Elite Mathematics
Pearson Edexcel International GCSE

IGCSE LINEAR · 4MA1

4MA1/1H May/November 2020 Worked Solutions

May/November 2020 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

4MA1/1H May/November 2020

May/November 2020

25	100	2 h
questions	marks	exam time

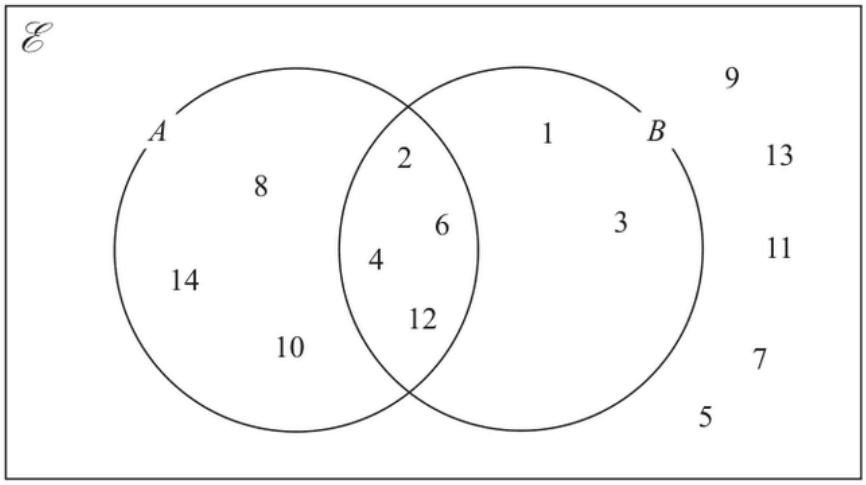
Each question is followed by its worked solution and final answer.

4MA1/1H MAY/NOVEMBER 2020

Question 1

4 marks | Set Notation & Venn Diagrams

1 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)

WORKED SOLUTION

Question 1 · 4MA1/1H May/November 2020

1 **(a) In both A and B**

$A \cap B = \{2, 4, 6, 12\}$

2 **(b) Not in B**

Everything outside circle B: $B' = \{5, 7, 8, 9, 10, 11, 13, 14\}$

3 **(c) In A but not in B**

$\{8, 10, 14\}$: 3 of the 14 numbers.

$$\frac{3}{14}$$

✓ **FINAL ANSWER**

(a) $2, 4, 6, 12$ (b) $5, 7, 8, 9, 10, 11, 13, 14$ (c) $\frac{3}{14}$

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Question 2

4 marks | Probability Toolkit

2 Toy cars are made in a factory.
The toy cars are made for 15 hours each day.
5 toy cars are made every 12 seconds.

For the toy cars made each day, the probability of a toy car being faulty is 0.002

Work out an estimate of the number of faulty toy cars that are made each day.

(Total for Question 2 is 4 marks)

WORKED SOLUTION

Question 2 · 4MA1/1H May/November 2020

1 Seconds in a working day

$$15 \times 60 \times 60 = 54\,000 \text{ seconds}$$

2 Toy cars made each day

$$\frac{54\,000}{12} \times 5 = 22\,500$$

3 Expected number of faulty cars

$$22\,500 \times 0.002 = 45$$

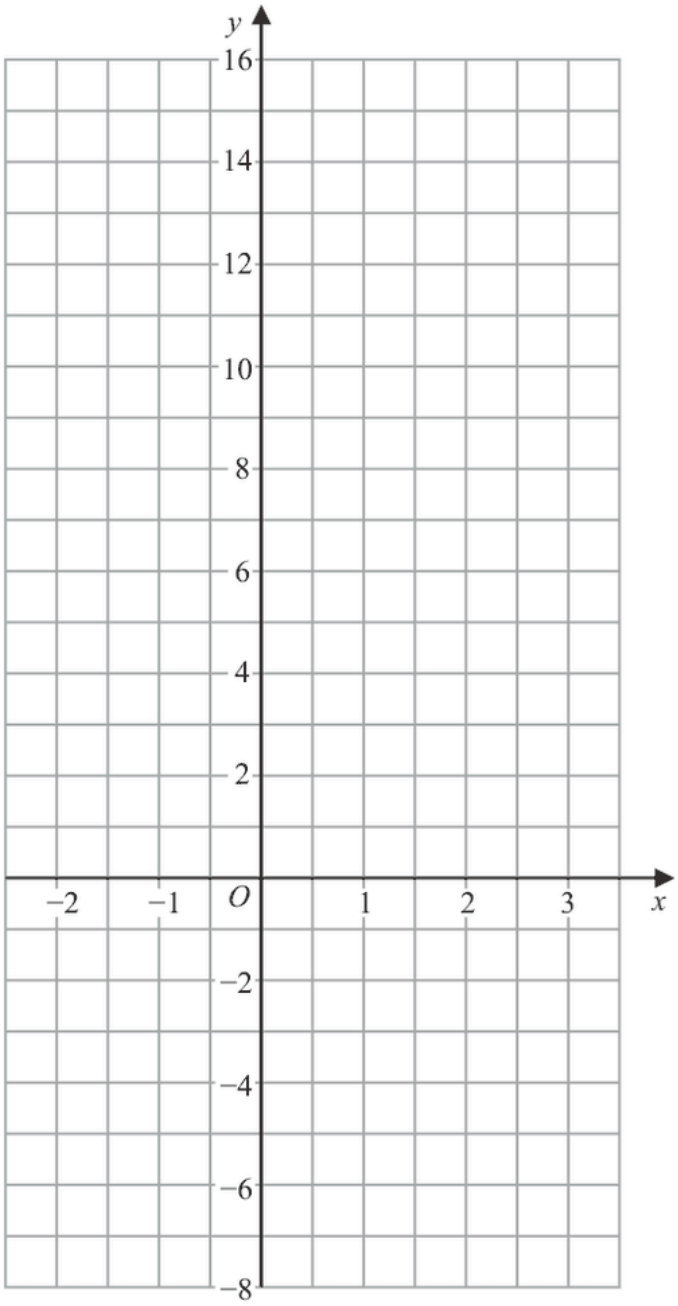
✓ **FINAL ANSWER**

45

Question 3

3 marks | Linear Graphs

3 On the grid, draw the graph of $y = 7 - 4x$ for values of x from -2 to 3



(Total for Question 3 is 3 marks)

1 Read the graph

$$y = 7 - 4x$$

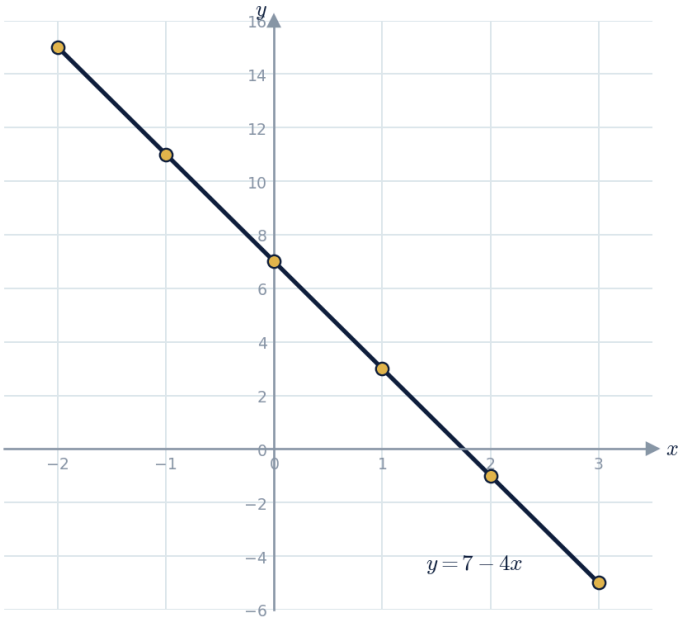
2 Useful points are

Useful points are:

$$(-2, 15), \quad (0, 7), \quad (1, 3), \quad (2, -1), \quad (3, -5)$$

3 Plot these points and join

Plot these points and join them with a straight line.



FINAL ANSWER

The graph is the straight line $y = 7 - 4x$.

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Question 4

4 marks | Statistics Toolkit

4 Here is a list of six numbers written in order of size.

$$4 \quad 7 \quad x \quad 10 \quad y \quad y$$

The numbers have

a median of 9
a mean of 11

Find the value of x and the value of y.

$x =$ .....

$y =$ .....

(Total for Question 4 is 4 marks)

WORKED SOLUTION

Question 4 · 4MA1/1H May/November 2020

1 The median is

The median is 9:

$$\frac{x + 10}{2} = 9$$

$$x = 8$$

2 Calculate statistic

The mean is 11, so the total is

$$6 \times 11 = 66$$

$$4 + 7 + 8 + 10 + y + y = 66$$

$$29 + 2y = 66$$

$$2y = 37$$

$$y = 18.5$$

FINAL ANSWER

$x = 8,\ y = 18.5$.

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Question 5

4 marks | Standard Form

5 (a) Write 5.7×10^{-3} as an ordinary number.

.....

(1)

(b) Write 800 000 in standard form.

.....

(1)

(c) Work out $\dfrac{3 \times 10^5 - 2.7 \times 10^4}{6 \times 10^{-2}}$

.....

(2)

(Total for Question 5 is 4 marks)

WORKED SOLUTION

Question 5 · 4MA1/1H May/November 2020

1 **Convert standard form**

$$5.7 \times 10^{-3} = 0.0057$$

$$800000 = 8 \times 10^5$$

2 **Convert standard form**

For part (c), first simplify the numerator:

$$3 \times 10^5 - 2.7 \times 10^4 = 300000 - 27000 = 273000$$

3 **Convert standard form**

Then

$$\frac{273000}{6 \times 10^{-2}} = \frac{273000}{0.06} = 4550000$$

$$4550000 = 4.55 \times 10^6$$

FINAL ANSWER

(a) 0.0057, (b) 8×10^5, (c) 4.55×10^6

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Question 6

3 marks | Standard & Compound Units

6 A rocket travelled 100 km at an average speed of 28 440 km/h.

Work out how long it took the rocket to travel the 100 km.
Give your answer in seconds, correct to the nearest second.

..... seconds

(Total for Question 6 is 3 marks)

WORKED SOLUTION

Question 6 · 4MA1/1H May/November 2020

1 Use

Use

$$\text{time} = \frac{\text{distance}}{\text{speed}}$$

$$\text{time} = \frac{100}{28440} \text{ hours}$$

2 Convert hours to seconds

Convert hours to seconds:

$$\frac{100}{28440} \times 3600 = 12.658\ldots$$

3 To the nearest second

To the nearest second,

$$12.658\ldots \approx 13$$

FINAL ANSWER

13 seconds.

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Question 7

8 marks | Factorising

7 (a) Solve $5(4 - x) = 7 - 3x$
Show clear algebraic working.

$x =$ .....

(3)

(b) Factorise fully $16m^3g^3 + 24m^2g^5$

.....

(2)

(c) (i) Factorise $y^2 - 2y - 48$

.....

(2)

(ii) Hence, solve $y^2 - 2y - 48 = 0$

.....

(1)

(Total for Question 7 is 8 marks)

WORKED SOLUTION

Question 7 · 4MA1/1H May/November 2020

1 **(a)**

(a)

$$5(4 - x) = 7 - 3x$$

$$20 - 5x = 7 - 3x$$

$$13 = 2x$$

$$x = \frac{13}{2}$$

2 **(b)**

(b)

$$16m^3g^3 + 24m^2g^5 = 8m^2g^3(2m + 3g^2)$$

3 **(c)(i)**

(c)(i)

$$y^2 - 2y - 48 = (y - 8)(y + 6)$$

4 **Factorise expression**

(c)(ii) $y = 8$ or $y = -6$.

FINAL ANSWER

$x = \frac{13}{2}$, $8m^2g^3(2m + 3g^2)$, $(y - 8)(y + 6)$, $y = 8$ or $y = -6$

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Question 8

4 marks | Angles in Polygons & Parallel Lines

8 Here is a 10-sided polygon.

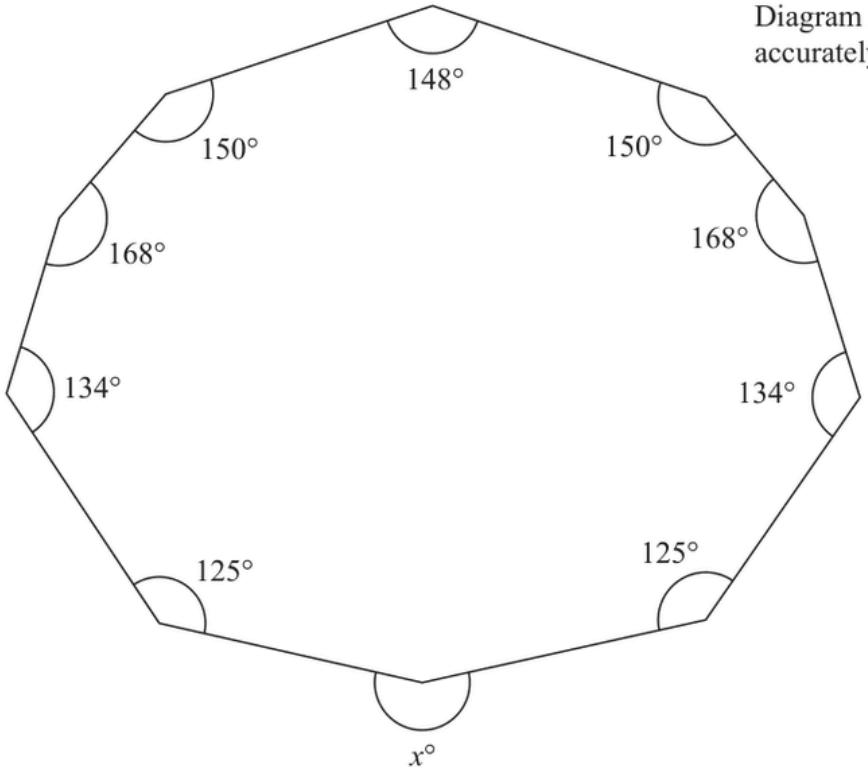


Diagram **NOT** accurately drawn

Work out the value of x.

$x =$ .....

(Total for Question 8 is 4 marks)

WORKED SOLUTION

Question 8 · 4MA1/1H May/November 2020

1 **The sum of the interior**

The sum of the interior angles of a 10-sided polygon is

$$(10 - 2) \times 180 = 1440°$$

2 **The sum of the 9**

The sum of the 9 given interior angles is

$$150 + 168 + 134 + 125 + 125 + 134 + 168 + 150 + 148 = 1302°$$

3 **Find the gradient**

So the missing interior angle is

$$1440° - 1302° = 138°$$

4 **The angle is the reflex**

The angle x is the reflex angle outside the polygon at this vertex:

$$x = 360° - 138° = 222°$$

✓ **FINAL ANSWER**

$222°$.

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Question 9

3 marks | Reverse Percentages

9 In a sale, normal prices are reduced by 20%

A bag costs 1080 rupees in the sale.

Work out the normal price of the bag.

..... rupees

(Total for Question 9 is 3 marks)

WORKED SOLUTION

Question 9 · 4MA1/1H May/November 2020

1 **A reduction of means the**

A reduction of 20% means the sale price is 80% of the normal price.

$$0.80 \times \text{normal price} = 1080$$

$$\text{normal price} = \frac{1080}{0.80} = 1350$$

FINAL ANSWER

1350 rupees

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Question 10

3 marks | Prime Factors, HCF & LCM

10 $A = 2 \times 3^{43}$
$B = 16 \times 3^{37}$

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

.....

(1)

(b) Express the number $A \times B$ as a product of powers of its prime factors.
Give your answer in its simplest form.

.....

(2)

(Total for Question 10 is 3 marks)

WORKED SOLUTION

Question 10 · 4MA1/1H May/November 2020

1 Find the LCM

$$A = 2 \times 3^{43}$$

$$B = 16 \times 3^{37} = 2^4 \times 3^{37}$$

2 Find the LCM

For the HCF, take the smaller powers:

$$\text{HCF} = 2 \times 3^{37}$$

3 Find the LCM

For $A \times B$,

$$A \times B = (2 \times 3^{43})(2^4 \times 3^{37})$$

$$A \times B = 2^5 \times 3^{80}$$

FINAL ANSWER

(a) 2×3^{37}, (b) $2^5 \times 3^{80}$

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Question 11

6 marks | Perimeter & Area

11 The diagram shows trapezium $ABCD$ in which BC and AD are parallel.

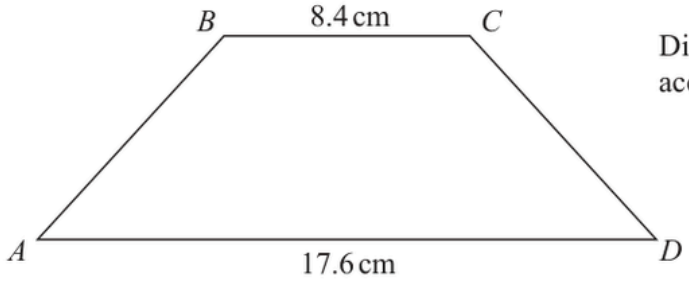


Diagram **NOT** accurately drawn

The trapezium has exactly one line of symmetry.

$BC = 8.4\,\text{cm}$
$AD = 17.6\,\text{cm}$

The trapezium has area $179.4\,\text{cm}^2$

Work out the size of angle ABC.
Give your answer correct to 1 decimal place.

.....°

(Total for Question 11 is 6 marks)

WORKED SOLUTION

Question 11 · 4MA1/1H May/November 2020

1 **The average of the parallel**

The average of the parallel sides is

$$\frac{8.4 + 17.6}{2} = 13$$

2 **Find the gradient**

So the perpendicular height is

$$179.4 \div 13 = 13.8$$

3 **The horizontal offset on each**

The horizontal offset on each side is

$$\frac{17.6 - 8.4}{2} = 4.6$$

4 **Use trigonometry**

The acute angle between AB and the horizontal is

$$\tan^{-1}\left(\frac{13.8}{4.6}\right) = 71.565\ldots^\circ$$

5 **Use trigonometry**

So the interior angle ABC is

$$180^\circ - 71.565\ldots^\circ = 108.434\ldots^\circ$$

✓ **FINAL ANSWER**

108.4°.

4MA1/1H MAY/NOVEMBER 2020

Question 12

4 marks | Simultaneous Equations

12 Solve the simultaneous equations

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

Show clear algebraic working.

$x =$ .....

$y =$ .....

(Total for Question 12 is 4 marks)

WORKED SOLUTION

Question 12 · 4MA1/1H May/November 2020

1 Solve simultaneous equations

$$7x - 2y = 34$$

$$3x + 5y = -3$$

2 Multiply the first equation by

Multiply the first equation by 5:

$$35x - 10y = 170$$

3 Multiply the second equation by

Multiply the second equation by 2:

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

4 Add

Add:

$$41x = 164$$

$$x = 4$$

5 **Solve simultaneous equations**

Substitute into $3x + 5y = -3$:

$$12 + 5y = -3$$

$$y = -3$$

FINAL ANSWER

$x = 4$, $y = -3$.

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Question 13

3 marks | Compound Interest & Depreciation

13 Jan invests \$8000 in a savings account.
The account pays compound interest at a rate of $x\%$ per year.

At the end of 6 years, there is a total of \$8877.62 in the account.

Work out the value of x.
Give your answer correct to 2 decimal places.

$x =$ .....

(Total for Question 13 is 3 marks)

WORKED SOLUTION

Question 13 · 4MA1/1H May/November 2020

1 Let the compound interest rate

Let the compound interest rate be $x\%$.

$$8000\left(1+\frac{x}{100}\right)^6 = 8877.62$$

$$1+\frac{x}{100} = \sqrt[6]{\frac{8877.62}{8000}} = 1.017500\ldots$$

$$x = 1.7500\ldots$$

2 Use compound interest

Correct to 2 decimal places,

$$x = 1.75$$

FINAL ANSWER

$x = 1.75$

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Question 14

3 marks | Direct & Inverse Proportion

14 F is inversely proportional to the square of v.

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

find a formula for F in terms of v.

(Total for Question 14 is 3 marks)

WORKED SOLUTION

Question 14 · 4MA1/1H May/November 2020

1 Find inverse function

F is inversely proportional to v^2, so

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

2 Use when

Use $F = 6.5$ when $v = 4$:

$$6.5 = \frac{k}{4^2}$$

$$k = 6.5 \times 16 = 104$$

3 Find inverse function

Therefore

$$F = \frac{104}{v^2}$$

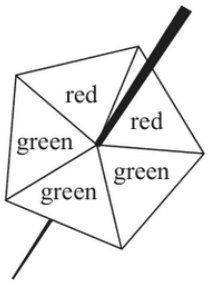
FINAL ANSWER

$F = \frac{104}{v^2}$.

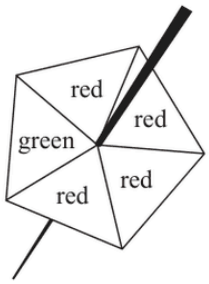
Question 15

5 marks | Tree Diagrams & Conditional Probability

15 Harry has two fair 5-sided spinners.



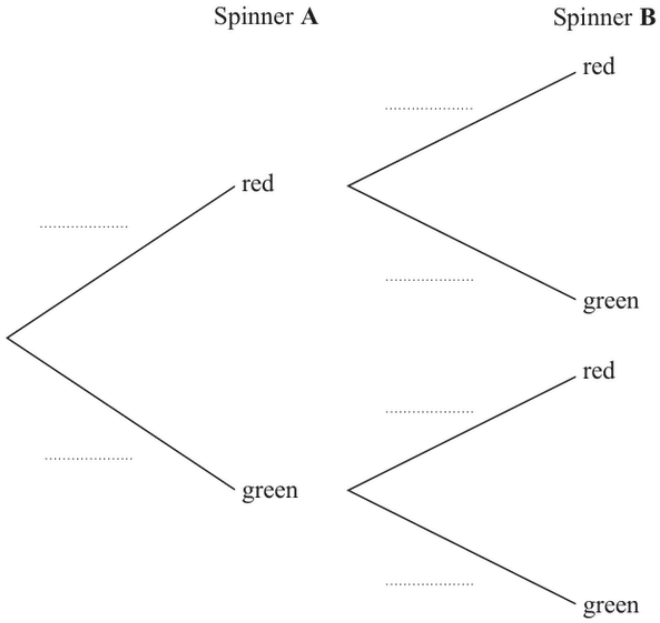
Spinner **A**



Spinner **B**

Harry is going to spin each spinner once.

(a) Complete the probability tree diagram.



(2)

(b) Work out the probability that at least one of the spinners will land on green.

.....

(3)

(Total for Question 15 is 5 marks)

1

(a) Complete the tree

Spinner A has 2 red and 3 green sections: red $\frac{2}{5}$, green $\frac{3}{5}$.

Spinner B has 4 red and 1 green (on both branches): red $\frac{4}{5}$, green $\frac{1}{5}$.

2

(b) Use the complement

"At least one green" is the opposite of "both red":

$$1 - \frac{2}{5} \times \frac{4}{5} = 1 - \frac{8}{25} = \frac{17}{25}$$

✓ **FINAL ANSWER**

(a) $\frac{2}{5}, \frac{3}{5}$; $\frac{4}{5}, \frac{1}{5}$ on both branches (b) $\frac{17}{25}$

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Question 16

4 marks | Circle Theorems

16

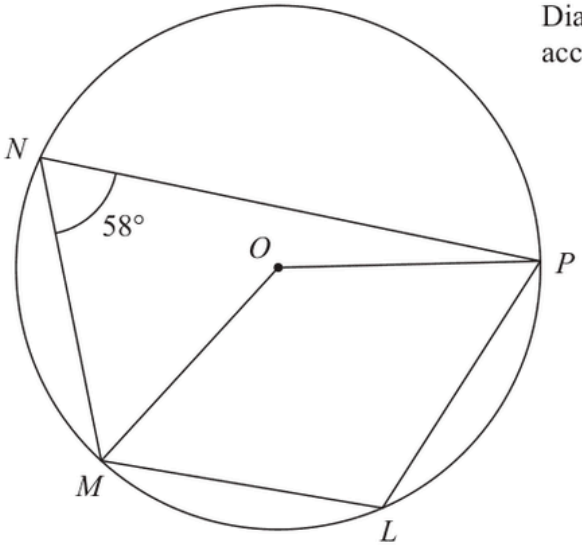


Diagram **NOT** accurately drawn

L, M, N and P are points on a circle, centre O

Angle $MNP = 58°$

(a) (i) Find the size of angle MLP

.....°

(ii) Give a reason for your answer.

.....

.....

(2)

(b) Find the size of the reflex angle MOP

.....°

.....

(2)

(Total for Question 16 is 4 marks)

WORKED SOLUTION

Question 16 · 4MA1/1H May/November 2020

1 (a) Opposite angles in cyclic

(a) Opposite angles in cyclic quadrilateral $MNPL$ add to $180°$:

$$\angle MLP = 180° - 58° = 122°$$

2 **(b) The angle at the**

(b) The angle at the centre is twice the angle at the circumference standing on the same arc MP:

$$\angle MOP = 2 \times 58^\circ = 116^\circ$$

---

3 **The reflex angle is**

The reflex angle is

$$360^\circ - 116^\circ = 244^\circ$$

✓ **FINAL ANSWER**

$\angle MLP = 122^\circ$, and reflex $\angle MOP = 244^\circ$.

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Question 17

4 marks | Rounding, Estimation & Bounds

17 A metal block has a mass of 5 kg, correct to the nearest 50 grams.
The block has a volume of $(1.84 \times 10^{-3})\,m^3$, correct to 3 significant figures.

Work out the upper bound for the density of the block.
Give your answer in kg/m^3 correct to 1 decimal place.
Show your working clearly.

..... kg/m^3

(Total for Question 17 is 4 marks)

WORKED SOLUTION

Question 17 · 4MA1/1H May/November 2020

1 Density is

Density is

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

2 To get the upper bound

To get the upper bound for density, use the upper bound for mass and the lower bound for volume.

3 The mass is kg correct

The mass is 5 kg correct to the nearest 50 g.

$$50\text{ g} = 0.05\text{ kg}$$

4 Find upper bound

Half of this is 0.025 kg, so

$$\text{upper bound for mass} = 5 + 0.025 = 5.025$$

5 Find upper bound

The volume is $1.84 \times 10^{-3} = 0.00184\ m^3$, correct to 3 significant figures.

6 The lower bound is

The lower bound is

$$0.00184 - 0.000005 = 0.001835$$

7 **Find upper bound**

So the upper bound for the density is

$$\frac{5.025}{0.001835} = 2738.419\ldots$$

8 **Find upper bound**

Correct to 1 decimal place,

$$2738.4$$

✓ **FINAL ANSWER**

$2738.4\ \mathrm{kg/m^3}$

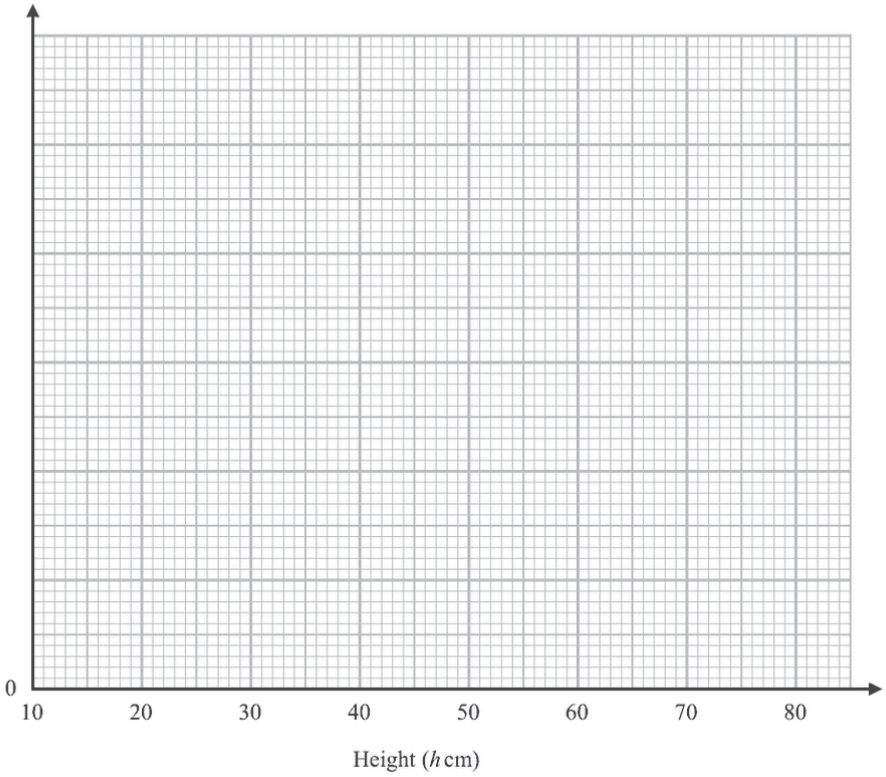
Question 18

5 marks | Histograms

18 The table gives information about the heights, in centimetres, of some plants.

Height (h cm)	Frequency
$10 < h \leqslant 20$	35
$20 < h \leqslant 35$	45
$35 < h \leqslant 50$	75
$50 < h \leqslant 70$	40
$70 < h \leqslant 80$	8

(a) On the grid, draw a histogram for this information.



(3)

(b) Work out an estimate for the number of these plants with a height greater than 40 cm.

.....

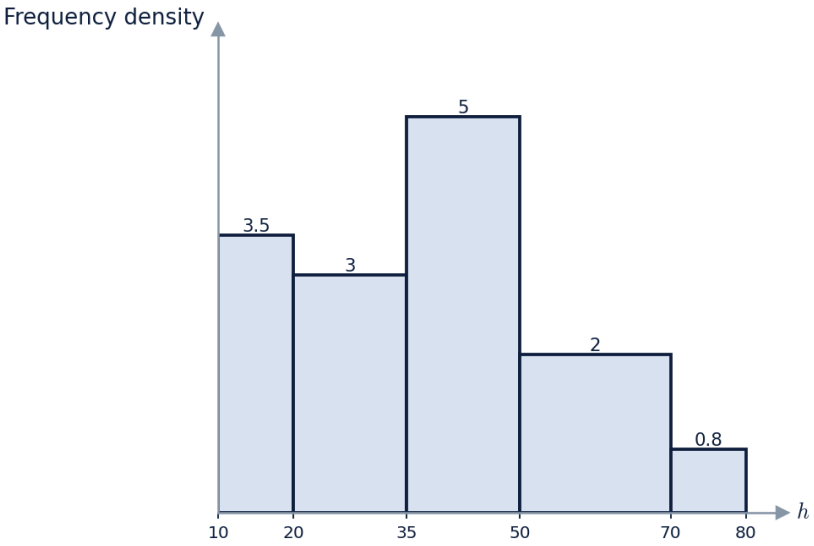
(2)

(Total for Question 18 is 5 marks)

1 **The histogram densities are**

The histogram densities are

$$\frac{35}{10} = 3.5, \quad \frac{45}{15} = 3, \quad \frac{75}{15} = 5, \quad \frac{40}{20} = 2, \quad \frac{8}{10} = 0.8$$



2 **Use histogram**

For plants taller than $40\ \text{cm}$:

3 **Use histogram**

From $40 < h \leq 50$:

$$10(5) = 50$$

4 **Use histogram**

From $50 < h \leq 70$:

$$40$$

5 **Use histogram**

From $70 < h \leq 80$:

$$8$$

$$50 + 40 + 8 = 98$$

FINAL ANSWER

draw bars with densities $3.5, 3, 5, 2, 0.8$, and 98 plants.

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Question 19

3 marks | Surds

19 Without using a calculator, rationalise the denominator of $\frac{6}{3-\sqrt{7}}$

Simplify your answer.
You must show each stage of your working.

(Total for Question 19 is 3 marks)

WORKED SOLUTION

Question 19 · 4MA1/1H May/November 2020

1 Simplify surd

$$\frac{6}{3-\sqrt{7}}$$

2 Rationalise the denominator

Rationalise the denominator:

$$\frac{6}{3-\sqrt{7}} \times \frac{3+\sqrt{7}}{3+\sqrt{7}} = \frac{6(3+\sqrt{7})}{9-7}$$

$$= \frac{6(3+\sqrt{7})}{2} = 3(3+\sqrt{7})$$

$$= 9+3\sqrt{7}$$

FINAL ANSWER

$9+3\sqrt{7}$

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Question 20

3 marks | Area & Volume of Similar Shapes

20 **R** and **S** are two similar solid shapes.

Shape **R** has surface area 108 cm^2 and volume 135 cm^3
Shape **S** has surface area 300 cm^2

Work out the volume of shape **S**.

..... cm^3

(Total for Question 20 is 3 marks)

WORKED SOLUTION

Question 20 · 4MA1/1H May/November 2020

1 **Shape R has surface area**

Shape R has surface area $108\ \text{cm}^2$ and volume $135\ \text{cm}^3$.

2 **Shape S has surface area**

Shape S has surface area $300\ \text{cm}^2$.

3 **Surface area ratio S R**

Surface area ratio S:R:

$$300 : 108 = 25 : 9$$

4 **Split the ratio**

So the linear ratio S:R is

$$5 : 3$$

5 **Split the ratio**

Therefore the volume ratio S:R is

$$5^3 : 3^3 = 125 : 27$$

6 **Volume of S**

Volume of S:

$$135 \times \frac{125}{27} = 625$$

FINAL ANSWER

$\boxed{625\ \text{cm}^3}$

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Question 21

5 marks | Algebraic Fractions

21 Express

$$\frac{1}{3x-2} \times \frac{9x^2-4}{3x^2-13x-10} - \frac{7}{x-1}$$

as a single fraction in its simplest form.

(Total for Question 21 is 5 marks)

WORKED SOLUTION

Question 21 · 4MA1/1H May/November 2020

1 Use trigonometry

$$\frac{1}{3x-2} \times \frac{9x^2-4}{3x^2-13x-10} - \frac{7}{x-1}$$

2 Factor

Factor:

$$9x^2-4 = (3x-2)(3x+2)$$

$$3x^2-13x-10 = (3x+2)(x-5)$$

3 Use trigonometry

So the first product becomes

$$\frac{1}{3x-2} \times \frac{(3x-2)(3x+2)}{(3x+2)(x-5)}$$

4 Cancel common factors

Cancel common factors:

$$\frac{1}{x-5}$$

5 Use trigonometry

Now subtract:

$$\frac{1}{x-5} - \frac{7}{x-1}$$

6 Use the common denominator

Use the common denominator $(x-5)(x-1)$:

$$\frac{x-1-7(x-5)}{(x-5)(x-1)}$$

$$=\frac{x-1-7x+35}{(x-5)(x-1)}$$

$$=\frac{34-6x}{(x-5)(x-1)}$$

FINAL ANSWER

$$\boxed{\frac{34-6x}{(x-5)(x-1)}}$$

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Question 22

4 marks | Linear Graphs

22 $ABCD$ is a rhombus.

The diagonals, AC and BD, intersect at the point M.
The coordinates of M are $(6, -11)$

The points A and C both lie on the line with equation $2y + 7x = 20$

Find the exact coordinates of the point where the line through B and D intersects the y-axis.

(..... , ...)

(Total for Question 22 is 4 marks)

WORKED SOLUTION

Question 22 · 4MA1/1H May/November 2020

1 Find the gradient

In a rhombus, the diagonals are perpendicular and bisect each other.

2 The diagonal lies on

The diagonal AC lies on

$$2y + 7x = 20$$

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

$$y = -\frac{7}{2}x + 10$$

3 Find the gradient

So the gradient of AC is

$$-\frac{7}{2}$$

4 Find the gradient

Therefore the gradient of BD is

$$\frac{2}{7}$$

5 **Calculate value**

The line BD passes through

$$M = (6, -11)$$

6 **Evaluate fraction**

So

$$y + 11 = \frac{2}{7}(x - 6)$$

7 **To find where this line**

To find where this line intersects the y-axis, put $x = 0$:

$$y + 11 = \frac{2}{7}(0 - 6)$$

$$y + 11 = -\frac{12}{7}$$

$$y = -11 - \frac{12}{7}$$

$$y = -\frac{89}{7}$$

✓ **FINAL ANSWER**

$$\left(0, -\frac{89}{7}\right)$$

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Question 23

4 marks | Differentiation & Turning Points

23 Curve **C** has equation $y = px^3 - mx$ where p and m are positive integers.

Find the range of values of x, in terms of p and m, for which the gradient of **C** is negative.

(Total for Question 23 is 4 marks)

WORKED SOLUTION

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1 Differentiate

$$y = px^3 - mx$$

2 Differentiate

Differentiate:

$$\frac{dy}{dx} = 3px^2 - m$$

3 The gradient is negative when

The gradient is negative when

$$3px^2 - m < 0$$

$$3px^2 < m$$

$$x^2 < \frac{m}{3p}$$

4 Simplify surd

So

$$-\sqrt{\frac{m}{3p}} < x < \sqrt{\frac{m}{3p}}$$

FINAL ANSWER

$$-\sqrt{\frac{m}{3p}} < x < \sqrt{\frac{m}{3p}}$$

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Question 24

4 marks | Sequences

24 Here are the first five terms of an arithmetic sequence.

8 15 22 29 36

Work out the sum of all the terms from the 50th term to the 100th term inclusive.

(Total for Question 24 is 4 marks)

WORKED SOLUTION

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1 The arithmetic sequence is

The arithmetic sequence is

$$8,\ 15,\ 22,\ 29,\ 36,\ldots$$

2 Calculate value

So

$$a = 8, \quad d = 7$$

3 The th term is

The nth term is

$$u_n = 8 + 7(n-1) = 7n + 1$$

$$u_{50} = 7(50) + 1 = 351$$

$$u_{100} = 7(100) + 1 = 701$$

4 There are

There are

$$100 - 50 + 1 = 51$$

5 **Find the nth term**

terms from the 50th to the 100th inclusive.

$$\text{sum} = \frac{51}{2}(351 + 701)$$

$$= 26826$$

✓ **FINAL ANSWER**

26826

Question 25

3 marks | Transformations of Graphs

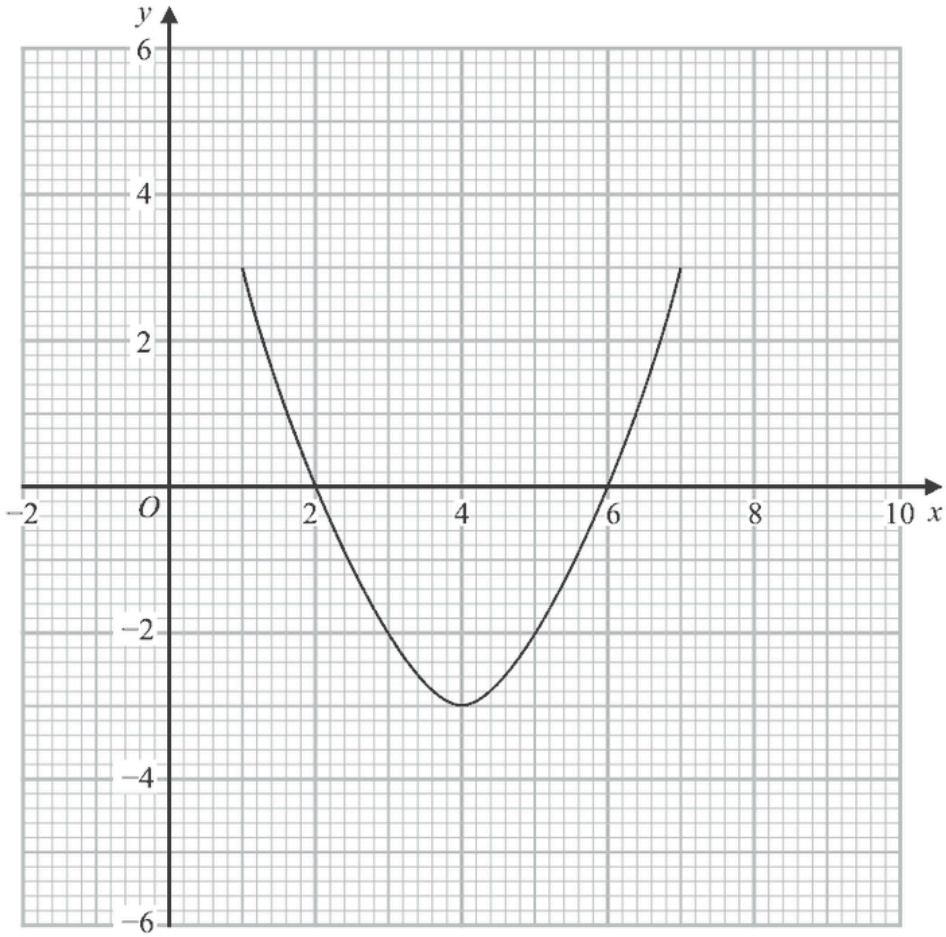
25 The curve with equation $y = g(x)$ is transformed to the curve with equation $y = -g(x)$ by the single transformation **T**.

(a) Describe fully the transformation **T**.

.....

(1)

The diagram shows the graph of $y = f(x)$



(b) On the grid, draw the graph of $y = 2f(x - 1)$

(2)

(Total for Question 25 is 3 marks)

1 **Apply transformation**

For part (a),

$$y = g(x) \rightarrow y = -g(x)$$

2 **The coordinates stay the same**

The x-coordinates stay the same and the y-coordinates change sign.

3 **Apply transformation**

So the transformation is a reflection in the x-axis.

4 **Calculate value**

For part (b),

$$y = 2f(x - 1)$$

5 **Read the graph**

First, $x - 1$ moves the graph 1 unit right. Then the factor 2 stretches the graph vertically by scale factor 2.

6 Use points from the original

Use points from the original graph:

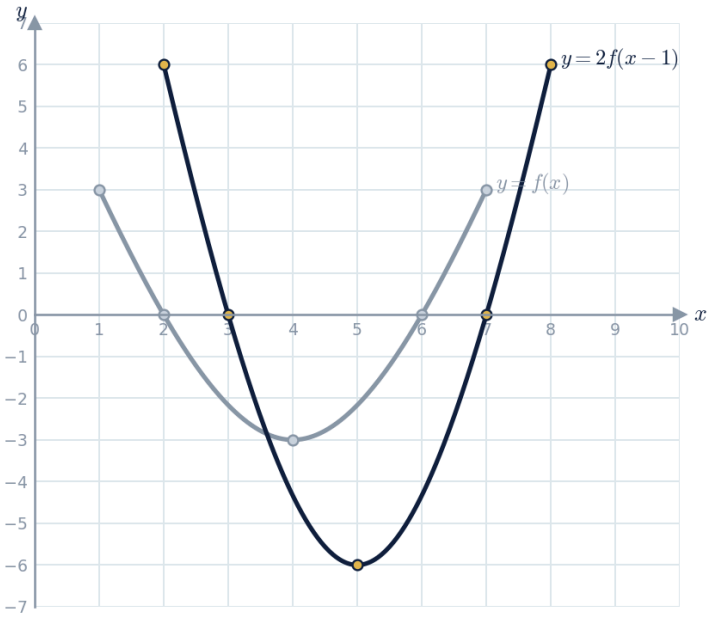
$$(1,3) \to (2,6)$$

$$(2,0) \to (3,0)$$

$$(4,-3) \to (5,-6)$$

$$(6,0) \to (7,0)$$

$$(7,3) \to (8,6)$$



7 Apply transformation

Draw the transformed parabola through these points.

FINAL ANSWER

reflection in the x-axis; transformed graph through $(2,6)$, $(3,0)$, $(5,-6)$, $(7,0)$, $(8,6)$