Elite Mathematics
Pearson Edexcel International GCSE

IGCSE LINEAR · 4MA1

4MA1/2H 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

4MA1/2H January 2021

January 2021

22	100	2 h
questions	marks	exam time

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

4MA1/2H JANUARY 2021

Question 1

3 marks | Standard & Compound Units

1 A train takes 6 hours 39 minutes to travel from New Delhi to Kanpur.
The train travels a distance of 429 km.

Work out the average speed of the train.
Give your answer in km/h correct to one decimal place.

..... km/h

(Total for Question 1 is 3 marks)

WORKED SOLUTION

Question 1 · 4MA1/2H January 2021

1 The time is

The time is

$$6\text{ h }39\text{ min} = 6.65\text{ h}$$

2 Average speed

Average speed:

$$429 \div 6.65 = 64.511\ldots$$

FINAL ANSWER

64.5 km/h.

4MA1/2H JANUARY 2021

Question 2

3 marks | Statistics Toolkit

2 Ava writes down five whole numbers.

For these five numbers

the median is 7

the mode is 8

the range is 5

Find a possible value for each of the five numbers that Ava writes down.

(Total for Question 2 is 3 marks)

WORKED SOLUTION

Question 2 · 4MA1/2H January 2021

1 Calculate statistic

The median is 7, so the middle number is 7.

2 Calculate statistic

The mode is 8, so use two 8s.

3 Calculate statistic

The range is 5, so choose the smallest and largest numbers to differ by 5.

One possible set is

$$3,\ 6,\ 7,\ 8,\ 8$$

4 Range

Range:

$$8 - 3 = 5$$

5 Mode

Mode:

$$8$$

6 **Median**

Median:

$$7$$

✓ **FINAL ANSWER**

$3,\ 6,\ 7,\ 8,\ 8.$

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Question 3

6 marks | Reverse Percentages

3 Gladys buys a table for \$465 to sell in her shop.

She sells the table for \$520

(a) Work out the percentage profit that Gladys makes from the sale of the table.
Give your answer correct to 3 significant figures.

.....%

(3)

Gladys has a sale in her shop.

She decreases all the normal prices by 12%
The normal price of an armchair was \$550

(b) Work out the sale price of the armchair.

\$.....

(3)

(Total for Question 3 is 6 marks)

WORKED SOLUTION

Question 3 · 4MA1/2H January 2021

1 Profit

Profit:

$$520 - 465 = 55$$

2 Percentage profit

Percentage profit:

$$\frac{55}{465} \times 100 = 11.827\ldots$$

3 Correct to 3 significant figures

Correct to 3 significant figures:

$$11.8\%$$

4 **Calculate statistic**

For the sale price, a 12% decrease means 88% of the original price:

$$550 \times 0.88 = 484$$

✓ **FINAL ANSWER**

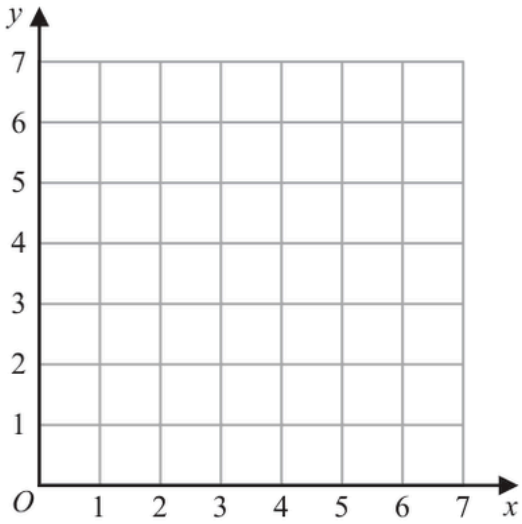
(a) 11.8%, (b) $\$484$

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Question 4

4 marks | Inequalities (Solving & Graphing)

4



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

(i) $x = 1.5$

(ii) $y = x$

(iii) $x + y = 6$

(3)

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

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

Label the region **R**.

(1)

(Total for Question 4 is 4 marks)

WORKED SOLUTION

Question 4 · 4MA1/2H January 2021

1 **Draw the three boundary lines**

Draw the three boundary lines:

$$x = 1.5, \qquad y = x, \qquad x + y = 6$$

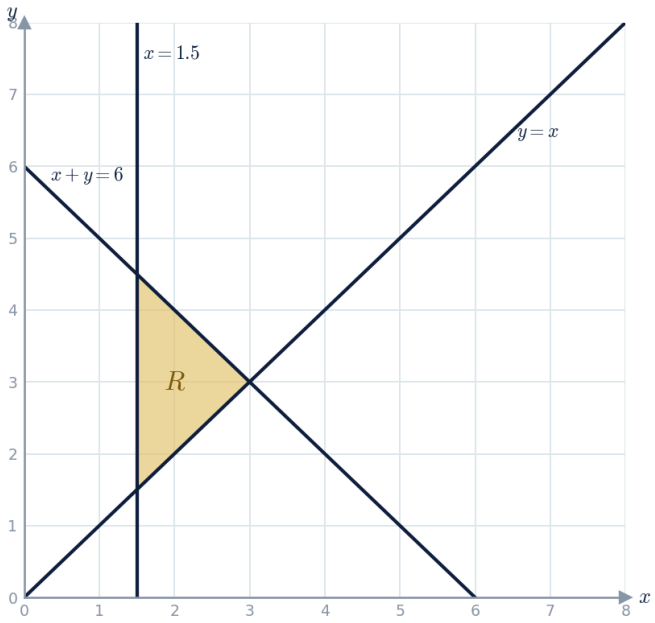
2 **The required region satisfies**

The required region satisfies

$$x > 1.5$$

$$y \geq x$$

$$x + y \leq 6$$



FINAL ANSWER

Shade the region $x > 1.5$, $y \geq x$, $x + y \leq 6$.

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Question 5

7 marks | Inequalities (Solving & Graphing)

5 (a) Expand and simplify $4x(2x + 5) - 3x(2x - 3)$

.....

(2)

Given that $\dfrac{y^5 \times y^n}{y^6} = y^{13}$

(b) work out the value of n.

$n =$ .....

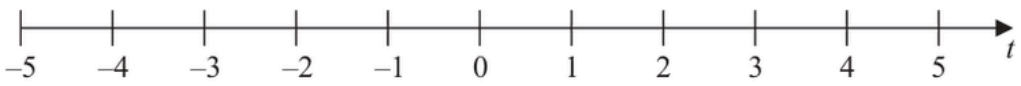
(2)

(c) (i) Solve the inequality $7t - 8 < 2t + 7$

.....

(2)

(ii) On the number line below, represent the solution set of the inequality solved in part (c)(i)



(1)

(Total for Question 5 is 7 marks)

WORKED SOLUTION

Question 5 · 4MA1/2H January 2021

1 **(a)**

(a)

$$4x(2x+5) - 3x(2x-3) = 8x^2 + 20x - 6x^2 + 9x = 2x^2 + 29x$$

2 **Expand brackets**

(b)

$$\frac{y^5 \times y^n}{y^6} = y^{n-1} = y^{13}$$

so $n - 1 = 13$, hence $n = 14$.

3 **(c)**

(c)

$$7t - 8 < 2t + 7$$

$$5t < 15$$

$$t < 3$$

---

4 **Expand brackets**

On the number line, use an open circle at 3 and shade to the left.

✓ **FINAL ANSWER**

(a) $2x^2 + 29x$, (b) $n = 14$, (c) $t < 3$

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Question 6

4 marks | Standard Form

6 (a) Write down the value of y^0

.....

(1)

(b) Work out $\dfrac{9.6 \times 10^{141} + 6.4 \times 10^{140}}{3.2 \times 10^{16}}$

Give your answer in standard form.

.....

(3)

(Total for Question 6 is 4 marks)

WORKED SOLUTION

Question 6 · 4MA1/2H January 2021

1 Convert standard form

Any non-zero value to the power 0 is 1, so

$$y^0 = 1$$

2 Convert standard form

For part (b),

$$9.6 \times 10^{141} + 6.4 \times 10^{140} = 9.6 \times 10^{141} + 0.64 \times 10^{141}$$

$$= 10.24 \times 10^{141} = 1.024 \times 10^{142}$$

3 Convert standard form

Now divide:

$$\frac{1.024 \times 10^{142}}{3.2 \times 10^{16}} = 0.32 \times 10^{126}$$

$$= 3.2 \times 10^{125}$$

✓ **FINAL ANSWER**

(a) 1, (b) 3.2×10^{125}

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Question 7

3 marks | Statistics Toolkit

7 There are 5 cocoa pods in a bag.
The mean weight of the 5 cocoa pods is 398 grams.

A sixth cocoa pod is put into the bag.
The mean weight of the 6 cocoa pods is 401 grams.

Work out the weight of the sixth cocoa pod that is put into the bag.

..... grams

(Total for Question 7 is 3 marks)

WORKED SOLUTION

Question 7 · 4MA1/2H January 2021

1 Total weight of 5 cocoa

Total weight of 5 cocoa pods:

$$5 \times 398 = 1990 \text{ g}$$

2 Total weight of 6 cocoa

Total weight of 6 cocoa pods:

$$6 \times 401 = 2406 \text{ g}$$

3 Weight of the sixth cocoa

Weight of the sixth cocoa pod:

$$2406 - 1990 = 416$$

FINAL ANSWER

416 grams.

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Question 8

5 marks | Perimeter & Area

8 A, B and C are points on a circle with centre O.

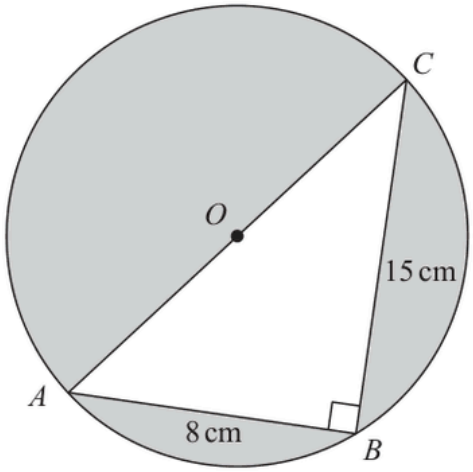


Diagram **NOT** accurately drawn

AOC is a diameter of the circle.

$AB = 8\,\text{cm}$ $BC = 15\,\text{cm}$

Angle $ABC = 90°$

Work out the total area of the regions shown shaded in the diagram.
Give your answer correct to 3 significant figures.

..... cm^2

(Total for Question 8 is 5 marks)

WORKED SOLUTION

Question 8 · 4MA1/2H January 2021

1 **Triangle is right angled**

Triangle ABC is right-angled:

$$AC^2 = 8^2 + 15^2 = 64 + 225 = 289$$

$$AC = 17\,\text{cm}$$

2 **Calculate area**

Since AOC is a diameter, the radius of the circle is

$$17 \div 2 = 8.5 \text{ cm}$$

3 **Area of the circle**

Area of the circle:

$$\pi(8.5)^2 = 226.98\ldots \text{ cm}^2$$

4 **Area of triangle**

Area of triangle ABC:

$$\frac{1}{2} \times 8 \times 15 = 60 \text{ cm}^2$$

5 **The shaded area is**

The shaded area is

$$226.98\ldots - 60 = 166.98\ldots$$

✓ **FINAL ANSWER**

167 cm^2.

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Question 9

2 marks | Prime Factors, HCF & LCM

9 $A = 2^3 \times 3^2 \times 5^2 \times 11$
$B = 2^4 \times 3 \times 5^4 \times 13$

Find the lowest common multiple (LCM) of A and B.
Give your answer as a product of powers of prime numbers.

(Total for Question 9 is 2 marks)

WORKED SOLUTION

Question 9 · 4MA1/2H January 2021

1 Find the LCM

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

$$B = 2^4 \times 3 \times 5^4 \times 13$$

2 Find the LCM

For the LCM, take the highest power of every prime that appears:

$$\text{LCM} = 2^4 \times 3^2 \times 5^4 \times 11 \times 13$$

FINAL ANSWER

$2^4 \times 3^2 \times 5^4 \times 11 \times 13$

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Question 10

3 marks | Percentages

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

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

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

24% of Team B work full time.

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

(Total for Question 10 is 3 marks)

WORKED SOLUTION

Question 10 · 4MA1/2H January 2021

1 The ratio of Team A

The ratio of Team A to Team B is $3 : 4$.

2 Use parts for Team A

Use 3 parts for Team A and 4 parts for Team B.

3 Full time part from Team

Full-time part from Team A:

$$\frac{4}{5} \times 3 = \frac{12}{5}$$

4 Full time part from Team

Full-time part from Team B:

$$24\% \times 4 = \frac{24}{100} \times 4 = \frac{24}{25}$$

5 Total full time parts

Total full-time parts:

$$\frac{12}{5} + \frac{24}{25} = \frac{60}{25} + \frac{24}{25} = \frac{84}{25}$$

6 **Total parts**

Total parts:

$$3+4=7$$

7 **Simplify fraction**

So the fraction who work full time is

$$\frac{\frac{84}{25}}{7}=\frac{84}{175}=\frac{12}{25}$$

✓ **FINAL ANSWER**

$$\frac{12}{25}$$

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Question 11

3 marks | Algebraic Roots & Indices

11 Simplify fully $\left(\frac{9t^4w^9}{18t^6w^{10}}\right)^{-2}$

(Total for Question 11 is 3 marks)

WORKED SOLUTION

Question 11 · 4MA1/2H January 2021

1 Use index laws

$$\left(\frac{9t^4w^9}{18t^6w^{10}}\right)^{-2}$$

2 Simplify inside the brackets

Simplify inside the brackets:

$$\frac{9t^4w^9}{18t^6w^{10}} = \frac{1}{2}t^{-2}w^{-1} = \frac{1}{2t^2w}$$

3 Use index laws

Now apply the power -2:

$$\left(\frac{1}{2t^2w}\right)^{-2} = (2t^2w)^2$$

$$= 4t^4w^2$$

✓ **FINAL ANSWER**

$4t^4w^2$.

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Question 12

2 marks | Statistics Toolkit

12 15 people were asked how long, in minutes, they had been waiting for a bus.

Here are the results.

2 3 3 4 5 6 6 8 9 10 11 13 14 15 18

Find the interquartile range of these times.

..... minutes

(Total for Question 12 is 2 marks)

WORKED SOLUTION

Question 12 · 4MA1/2H January 2021

1 Use Statistics Toolkit correct

The data is already in order:

$$2, 3, 3, 4, 5, 6, 6, 8, 9, 10, 11, 13, 14, 15, 18$$

2 Calculate value

For 15 values,

$$Q_1 = 4, \qquad Q_3 = 13$$

$$\text{IQR} = 13 - 4 = 9$$

FINAL ANSWER

9 minutes.

4MA1/2H JANUARY 2021

Question 13

3 marks | Circle Theorems

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

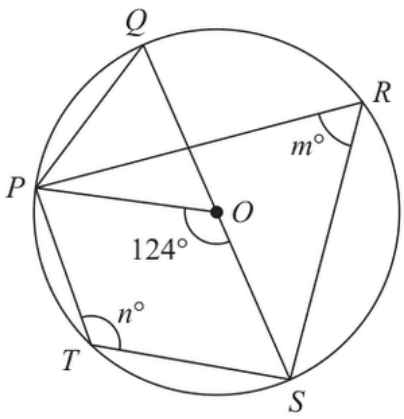


Diagram **NOT** accurately drawn

QOS is a diameter of the circle.

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

(a) Find the value of

(i) m

.....

(ii) n

.....

(2)

(b) Find the size of angle QPO.

..... °

(1)

(Total for Question 13 is 3 marks)

WORKED SOLUTION

Question 13 · 4MA1/2H January 2021

1 **Use trigonometry**

The central angle $\angle POS$ is $124°$. The angle at the circumference standing on the same chord PS is half this angle.

$$m = \frac{124}{2} = 62$$

2 **Use circle theorem**

Angles opposite each other in a cyclic quadrilateral add to $180°$, so

$$n = 180 - 62 = 118$$

---

3 **Use trigonometry**

Since QOS is a diameter,

$$\angle QOP = 180° - 124° = 56°$$

---

4 **Use trigonometry**

Triangle QOP is isosceles because $OQ = OP$. Therefore

$$\angle QPO = \frac{180 - 56}{2} = 62°$$

✓ **FINAL ANSWER**

$m = 62$, $n = 118$, and $\angle QPO = 62°$.

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Question 14

7 marks | Rearranging Formulae

14 (a) Solve $\frac{9a-7}{5} - \frac{3a-7}{4} = 4.55$

Show clear algebraic working.

$a =$ .....

(3)

(b) Make c the subject of the formula $p = \sqrt{\frac{ac+8}{3+c}}$

.....

(4)

(Total for Question 14 is 7 marks)

WORKED SOLUTION

Question 14 · 4MA1/2H January 2021

1 **(a)**

(a)

$$\frac{9a-7}{5} - \frac{3a-7}{4} = 4.55$$

2 **Multiply by 20**

Multiply by 20:

$$4(9a-7) - 5(3a-7) = 91$$

$$36a - 28 - 15a + 35 = 91$$

$$21a + 7 = 91$$

$$a = 4$$

3 **(b)**

(b)

$$p = \sqrt{\frac{ac+8}{3+c}}$$

$$p^2 = \frac{ac+8}{3+c}$$

$$p^2(3+c) = ac+8$$

$$c(p^2 - a) = 8 - 3p^2$$

FINAL ANSWER

(a) $a = 4$, (b) $c = \frac{8-3p^2}{p^2-a}$

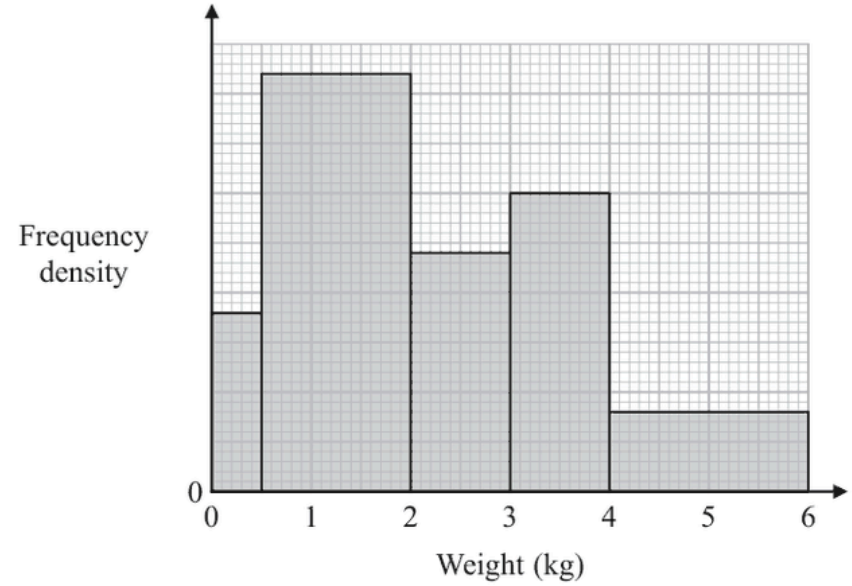
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Question 15

6 marks | Histograms

15 A postman records the weight of each parcel that he delivers.

The histogram shows information about the weights of all the parcels that the postman delivered last Monday. No parcels weighed more than 6 kg.



63 of the parcels that the postman delivered last Monday each had a weight between 0.5 kg and 2 kg.

(a) Work out the total number of parcels the postman delivered last Monday.

.....

(3)

The postman picks at random two of the records of the parcels he delivered last Monday.

(b) Work out an estimate for the probability that each parcel weighed more than 2.25 kg.

.....

(3)

(Total for Question 15 is 6 marks)

WORKED SOLUTION

Question 15 · 4MA1/2H January 2021

1 **Use histogram**

For $0.5 < w \leq 2$, the frequency is 63, so the density is

$$\frac{63}{1.5} = 42$$

2 **Use histogram**

Using the histogram heights, the class frequencies are

$$9,\ 63,\ 24,\ 30,\ 16$$

---

3 **Use histogram**

So the total number of parcels is

$$9 + 63 + 24 + 30 + 16 = 142$$

---

4 **Use histogram**

For weight greater than $2.25\ \text{kg}$:

$$0.75(24) + 30 + 16 = 64$$

---

5 **The probability that both randomly**

The probability that both randomly chosen records are greater than $2.25\ \text{kg}$ is

$$\frac{64}{142} \times \frac{63}{141} = 0.201\ldots$$

✓ **FINAL ANSWER**

142, then 0.201 approximately.

Question 16

6 marks | Set Notation & Venn Diagrams

16 Some students were asked the following question.

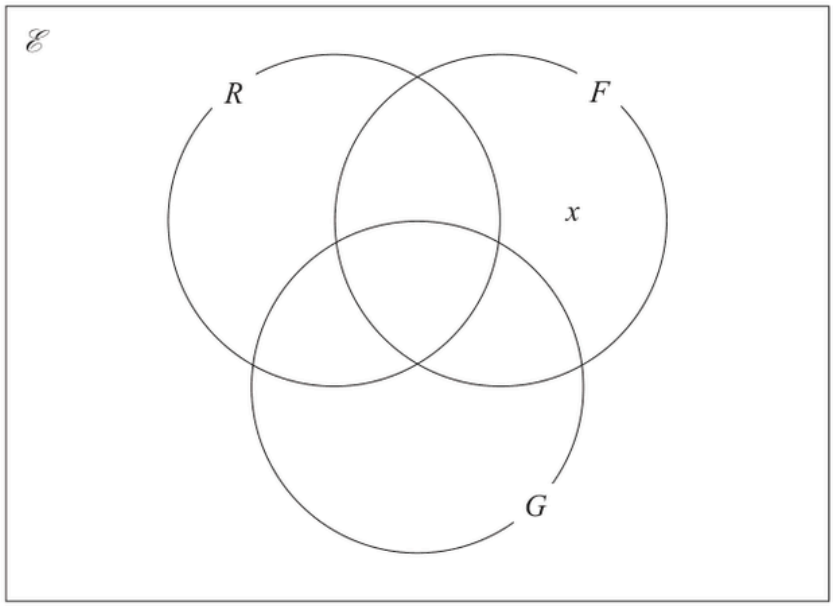
"Which of the subjects Russian (R), French (F) and German (G) do you study?"

Of these students

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

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

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



(3)

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

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

.....

(3)

(Total for Question 16 is 6 marks)

1 **The number studying all three**

The number studying all three languages is 4.

2 **Calculate value**

So the two-language-only regions are

$$R \cap F \text{ only} = 10 - 4 = 6$$

$$F \cap G \text{ only} = 13 - 4 = 9$$

$$R \cap G \text{ only} = 6 - 4 = 2$$

3 **The German only region is**

The German-only region is

$$24 - 9 - 2 - 4 = 9$$

4 **The French only region is**

The French-only region is x and the Russian-only region is $2x$. There are 11 students outside all three sets.

5 **Calculate value**

Using the total 80,

$$2x + x + 9 + 6 + 9 + 2 + 4 + 11 = 80$$

$$3x + 41 = 80$$

$$x = 13$$

6 **The number studying Russian is**

The number studying Russian is

$$2x + 6 + 2 + 4 = 26 + 6 + 2 + 4 = 38$$

✓ **FINAL ANSWER**

38

Question 17

7 marks | Volume & Surface Area

17 The diagram shows a solid prism *ABCDEFGH*.

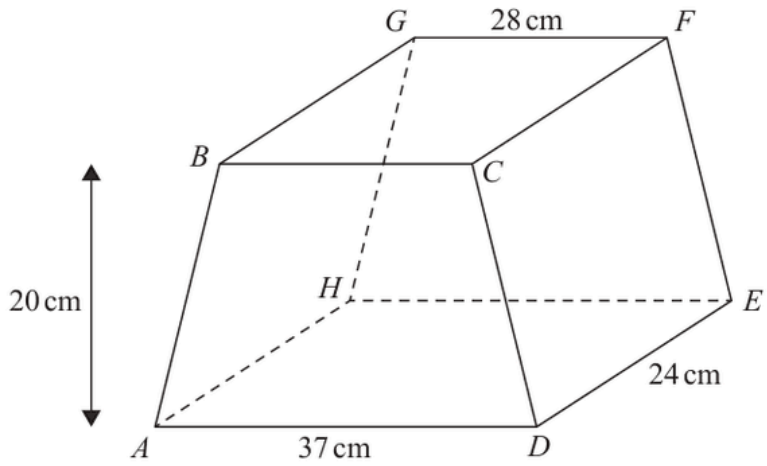


Diagram **NOT** accurately drawn

The trapezium *ABCD*, in which *AD* is parallel to *BC*, is a cross section of the prism.
The base *ADEH* of the prism is a horizontal plane.
ADEH and *BCFG* are rectangles.
The midpoint of *BC* is vertically above the midpoint of *AD* so that $BA = CD$.

$AD = 37$ cm $GF = 28$ cm $DE = 24$ cm

The perpendicular distance between edges *AD* and *BC* is 20 cm.

(a) Work out the total surface area of the prism.

..... cm^2

(4)

(b) Calculate the size of the angle between *AF* and the plane *ADEH*.
Give your answer correct to one decimal place.

.....°

(3)

(Total for Question 17 is 7 marks)

1 **The cross section is a**

The cross-section is a trapezium with parallel sides 37 cm and 28 cm, and perpendicular height 20 cm.

$$\text{Area of cross-section} = \frac{1}{2}(37+28)(20) = 650$$

2 **Calculate area**

Since the trapezium is isosceles, the horizontal difference on each side is

$$\frac{37-28}{2} = 4.5$$

3 **Calculate area**

So

$$AB = CD = \sqrt{20^2 + 4.5^2} = 20.5$$

4 **The perimeter of the cross**

The perimeter of the cross-section is

$$37 + 28 + 20.5 + 20.5 = 106$$

5 **The length of the prism**

The length of the prism is 24 cm, so the total surface area is

$$2(650) + 106(24) = 3844$$

6 **Use trigonometry**

For the angle between AF and the horizontal plane, the horizontal projection has length

$$\sqrt{24^2 + 4.5^2}$$

7 **Use trigonometry**

The vertical height is 20, so

$$\tan\theta = \frac{20}{\sqrt{24^2 + 4.5^2}}$$

$$\theta = 39.3°$$

FINAL ANSWER

$3844\ \text{cm}^2$, and $39.3°$.

4MA1/2H JANUARY 2021

Question 18

7 marks | Linear Graphs

18 A rectangle $ABCD$ is to be drawn on a centimetre grid such that

A has coordinates $(-4, -2)$
B has coordinates $(1, 10)$
C has coordinates $(19, a)$
D has coordinates (b, c)

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

$a =$ .....

$b =$ .....

$c =$ .....

(4)

(b) Calculate the perimeter, in centimetres, of rectangle $ABCD$.

..... cm

(3)

(Total for Question 18 is 7 marks)

WORKED SOLUTION

Question 18 · 4MA1/2H January 2021

1 Calculate value

$$A = (-4, -2), \quad B = (1, 10), \quad C = (19, a), \quad D = (b, c)$$

2 The vector is

The vector AB is

$$(1 - (-4), 10 - (-2)) = (5, 12)$$

3 The vector is

The vector BC is

$$(19 - 1, a - 10) = (18, a - 10)$$

4 **Adjacent sides of a rectangle**

Adjacent sides of a rectangle are perpendicular, so their dot product is zero:

$$5(18) + 12(a - 10) = 0$$

$$90 + 12a - 120 = 0$$

$$a = \frac{5}{2}$$

---

5 **Calculate value**

Now

$$BC = (18, -7.5)$$

---

6 **Calculate value**

So

$$D = A + BC = (-4, -2) + (18, -7.5) = (14, -9.5)$$

$$b = 14, \qquad c = -9.5$$

---

7 **The side lengths are**

The side lengths are

$$AB = \sqrt{5^2 + 12^2} = 13$$

$$BC = \sqrt{18^2 + (-7.5)^2} = 19.5$$

---

8 **Perimeter**

Perimeter:

$$2(13 + 19.5) = 65$$

✓ **FINAL ANSWER**

$a = \frac{5}{2}$, $b = 14$, $c = -9.5$, and perimeter $65\ \text{cm}$.

4MA1/2H JANUARY 2021

Question 19

5 marks | Differentiation & Turning Points

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

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

$$s = t^3 + 5t^2 - 8t + 10$$

Find the displacement of P from O when P is instantaneously at rest.

Give your answer in the form $\frac{a}{b}$ where a and b are integers.

..... metres

(Total for Question 19 is 5 marks)

WORKED SOLUTION

Question 19 · 4MA1/2H January 2021

1 Calculate statistic

$$s = t^3 + 5t^2 - 8t + 10$$

2 Velocity is

Velocity is

$$\frac{ds}{dt} = 3t^2 + 10t - 8$$

3 Calculate statistic

At rest,

$$3t^2 + 10t - 8 = 0$$

4 Factorise

Factorise:

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

5 Calculate statistic

So

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

6 **Calculate statistic**

Since $t \geq 0$,

$$t = \frac{2}{3}$$

---

7 **Calculate statistic**

Now find s:

$$s = \left(\frac{2}{3}\right)^3 + 5\left(\frac{2}{3}\right)^2 - 8\left(\frac{2}{3}\right) + 10$$

$$s = \frac{8}{27} + \frac{20}{9} - \frac{16}{3} + 10$$

$$s = \frac{194}{27}$$

✓ **FINAL ANSWER**

$\frac{194}{27}$ metres.

4MA1/2H JANUARY 2021

Question 20

4 marks | Perimeter & Area

20

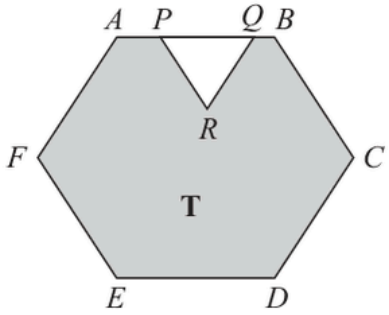


Diagram **NOT** accurately drawn

The diagram shows a shaded region **T** formed by removing an equilateral triangle PQR from a regular hexagon $ABCDEF$.

The points P and Q lie on AB such that $AB = 1.5 \times PQ$

Given that the area of region **T** is $72\sqrt{3}$ cm^2

work out the length of PQ.

..... cm

(Total for Question 20 is 4 marks)

WORKED SOLUTION

Question 20 · 4MA1/2H January 2021

1 Let

Let

$$PQ = p$$

2 Given

Given

$$AB = 1.5PQ$$

3 Find the gradient

so the side length of the regular hexagon is

$$1.5p = \frac{3}{2}p$$

4 **Area of a regular hexagon**

Area of a regular hexagon with side length s is

$$\frac{3\sqrt{3}}{2}s^2$$

5 **Find the gradient**

So the area of the hexagon is

$$\frac{3\sqrt{3}}{2}\left(\frac{3}{2}p\right)^2$$

$$=\frac{27\sqrt{3}}{8}p^2$$

6 **Find the gradient**

The removed triangle PQR is equilateral, so its area is

$$\frac{\sqrt{3}}{4}p^2$$

7 **The shaded area is**

The shaded area is

$$\frac{27\sqrt{3}}{8}p^2-\frac{\sqrt{3}}{4}p^2$$

$$=\frac{25\sqrt{3}}{8}p^2$$

8 **Find the gradient**

This is $72\sqrt{3}$, so

$$\frac{25\sqrt{3}}{8}p^2=72\sqrt{3}$$

$$\frac{25}{8}p^2=72$$

$$p^2=\frac{576}{25}$$

$$p=4.8$$

FINAL ANSWER

$PQ = 4.8\ \text{cm}$

4MA1/2H JANUARY 2021

Question 21

4 marks | Algebraic Fractions

21 Write $\frac{25x^2 - 64}{5x^2 - 13x - 6} \times \frac{x^2 - 8x + 15}{5x + 8} - (x - 7)$

as a single fraction in its simplest form.
Show clear algebraic working.

(Total for Question 21 is 4 marks)

WORKED SOLUTION

Question 21 · 4MA1/2H January 2021

1 Use trigonometry

$$\frac{25x^2 - 64}{5x^2 - 13x - 6} \times \frac{x^2 - 8x + 15}{5x + 8} - (x - 7)$$

2 Factor

Factor:

$$25x^2 - 64 = (5x - 8)(5x + 8)$$

$$5x^2 - 13x - 6 = (5x + 2)(x - 3)$$

$$x^2 - 8x + 15 = (x - 3)(x - 5)$$

3 Use trigonometry

So

$$\frac{(5x - 8)(5x + 8)}{(5x + 2)(x - 3)} \times \frac{(x - 3)(x - 5)}{5x + 8} - (x - 7)$$

4 Cancel common factors

Cancel common factors:

$$\frac{(5x - 8)(x - 5)}{5x + 2} - (x - 7)$$

5 Use the common denominator

Use the common denominator $5x + 2$:

$$\frac{(5x - 8)(x - 5) - (x - 7)(5x + 2)}{5x + 2}$$

6 Expand

Expand:

$$(5x - 8)(x - 5) = 5x^2 - 33x + 40$$

$$(x - 7)(5x + 2) = 5x^2 - 33x - 14$$

7 Use trigonometry

So the numerator is

$$5x^2 - 33x + 40 - (5x^2 - 33x - 14) = 54$$

FINAL ANSWER

$$\boxed{\frac{54}{5x + 2}}$$

4MA1/2H JANUARY 2021

Question 22

6 marks | Circles, Arcs & Sectors

22 The diagram shows a sector OBC of a circle with centre O and radius $(6 + x)$ cm.

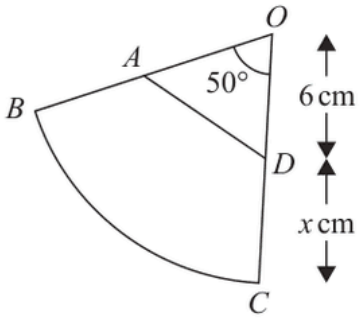


Diagram **NOT** accurately drawn

A is the point on OB and D is the point on OC such that $OA = OD = 6$ cm

Angle $BOC = 50°$

Given that

the perimeter of sector $OBC = 2 \times$ the perimeter of triangle OAD

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

$x =$ .....

(Total for Question 22 is 6 marks)

WORKED SOLUTION

Question 22 · 4MA1/2H January 2021

1 **The radius of sector is**

The radius of sector OBC is

$$6 + x$$

2 **Use trigonometry**

The angle is $50°$, so the arc length of sector OBC is

$$\frac{50}{360} \times 2\pi(6 + x)$$

3 **Evaluate fraction**

Therefore the perimeter of sector OBC is

$$2(6+x)+\frac{50}{360}\times 2\pi(6+x)$$

$$=(6+x)\left(2+\frac{5\pi}{18}\right)$$

4 **Use trigonometry**

In triangle OAD,

$$OA=OD=6,\qquad \angle AOD=50^\circ$$

5 **Use trigonometry**

So

$$AD=2(6)\sin 25^\circ=12\sin 25^\circ$$

6 **The perimeter of triangle is**

The perimeter of triangle OAD is

$$12+12\sin 25^\circ$$

7 **Given that**

Given that

$$\text{perimeter of sector } OBC=2\times\text{perimeter of triangle } OAD$$

$$(6+x)\left(2+\frac{5\pi}{18}\right)=2(12+12\sin 25^\circ)$$

$$x=\frac{2(12+12\sin 25^\circ)}{2+\frac{5\pi}{18}}-6$$

$$x=5.8854\ldots$$

✓ **FINAL ANSWER**

$\boxed{5.89}$