EDUCATION SOUTH WEST

KING EDWARD VI
COMMUNITY COLLEGE

**Year 12
Induction task**

Name: _____

Induction Task

The aim of this task is to 'bridge the gap' between GCSE and A-level Mathematics.

There are two levels of questions, GCSE and AS level.

- Complete all of the GCSE questions. Use the mark scheme to mark these in **purple pen**, when you have finished. You should spend approximately 3 hours on this
- Complete as many as you can of the AS level questions. Some of these are tricky, but some of them are no more difficult than the GCSE questions. Those doing Further Maths should attempt all of these.
- Students should use purple pen to comment on what went well and what they need to improve on and complete the grid at the front of the booklet
- During the third week, you will be given an **induction test** based on these types of questions

Deadline: Friday 12th September 2025

Learning = a change in long-term memory

'if nothing has changed nothing has been learned'

Meaningful learning is about producing organised, coherent and integrated mental models that allow people to make inferences and apply their knowledge. (Karpicke, J. 2012)

THE BENEFITS:

① Retrieval practice aids later retention
'every time you retrieve a memory it becomes deeper, stronger and easier to access in the future'

② Testing identifies gaps in knowledge

③ Testing causes students to learn more from the next learning episode

④ Testing produces better organisation of knowledge

⑤ Testing improves transfer of knowledge to new contexts

⑥ Facilitates retrieval of material that wasn't tested

⑦ Improves metacognition

⑧ Prevents interference from previous material when learning new content

⑨ Provides valuable feedback to teachers

⑩ Regular testing encourages students to study more

Exemplar marking

<u>PURE: Surds and indices</u>

Q1.(a)   Circle the value of 3^{-2}

-6 $\dfrac{1}{6}$ $\boxed{\dfrac{1}{9}}$ -9

① ✓ **(1)**

(b)   Work out the value of $(-8)^0 + 8^{-\frac{2}{3}}$

$$8^{-2/3} = \left(8^{1/3}\right)^{-2}$$

$$= 2^{-2}$$

$$= \frac{1}{4} \quad \checkmark \qquad \qquad ①$$

$$(-8)^0 + 8^{-2/3} = 0^+ + \frac{1}{4}$$

$$= \frac{1}{4}$$

Answer .... $\frac{1}{4}$ .... ✗

(3)
(Total 4 marks)

GCSE: Surds and indices

Question number	Topic	Estimated number of marks		Comment
1	Negative and fractional indices	2	Total 4	Correct negative & fractional indices but forgot $(-8)^0 = 1$.

GCSE: Surds and indices

Question number	Topic	Estimated number of marks		Comment
1	Negative and fractional indices		Total 4	
2	Negative and fractional indices		Total 3	
3	Simplifying indices		Total 5	
4(a)	Simplifying indices		Total 1	
4(b)	Expand and simplify surds		Total 2	
4(c)	Negative and fractional indices		Total 3	
5	Simplify surds		Total 3	
6	Rationalise the denominator		Total 2	
7	Exact trig values and simplifying surds		Total 3	

GCSE: Factorising, expanding and solving equations

Question number	Topic	Estimated number of marks		Comment
8	Factorise $ax^2 + bx$		Total 2	
9	Solving simultaneous equations; two linear		Total 3	
10	Expand and simplify triple brackets		Total 3	
11	Factorise $ax^2 + bx + c$		Total 2	
12	Simplify algebraic fractions		Total 3	
13	Solve equations with algebraic fractions		Total 5	
14	Solve simultaneous equations; one linear, one quadratic		Total 2	
15	Complete the square		Total 4	

16(a)	Complete the square $ax^2 + bx + c$		Total 3	
16(b)	Solve by completing the square		Total 3	
17	Rearrange equations when the variable appears twice		Total 3	

GCSE: Linear graphs

Question number	Topic	Estimated number of marks		Comment
18	Finding the equation of parallel lines		Total 3	
19	Finding the equation of perpendicular lines		Total 4	
20	Finding the equation of a tangent to a circle		Total 5	

GCSE: Sequences and functions

Question number	Topic	Estimated number of marks		Comment
21	Finding the nth term		Total 2	
22	Finding the inverse function		Total 1	
23	Composite functions		Total 3	

GCSE: Trigonometry and proof

Question number	Topic	Estimated number of marks		Comment
24	Transformations of trig graphs		Total 2	
25	Algebraic proof		Total 4	
26	Right-angle trig		Total 4	

GCSE: Sectors

Question number	Topic	Estimated number of marks		Comment
27	Arc length		Total 2	
28(a)	Area of a sector		Total 3	
28(b)	Area of a segment		Total 3	

GCSE: Statistical diagrams and probability

Question number	Topic	Estimated number of marks		Comment
29(a)	Cumulative frequency		Total 4	
29(b)	Box plots		Total 3	
30	Histograms		Total 4	
31	Venn diagrams and probability		Total 5	
32	Conditional probability		Total 3	
33	Probability reasoning		Total 4	

GCSE: Speed-time graphs

Question number	Topic	Estimated number of marks		Comment
34	Area under a graph		Total 5	
35(a)	Area under a curved graph		Total 4	
35(b)	Gradient of a tangent		Total 3	

AS level: Trigonometry

Question number	Topic	Estimated number of marks		Comment
36(a)	Pythagoras' theorem and trigonometry		Total 6	
36(b)	Area of a triangle using trigonometry		Total 3	
37	Cosine rule and area of a triangle		Total 5	

AS level: Algebra and graphs

Question number	Topic	Estimated number of marks		Comment
38	Rearranging formula		Total 2	
39	Rearranging formula when the variable appears twice		Total 4	
40	Finding the equation of a parallel line		Total 5	
41	Transformations of graphs		Total 4	
42	Transformations of graphs		Total 4	
43	Finding the points of intersection of two lines		Total 4	

AS level: Surds and indices

Question number	Topic	Estimated number of marks		Comment
44	Evaluate fractional and negative indices		Total 4	
45	Evaluate fractional indices and simplify expressions		Total 5	
46	Expand and simplify surds		Total 5	

AS level: Inequalities

Question number	Topic	Estimated number of marks		Comment
47	Solve linear algebraic inequalities		Total 3	
48	Solve quadratic inequalities		Total 3	

AS level: Quadratics and their graphs

Question number	Topic	Estimated number of marks	Comment
49	Algebraic Pythagoras & solving quadratics	Total 5	
50(a)	Complete the square and find the minimum	Total 4	
50(b)	Sketch a quadratic showing points of intersection	Total 4	
51	Complete the square and find the minimum	Total 5	
52	Interpreting quadratic graphs and their equations	Total 8	
53(i)	Sketching a cubic	Total 3	
53(ii)	Expanding triple brackets	Total 2	
53(iii)	Describe a graphical transformation	Total 2	

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AS level: Proof

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Question number	Topic	Estimated number of marks		Comment
54	Factorise cubic and use it to prove		Total 3	
55	Proof of consecutive integer		Total 4	

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AS level: Statistics and probability

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Question number	Topic	Estimated number of marks		Comment
56(i)	Drawing a cumulative frequency curve		Total 5	
56(ii)	Finding the median and IQR		Total 3	
57(i)	Drawing a probability tree		Total 3	
57(ii)&(iii)	Find probabilities from a probability tree		Total 5	
58(i)&(ii)	Conditions of independent events		Total 3	

58(iii)	Drawing a Venn diagram		Total 3	
59	Interpreting a Venn diagram		Total 5	

AS level: Kinematic graphs

Question number	Topic	Estimated number of marks		Comment
60	Interpreting velocity-time graphs		Total 6	

GCSE: Surds and indices

Q1.(a)   Circle the value of 3^{-2}

$$-6 \qquad \frac{1}{6} \qquad \frac{1}{9} \qquad -9$$

(1)

(b)   Work out the value of $(-8)^0 + 8^{-\frac{2}{3}}$

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Answer ....

(3)
(Total 4 marks)

Q2. Express $\dfrac{1}{\sqrt[3]{x^2}}$ in the form x^a

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Answer ....

(Total 3 marks)

Q3.(a) Simplify fully $\dfrac{w^3 \times w^4}{w^2}$

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Answer ....

(1)

(b)   Simplify fully $2x^2y^3 \times 4xy^2$

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        Answer ....

(2)

(c)   Simplify fully $12a^4b^5 \div 2a^2b$

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        Answer ....

(2)
(Total 5 marks)

Q4.(a) Simplify fully $\dfrac{m^3 \times m^5 \times m}{m^2 \times m^4}$

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        Answer ....

(1)

(b) Expand and simplify $(3 + \sqrt{2})(5 - \sqrt{2})$

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        Answer ....

(2)

  (c) Work out the value of $25^{-\frac{1}{2}} \times 81^{\frac{3}{4}}$

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        Answer ....

(3)
(Total 6 marks)

Q5. (a) Simplify fully $\sqrt{72}$

Circle your answer.

$36\sqrt{2}$ $3\sqrt{8}$ $6\sqrt{2}$ $2\sqrt{18}$

(1)

(b) Given that $p = \sqrt{3}$ $q = \sqrt{8}$ and $r = \sqrt{6}$

work out the value of $\dfrac{pq}{r}$

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Answer ....

(2)
(Total 3 marks)

Q6. Rationalise the denominator and simplify $\dfrac{10}{3\sqrt{5}}$

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Answer ....

(Total 2 marks)

Q7.

Show that $12 \cos 30° - 2 \tan 60°$ can be written in the form $\sqrt{k}$

where k is an integer.

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(Total 3 marks)

GCSE: Factorising, expanding and solving equations

Q8. Factorise fully $6x^2 - 14x$

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Answer ....

(Total 2 marks)

Q9.

Solve the simultaneous equations

$$2x - 3y = 24$$

$$6x + 2y = -5$$

Do **not** use trial and improvement.
You **must** show your working.

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Answer ....

(Total 3 marks)

Q10.

Expand and simplify $(t + 4)^3$

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Answer...

(Total 3 marks)

Q11.

Factorise $3x^2 + 14x + 8$

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Answer ....

(Total 2 marks)

Q12. Simplify $\dfrac{4x^2 - 1}{4x^2 + 12x + 5}$

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Answer ....

(Total 3 marks)

Q13. Solve $\dfrac{6}{x-2} - \dfrac{2}{x+3} = 1$

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Answer ....

(Total 5 marks)

Q14.

Solve the simultaneous equations

$$4x + y = -3 \quad \text{and} \quad y = x^2 + 2x + 5$$

Do **not** use trial and improvement.
You **must** show your working.

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Answer ....

(Total 6 marks)

Q15.(a) $x^2 + ax + b \equiv (x - 3)^2 - a$ where a and b are integers.

Work out the values of a and b.

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a = ... b = ...

(3)

(b)   Circle the smallest possible value of $(x - 7)^2 + 2$

        -7 -2 2 7

(1)
(Total 4 mark)

Q16.

$2x^2 - 6x + 5$ can be written in the form $a(x - b)^2 + c$

where a, b and c are positive numbers.

(a)   Work out the values of a, b and c

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                                a = ...

                                b = ...

                                c = ...

(3)

(b)   Using your answer to part (a), or otherwise, solve $2x^2 - 6x + 5 = 8.5$

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Answer ....

(3)
(Total 6 marks)

Q17. Make x the subject of $y = \dfrac{8 - 3x}{4x + 9}$

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Answer ....

(Total 4 marks)

GCSE : Linear graphs

Q18.

The line $y = mx + c$ passes through the point (4, 3).
It is parallel to the line $y = 5x + 6$

Work out the values of m and c.

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m = ..., c = ...

(Total 3 marks)

Q19.

The gradient of line *OR* is $\frac{7}{4}$

PQ is perpendicular to *OR*.
P is the point (14, 0).

Not drawn accurately
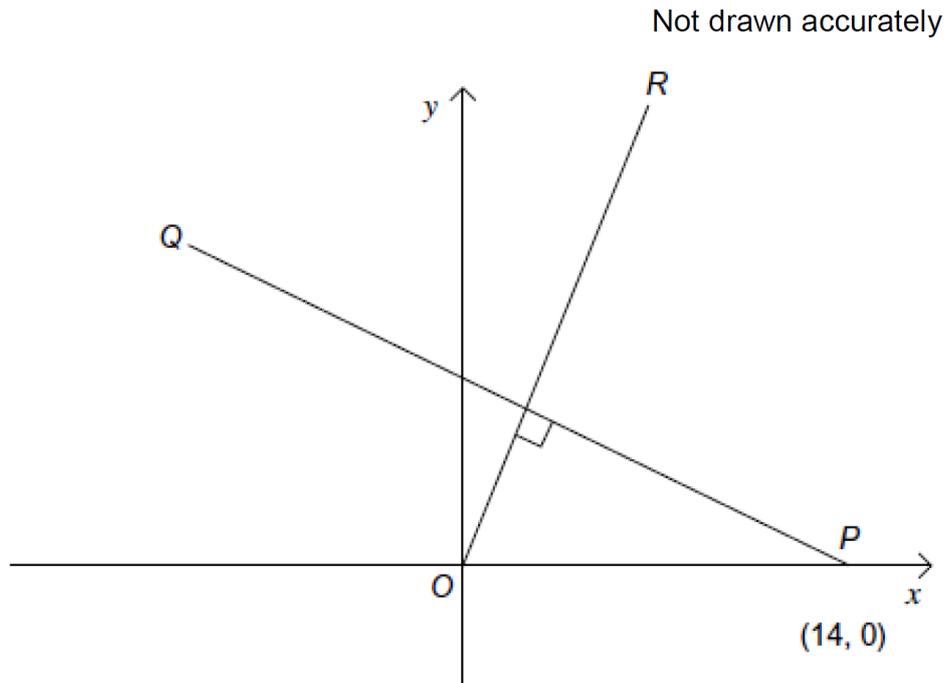
Work out the equation of line *PQ*.
Give your answer in the form $ax + by = c$, where a, b and c are integers.

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Answer ....

(Total 4 marks)

Q20.

The diagram shows the circle $x^2 + y^2 + 10$

P lies on the circle and has x-coordinate 1

The tangent at P intersects the x-axis at Q.

Not drawn accurately
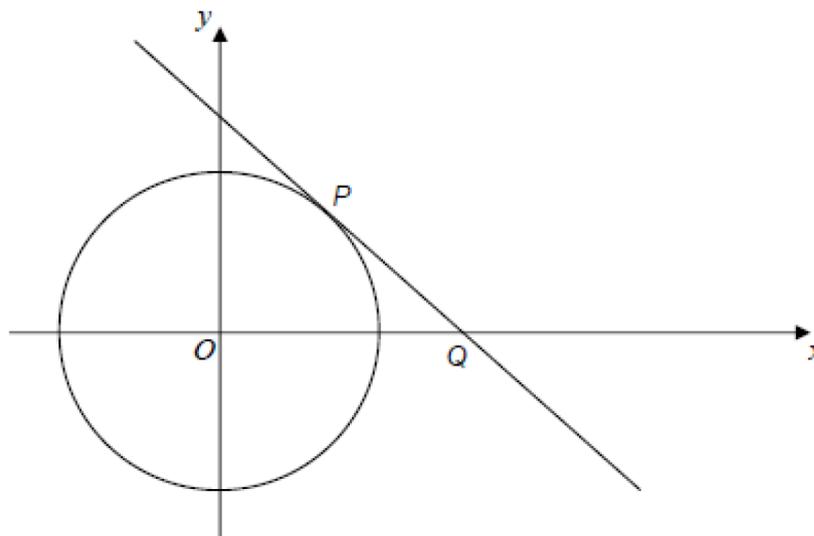
Work out the coordinates of Q.

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

(Total 5 marks)

Q21.

(a) The nth term of a sequence is $2^n + 2^{n-1}$

Work out the 10th term of the sequence.

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Answer ....

(1)

(b) The nth term of a different sequence is $4(2^n + 2^{n-1})$

Circle the expression that is equivalent to $4(2^n + 2^{n-1})$

$$2^{n+2} + 2^{n+1} \qquad\qquad 2^{2n} + 2^{2(n-1)}$$

$$8^n + 8^{n-1} \qquad\qquad 2^{n+2} + 2^{n-1}$$

(1)
(Total 2 marks)

Q22.

$f(x) = 3x$

Circle the expression for $f^{-1}(x)$

$$-3x \qquad\qquad \frac{3}{x} \qquad\qquad \frac{1}{3x} \qquad\qquad \frac{x}{3}$$

(Total 1 mark)

Q23.

$f(x) = 2x + c$

$g(x) = cx + 5$

$fg(x) = 6x + d$

c and d are constants.

Work out the value of d.

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Answer ....

[Total 3 marks]

GCSE: Trigonometry and proof

Q24. The graph of $y = \sin x$ for $0° \leq x \leq 360°$ is shown.
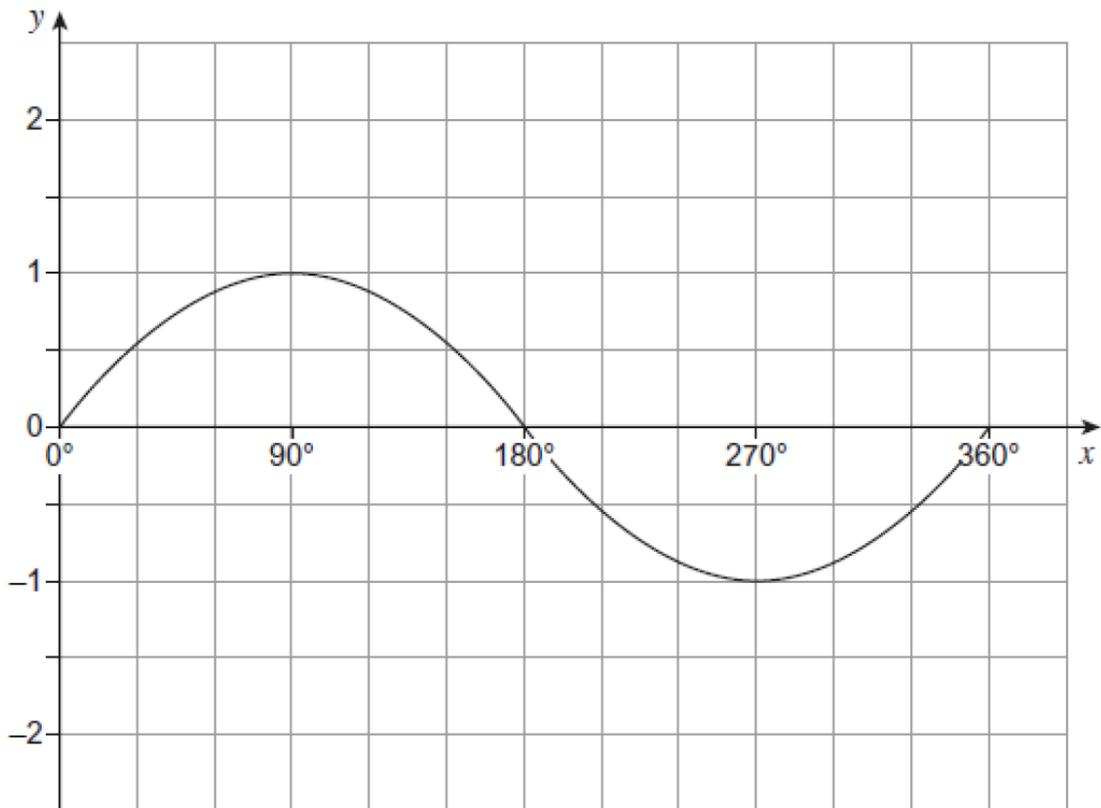
(a)   On the grid below, draw the graph of $y = 1 + \sin x$ for $0° \leq x \leq 360°$

The graph of $y = \sin x$ is shown to help you.
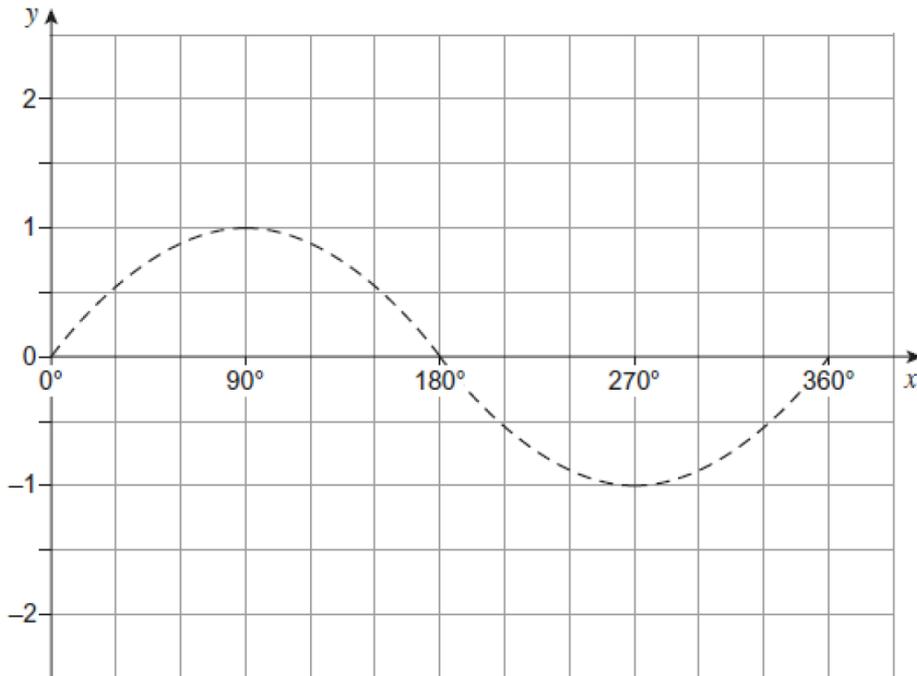
(1)

(b)   On the grid below, draw the graph of $y = \sin (x + 90°)$ for $0° \leq x \leq 360°$

The graph of $y = \sin x$ is shown to help you.
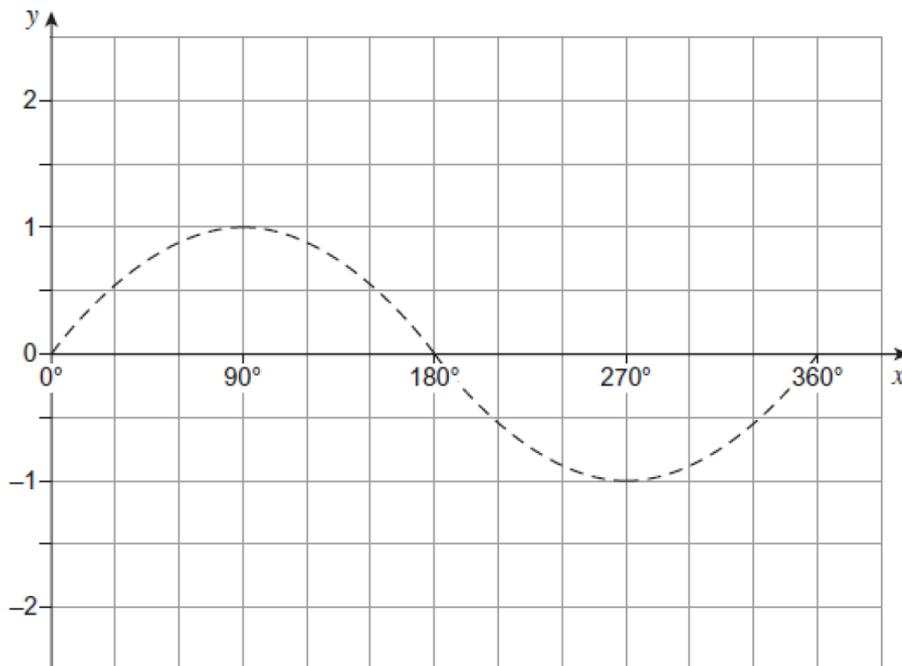
(1)
(Total 2 marks)

Q25. The square number sequence is

1   4   9   16   25   ......

Prove algebraically that the difference of two consecutive square numbers is an odd number.

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(Total 4 marks)

Q26.
The diagram shows a design for a zipwire.

The zipwire will run between the top of two vertical posts, *AB* and *CD*.
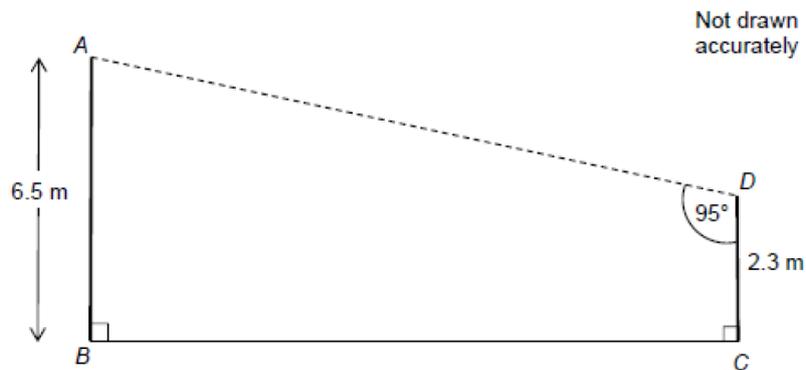
Work out the distance *AD*.

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Answer .... m

(Total 4 marks)

GCSE: Sectors

Q27. *OAB* is a sector of a circle of radius 12 cm
Angle *AOB* = 60°

Not drawn accurately
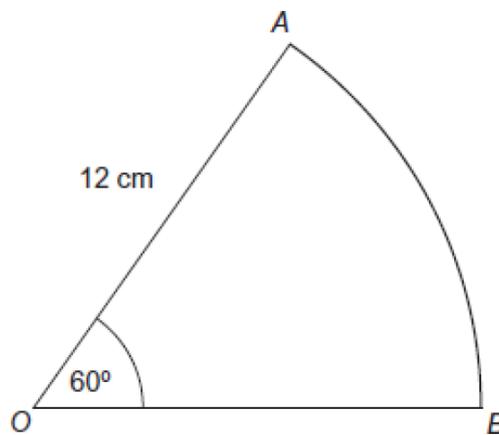
Work out the length of the arc *AB*.
Give your answer in terms of π.

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Answer .... cm

(Total 2 marks)

Q28. The diagram shows a sector of a circle with radius 9.2 cm

Not drawn accurately

125°

9.2 cm
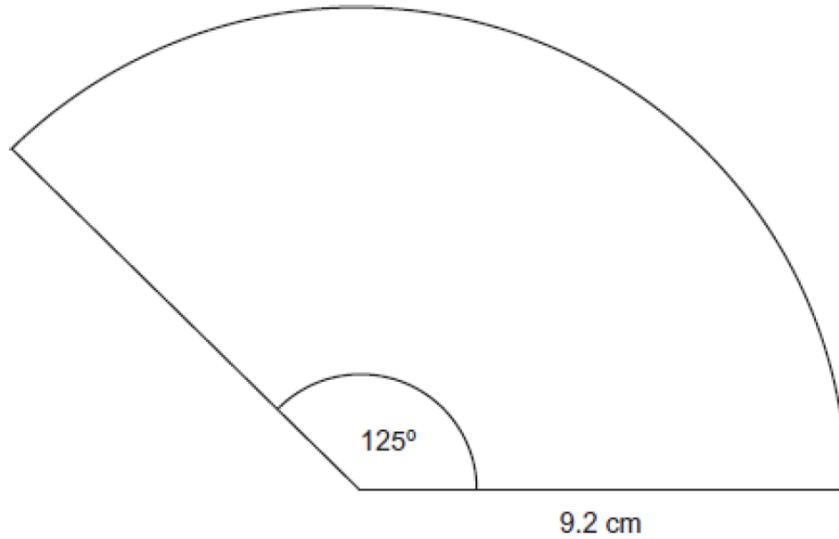
(a)   Work out the area of the sector.

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Answer .... cm²

(3)

(b)   Work out the area of the shaded segment.

Not drawn accurately

125°

9.2 cm

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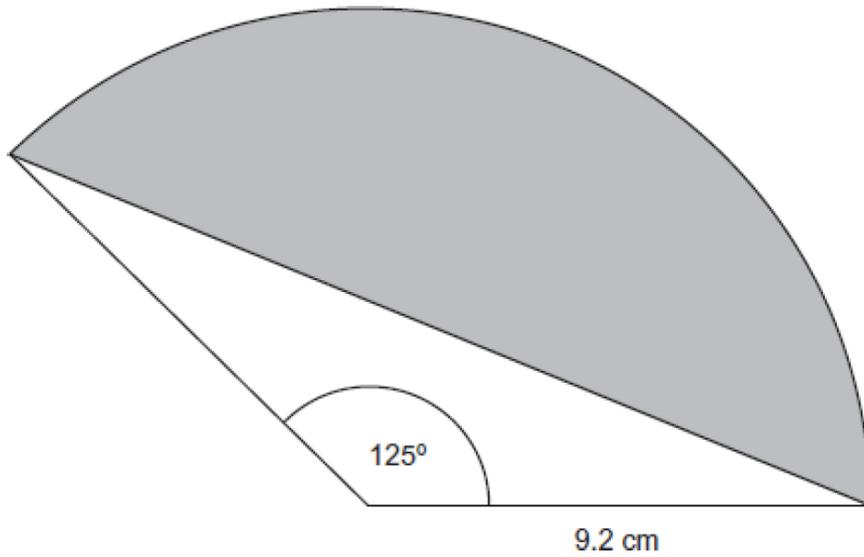
Answer .... cm²

(3)
(Total 6 marks)

GCSE: Statistical diagrams and probability

Q29.

The table shows information about the ages of 100 rugby supporters.

Age, a (years)	Frequency	
$5 \leq a < 15$	12	
$15 \leq a < 20$	11	
$20 \leq a < 40$	25	
$40 \leq a < 55$	39	
$55 \leq a < 70$	13	

(a)   Plot a cumulative frequency diagram for the data.
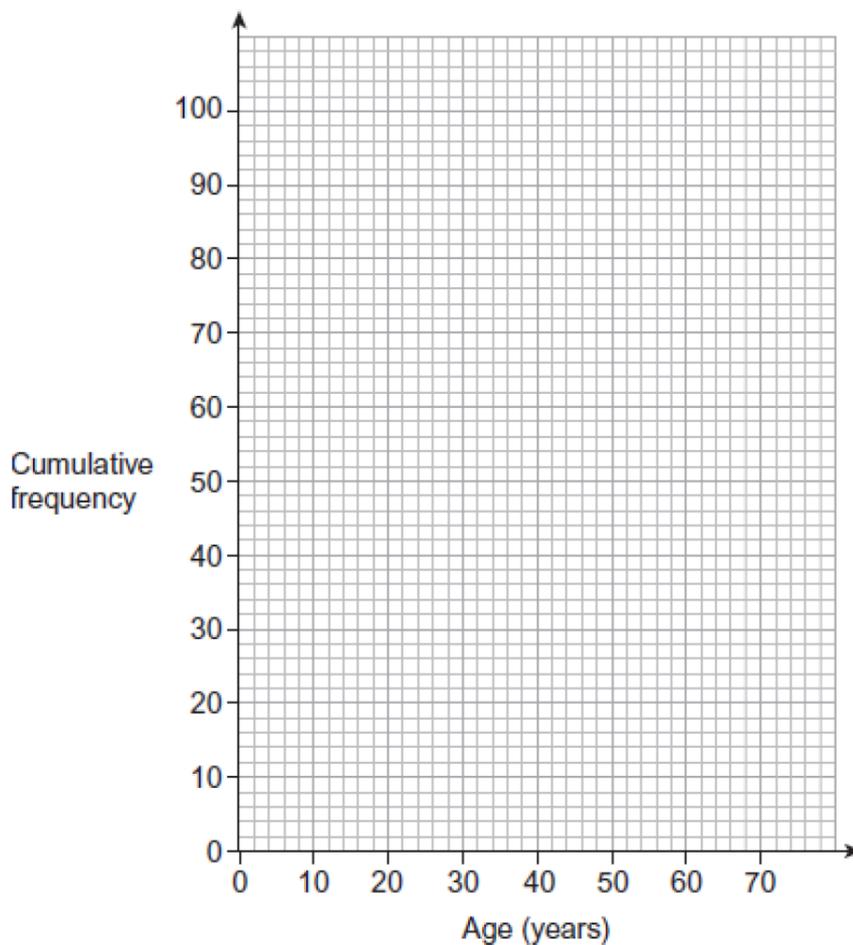
(4)

(b)   The youngest supporter is 8 years old.
The oldest supporter is 69 years old.

Draw a box plot for the data.

Age (years)
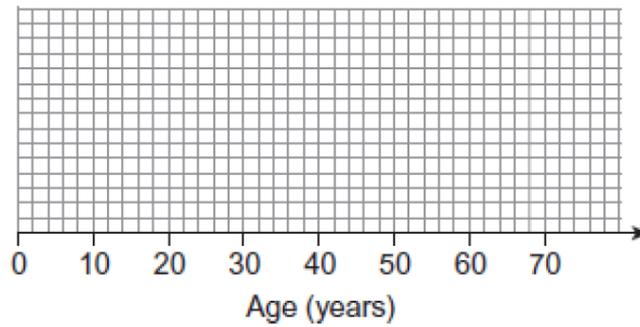
(3)
(Total 7 marks)

Q30. The table and histogram show some information about the cholesterol level in the blood of 100 hospital patients.

Cholesterol level, c	Frequency
$0 < c \leq 2$	8
$2 < c \leq 3$	13
$3 < c \leq 4$	
$4 < c \leq 5$	19
$5 < c \leq 7$	
$7 < c \leq 10$	15
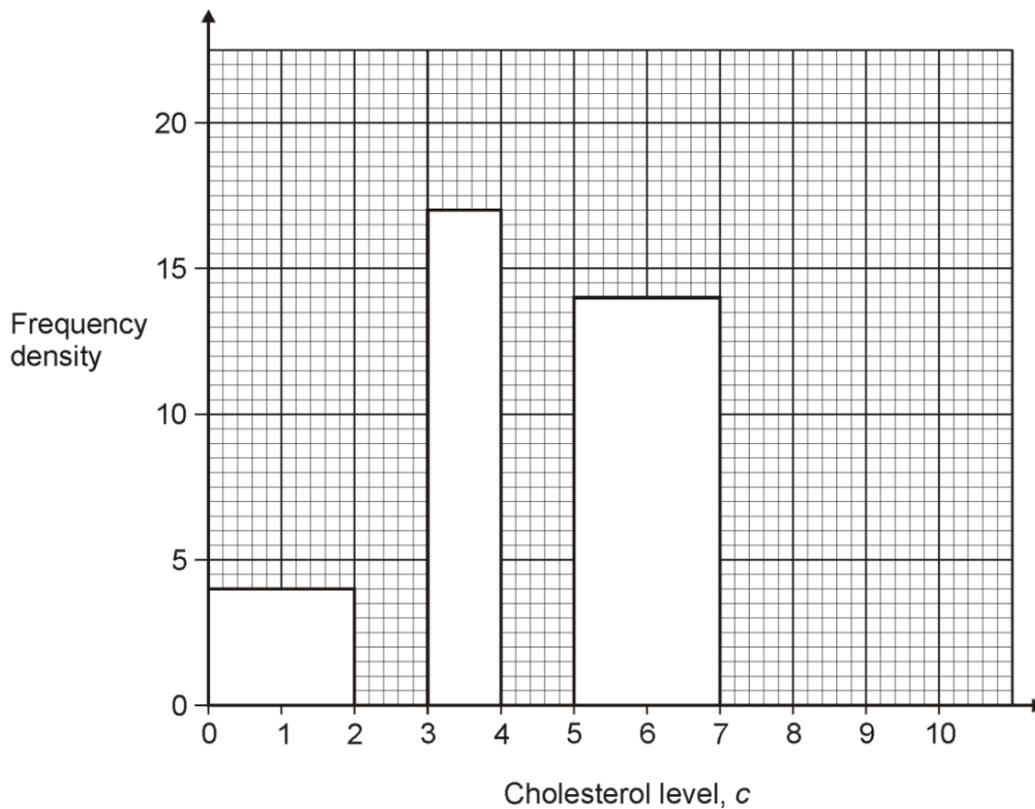
(a)   Use the table to complete the histogram.

(2)

(b)   Use the histogram to complete the table.

(2)
(Total 4 marks)

Q31.

Here is a Venn diagram.
It shows information about the number of students who have a laptop or a TV.

Set L represents students with a laptop.
Set T represents students with a TV.
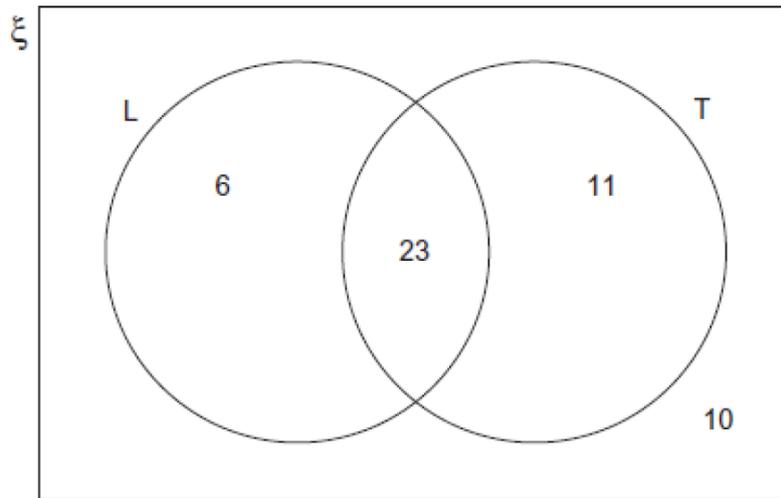
There are 50 students altogether.

A student is chosen at random.

(a)   Work out P(L).

Answer ....

(1)

(b)   Work out P(L ∩ T).

Answer ....

(1)

(c)   Complete the following using set notation.

P(.........................) = $\dfrac{21}{50}$

(1)

(d)   Complete the following using set notation.

P(.........................) = $\dfrac{4}{5}$

(2)
(Total 5 marks)

Q32. A bag contains 10 counters.
4 of the counters are black and 6 are white.

Two counters are picked at random.

Work out the probability that they are both black.

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Answer ....

(Total 3 marks)

Q33.

Bag X contains 9 blue balls and 18 red balls.

Bag Y contains 7 blue balls and 14 red balls.

Liz picks a ball at random from bag X.

She puts the ball into bag Y.

Mike now picks a ball at random from bag Y.

Show that

P (Liz picks a blue ball) = P (Mike picks a blue ball)

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(Total 4 marks)

GCSE: Speed-time graphs

Q34.

The distance around a cycle track is 400 metres.

Robin cycles on the track.
Here is his speed-time graph.
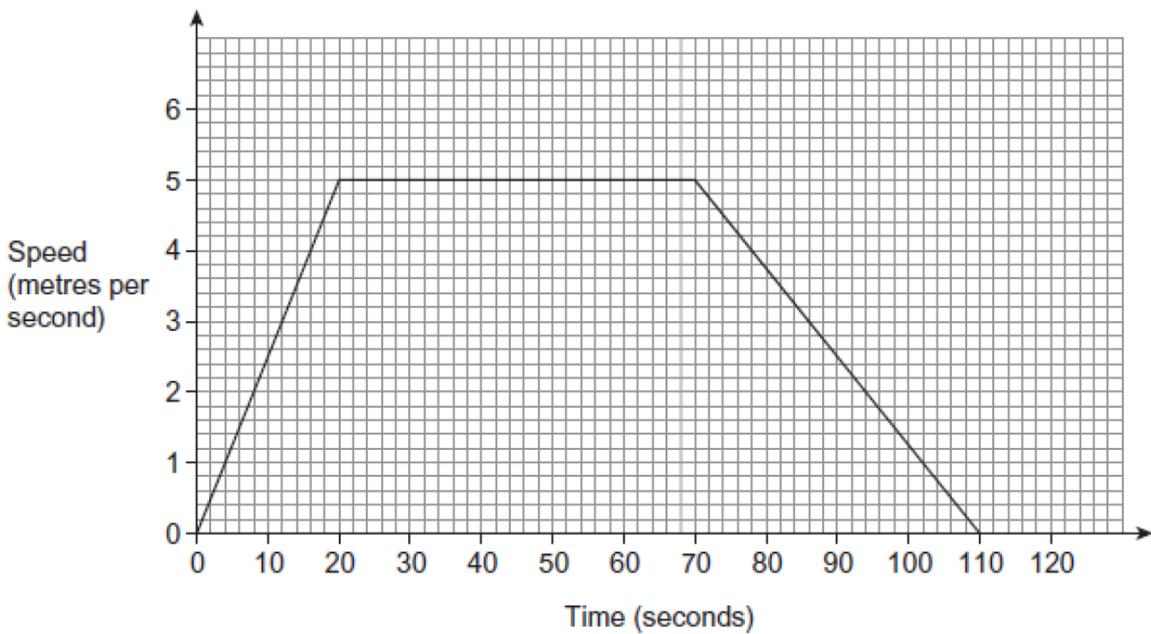
(a) Show that Robin cycles **exactly** once around the track in 110 seconds.

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(2)

(b)   Sanjay cycles on the same track.

Here is his speed-time graph.
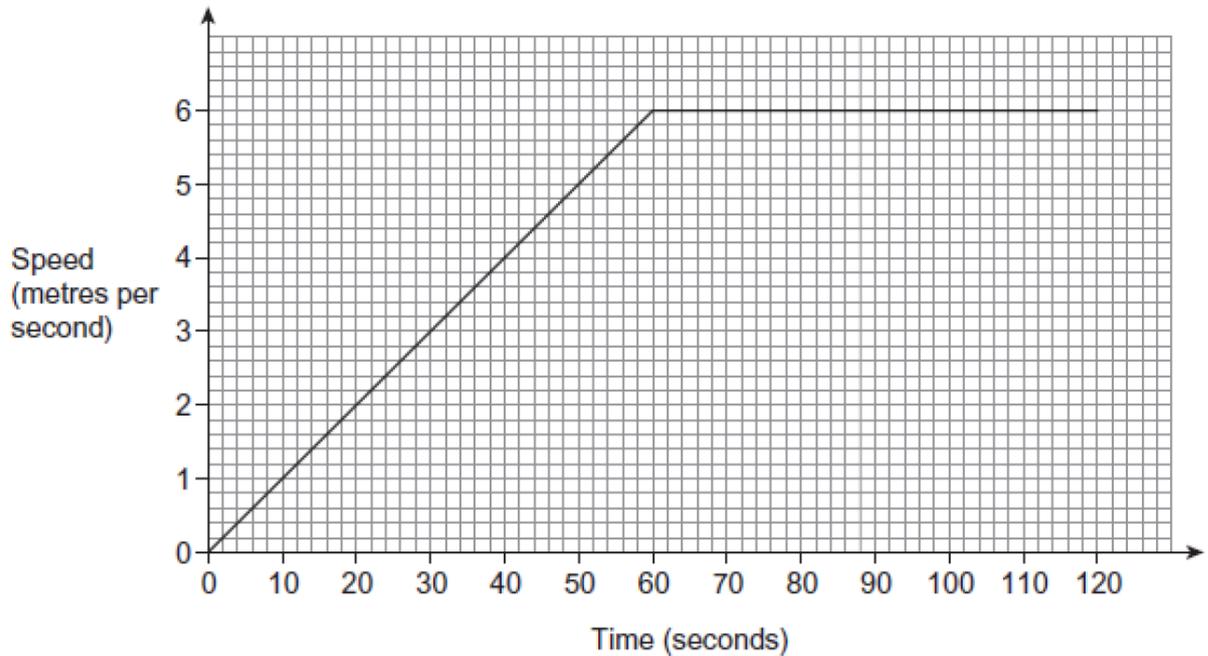
Does Sanjay cycle the first 400 metres in a quicker time than Robin?
You **must** show your working.

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(3)
(Total 5 marks)

Q35.
The graph shows the speed of a snowboarder for 2 minutes.
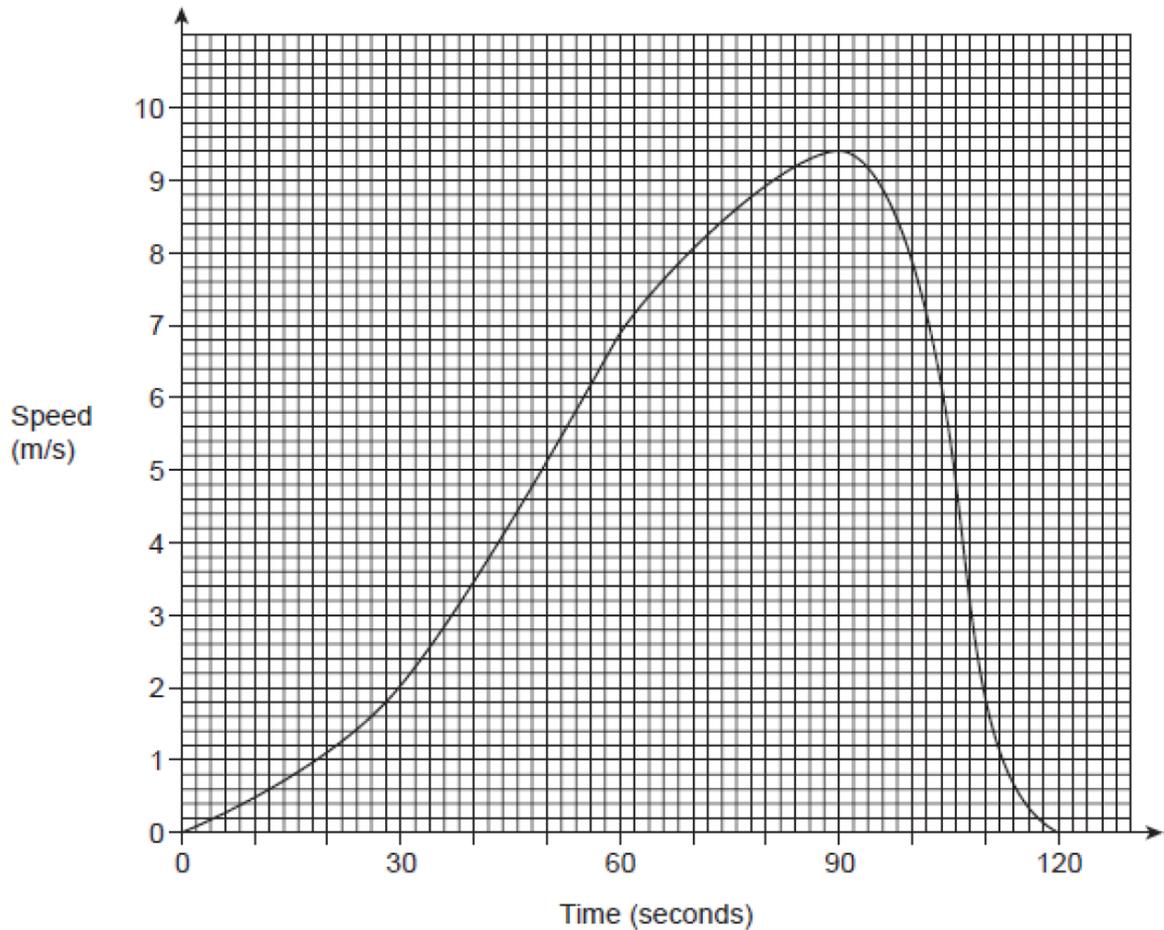
(a)   Estimate the distance travelled by the snowboarder.
State the units of your answer.

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            Answer ....

(4)

(b)   Work out the gradient of the graph at 70 seconds.

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      Answer .... m/s²

(3)
(Total 7 marks)

AS level: Trigonometry

Q36.

Fig. 10.1 shows Jean's back garden. This is a quadrilateral ABCD with dimensions as shown.

Not to scale
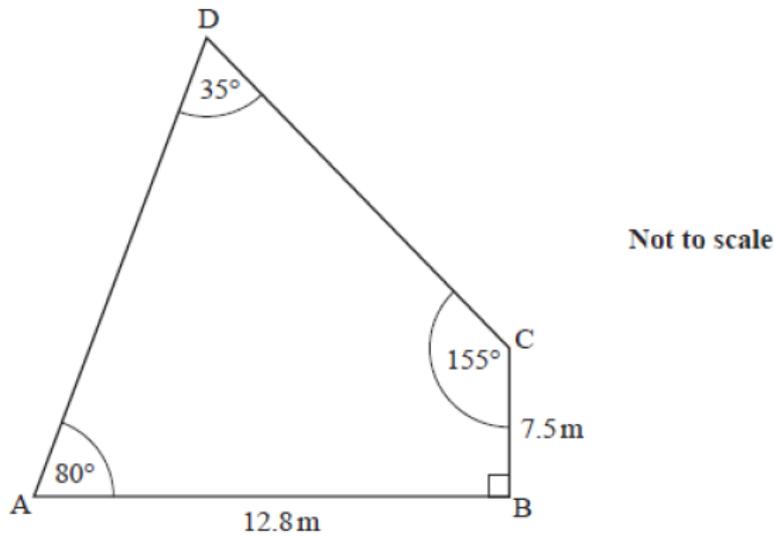
Fig. 10.1

(a) Calculate AC and angle ACB. Hence calculate AD

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(6)

(b) Calculate the area of the garden

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(3)
(Total 9 marks)

Q37.

Fig. 7 shows a sketch of a village green ABC which is bounded by three straight roads. AB = 92 m, BC = 75 m and AC = 105 m.
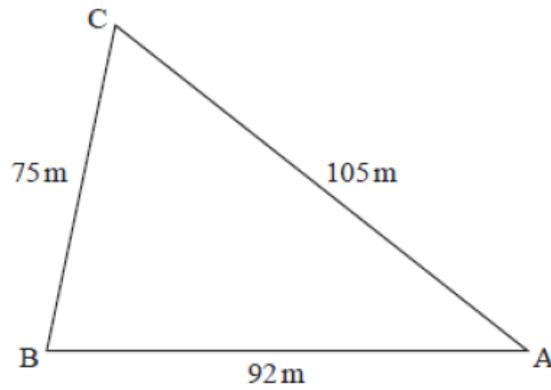
Fig. 7

Calculate the area of the village green

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(Total 5 marks)

AS level: Algebra and graphs

Q38. Make r the subject of the formula

$$A = \pi r^2 (x + y)$$

where r > 0

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(Total 2 marks)

Q39. Make x the subject of the equation

$$y = \frac{x + 3}{x - 2}$$

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(Total 4 marks)

Q40.

A line L is parallel to $y = 4x + 5$ and passes through the point (-1, 6).
Find the equation of the line L in the form $y = ax + b$
Find also the coordinates of its intersections with axis

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(Total 5 marks)

Q41. The graph below shows the graph of f(x)
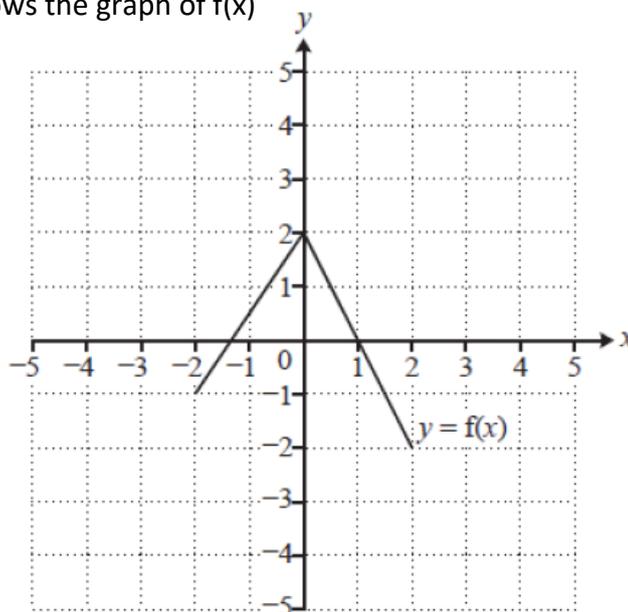
Draw the graphs of the following:
(a) $y = f(x) - 2$

(2)

(b) $y = f(x - 3)$

(2)
(Total 4 marks)

Q42.

The point R(6, -3) is on the curve $y = f(x)$

(a) Find the coordinates of the image of R when the curve is transformed to $y = \frac{1}{2} f(x)$

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(2)

(b) Find the coordinates of the image of R when the curve is transformed to $y = f(3x)$

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(2)
(Total 4 marks)

Q43.

Find the coordinates of the point of intersection of the lines $y = 5x - 2$ and $x + 3y = 8$

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(Total 4 marks)

AS level: Surds and indices

Q44.

Evaluate the following

(a) 200^0

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(b) $\left(\dfrac{25}{9}\right)^{-\frac{1}{2}}$

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(3)
(Total 4 marks)

Q45.

(a) Evaluate $\left(\dfrac{1}{27}\right)^{\frac{2}{3}}$.

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(2)

(b) Simplify fully $\dfrac{(4a^2c)^3}{32a^4c^7}$

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(3)
(Total 5 marks)

Q46.

(a) Expand and simplify $(3 + 4\sqrt{5})(3 - 2\sqrt{5})$

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(3)

(b) Express $\sqrt{72} + \dfrac{32}{\sqrt{2}}$ in the form $a\sqrt{b}$ where a and b are integers and b is as small as possible

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(2)
(Total 5 marks)

Q47. Solve the inequality $\dfrac{4x-5}{7} > 2x+1$.

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(Total 3 marks)

Q48 Solve the inequality $3x^2 + 10x + 3 > 0$.

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(Total 3 marks)

AS level: Quadratics and their graphs

Q49. Fig. 8 shows a right-angled triangle with base $2x + 1$, height h and hypotenuse $3x$.
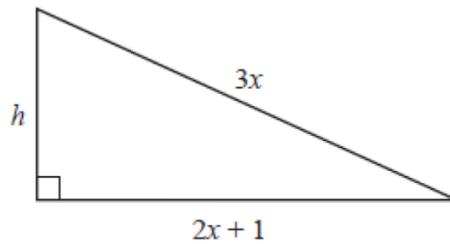
Not to scale

Fig. 8

(a)   Show that $h^2 = 5x^2 - 4x - 1$

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(2)

(b)   Given that h = $\sqrt{7}$ find the value of x, giving your answer in surd form

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(3)
(Total 5 marks)

Q50.

(a) Express $x^2 - 5x + 6$ in the form $a(x - b)^2 - c$. Hence state the coordinates of the turning point of the curve $y = x^2 - 5x + 6$

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(4)

(b) Find the coordinates of the intersection of the curve $y = x^2 - 5x + 6$ with the axes and sketch this curve

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(4)
(Total 8 marks)

Q51. Express $3x^2 - 12x + 5$ in the form $a(x - b)^2 - c$. Hence state the minimum value of y on the curve $y = 3x^2 - 12x + 5$

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(Total 5 marks)

Q52.
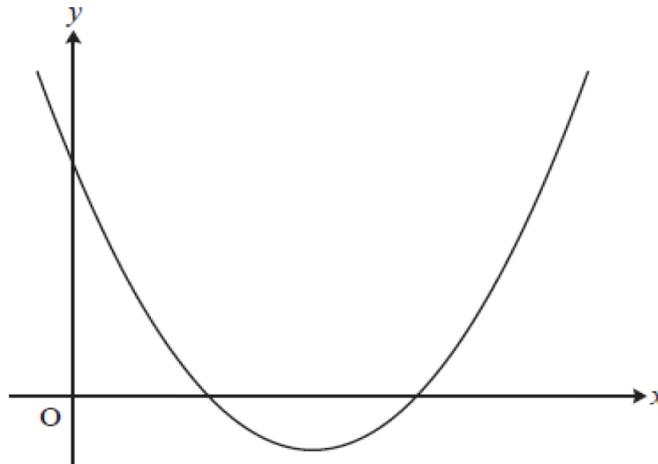
Fig. 11

Fig. 11 shows a sketch of the curve with equation $y = (x-4)^2 - 3$.

(i) Write down the equation of the line of symmetry of the curve and the coordinates of the minimum point. **[2]**

(ii) Find the coordinates of the points of intersection of the curve with the x-axis and the y-axis, using surds where necessary. **[4]**

(iii) The curve is translated by $\binom{2}{0}$. Show that the equation of the translated curve may be written as $y = x^2 - 12x + 33$. **[2]**

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Q53.

You are given that $f(x) = (x+3)(x-2)(x-5)$.

(i) Sketch the curve $y = f(x)$. [3]

(ii) Show that f(x) may be written as $x^3 - 4x^2 - 11x + 30$. [2]

(iii) Describe fully the transformation that maps the graph of $y = f(x)$ onto the graph of $y = g(x)$, where $g(x) = x^3 - 4x^2 - 11x - 6$. [2]

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Q54.

Factorise $n^3 + 3n^2 + 2n$. Hence prove that, when n is a positive integer, $n^3 + 3n^2 + 2n$ is always divisible by 6. [3]

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Q55.

$n - 1$, n and $n + 1$ are any three consecutive integers.

(i) Show that the sum of these integers is always divisible by 3. [1]

(ii) Find the sum of the squares of these three consecutive integers and explain how this shows that the sum of the squares of any three consecutive integers is never divisible by 3. [3]
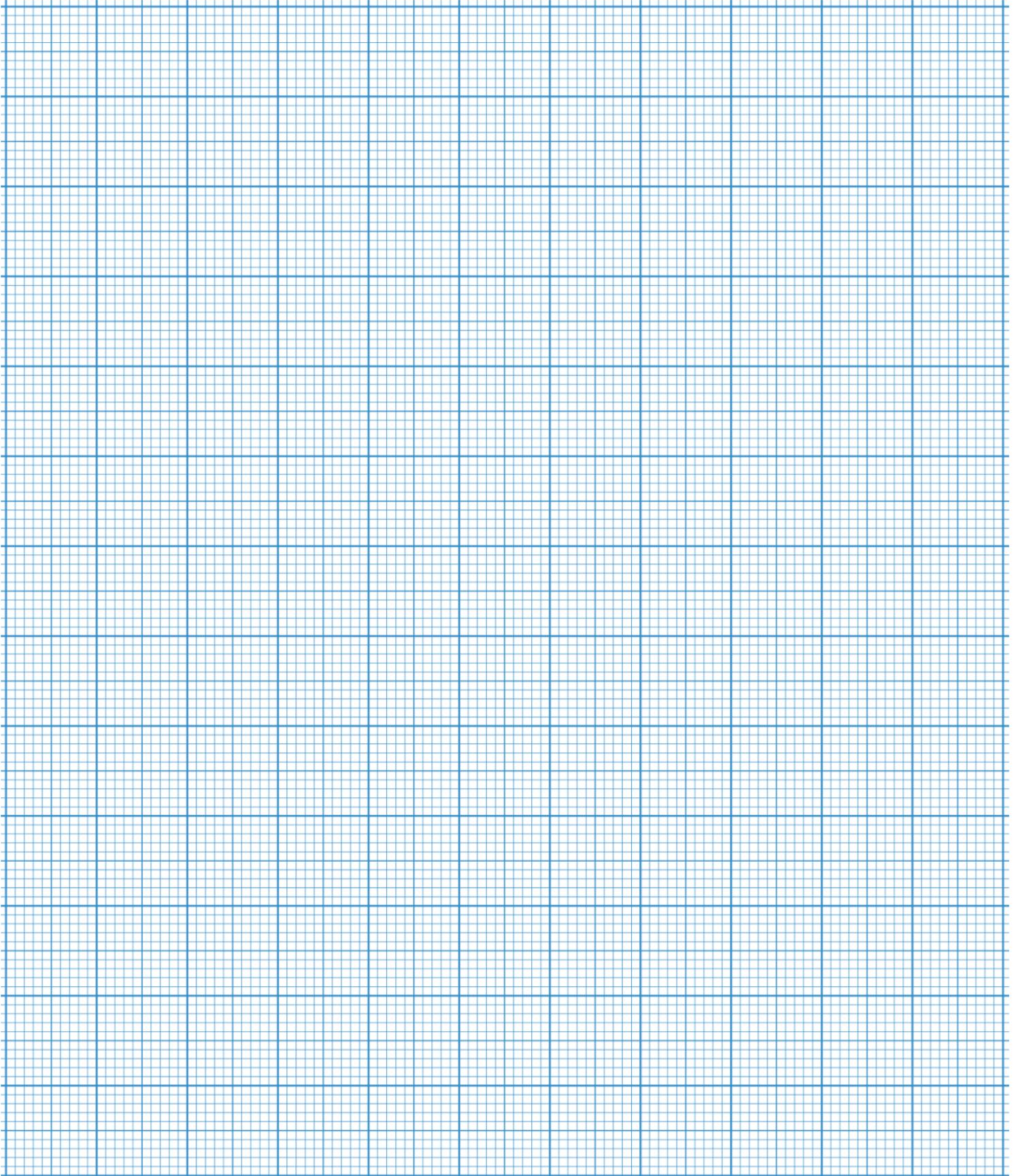
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AS level: Statistics and probability

Q56.

The ages, x years, of the senior members of a running club are summarised in the table below.

Age (x)	$20 \leqslant x < 30$	$30 \leqslant x < 40$	$40 \leqslant x < 50$	$50 \leqslant x < 60$	$60 \leqslant x < 70$	$70 \leqslant x < 80$	$80 \leqslant x < 90$
Frequency	10	30	42	23	9	5	1

(i) Draw a cumulative frequency diagram to illustrate the data. [5]

(ii) Use your diagram to estimate the median and interquartile range of the data. [3]

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Q57.

Candidates applying for jobs in a large company take an aptitude test, as a result of which they are either accepted, rejected or retested, with probabilities 0.2, 0.5 and 0.3 respectively. When a candidate is retested for the first time, the three possible outcomes and their probabilities remain the same as for the original test. When a candidate is retested for the second time there are just two possible outcomes, accepted or rejected, with probabilities 0.4 and 0.6 respectively.

(i) Draw a probability tree diagram to illustrate the outcomes. [3]

(ii) Find the probability that a randomly selected candidate is accepted. [2]

(iii) Find the probability that a randomly selected candidate is retested at least once, given that this candidate is accepted. [3]

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Q58.

Each weekday, Marta travels to school by bus. Sometimes she arrives late.

- L is the event that Marta arrives late.
- R is the event that it is raining.

You are given that $P(L) = 0.15$, $P(R) = 0.22$ and $P(L \mid R) = 0.45$.

(i) Use this information to show that the events L and R are not independent. **[1]**

(ii) Find $P(L \cap R)$. **[2]**

(iii) Draw a Venn diagram showing the events L and R, and fill in the probability corresponding to each of the four regions of your diagram. **[3]**

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Q59.

A survey is being carried out into the sports viewing habits of people in a particular area. As part of the survey, 250 people are asked which of the following sports they have watched on television in the past month.

- Football
- Cycling
- Rugby

The numbers of people who have watched these sports are shown in the Venn diagram.
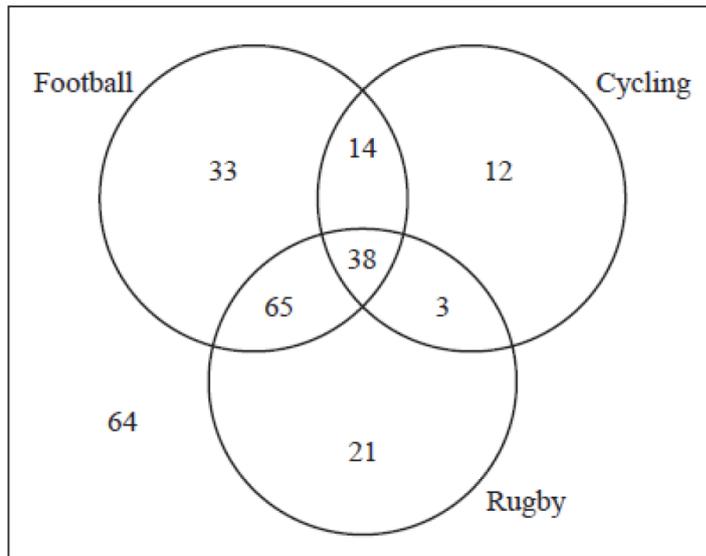
One of the people is selected at random.

(i) Find the probability that this person has in the past month

    (A) watched cycling but not football, [1]

    (B) watched either one or two of the three sports. [2]

(ii) Given that this person has watched cycling, find the probability that this person has not watched football. [2]

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AS level: Kinematic graphs

Q60.

Fig. 1 shows the velocity-time graph of a cyclist travelling along a straight horizontal road between two sets of traffic lights. The velocity, v, is measured in metres per second and the time, t, in seconds. The distance travelled, s metres, is measured from when $t = 0$.
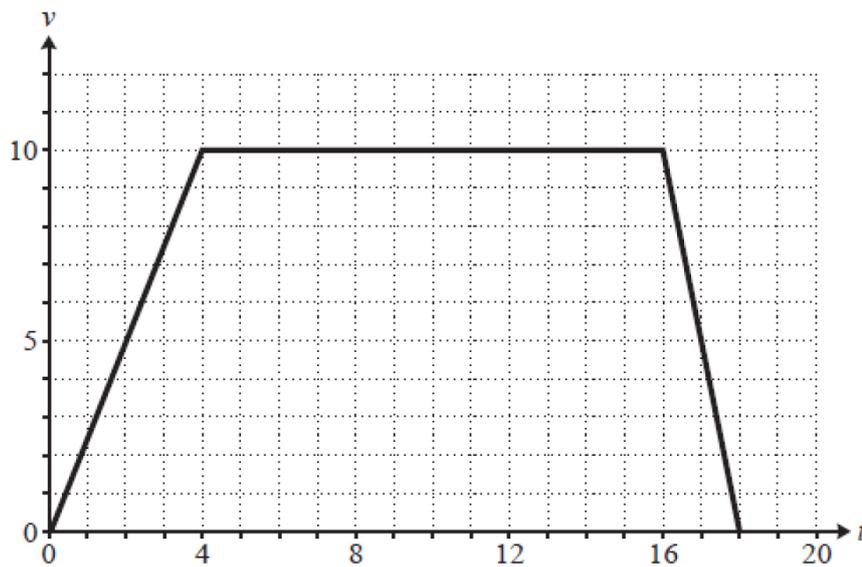

Fig. 1

(i) Find the values of s when $t = 4$ and when $t = 18$. [3]

(ii) Sketch the graph of s against t for $0 \leqslant t \leqslant 18$. [3]

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