Elite Mathematics
Pearson Edexcel International GCSE

IGCSE LINEAR · 4MA1

4MA1/1HR May 2023 Worked Solutions

May 2023 paper rebuilt with the worked solution after each question.

25	2020–2026	Single-paper solutions
paper questions	52 past papers	checked by Dr Eslam



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PAST PAPER

4MA1/1HR May 2023

May 2023

25	100	2 h
questions	marks	exam time

Each question is followed by its worked solution and final answer.

4MA1/1HR MAY 2023

Question 1

3 marks | Prime Factors, HCF & LCM

1 Write 2250 as a product of powers of its prime factors.
Show your working clearly.

(Total for Question 1 is 3 marks)

WORKED SOLUTION

Question 1 · 4MA1/1HR May 2023

1 Find the LCM

$$2250 = 225 \times 10$$

$$225 = 3^2 \times 5^2, \qquad 10 = 2 \times 5$$

2 Find the LCM

So

$$2250 = 3^2 \times 5^2 \times 2 \times 5$$

$$2250 = 2 \times 3^2 \times 5^3$$

✓ **FINAL ANSWER**

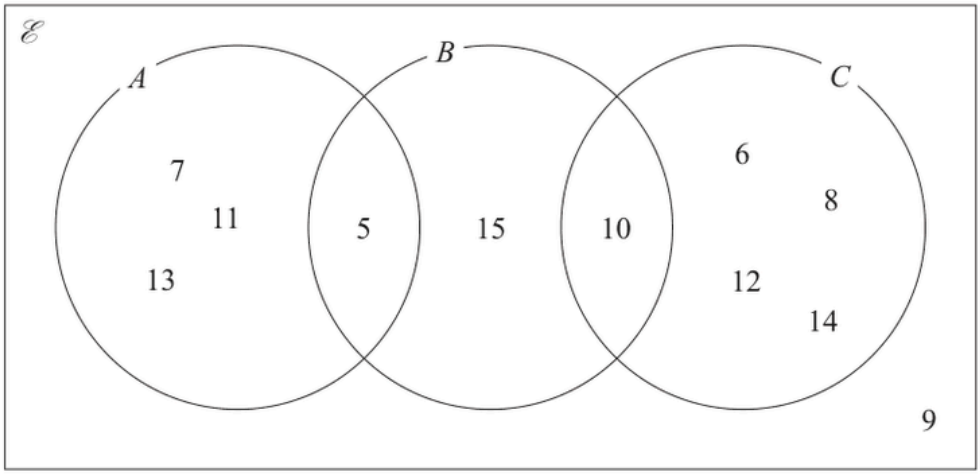
$2 \times 3^2 \times 5^3$

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Question 2

3 marks | Set Notation & Venn Diagrams

2 Here is a Venn diagram.



(a) Write down the numbers that are in the set

(i) A

.....

(1)

(ii) $B \cup C$

.....

(1)

Dominic writes down $9 \notin C$

(b) Explain why Dominic is correct.

.....

.....

(1)

(Total for Question 2 is 3 marks)

WORKED SOLUTION

Question 2 · 4MA1/1HR May 2023

1 **The numbers inside are the**

The numbers inside A are the numbers in the A-only region and the overlap with B:

$$A = \{5, 7, 11, 13\}$$

2 **Calculate statistic**

$B \cup C$ means every number inside B or C:

$$B \cup C = \{5, 6, 8, 10, 12, 14, 15\}$$

---

3 **Dominic writes . This is**

Dominic writes $9 \notin C$. This is correct because 9 is outside circle C in the Venn diagram.

✓ **FINAL ANSWER**

(a)(i) $\{5, 7, 11, 13\}$, (a)(ii) $\{5, 6, 8, 10, 12, 14, 15\}$. Dominic is correct because 9 is not in C.

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Question 3

4 marks | Similar Shapes

3 $ABCD$ and $EFGH$ are similar quadrilaterals.

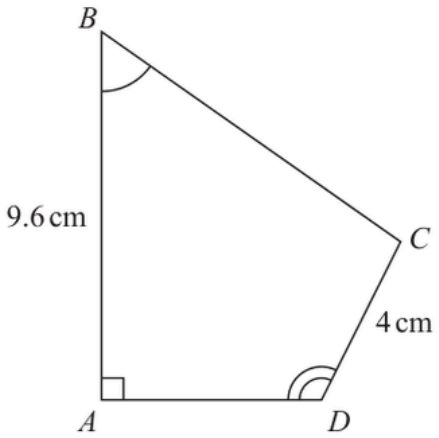
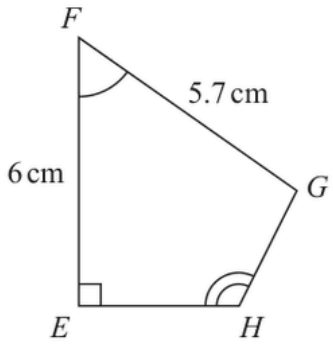


Diagram **NOT** accurately drawn



(a) Work out the length of GH

..... cm

(2)

(b) Work out the length of BC

..... cm

(2)

(Total for Question 3 is 4 marks)

WORKED SOLUTION

Question 3 · 4MA1/1HR May 2023

1 **Evaluate fraction**

The scale factor from $EFGH$ to $ABCD$ is

$$\frac{9.6}{6} = 1.6$$

2 **Evaluate fraction**

Since GH corresponds to CD,

$$GH = \frac{4}{1.6} = 2.5$$

3 Calculate value

Since FG corresponds to BC,

$$BC = 5.7 \times 1.6 = 9.12$$

FINAL ANSWER

$GH = 2.5\ \text{cm}$, and $BC = 9.12\ \text{cm}$.

4MA1/1HR MAY 2023

Question 4

5 marks | Circles, Arcs & Sectors

4 The diagram shows a shape made up of three semicircles, enclosing a right-angled triangle.

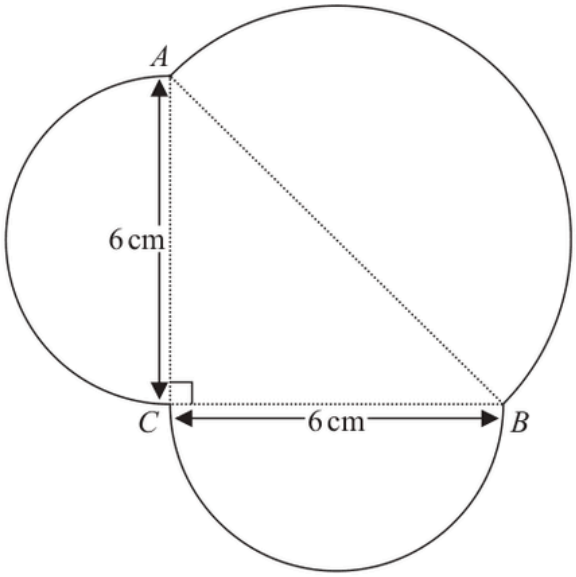


Diagram **NOT** accurately drawn

AB, BC and CA are each the diameter of a semicircle.

$BC = CA = 6$ cm.

Work out the perimeter of the shape.
Give your answer correct to one decimal place.

..... cm

(Total for Question 4 is 5 marks)

WORKED SOLUTION

Question 4 · 4MA1/1HR May 2023

1 **Simplify surd**

$$AB = \sqrt{6^2 + 6^2} = \sqrt{72} = 8.485\ldots$$

2 **The perimeter is the sum**

The perimeter is the sum of three semicircular arcs:

$$\frac{\pi}{2}(AB + BC + CA) = \frac{\pi}{2}(8.485\ldots + 6 + 6) = 32.178\ldots$$

FINAL ANSWER

$32.2\ \text{cm}$.

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Question 5

2 marks | Probability Toolkit

5 Each time Evie plays a game against her computer, she will win or lose.

For each game, the probability that Evie will win is 0.74
Evie is going to play 300 games against her computer.

Work out an estimate for the number of games that Evie will lose.

(Total for Question 5 is 2 marks)

WORKED SOLUTION

Question 5 · 4MA1/1HR May 2023

1 Probability of losing

$$1 - 0.74 = 0.26$$

2 Estimate for 300 games

$$300 \times 0.26 = 78$$

FINAL ANSWER

78

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Question 6

4 marks | Algebraic Roots & Indices

6 (a) Simplify $m^{10} \div m^3$

.....

(1)

$k^n \times k^4 = k^{12}$

(b) Write down the value of n

$n =$ .....

(1)

(c) Simplify $(3x^6y^8)^2$

.....

(2)

(Total for Question 6 is 4 marks)

WORKED SOLUTION

Question 6 · 4MA1/1HR May 2023

1 **(a)**

(a) $m^{10} \div m^3 = m^{10-3} = m^7$.

2 **Use index laws**

(b) $k^n \times k^4 = k^{n+4} = k^{12}$, so $n + 4 = 12$ and $n = 8$.

3 **(c)**

(c) $(3x^6y^8)^2 = 3^2x^{12}y^{16} = 9x^{12}y^{16}$.

✓ **FINAL ANSWER**

(a) m^7, (b) 8, (c) $9x^{12}y^{16}$

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Question 7

3 marks | Factorising

7 (a) Expand $4x(x - 5)$

.....

(1)

(b) Factorise $y^2 - 9y + 20$

.....

(2)

(Total for Question 7 is 3 marks)

WORKED SOLUTION

Question 7 · 4MA1/1HR May 2023

1 (a)

(a)

$$4x(x-5) = 4x^2 - 20x$$

2 (b)

(b)

$$y^2 - 9y + 20 = (y-4)(y-5)$$

FINAL ANSWER

(a) $4x^2 - 20x$, (b) $(y-4)(y-5)$

4MA1/1HR MAY 2023

Question 8

3 marks | Standard Form

8 (a) Write 5.6×10^{-3} as an ordinary number.

.....

(1)

(b) Work out $\dfrac{6 \times 10^{3}}{2.1 \times 10^{-4} + 9 \times 10^{-5}}$

Give your answer in standard form.

.....

(2)

(Total for Question 8 is 3 marks)

WORKED SOLUTION

Question 8 · 4MA1/1HR May 2023

1 **Convert standard form**

$$5.6 \times 10^{-3} = 0.0056$$

2 **Convert standard form**

For part (b), simplify the denominator:

$$2.1 \times 10^{-4} + 9 \times 10^{-5} = 0.00021 + 0.00009$$

$$= 0.00030 = 3 \times 10^{-4}$$

3 **Convert standard form**

Then

$$\frac{6 \times 10^{3}}{3 \times 10^{-4}} = 2 \times 10^{3-(-4)}$$

$$= 2 \times 10^{7}$$

✓ **FINAL ANSWER**

(a) 0.0056, (b) 2×10^{7}

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Question 9

3 marks | Compound Interest & Depreciation

9 Kazi buys a car for 700 000 taka.
The value of the car depreciates by 12% each year.

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

..... taka

(Total for Question 9 is 3 marks)

WORKED SOLUTION

Question 9 · 4MA1/1HR May 2023

1 A depreciation of gives multiplier

A depreciation of 12% gives multiplier

$$0.88$$

2 Use compound interest

After 3 years,

$$700000(0.88)^3 = 477030.4$$

3 Use compound interest

Correct to the nearest taka,

$$477030.4 \approx 477030$$

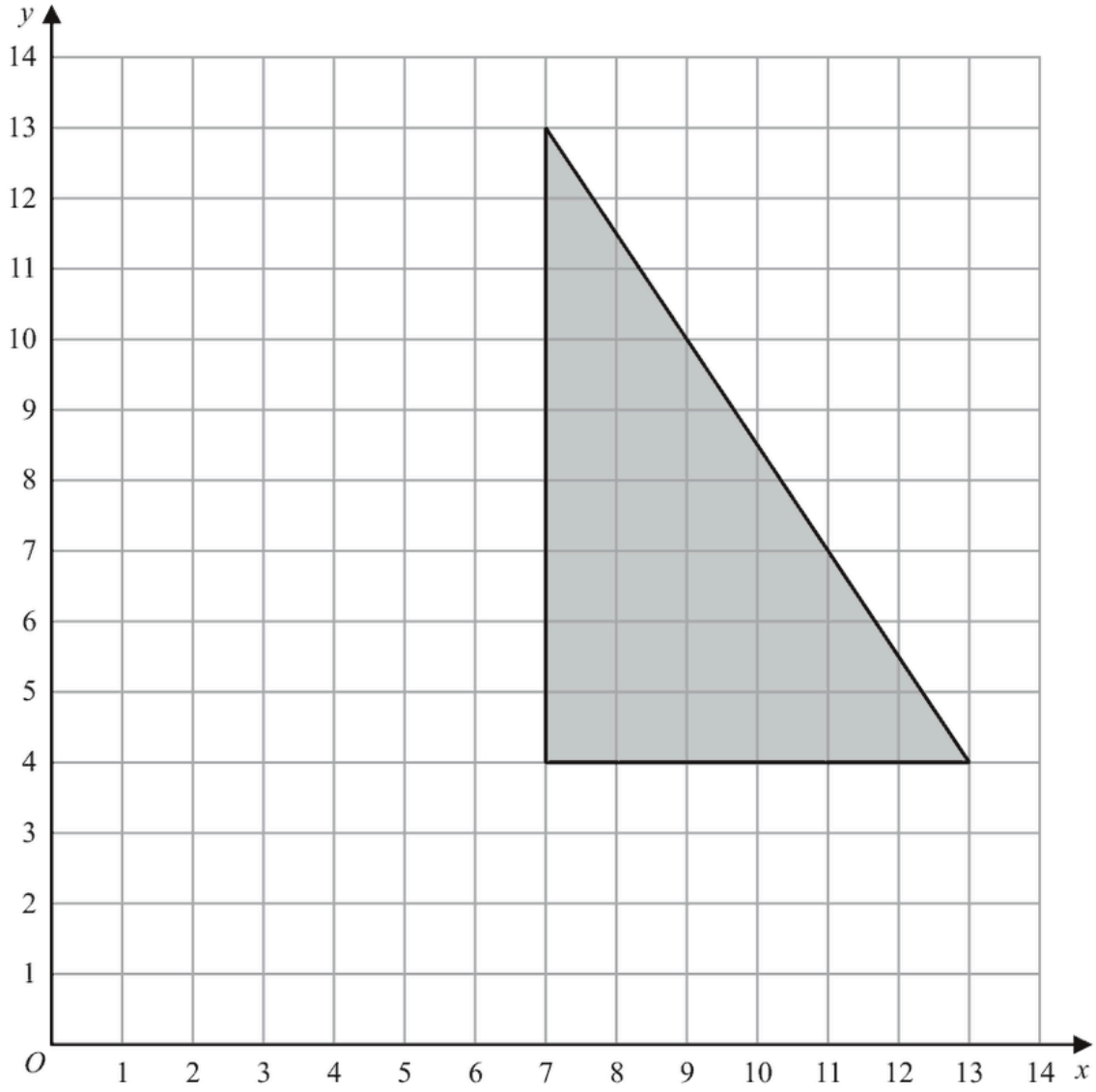
✓ **FINAL ANSWER**

477030 taka

Question 10

2 marks | Transformations

10



On the grid, enlarge the shaded shape with scale factor $\frac{1}{3}$ and centre (1, 7)

(Total for Question 10 is 2 marks)

1 **Use**

Use

$$\text{new point} = (1,7) + \frac{1}{3}(\text{old point} - (1,7))$$

2 **The original vertices are**

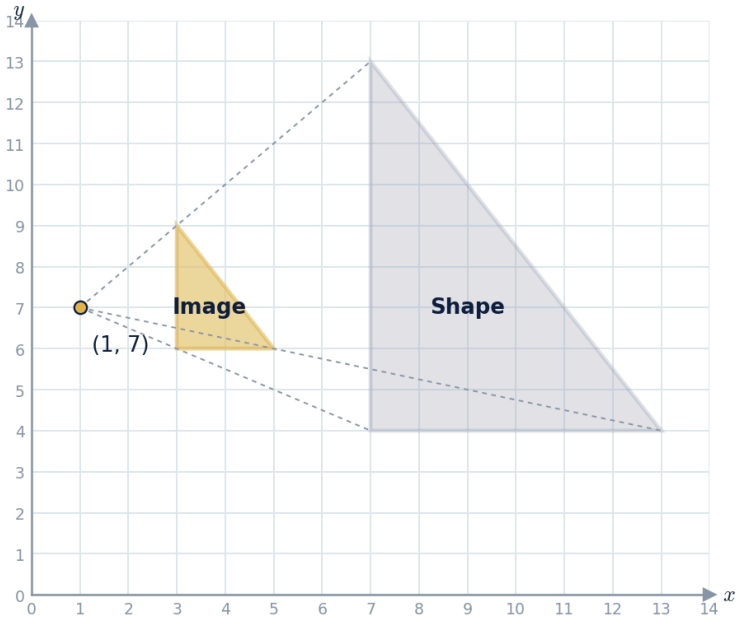
The original vertices are

$$(7,4),\ (13,4),\ (7,13)$$

3 **They become**

They become

$$(3,6),\ (5,6),\ (3,9)$$



FINAL ANSWER

draw the triangle with vertices $(3,6), (5,6), (3,9)$.

Question 11

3 marks | Standard & Compound Units

11 The diagram shows a block of iron in the shape of a cuboid.

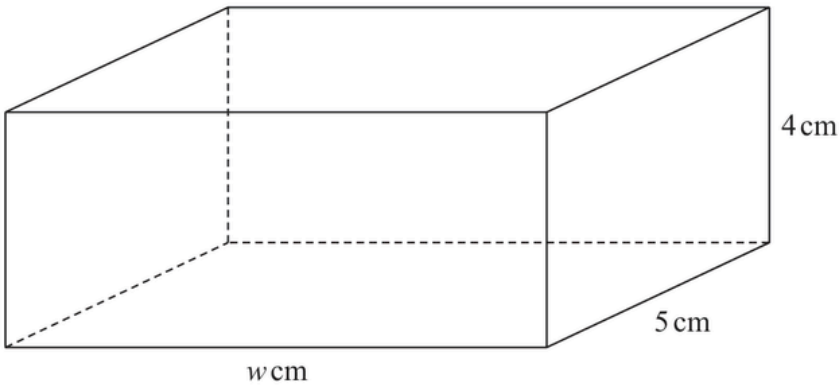


Diagram **NOT** accurately drawn

The block has length w cm, width 5 cm and height 4 cm

The density of iron is 7.8 g/cm^3
The mass of the block is 1950 g

Work out the value of w

$w =$ .....

(Total for Question 11 is 3 marks)

1 Calculate volume

$$\text{density} = \frac{\text{mass}}{\text{volume}}$$

$$7.8 = \frac{1950}{\text{volume}}$$

$$\text{volume} = \frac{1950}{7.8} = 250 \text{ cm}^3$$

2 Calculate value

For the cuboid,

$$w \times 5 \times 4 = 250$$

$$20w = 250$$

$$w = 12.5$$

FINAL ANSWER

$w = 12.5$ cm.

Question 12

5 marks | Tree Diagrams & Conditional Probability

12 Moeen has a biased 6-sided dice.

The table gives information about the probability that, when the dice is thrown, it will land on each number.

Number	1	2	3	4	5	6
Probability	x	0.15	0.5	y	0.13	0.03

(a) Show that $x + y = 0.19$

(2)

Given that $3x - y = 0.09$

and $x + y = 0.19$

(b) work out the value of x and the value of y
Show clear algebraic working.

$x =$ .....

$y =$ .....

(3)

(Total for Question 12 is 5 marks)

1 **(a) Probabilities add to 1**

$$x + 0.15 + 0.5 + y + 0.13 + 0.03 = 1 \Rightarrow x + y + 0.81 = 1 \Rightarrow x + y = 0.19$$

2 **(b) Add the two equations**

$$(3x - y) + (x + y) = 0.09 + 0.19 \Rightarrow 4x = 0.28 \Rightarrow x = 0.07$$

3 **(b) Find y**

$$y = 0.19 - 0.07 = 0.12$$

✓ **FINAL ANSWER**

(b) $x = 0.07,\ y = 0.12$

Question 13

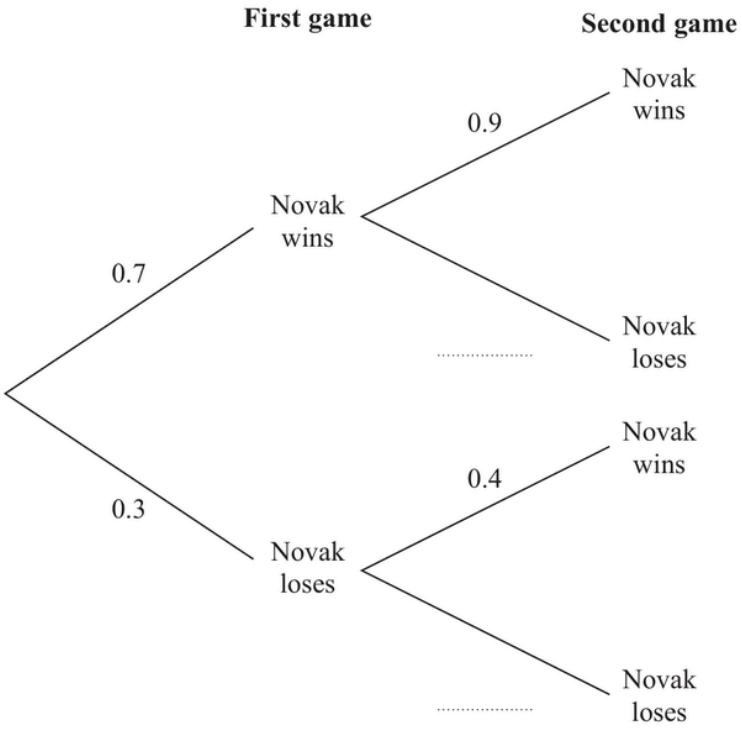
3 marks | Tree Diagrams & Conditional Probability

13 Novak is going to play two games of tennis.

The probability that he wins the first game is 0.7

If he wins the first game, the probability that he wins the second game is 0.9
If he loses the first game, the probability that he wins the second game is 0.4

(a) Complete the probability tree diagram.



(1)

(b) Work out the probability that Novak wins both games of tennis.

.....

(2)

(Total for Question 13 is 3 marks)

1 (a) Complete the tree

After a win: loses $1 - 0.9 = 0.1$. After a loss: loses $1 - 0.4 = 0.6$.

2 (b) Wins both games

$$0.7 \times 0.9 = 0.63$$

FINAL ANSWER

(a) 0.1, 0.6 (b) 0.63

Question 14

6 marks | Cumulative Frequency Diagrams

14 The table gives information about the times taken by 80 people to run a race.

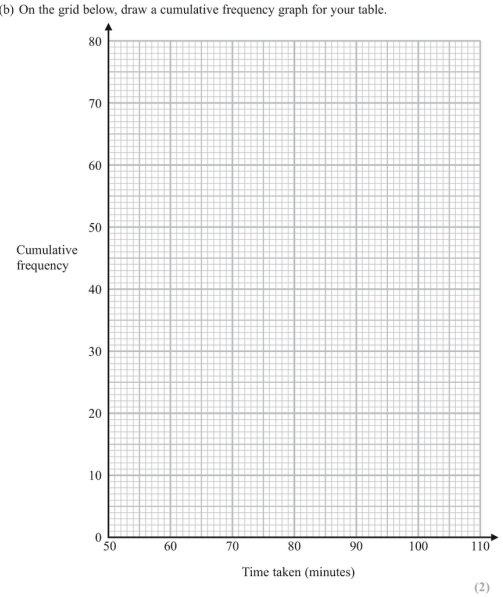
Time taken (t minutes)	Frequency
$50 < t \leqslant 60$	15
$60 < t \leqslant 70$	16
$70 < t \leqslant 80$	21
$80 < t \leqslant 90$	14
$90 < t \leqslant 100$	8
$100 < t \leqslant 110$	6

(a) Complete the cumulative frequency table.

Time taken (t minutes)	Cumulative frequency
$50 < t \leqslant 60$	
$50 < t \leqslant 70$	
$50 < t \leqslant 80$	
$50 < t \leqslant 90$	
$50 < t \leqslant 100$	
$50 < t \leqslant 110$	

(1)

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



(2)

(c) Use your graph to find an estimate for the median time taken.

..... minutes

(1)

(d) Use your graph to find an estimate for the interquartile range of the times taken.

..... minutes

(2)

(Total for Question 14 is 6 marks)

1 **(a) Running totals**

$$15,\ 31,\ 52,\ 66,\ 74,\ 80$$

2 **(b) Plot at the upper class boundaries**

Plot $(60, 15), (70, 31), (80, 52), (90, 66), (100, 74), (110, 80)$, start at $(50, 0)$, and join with a smooth curve.

3 **(c) Median**

Read across from 40: about 74 minutes.

4 **(d) Interquartile range**

Lower quartile at 20: about 63 minutes. Upper quartile at 60: about 86 minutes.

$$\text{IQR} \approx 86 - 63 = 23 \text{ minutes}$$

✓ **FINAL ANSWER**

(a) $15, 31, 52, 66, 74, 80$ (c) about 74 minutes (d) about 23 minutes

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Question 15

4 marks | Angles in Polygons & Parallel Lines

15

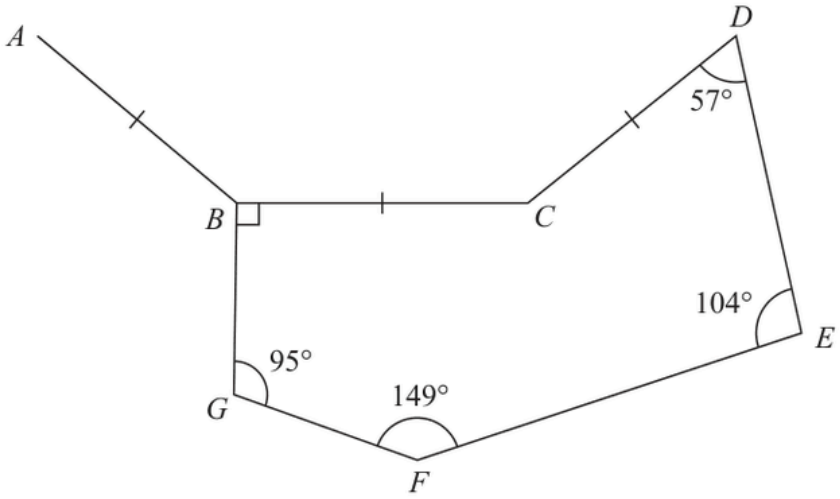


Diagram **NOT** accurately drawn

BCDEFG is a hexagon.
AB, *BC* and *CD* are three sides of a regular *n*-sided polygon.

Calculate the value of *n*
Show your working clearly.

$n =$ .....

(Total for Question 15 is 4 marks)

WORKED SOLUTION

Question 15 · 4MA1/1HR May 2023

1 The sum of the interior

The sum of the interior angles of a hexagon is

$$(6-2)\times 180 = 720^\circ$$

2 Find the gradient

The reflex angle at C in the hexagon is

$$720^\circ - (90^\circ + 95^\circ + 149^\circ + 104^\circ + 57^\circ) = 225^\circ$$

3 Find the gradient

So the smaller angle BCD is

$$360^\circ - 225^\circ = 135^\circ$$

4 **This is the interior angle**

This is the interior angle of the regular n-sided polygon.

5 **Find the gradient**

So the exterior angle is

$$180^\circ - 135^\circ = 45^\circ$$

$$n = \frac{360}{45} = 8$$

✓ **FINAL ANSWER**

$n = 8$.

4MA1/1HR MAY 2023

Question 16

2 marks | Algebraic Proof

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

(Total for Question 16 is 2 marks)

WORKED SOLUTION

Question 16 · 4MA1/1HR May 2023

1 Let

Let

$$x = 0.1767676\ldots$$

2 Calculate value

Then

$$10x = 1.767676\ldots$$

3 Calculate value

and

$$1000x = 176.767676\ldots$$

4 Subtract

Subtract:

$$990x = 175$$

$$x = \frac{175}{990} = \frac{35}{198}$$

FINAL ANSWER

$0.1767676\ldots = \frac{35}{198}$.

4MA1/1HR MAY 2023

Question 17

4 marks | Direct & Inverse Proportion

17 F is inversely proportional to the square of r

$F = 36$ when $r = 4$

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

.....

(3)

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

.....

(1)

(Total for Question 17 is 4 marks)

WORKED SOLUTION

Question 17 · 4MA1/1HR May 2023

1 Find inverse function

F is inversely proportional to r^2, so

$$F = \frac{k}{r^2}$$

2 Use when

Use $F = 36$ when $r = 4$:

$$36 = \frac{k}{4^2}$$

$$k = 36 \times 16 = 576$$

3 Find inverse function

So

$$F = \frac{576}{r^2}$$

4 Find inverse function

When $r = 48$,

$$F = \frac{576}{48^2} = \frac{576}{2304} = 0.25$$

FINAL ANSWER

$F = \frac{576}{r^2}$, and $F = 0.25$ when $r = 48$.

4MA1/1HR MAY 2023

Question 18

4 marks | Rounding, Estimation & Bounds

18 Diego builds a fence using fence panels.

The total length of the fence is 50 metres, correct to the nearest 5 metres.
The length of each fence panel is 1.3 metres, correct to the nearest 10 cm.

The cost of each fence panel is £8.65

Diego may only buy complete fence panels.
Diego only pays for the number of panels he needs to build the fence.

Work out the greatest difference in the possible amounts that Diego could pay to build the fence.
Show your working clearly.

£.....

(Total for Question 18 is 4 marks)

WORKED SOLUTION

Question 18 · 4MA1/1HR May 2023

1 The fence length m correct

The fence length 50 m correct to the nearest 5 m has bounds

$$47.5 \leq L < 52.5$$

2 The panel length m correct

The panel length 1.3 m correct to the nearest 10 cm has bounds

$$1.25 \leq p < 1.35$$

3 Smallest possible number of panels

Smallest possible number of panels:

$$\left\lceil \frac{47.5}{1.35} \right\rceil = 36$$

4 Greatest possible number of panels

Greatest possible number of panels:

$$\left\lceil \frac{52.5}{1.25} \right\rceil = 42$$

5 Difference in number of panels

Difference in number of panels:

$$42 - 36 = 6$$

6 Greatest difference in cost

Greatest difference in cost:

$$6 \times 8.65 = 51.90$$

FINAL ANSWER

51.90 pounds

4MA1/1HR MAY 2023

Question 19

5 marks | Vectors

19 The diagram shows a triangle ABC where A, B and C represent the positions of three towns.

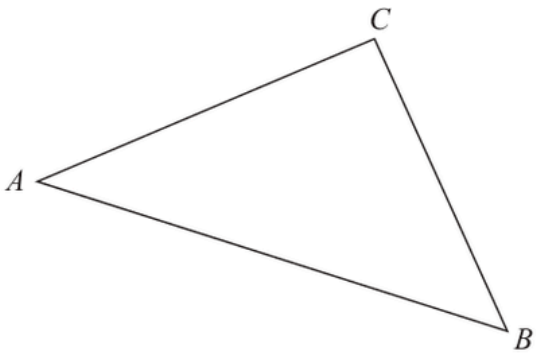


Diagram **NOT** accurately drawn

$$\overrightarrow{AB} = \begin{pmatrix} 7 \\ -2 \end{pmatrix} \qquad \overrightarrow{BC} = \begin{pmatrix} -3 \\ 5 \end{pmatrix}$$

Pru travels directly from A to B and then directly from B to C

Yang travels directly from A to C

Given that the values for $\overrightarrow{AB}$ and $\overrightarrow{BC}$ are in kilometres,

work out how much further Pru travels than Yang travels.
Give your answer in km, correct to one decimal place.

..... km

(Total for Question 19 is 5 marks)

WORKED SOLUTION

Question 19 · 4MA1/1HR May 2023

1 **Pru travels**

Pru travels

$$|AB| + |BC| = \sqrt{7^2 + (-2)^2} + \sqrt{(-3)^2 + 5^2}$$

$$= \sqrt{53} + \sqrt{34} = 13.111\ldots$$

2 **Simplify surd**

Yang travels from A to C.

$$\overrightarrow{AC} = \overrightarrow{AB} + \overrightarrow{BC} = \begin{pmatrix} 7 \\ -2 \end{pmatrix} + \begin{pmatrix} -3 \\ 5 \end{pmatrix} = \begin{pmatrix} 4 \\ 3 \end{pmatrix}$$

$$|AC| = \sqrt{4^2 + 3^2} = 5$$

---

3 **Difference**

Difference:

$$13.111\ldots - 5 = 8.111\ldots$$

FINAL ANSWER

Pru travels $8.1\ \text{km}$ further.

4MA1/1HR MAY 2023

Question 20

7 marks | Transformations of Graphs

20 Curve **C** has equation $y = f(x)$
The graph of curve **C** has one maximum point.
The coordinates of this maximum point are (3, 5)

(a) Write down the coordinates of the maximum point on the curve with equation

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

(..... , ...)
(1)

(ii) $y = f(x) - 7$

(..... , ...)
(1)

(iii) $y = f(-x)$

(..... , ...)
(1)

Curve **L** has equation $y = x^2 + 7x + 20$

Curve **L** is transformed to curve **S** under the translation $\begin{pmatrix} 2 \\ 0 \end{pmatrix}$

(b) Find an equation for **S**
Give your answer in the form $y = ax^2 + bx + c$

$y =$ .....
(4)

(Total for Question 20 is 7 marks)

WORKED SOLUTION

Question 20 · 4MA1/1HR May 2023

1 **The maximum point of is**

The maximum point of $y = f(x)$ is $(3, 5)$.

2 **Calculate value**

For

$$y = 2f(x)$$

3 **the coordinate is multiplied by**

the y-coordinate is multiplied by 2:

$$(3, 5) \to (3, 10)$$

4 **Calculate value**

For

$$y = f(x) - 7$$

5 **the graph moves 7 units**

the graph moves 7 units down:

$$(3, 5) \to (3, -2)$$

6 **Calculate value**

For

$$y = f(-x)$$

7 **the graph reflects in the**

the graph reflects in the y-axis:

$$(3, 5) \to (-3, 5)$$

8 **Calculate value**

For part (b),

$$y = x^2 + 7x + 20$$

9 **The translation vector is**

The translation vector is

$$\begin{pmatrix} 2 \\ 0 \end{pmatrix}$$

10 **Read the graph**

So the graph moves 2 units right.

11 **Replace by**

Replace x by $x - 2$:

$$y = (x - 2)^2 + 7(x - 2) + 20$$

$$y = x^2 + 3x + 10$$

FINAL ANSWER

$(3, 10)$, $(3, -2)$, $(-3, 5)$, and $y = x^2 + 3x + 10$

4MA1/1HR MAY 2023

Question 21

6 marks | Differentiation & Turning Points

21 The curve **T** has equation $y = x^3 - 2x^2 - 9x + 15$

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

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

(2)

(b) Find the range of values of x for which **T** has a positive gradient.
Give your values correct to 3 significant figures.
Show your working clearly.

(4)

(Total for Question 21 is 6 marks)

WORKED SOLUTION

Question 21 · 4MA1/1HR May 2023

1 **(a)**

(a)

$$y = x^3 - 2x^2 - 9x + 15$$

$$\frac{dy}{dx} = 3x^2 - 4x - 9$$

2 **(b) The curve has a**

(b) The curve has a positive gradient when

$$3x^2 - 4x - 9 > 0$$

3 **Solve**

Solve

$$3x^2 - 4x - 9 = 0$$

$$x = \frac{4 \pm \sqrt{16 + 108}}{6}$$

$$x = \frac{2 \pm \sqrt{31}}{3}$$

---

4 **Differentiate**

To 3 significant figures, the roots are

$$x = -1.19, \quad x = 2.52$$

---

5 **Solve quadratic equation**

Since the quadratic opens upwards, it is positive outside the roots.

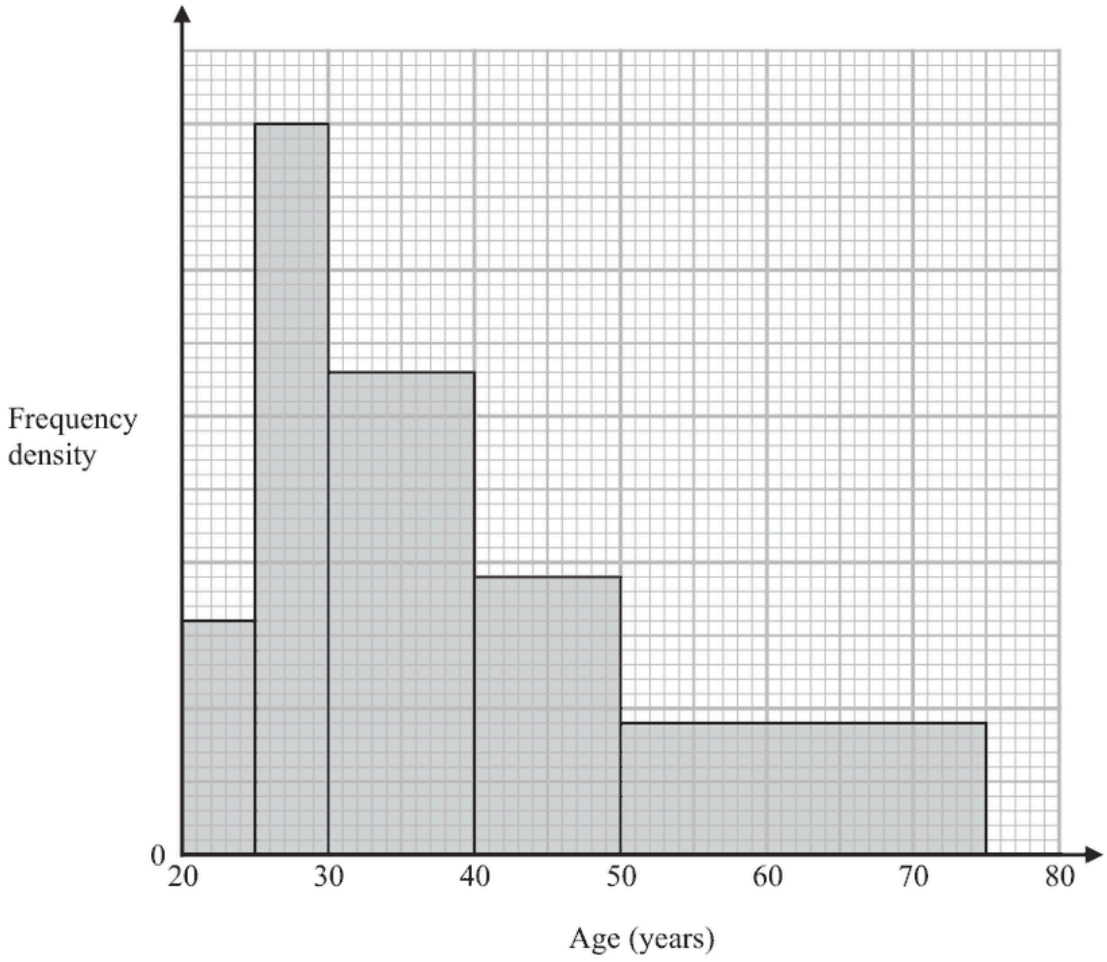
✓ **FINAL ANSWER**

(a) $\frac{dy}{dx} = 3x^2 - 4x - 9$, (b) $x < -1.19$ or $x > 2.52$

Question 22

4 marks | Histograms

22 Some people attend a concert.
The histogram shows information about the ages of these people.



Work out an estimate for the percentage of these people who are aged more than 55 years.
Give your answer correct to one decimal place.

.....%

(Total for Question 22 is 4 marks)

1 The scale of the frequency

The scale of the frequency density axis is not needed because the percentage is found from areas.

2 Calculate area

Using the bar heights from the histogram, the relative areas are:

$$(5)(277) + (5)(866) + (10)(571) + (10)(329) + (25)(155)$$

$$= 1385 + 4330 + 5710 + 3290 + 3875$$

$$= 18590$$

3 Calculate value

For ages more than 55, use the part of the last bar from 55 to 75:

$$(20)(155) = 3100$$

4 Calculate percentage

So the estimated percentage is

$$\frac{3100}{18590} \times 100 = 16.675\ldots$$

FINAL ANSWER

16.7%

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Question 23

4 marks | Algebraic Fractions

23 Simplify $(x^2 - 4) \div \left(\frac{4x^2 - 7x - 2}{x}\right) - 2x$

Give your answer in the form $\frac{ax^2}{bx + c}$ where a, b and c are integers.

(Total for Question 23 is 4 marks)

WORKED SOLUTION

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1 Simplify surd

$$(x^2 - 4) \div \left(\frac{4x^2 - 7x - 2}{x}\right) - 2x$$

2 Change division into multiplication by

Change division into multiplication by the reciprocal:

$$(x^2 - 4) \times \frac{x}{4x^2 - 7x - 2} - 2x$$

3 Factorise

Factorise:

$$x^2 - 4 = (x - 2)(x + 2)$$

$$4x^2 - 7x - 2 = (4x + 1)(x - 2)$$

4 Simplify surd

So

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

$$\frac{x(x + 2) - 2x(4x + 1)}{4x + 1} = \frac{x^2 + 2x - 8x^2 - 2x}{4x + 1} = \frac{-7x^2}{4x + 1}$$

FINAL ANSWER

$$\frac{-7x^2}{4x + 1}$$

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Question 24

5 marks | Algebraic Roots & Indices

24 Given that

$$2^n = 2^{x^2} \times 16^x \times 8$$

and

$$x > 0$$

find an expression for x in terms of n
State any restrictions on n

(Total for Question 24 is 5 marks)

WORKED SOLUTION

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1 **Use index laws**

$$16^x = 2^{4x}, \qquad 8 = 2^3$$

2 **Use index laws**

So

$$2^n = 2^{x^2} \times 2^{4x} \times 2^3 = 2^{x^2+4x+3}$$

3 **Hence**

Hence

$$n = x^2 + 4x + 3 = (x+2)^2 - 1$$

$$(x+2)^2 = n + 1$$

4 **Simplify surd**

Since $x > 0$,

$$x + 2 = \sqrt{n+1}$$

$$x = -2 + \sqrt{n+1}$$

5 **Simplify surd**

For $x > 0$, $\sqrt{n+1} > 2$, so $n > 3$.

FINAL ANSWER

$x = -2 + \sqrt{n+1}, n > 3$

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Question 25

6 marks | Sine & Cosine Rules

25 Here is a triangle ABC

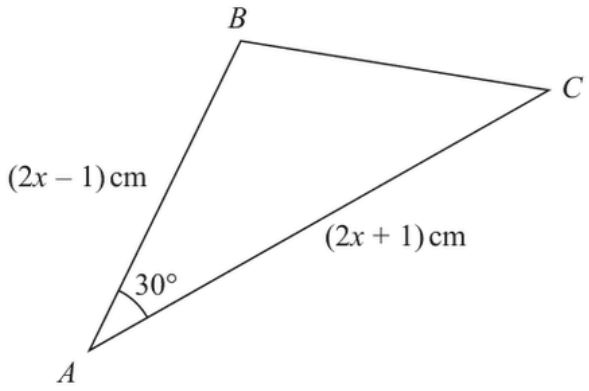


Diagram **NOT** accurately drawn

The area of the triangle is $(x^2 + x - 3.75)\,\text{cm}^2$

Find the size of the largest angle in triangle ABC
Give your answer correct to the nearest degree.

.....°

(Total for Question 25 is 6 marks)

WORKED SOLUTION

Question 25 · 4MA1/1HR May 2023

1 **The two sides around the**

The two sides around the $30°$ angle are

$$2x - 1 \quad \text{and} \quad 2x + 1$$

2 **Use trigonometry**

Using the area formula,

$$\text{area} = \frac{1}{2}ab\sin C$$

$$x^2 + x - 3.75 = \frac{1}{2}(2x - 1)(2x + 1)\sin 30°$$

3 **Use trigonometry**

Since $\sin 30° = \frac{1}{2}$,

$$x^2 + x - 3.75 = \frac{1}{4}(2x - 1)(2x + 1)$$

$$x^2 + x - 3.75 = \frac{1}{4}(4x^2 - 1)$$

$$x^2 + x - 3.75 = x^2 - 0.25$$

$$x = 3.5$$

---

4 **Use trigonometry**

So

$$AB = 2x - 1 = 6, \qquad AC = 2x + 1 = 8$$

---

5 **Use cosine rule**

Use the cosine rule to find BC:

$$BC^2 = 6^2 + 8^2 - 2(6)(8)\cos 30°$$

$$BC = 4.1063\ldots$$

---

6 **Use trigonometry**

The largest side is $AC = 8$, so the largest angle is $\angle B$.

---

7 **Use trigonometry**

Using the cosine rule again:

$$\cos B = \frac{6^2 + BC^2 - 8^2}{2(6)(BC)}$$

$$B = 103.0643\ldots°$$

✓ **FINAL ANSWER**

$\boxed{103°}$