6)}$
					Total 3 marks

Proof

15	E.g. $n, n+1, n+2$ $(n^2 =)n^2$ $((n+1)^2 =)n^2+n+n+1=n^2+2n+1$ oe $((n+2)^2 =)n^2+2n+2n+4=n^2+4n+4$ oe or E.g. $n-1, n, n+1$ $((n-1)^2 =)n^2-n-n+1=n^2-2n+1$ oe $(n^2 =)n^2$ $((n+1)^2 =)n^2+n+n+1=n^2+2n+1$ oe		3	M1 for 3 appropriate terms for their 3 numbers **and** for correctly finding the expansion of at least 2 squares (Allow 2 × middle number + 2)
	$n^2+n^2+2n+2n+4\,(=2n^2+4n+4)$ oe and $2(n+1)^2=2n^2+2n+2n+2(=2n^2+4n+2)$ oe or $n^2-2n+1+n^2+2n+1\,(=2n^2+2)$ oe			M1 for finding the sum of first and last square **and** double the square of the middle (Allow 2 × middle number + 2)
	E.g. $2n^2+4n+4=2n^2+4n+2+2$ oe or $2(x+1)^2+2=2(x+1)^2+2$ oe or $2n^2+2=2n^2+2$ oe	Complete proof		A1 for conclusion from two correct expressions e.g. $2n^2+4n+4$ **and** $2n^2+4n+2$
				Total 3 marks

Percentage Change

4	0.07 × 10 800 (= 756) oe 10 800 + '756'	11 556	3	M1 M1 A1	M2 for 1.07 × 10 800 oe

Constructions

2	Two pairs of intersecting arcs with equal radius centre D and E			M1 for 2 pairs of arcs that intersect within guidelines **or** correct perpendicular bisector without arcs.	
		Correct bisector with arcs	2	A1	
				Total 2 marks	

5		Fully correct angle bisector with all relevant arcs shown	2	B2	Fully correct angle bisector with all arcs shown. B1 for all arcs and no angle bisector drawn or for a correct angle bisector within guidelines but not arcs or insufficient arcs
					Total 2 marks

Transformations of Shapes

5	(a)	vertices at (–9, 6) (–9, 9) (–3, 9) (–6, 6)	Shape in correct position	2	B2	B1 for congruent shape in correct orientation but wrong position **or** quadrilateral with 2 or 3 vertices correct.
	(b)	vertices at (7, 3) (10, 6) (13, 6) (13, 3)	Shape in correct position	1	B1	
	(c)		enlargement scale factor 2 centre (– 3, 3)	3	B1 B1 B1	for enlargement, enlarge, etc so long as no mention of rotation, reflection or translation, flip, move etc. SF 2, double, two times etc. (– 3, 3) stated. Accept about, from etc. with no mention of line, or column vector.
						Total 6 marks

Similar Shapes Linear

6	(a)	$\frac{15}{6}$ **or** $\frac{6}{15}$ **or** $\frac{4.2}{6}$ **or** $\frac{6}{4.2}$ oe 2.5 **or** 0.4 **or** 0.7 **or** 1.4(2857.....)			M1 for a correct scale factor, accept ratio notation eg 6 : 15
			10.5	2	A1 oe
	(b)	19.5 ÷ 2.5 **or** 19.5 × 0.4 oe **or** $4.2\times\frac{19.5}{(a)}$			M1 If using *DF* ft their answer from part (a)
			7.8	2	A1 oe
					Total 4 marks

Prisms and Cylinders

Volume = $\frac{5\times12}{2}\times15$ Mass = $\frac{5\times12}{2}\times15\times6.6$	2970	3	M1 $\frac{5\times12}{2}\times15$ (=450) M1 (dep on 1st M1) '450'×6.6 A1 cao SC: If no marks awarded then award B1 for an answer of 5940

Circle Theorems – chords

16	(a)	$x(x+4)=12(12+x)$	Shown	3	M1	
		$x^2+4x=144+12x$			M1	for at least one correct expression
					A1	for completion
	(b)	$x=\frac{--8\pm\sqrt{(-8)^2-4\times1\times(-144)}}{2}$ or $\frac{8\pm\sqrt{8^2-4\times1\times(-144)}}{2}$ or $\frac{8\pm\sqrt{-8^2-4\times1\times(-144)}}{2}$	20.6	4	M1	M1 for correctly substituting into the quadratic formula condone one sign error in substitution; allow partial correct evaluation
		$\frac{8\pm\sqrt{640}}{2}$ **or** $\frac{--8\pm\sqrt{(-8)^2--576}}{2\times1}$ **or** $\frac{8\pm8\sqrt{10}}{2}$ NB denominator must be 2×1 or 2 **and** there must be evidence for correct order of operations in the numerator Allow + instead of ± in the formula			M1	If the first M1 is awarded and an answer of 16.6.... or $4+4\sqrt{10}$ seen award this M mark
					A1	(dep on M1) 16.6....
					B1	(dep on M1) 20.6 - 20.65 ft
						Total 7 marks

Compound Percentages

10		150000 x 0.82^3		3	M2	If not M2 then M1 for 1st year e.g 150000 x 0.82 (= 123000) or 150000 x 0.18 (= 27000) SC B1 for 150000 x 1.18 (= 177000) or 150000 x 1.18^3 (= 246454.8)or 150000 x 0.54 (=81000) or 150000 x 0.46 (= 69000)
			82705		A1	Accept 82705.2
						Total 3 marks