Elite Mathematics
Pearson Edexcel International GCSE

IGCSE LINEAR · 4MA1

4MA1/1HR January 2021 Worked Solutions

January 2021 paper rebuilt with the worked solution after each question.

22	2020–2026	Single-paper solutions
paper questions	52 past papers	checked by Dr Eslam



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PAST PAPER

4MA1/1HR January 2021

January 2021

22	100	2 h
questions	marks	exam time

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

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Question 1

3 marks | Fractions

1 Show that $3\frac{1}{5} \times 1\frac{5}{6} = 5\frac{13}{15}$

(Total for Question 1 is 3 marks)

WORKED SOLUTION

Question 1 · 4MA1/1HR January 2021

1 Simplify fraction

Convert the mixed numbers to improper fractions:

$$3\frac{1}{5} = \frac{16}{5}$$

$$1\frac{5}{6} = \frac{11}{6}$$

2 Simplify fraction

Now multiply:

$$\frac{16}{5} \times \frac{11}{6} = \frac{176}{30}$$

$$= \frac{88}{15} = 5\frac{13}{15}$$

FINAL ANSWER

$5\frac{13}{15}$

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Question 2

4 marks | Statistics Toolkit

2 Given that $a < b < c$

the four whole numbers a, a, b and c have

a mode of 7
a median of 8.5
a mean of 9

Work out the value of a, the value of b and the value of c.

$a =$ .....

$b =$ .....

$c =$ .....

(Total for Question 2 is 4 marks)

WORKED SOLUTION

Question 2 · 4MA1/1HR January 2021

1 Calculate statistic

The mode is 7, and the numbers are a, a, b, c, so

$$a = 7$$

2 The median of four numbers

The median of four numbers is

$$\frac{a+b}{2}$$

3 Evaluate fraction

So

$$\frac{7+b}{2} = 8.5$$

$$7 + b = 17$$

$$b = 10$$

4 **Calculate statistic**

The mean is 9, so the total is

$$4 \times 9 = 36$$

$$7 + 7 + 10 + c = 36$$

$$c = 12$$

✓ **FINAL ANSWER**

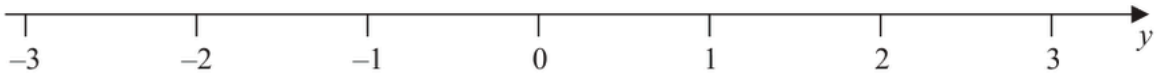
$a = 7,\ b = 10,\ c = 12$.

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Question 3

4 marks | Inequalities (Solving & Graphing)

3 (a) On the number line, show the inequality $-2 \leqslant y < 1$



(2)

n is an integer.

(b) Write down all the values of n that satisfy $-3.4 < n \leqslant 2$

.....

(2)

(Total for Question 3 is 4 marks)

WORKED SOLUTION

Question 3 · 4MA1/1HR January 2021

1 Solve inequality

(a) For

$$-2 \leq y < 1$$

2 use a closed circle at

use a closed circle at -2, an open circle at 1, and shade the line between them.

3 (b)

(b)

$$-3.4 < n \leq 2$$

4 The integer values are

The integer values are

$$-3,\ -2,\ -1,\ 0,\ 1,\ 2$$

FINAL ANSWER

Closed at -2, open at 1; integers $-3, -2, -1, 0, 1, 2$.

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Question 4

3 marks | Standard & Compound Units

4 A train journey from Paris to Amsterdam took 3 hours 24 minutes.
The total distance the train travelled was 433.5 km.

Work out the average speed of the train.
Give your answer in kilometres per hour.

..... km/h

(Total for Question 4 is 3 marks)

WORKED SOLUTION

Question 4 · 4MA1/1HR January 2021

1 The time is

The time is

$$3\text{ h }24\text{ min} = 3.4\text{ h}$$

2 Average speed

Average speed:

$$433.5 \div 3.4 = 127.5$$

✓ **FINAL ANSWER**

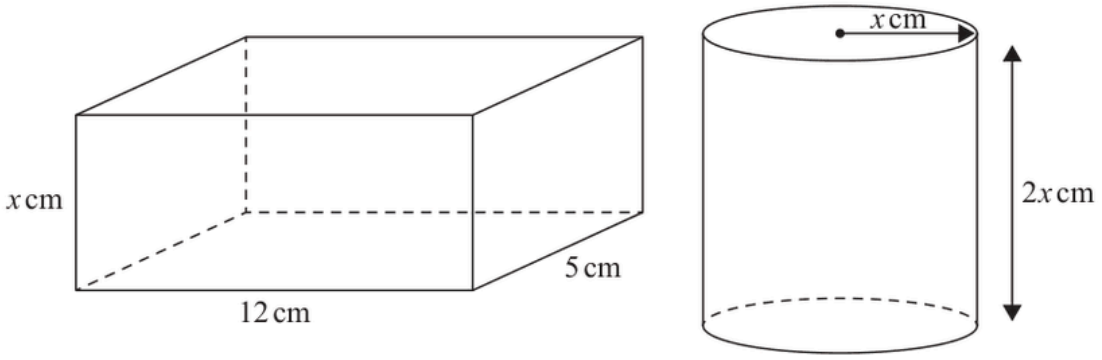
127.5 km/h.

Question 5

4 marks | Volume & Surface Area

5 The diagram shows a cuboid and a cylinder.

Diagram **NOT** accurately drawn



The dimensions of the cuboid are x cm by 12 cm by 5 cm.
The volume of the cuboid is 270 cm^3

The radius of the cylinder is x cm.
The height of the cylinder is $2x$ cm.

(a) Work out the volume of the cylinder.
Give your answer correct to the nearest whole number.

..... cm^3

(3)

(b) Change 1 m^3 to cm^3

..... cm^3

(1)

(Total for Question 5 is 4 marks)

1 **Calculate area**

For the cuboid,

$$12 \times 5 \times x = 270$$

$$60x = 270$$

$$x = 4.5$$

2 **Calculate area**

The cylinder has radius $4.5\ \text{cm}$ and height $9\ \text{cm}$.

$$V = \pi r^2 h = \pi(4.5)^2(9) = 572.555\ldots$$

3 **Calculate area**

Also,

$$1\ \text{m}^3 = 100^3 = 1000000\ \text{cm}^3$$

FINAL ANSWER

$573\ \text{cm}^3$, and $1\ \text{m}^3 = 1000000\ \text{cm}^3$.

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Question 6

5 marks | Rearranging Formulae

6 (a) Make c the subject of $A = \frac{c}{y} - 5z$

.....

(2)

(b) Write down the value of g^0

.....

(1)

(c) Factorise $x^2 - 11x + 24$

.....

(2)

(Total for Question 6 is 5 marks)

WORKED SOLUTION

Question 6 · 4MA1/1HR January 2021

1 **(a)**

(a)

$$A = \frac{c}{y} - 5z$$

$$A + 5z = \frac{c}{y}$$

$$c = y(A + 5z)$$

2 **(b)**

(b) $g^0 = 1$.

3 **(c)**

(c)

$$x^2 - 11x + 24 = (x - 3)(x - 8)$$

✓ **FINAL ANSWER**

$c = y(A + 5z)$, 1, $(x - 3)(x - 8)$

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Question 7

3 marks | Compound Interest & Depreciation

7 Kuro invests 50 000 yen for 3 years in a savings account.
She gets 2.4% per year compound interest.

Work out how much money Kuro will have in her savings account at the end of the 3 years.
Give your answer correct to the nearest yen.

..... yen

(Total for Question 7 is 3 marks)

WORKED SOLUTION

Question 7 · 4MA1/1HR January 2021

1 The multiplier for a increase

The multiplier for a 2.4% increase is

$$1.024$$

2 Use compound interest

After 3 years,

$$50000(1.024)^3 = 53687.0912$$

3 Use compound interest

Correct to the nearest yen,

$$53687.0912 \approx 53687$$

✓ **FINAL ANSWER**

53687 yen

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Question 8

5 marks | Angles in Polygons & Parallel Lines

8 The diagram shows a regular pentagon, $ABCDE$, a regular hexagon, $CFGHID$, and a quadrilateral, $EDIJ$.

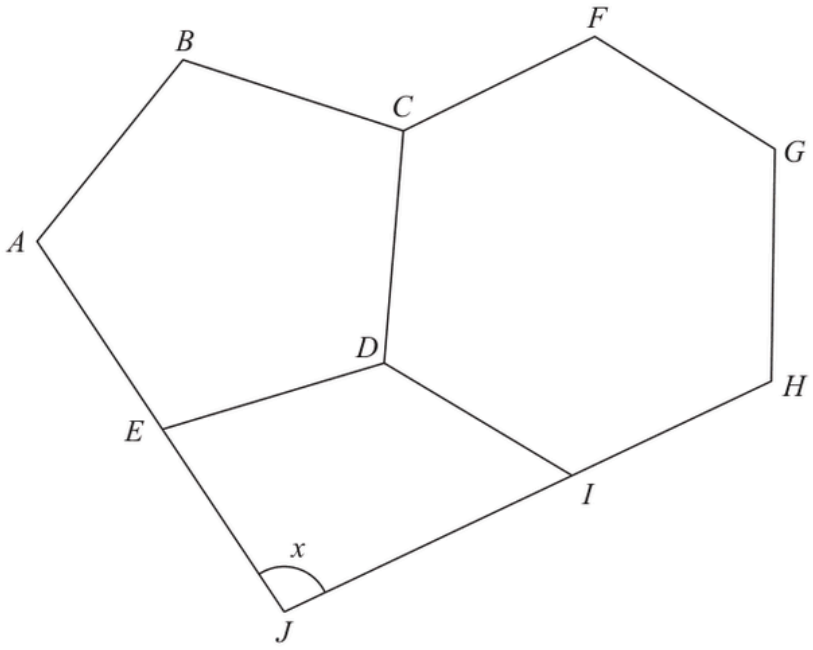


Diagram **NOT** accurately drawn

AEJ and HIJ are straight lines.

Work out the size of the angle marked x.
Show your working clearly.

.....°

(Total for Question 8 is 5 marks)

WORKED SOLUTION

Question 8 · 4MA1/1HR January 2021

1 **A regular pentagon has interior**

A regular pentagon has interior angle

$$\frac{(5-2)180}{5} = 108°$$

2 **A regular hexagon has interior**

A regular hexagon has interior angle

$$\frac{(6-2)180}{6} = 120°$$

3 **Find the gradient**

At E, since AEJ is a straight line,

$$\angle DEJ = 180 - 108 = 72^\circ$$

---

4 **Find the gradient**

At D, the angles around the point include the pentagon angle 108° and the hexagon angle 120°, so

$$\angle EDI = 360 - 108 - 120 = 132^\circ$$

---

5 **Find the gradient**

At I, since HIJ is a straight line,

$$\angle DIJ = 180 - 120 = 60^\circ$$

---

6 **Find the gradient**

In quadrilateral $EDIJ$, angles sum to 360°:

$$x = 360 - 72 - 132 - 60 = 96$$

✓ **FINAL ANSWER**

96°.

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Question 9

4 marks | Prime Factors, HCF & LCM

9 $A = 2^8 \times 3^5 \times 11^4$ $B = 2^6 \times 3 \times 11^8$

(a) Find the highest common factor (HCF) of A and B.

.....

(2)

(b) Find the lowest common multiple (LCM) of $2A$ and $3B$.
Give the LCM as a product of powers of its prime factors.

.....

(2)

(Total for Question 9 is 4 marks)

WORKED SOLUTION

Question 9 · 4MA1/1HR January 2021

1 Find the LCM

$$A = 2^8 \times 3^5 \times 11^4$$

$$B = 2^6 \times 3 \times 11^8$$

2 Find the LCM

For the HCF, take the smaller power of each common prime:

$$\text{HCF} = 2^6 \times 3 \times 11^4$$

3 Find the LCM

Now

$$2A = 2^9 \times 3^5 \times 11^4$$

4 Find the LCM

and

$$3B = 2^6 \times 3^2 \times 11^8$$

5 Find the LCM

For the LCM of $2A$ and $3B$, take the larger power of each prime:

$$\text{LCM} = 2^9 \times 3^5 \times 11^8$$

FINAL ANSWER

(a) $2^6 \times 3 \times 11^4$, (b) $2^9 \times 3^5 \times 11^8$

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Question 10

5 marks | Perimeter & Area

10 The diagram shows one face of a wall.
This face is in the shape of a pentagon with exactly one line of symmetry.

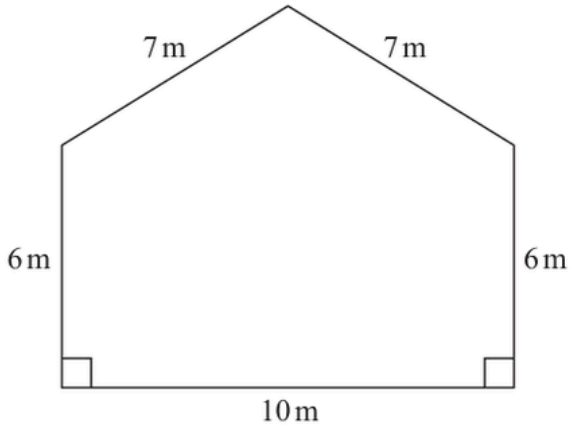


Diagram **NOT** accurately drawn

Omondi is going to paint this face of the wall once.
He has to buy all the paint that he needs to use.

The paint in each tin of paint Omondi is going to buy will cover $16\,m^2$ of the face of the wall.

Work out the least number of tins of paint Omondi will need to buy.
Show your working clearly.

(Total for Question 10 is 5 marks)

WORKED SOLUTION

Question 10 · 4MA1/1HR January 2021

1 **The wall is a rectangle**

The wall is a rectangle plus an isosceles triangle.

2 **Rectangle area**

Rectangle area:

$$10 \times 6 = 60$$

3 **Use trigonometry**

For the triangle, half the base is 5 m.

$$h^2 = 7^2 - 5^2 = 24$$

$$h = \sqrt{24}$$

4 **Triangle area**

Triangle area:

$$\frac{1}{2} \times 10 \times \sqrt{24} = 24.494\ldots$$

5 **Total area**

Total area:

$$60 + 24.494\ldots = 84.494\ldots$$

6 **Each tin covers**

Each tin covers $16\ \text{m}^2$:

$$\frac{84.494\ldots}{16} = 5.28\ldots$$

7 **Calculate area**

Omondi must buy whole tins, so he needs 6 tins.

✓ **FINAL ANSWER**

6 tins.

Question 11

6 marks | Cumulative Frequency Diagrams

11 The manager of a call centre asked the 120 people, who rang the call centre last week, how long they each waited before their call was answered.

The table gives information about their replies.

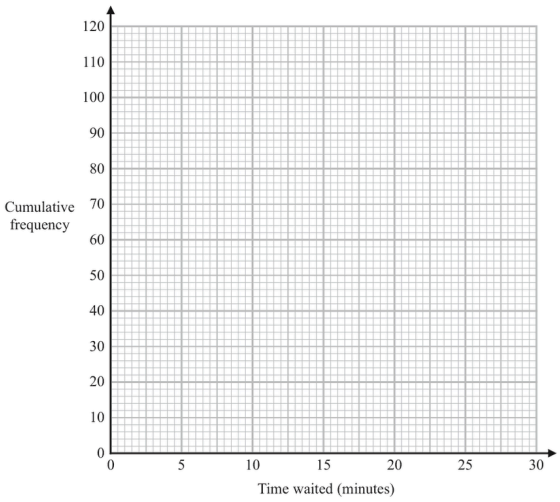
Time waited (t minutes)	Frequency
$0 < t \leqslant 5$	8
$5 < t \leqslant 10$	15
$10 < t \leqslant 15$	17
$15 < t \leqslant 20$	28
$20 < t \leqslant 25$	33
$25 < t \leqslant 30$	19

(a) Complete the cumulative frequency table.

Time waited (t minutes)	Cumulative frequency
$0 < t \leqslant 5$	
$0 < t \leqslant 10$	
$0 < t \leqslant 15$	
$0 < t \leqslant 20$	
$0 < t \leqslant 25$	
$0 < t \leqslant 30$	

(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 of the times waited.

..... minutes

(1)

(d) Using your graph, find an estimate for the percentage of the 120 people who said that they waited longer than 23 minutes before their call was answered.
Show your working clearly.

.....%

(2)

(Total for Question 11 is 6 marks)

1 Complete the cumulative frequencies

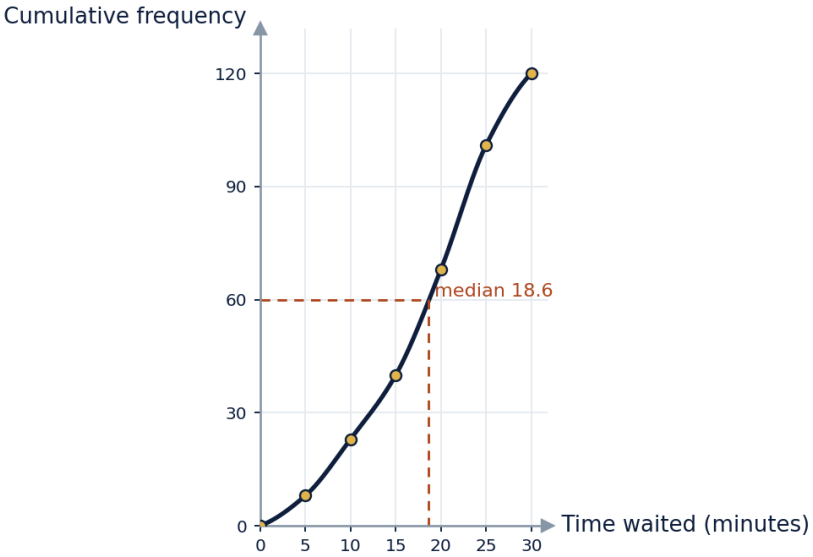
Complete the cumulative frequencies:

$$8,\ 23,\ 40,\ 68,\ 101,\ 120$$

2 Plot the points

Plot the points

$$(0,0),(5,8),(10,23),(15,40),(20,68),(25,101),(30,120)$$



3 The median is at cumulative

The median is at cumulative frequency 60.

4 Use cumulative frequency

This lies between $(15,40)$ and $(20,68)$:

$$15+\frac{60-40}{68-40}\times 5=18.57\ldots$$

5 Use cumulative frequency

So the median is about 18.6 minutes.

6 At minutes

At 23 minutes:

$$68+\frac{3}{5}(101-68)=87.8$$

7 Number who waited longer than

Number who waited longer than 23 minutes:

$$120 - 87.8 = 32.2$$

$$\frac{32.2}{120} \times 100 = 26.8\%$$

FINAL ANSWER

cumulative frequencies $8, 23, 40, 68, 101, 120$, median about 18.6 minutes, percentage about 27%.

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Question 12

9 marks | Algebraic Roots & Indices

12 (a) Simplify $(16e^{10}f^{6})^{\frac{1}{2}}$

.....

(2)

(b) Write $\frac{2x+1}{4}+\frac{x-2}{3}$ as a single fraction in its simplest form.

.....

(3)

Given that $4^{k+3}=16\times 2^{k}$

(c) find the value of k.
Show your working clearly.

$k =$ .....

(4)

(Total for Question 12 is 9 marks)

WORKED SOLUTION

Question 12 · 4MA1/1HR January 2021

1 **(a)**

(a)

$$(16e^{10}f^{6})^{\frac{1}{2}}=4e^{5}f^{3}$$

2 **(b)**

(b)

$$\frac{2x+1}{4}+\frac{x-2}{3}=\frac{3(2x+1)+4(x-2)}{12}$$

$$=\frac{6x+3+4x-8}{12}=\frac{10x-5}{12}=\frac{5(2x-1)}{12}$$

3 **(c)**

(c)

$$4^{k+3} = 16 \times 2^k$$

$$(2^2)^{k+3} = 2^4 \times 2^k$$

$$2^{2k+6} = 2^{k+4}$$

$$2k + 6 = k + 4$$

$$k = -2$$

FINAL ANSWER

(a) $4e^5f^3$, (b) $\frac{5(2x-1)}{12}$, (c) $k = -2$.

4MA1/1HR JANUARY 2021

Question 13

2 marks | Vectors

13 Here are two vectors.

$$\overrightarrow{AB} = \begin{pmatrix} 5 \\ 3 \end{pmatrix} \qquad \overrightarrow{CB} = \begin{pmatrix} -2 \\ 4 \end{pmatrix}$$

Find, as a column vector, $\overrightarrow{AC}$

(Total for Question 13 is 2 marks)

WORKED SOLUTION

Question 13 · 4MA1/1HR January 2021

1 **Use vectors**

$$\overrightarrow{AB} = \begin{pmatrix} 5 \\ 3 \end{pmatrix}$$

2 **Use vectors**

and

$$\overrightarrow{CB} = \begin{pmatrix} -2 \\ 4 \end{pmatrix}$$

3 **Use vectors**

So

$$\overrightarrow{BC} = -\overrightarrow{CB} = \begin{pmatrix} 2 \\ -4 \end{pmatrix}$$

$$\overrightarrow{AC} = \overrightarrow{AB} + \overrightarrow{BC} = \begin{pmatrix} 5 \\ 3 \end{pmatrix} + \begin{pmatrix} 2 \\ -4 \end{pmatrix} = \begin{pmatrix} 7 \\ -1 \end{pmatrix}$$

✓ **FINAL ANSWER**

$\begin{pmatrix} 7 \\ -1 \end{pmatrix}$.

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Question 14

4 marks | Circle Theorems

14

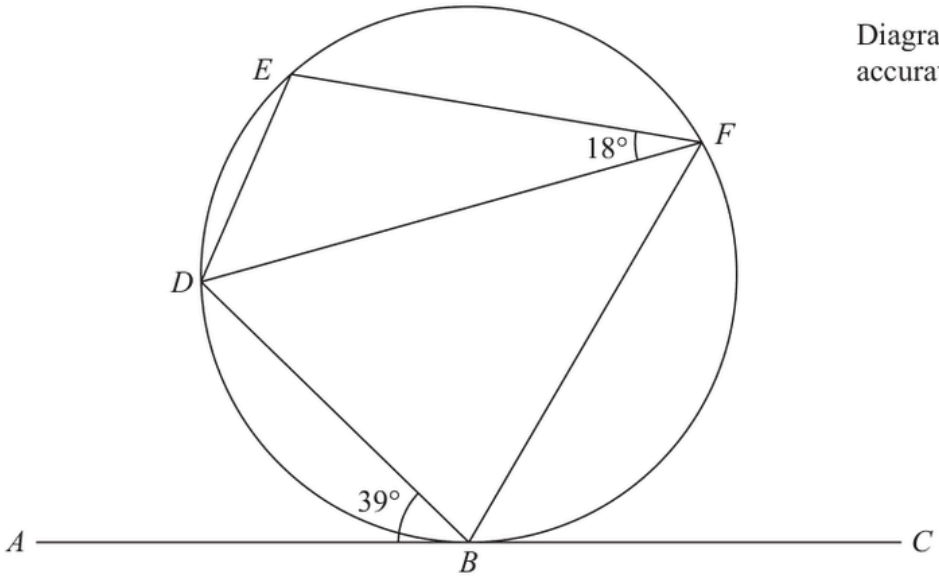


Diagram **NOT** accurately drawn

B, D, E and F are points on a circle.

ABC is the tangent at B to the circle.
Angle $ABD = 39°$
Angle $EFD = 18°$

Work out the size of angle BDE.
Give reasons for your working.

.....°

(Total for Question 14 is 4 marks)

WORKED SOLUTION

Question 14 · 4MA1/1HR January 2021

1 **Use trigonometry**

By the alternate segment theorem, the angle between the tangent and chord BD is equal to the angle in the opposite segment:

$$\angle BFD = 39°$$

2 **Given**

Given

$$\angle EFD = 18°$$

3 Use trigonometry

So

$$\angle BFE = 39^\circ + 18^\circ = 57^\circ$$

4 Opposite angles in cyclic quadrilateral

Opposite angles in cyclic quadrilateral $BDEF$ add to 180°:

$$\angle BDE = 180^\circ - 57^\circ = 123^\circ$$

FINAL ANSWER

123°.

4MA1/1HR JANUARY 2021

Question 15

5 marks | Algebraic Proof

15 (a) Use algebra to show that $4.\dot{5}\dot{7} = 4\frac{19}{33}$

(2)

(b) Show that $\frac{2}{6-3\sqrt{2}}$ can be written in the form $\frac{a+\sqrt{a}}{b}$ where a and b are integers.
Show your working clearly.

(3)

(Total for Question 15 is 5 marks)

WORKED SOLUTION

Question 15 · 4MA1/1HR January 2021

1 (a) Let

(a) Let

$$x = 4.\dot{5}\dot{7}$$

2 Calculate value

Then

$$100x = 457.\dot{5}\dot{7}$$

3 Subtract

Subtract:

$$100x - x = 457.\dot{5}\dot{7} - 4.\dot{5}\dot{7}$$

$$99x = 453$$

$$x = \frac{453}{99} = \frac{151}{33} = 4\frac{19}{33}$$

4 **(b)**

(b)

$$\frac{2}{6-3\sqrt{2}} \times \frac{6+3\sqrt{2}}{6+3\sqrt{2}} = \frac{12+6\sqrt{2}}{36-18}$$

$$= \frac{12+6\sqrt{2}}{18} = \frac{2+\sqrt{2}}{3}$$

---

5 **Simplify surd**

So this is in the form $\frac{a+\sqrt{a}}{b}$, with $a = 2$ and $b = 3$.

FINAL ANSWER

$4.\dot{5}\dot{7} = 4\frac{19}{33}$ and $\frac{2}{6-3\sqrt{2}} = \frac{2+\sqrt{2}}{3}$.

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Question 16

5 marks | Expanding Brackets

16 (a) Expand and simplify $(x + 4)(x - 2)(x + 1)$

.....

(3)

(b) Express $x^2 - 10x + 40$ in the form $(x + a)^2 + b$, where a and b are integers.

.....

(2)

(Total for Question 16 is 5 marks)

WORKED SOLUTION

Question 16 · 4MA1/1HR January 2021

1 **(a)**

(a)

$$(x+4)(x-2)(x+1)$$

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

$$(x+4)(x^2 - x - 2) = x^3 + 3x^2 - 6x - 8$$

2 **(b)**

(b)

$$x^2 - 10x + 40 = (x-5)^2 + 15$$

✓ **FINAL ANSWER**

(a) $x^3 + 3x^2 - 6x - 8$, (b) $(x-5)^2 + 15$

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Question 17

5 marks | Simultaneous Equations

17 Solve the simultaneous equations

$$x - 6y = 5$$
$$xy - 2y^2 = 6$$

Show clear algebraic working.

(Total for Question 17 is 5 marks)

WORKED SOLUTION

Question 17 · 4MA1/1HR January 2021

1 Solve simultaneous equations

$$x - 6y = 5$$

$$xy - 2y^2 = 6$$

2 From the first equation

From the first equation:

$$x = 6y + 5$$

3 Substitute into the second equation

Substitute into the second equation:

$$y(6y + 5) - 2y^2 = 6$$

$$4y^2 + 5y - 6 = 0$$

4 Factorise

Factorise:

$$(4y - 3)(y + 2) = 0$$

5 Solve simultaneous equations

So

$$y = \frac{3}{4} \quad \text{or} \quad y = -2$$

6 **Solve simultaneous equations**

If $y = \frac{3}{4}$:

$$x = 6\left(\frac{3}{4}\right) + 5 = \frac{19}{2}$$

---

7 **Solve simultaneous equations**

If $y = -2$:

$$x = 6(-2) + 5 = -7$$

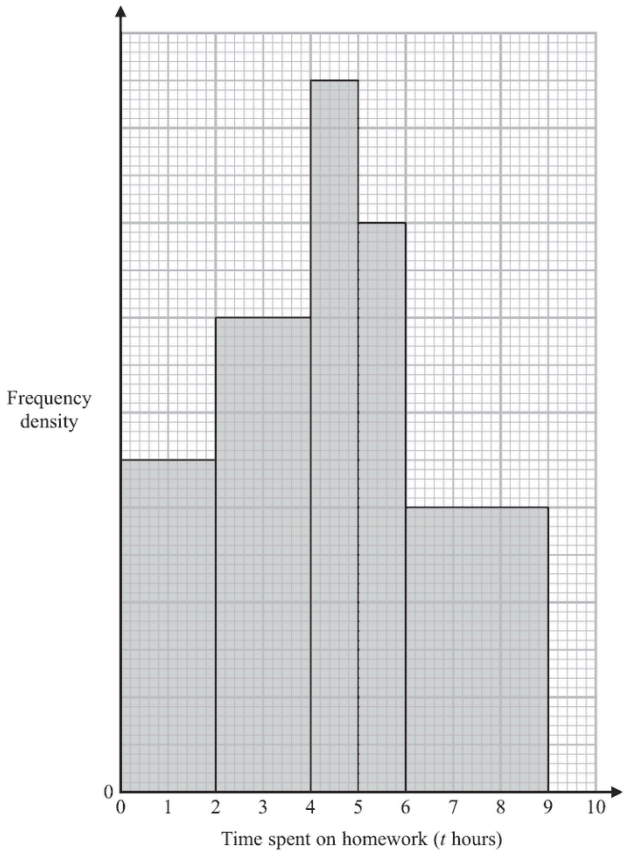
✓ **FINAL ANSWER**

$(x, y) = \left(\frac{19}{2}, \frac{3}{4}\right)$ or $(-7, -2)$.

Question 18

5 marks | Histograms

18 The histogram and the table give some information about the amounts of time, in hours, that Year 11 students at Bergdesh Academy spent, in total, on their homework last week.
No student in Year 11 spent longer than 9 hours on their homework.



Time spent on homework (t hours)	Frequency
$0 < t \leqslant 2$	28
$2 < t \leqslant 4$	
$4 < t \leqslant 5$	
$5 < t \leqslant 6$	
$6 < t \leqslant 9$	

Using the information in the histogram and in the table, work out an estimate for the mean amount of time the Year 11 students spent on their homework last week.
Give your answer in hours correct to 3 significant figures.

..... hours

(Total for Question 18 is 5 marks)

1 **Use histogram**

The $0 < t \leq 2$ class has frequency 28. From the histogram, the relative heights are

$$1,\ 4,\ 9,\ 6,\ 1$$

2 **Use histogram**

So the frequencies are

$$28,\ 112,\ 126,\ 84,\ 42$$

3 **Use midpoints**

Use midpoints $1, 3, 4.5, 5.5, 7.5$.

$$\text{total frequency} = 28 + 112 + 126 + 84 + 42 = 392$$

$$\text{estimated total} = 1(28) + 3(112) + 4.5(126) + 5.5(84) + 7.5(42) = 1708$$

$$\text{mean} = \frac{1708}{392} = 4.357\ldots$$

FINAL ANSWER

4.36 hours.

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Question 19

3 marks | Rounding, Estimation & Bounds

19 $k = \dfrac{t}{a-h}$

$t = 14$ correct to 2 significant figures
$a = 7.8$ correct to 2 significant figures
$h = 3.4$ correct to 2 significant figures

Work out the lower bound for the value of k.
Show your working clearly.

(Total for Question 19 is 3 marks)

WORKED SOLUTION

Question 19 · 4MA1/1HR January 2021

1 Estimate the value

$$k = \frac{t}{a-h}$$

2 Find lower bound

For the lower bound of k, use the lower bound of t and make the denominator as large as possible.

$$t \geq 13.5$$

$$a < 7.85, \quad h \geq 3.35$$

$$(a-h)_{\text{upper}} = 7.85 - 3.35 = 4.5$$

$$k_{\text{lower}} = \frac{13.5}{4.5} = 3$$

FINAL ANSWER

3

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Question 20

5 marks | Differentiation & Turning Points

20 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)

WORKED SOLUTION

Question 20 · 4MA1/1HR January 2021

1 **Read the graph**

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

2 **Read the graph**

Velocity is the rate of change of displacement:

$$v = \frac{ds}{dt}$$

$$v = 3t^2 - 18t + 33$$

3 **Complete the square**

Complete the square:

$$v = 3(t^2 - 6t + 11)$$

$$v = 3[(t-3)^2 + 2]$$

$$v = 3(t-3)^2 + 6$$

4 **Read the graph**

Since $(t-3)^2 \geq 0$, the minimum value of v is

$$6$$

5 **Read the graph**

The velocity is always positive, so the minimum speed is also 6.

✓ **FINAL ANSWER**

$6\ \text{m/s}$

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Question 21

6 marks | Sequences

21 The nth term of an arithmetic series is u_n where $u_n > 0$ for all n
The sum to n terms of the series is S_n

Given that $u_4 = 6$ and that $S_{11} = (u_6)^2 + 18$

find the value of u_{20}

(Total for Question 21 is 6 marks)

WORKED SOLUTION

Question 21 · 4MA1/1HR January 2021

1 Let

Let $u_6 = v$.

2 Use series formula

For an arithmetic series,

$$S_{11} = \frac{11}{2}(u_1 + u_{11})$$

3 The average of and is

The average of u_1 and u_{11} is u_6, so

$$S_{11} = 11u_6 = 11v$$

4 **Given**

Given

$$S_{11} = (u_6)^2 + 18$$

$$11v = v^2 + 18$$

$$v^2 - 11v + 18 = 0$$

$$(v - 2)(v - 9) = 0$$

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5 **Calculate value**

So

$$u_6 = 2 \quad \text{or} \quad u_6 = 9$$

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6 **Find the nth term**

But $u_4 = 6$. If $u_6 = 2$, then the common difference is negative and later terms would not all be positive. Therefore,

$$u_6 = 9$$

$$d = \frac{u_6 - u_4}{2} = \frac{9 - 6}{2} = \frac{3}{2}$$

$$u_{20} = u_6 + 14d$$

$$u_{20} = 9 + 14\left(\frac{3}{2}\right) = 30$$

✓ **FINAL ANSWER**

$u_{20} = 30$

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Question 22

5 marks | Linear Graphs

22 ABC is an isosceles triangle with $AB = AC$.

B is the point with coordinates $(-1, 5)$
C is the point with coordinates $(2, 10)$
M is the midpoint of BC.

Find an equation of the line through the points A and M.
Give your answer in the form $py + qx = r$ where p, q and r are integers.

(Total for Question 22 is 5 marks)

WORKED SOLUTION

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1 Find the gradient

Since $AB = AC$, point A lies on the perpendicular bisector of BC.

2 The midpoint of is

The midpoint of BC is

$$M = \left(\frac{-1+2}{2}, \frac{5+10}{2}\right)$$

$$M = \left(\frac{1}{2}, \frac{15}{2}\right)$$

3 The gradient of is

The gradient of BC is

$$\frac{10-5}{2-(-1)} = \frac{5}{3}$$

4 Find the gradient

So the gradient of the perpendicular bisector is

$$-\frac{3}{5}$$

5 **Find line equation**

Use the line through M:

$$y - \frac{15}{2} = -\frac{3}{5}\left(x - \frac{1}{2}\right)$$

6 **Multiply by 10**

Multiply by 10:

$$10y - 75 = -6x + 3$$

$$10y + 6x = 78$$

7 **Divide by 2**

Divide by 2:

$$5y + 3x = 39$$

✓ **FINAL ANSWER**

$5y + 3x = 39$