



Please write clearly in block capitals.

Centre number

Candidate number

Surname _____

Forename(s) _____

Candidate signature _____

I declare this is my own work.

GCSE MATHEMATICS



Higher Tier Paper 2 Calculator

Thursday 3 November 2022 Morning Time allowed: 1 hour 30 minutes

Materials

For this paper you must have:

- a calculator
- mathematical instruments
- the Formulae Sheet (enclosed).



Instructions

- Use black ink or black ball-point pen. Draw diagrams in pencil.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- If you need extra space for your answer(s), use the lined pages at the end of this book. Write the question number against your answer(s).
- Do **all** rough work in this book. Cross through any work you do not want to be marked.

Information

- The marks for questions are shown in brackets.
- The maximum mark for this paper is 80.
- You may ask for more answer paper, graph paper and tracing paper. These must be tagged securely to this answer book.

Advice

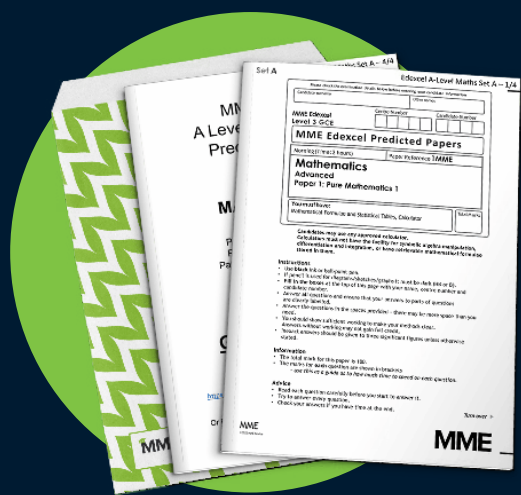
In all calculations, show clearly how you work out your answer.

For Examiner's Use	
Pages	Mark
2-3	
4-5	
6-7	
8-9	
10-11	
12-13	
14-15	
16-17	
18-19	
20-21	
22-23	
24	
TOTAL	

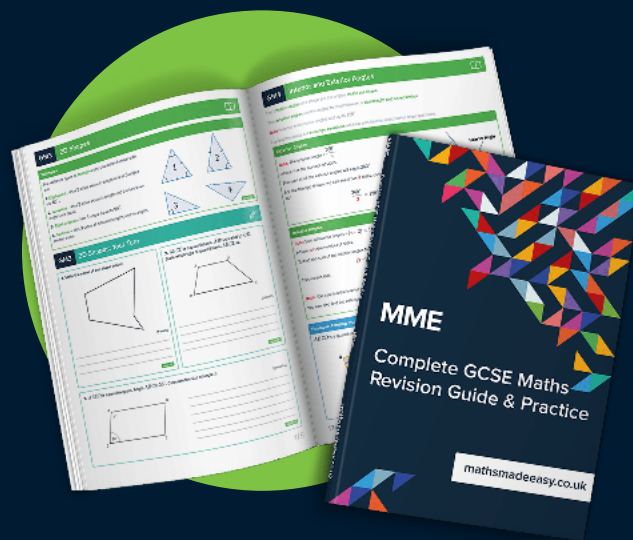


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GCSE Maths Revision Guide



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Answer all questions in the spaces provided.

Do not write
outside the
box

1 Work out $\frac{4^6 - 11}{\sqrt{625 - 225}}$

Circle your answer.

[1 mark]

-61.6

-20.425

204.25

3870.56

2 Work out $(3.1 \times 10^9)^2$

Circle your answer.

[1 mark]

6.2×10^{18}

6.2×10^{81}

9.61×10^{18}

9.61×10^{81}

3 The equation of a line is $y = 3x - 6$

Circle the coordinates of the y -intercept.

[1 mark]

(0, -6)

(-6, 0)

(0, 3)

(3, 0)



Do not write outside the box

4 $a \times b^4 = c$

Circle the correct expression for a .

[1 mark]

$\frac{c}{\sqrt[4]{b}}$

$\frac{c}{b^{-4}}$

$\left(\frac{c}{b}\right)^4$

$\frac{c}{b^4}$

5 Written as the product of prime factors,

$12600 = 2^3 \times 3^2 \times 5^2 \times 7$

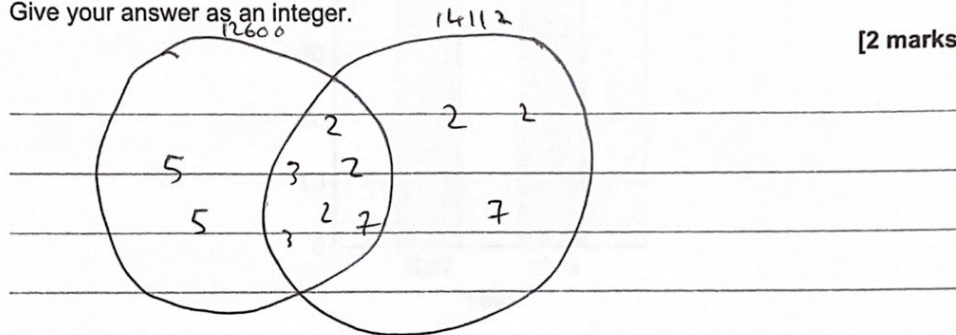
and

$14112 = 2^5 \times 3^2 \times 7^2$

Work out the highest common factor (HCF) of 12600 and 14112

Give your answer as an integer.

[2 marks]



Answer 504

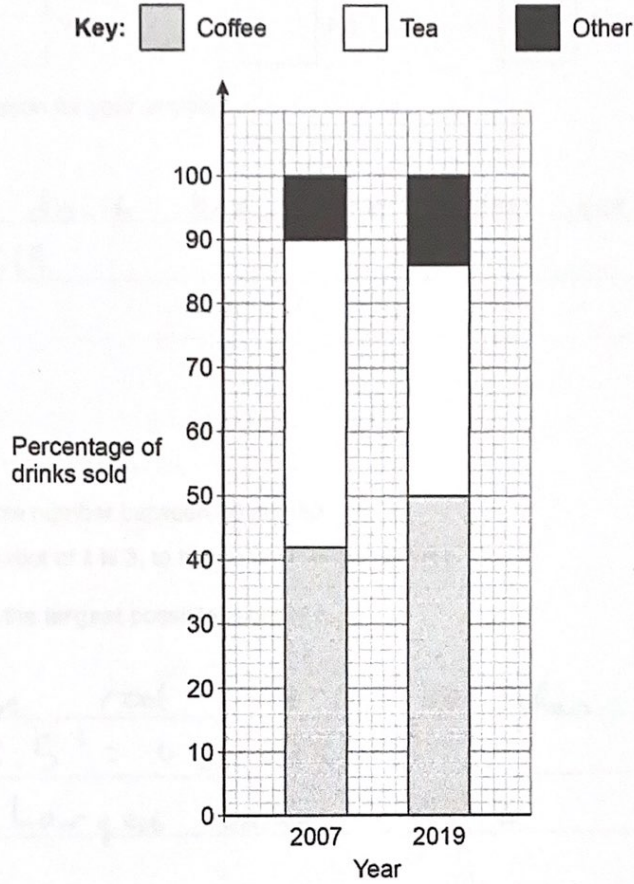
$$\begin{aligned} \text{HCF} &= 2 \times 2 \times 2 \times 3 \times 3 \times 7 \\ &= 504 \end{aligned}$$

Turn over ►



Do not write outside the box

6 The composite bar chart shows information about the **percentage** of drinks sold by a café in 2007 and 2019



6 (a) In 2007 the café sold a total of 24 000 drinks.

How many **more** teas than coffees were sold?

[2 marks]

$$\begin{aligned} \text{Coffee} &= 42\% & 24000 \times 0.42 &= 10080 \\ \text{Tea} &= 48\% & 24000 \times 0.48 &= 11520 \\ 11520 - 10080 &= \del{1440} & & 1440 \end{aligned}$$

Answer 1440



- 6 (b) Were more coffees sold at the café in 2019 than in 2007?

Tick a box.

Yes

No

Cannot tell

Give a reason for your answer.

[1 mark]

We don't know the total sold in
2019

- 7 (a) k is a whole number between 40 and 50

The cube root of k is 3, to the nearest whole number.

Work out the largest possible value of k .

[2 marks]

Cube root must be less than 3.5

$$3.5^3 = 42.875$$

Largest value is 42

Answer

42

- 7 (b) Fay tries to solve $x^2 = 100$

She says,

"The only possible value of x is 10"

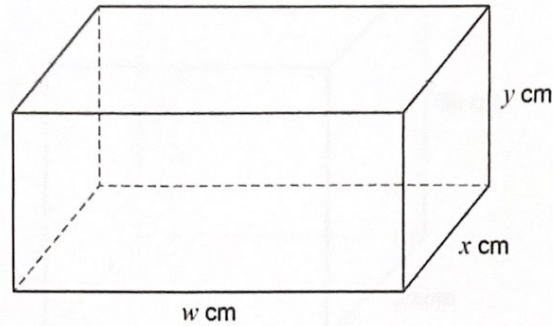
Give a reason why she is **not** correct.

[1 mark]

$$-10^2 = 100 \text{ so } x = -10 \text{ is valid}$$



- 8 (a) Here is a cuboid.
 w , x and y are **different** whole numbers.



The total length of **all** the edges of the cuboid is 80 cm

The volume is **greater** than 200 cm^3

Work out one possible set of values for w , x and y .

[2 marks]

Since each edge appears 4 times, need

$$w + x + y = 20 \text{ cm}$$

$$10 + 7 + 3 = 20 \text{ cm}$$

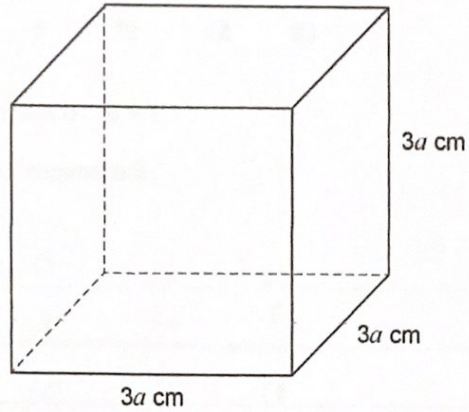
$$10 \times 7 \times 3 = 210 \text{ cm}^3 > 200 \text{ cm}^3$$

$$w = 10 \quad x = 7 \quad y = 3$$



- 8 (b) Here is a solid cube.

Do not write
outside the
box



Circle the expression for the **total** surface area in cm^2

[1 mark]

$36a$

$54a$

$36a^2$

$54a^2$

- 9 The 47th triangular number is 1128
The 48th triangular number is 1176
Work out the 49th triangular number.

[1 mark]

~~1128~~ ~~1176~~ ~~1176~~

$$1176 + 49 = 1225$$

Answer

1225

Turn over ►



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10 The n th terms of two linear sequences, A and B, are added to give the n th term of a new sequence.

The new sequence starts

8 13 18 23

The n th term of sequence A is $n + 1$

Work out the n th term of sequence B.

[4 marks]

new	8	13	18	23
- A	2	3	4	5
B	6	10	14	18

$\underbrace{\quad\quad}_{+4}$ $\underbrace{\quad\quad}_{+4}$ $\underbrace{\quad\quad}_{+4}$

$$B = 4n + x$$

$$6 = 4(1) + x$$

$$6 = 4 + x$$

$$x = 2$$

Answer 4n + 2

11 A tank contains 40 litres of water.

11 (a) Water leaks out of the tank at a rate of 1.2 litres per minute.

The leak is stopped after 20 minutes.

Show that, when the leak is stopped, the tank contains 16 litres of water.

[1 mark]

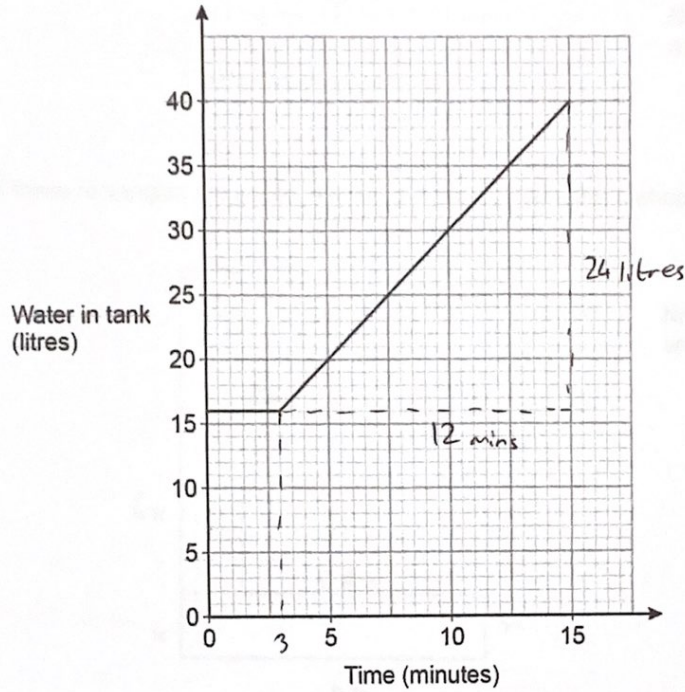
$$1.2 \times 20 = 24 \text{ litres leaked}$$

$$40 - 24 = 16 \text{ litres left}$$



Do not write outside the box

- 11 (b) The tank is refilled with water from a tap.
The graph shows the amount of water in the tank after the leak is stopped.



Complete this report by writing a number in each answer space.

[3 marks]

Report

_____ 3 _____ minutes after the leak is stopped, the tap starts to refill the tank.

The rate at which the tank refills is _____ 2 _____ litres per minute.

Tank is filled 24 litres in 12 minutes.
 $24 \div 12 = 2$ litres per minute.

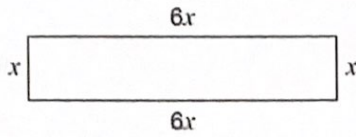
8

Turn over ►



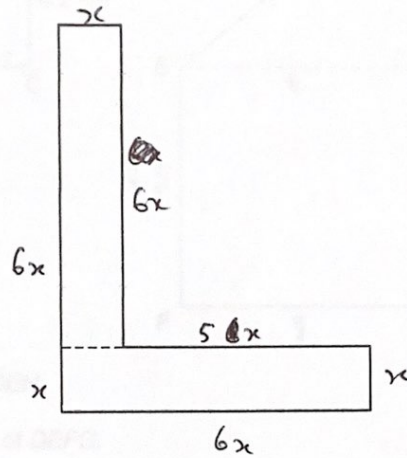
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12 The length of this rectangle is 6 times the width.



Not drawn accurately

Two of these rectangles are joined, with no overlap, to make this L-shape.



Not drawn accurately

The perimeter of the L-shape is 98.8 cm

Work out the value of the perimeter of **one** of the rectangles.

[4 marks]

$$98.8 = x + 6x + 5x + x + 6x + x + 6x$$

$$98.8 = 26x$$

$$x = 3.8$$

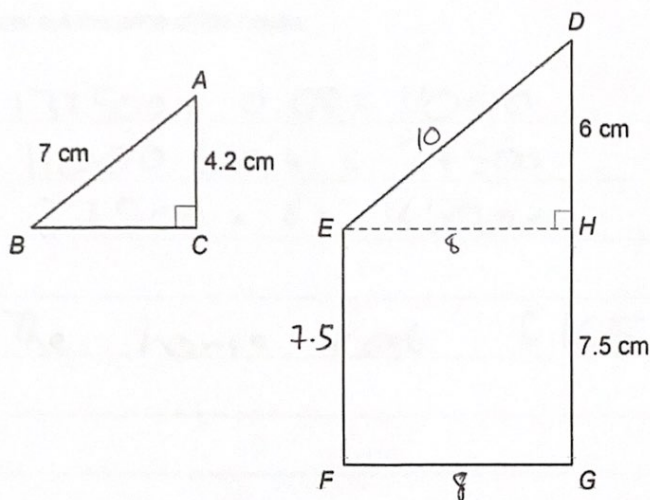
$$x + 6x + x + 6x = 14x = 14 \times 3.8 = 53.2$$

Answer 53.2 cm



Do not write outside the box

- 13 Trapezium $DEFG$ is formed by joining triangle DEH to rectangle $EFGH$.



Not drawn accurately

ABC is similar to DEH .

Work out the area of $DEFG$.

[5 marks]

$$BC = \sqrt{7^2 - 4.2^2} = 5.6 \text{ cm}$$

$$6 \div 4.2 = \frac{10}{7} \text{ (scale factor)}$$

$$DE = 7 \times \frac{10}{7} = 10 \text{ cm}$$

$$EH = 5.6 \times \frac{10}{7} = 8 \text{ cm}$$

$$EF = 7.5 \text{ cm} \text{ and } FG = 8 \text{ cm}$$

$$\text{Area} = \frac{1}{2} \times 6 \times 8 + 7.5 \times 8$$

$$= 24 + 60$$

$$= 84 \text{ cm}^2$$

Answer 84 cm²

9

Turn over ►



- 14 Fred bought an apartment for £137 500
He made 8% profit when he sold the apartment.
He used all of this profit to pay 40% of the deposit on a house.
The deposit was one sixth of the price of the house.
Work out the price of the house.

[4 marks]

$$137500 \times 0.08 = 11000$$

$$11000 \div 0.4 = 27500$$

$$27500 \times 6 = 165000$$

The house cost £165000

Answer £ 165000

- 15 Circle the correct statement.

[1 mark]

$1 \text{ m}^2 = 100 \text{ mm}^2$

$1 \text{ cm}^2 = 100 \text{ mm}^2$

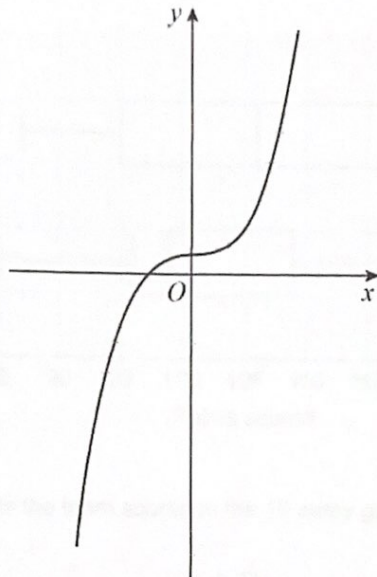
$1 \text{ m}^2 = 100 \text{ cm}^2$

$1 \text{ km}^2 = 100 \text{ m}^2$



- 16 Here is a sketch of a graph.

Do not write
outside the
box



Circle the possible equation of the graph.

[1 mark]

$$y = x^2 + 1$$

$$y = \frac{1}{x} + 1$$

$$y = x^3 + 1$$

$$y = 1 - x^2$$

- 17 A sequence of numbers is formed by the iterative process

$$u_{n+1} = \frac{20}{u_n + 3} \quad \text{where} \quad u_1 = 1$$

Work out u_3

Circle your answer.

[1 mark]

$$\frac{40}{11}$$

$$\frac{5}{2}$$

7

5

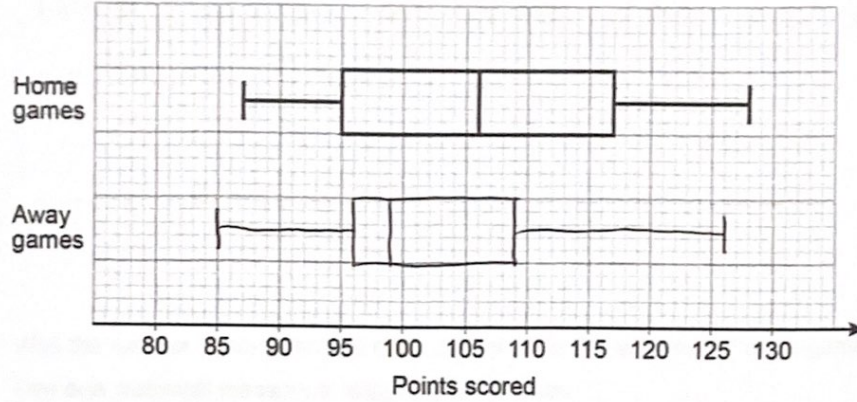
$\frac{\quad}{7}$

Turn over ►



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- 18 A basketball team plays 19 home games and 19 away games.
The box plot shows information about the points the team scored in **home** games.



Here are the points the team scored in the 19 away games.

L 85 89 93 95 LQ 96 96 98 98 98 M 99
 100 103 105 107 UQ 109 110 114 119 U 126

- 18 (a) On the grid, draw a box plot for the away games.

[4 marks]



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18 (b) On average, did the team score more points in home games or away games?
Use **one** statistical measure to support your decision.

[1 mark]

Home games as these had a higher median.

18 (c) Was the number of points scored more consistent in home games or away games?
Use **one** statistical measure to support your decision.

[1 mark]

Away games as these had a smaller interquartile range.

19 Using the quadratic formula, or otherwise, solve $3x^2 + x - 5 = 0$

[2 marks]

$$3x^2 + x - 5 = 0$$

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$a = 3 \quad b = 1 \quad c = -5$$

$$x = \frac{-1 \pm \sqrt{1^2 - 4 \times 3 \times (-5)}}{2 \times 3} = \frac{-1 \pm \sqrt{1 + 60}}{6}$$

$$= \frac{-1 \pm \sqrt{61}}{6} = \frac{-1 \pm \sqrt{61}}{6} \quad \text{or} \quad \frac{10}{6} \quad \text{or} \quad \frac{12}{6} = \frac{5}{3} \quad \text{or} \quad 2$$

Answer ~~$x = \frac{5}{3}$ or $x = 2$~~
 $x = 1.135 \quad x = -1.468$

8

Turn over ►



20

A vending machine has a different item in each section.

It sells

7 drinks, 3 of which are juice

5 snacks, 2 of which are fruit bars

11 meals, 4 of which are salad.

One drink, one snack and one meal are chosen at random.

Show that the probability of getting a juice, a fruit bar and a salad is **more** than 5%

[3 marks]

$$\frac{3}{7} \times \frac{2}{5} \times \frac{4}{11} =$$

$$\frac{3 \times 2 \times 4}{7 \times 5 \times 11} = \frac{24}{385} = 0.062 \dots$$

which is 6.2...% > 5%



21 $f(x) = \frac{3x+9}{5}$ and $g(x) = 6x-1$

21 (a) Show that $gf(2)$ is an integer.

[2 marks]

$$\begin{aligned}
 gf(2) &= g(f(2)) \\
 &= g\left(\frac{3 \times 2 + 9}{5}\right) \\
 &= g\left(\frac{6+9}{5}\right) \\
 &= g\left(\frac{15}{5}\right) \\
 &= g(3) \\
 &= 6 \times 3 - 1 \\
 &= 18 - 1 \\
 &= 17
 \end{aligned}$$

21 (b) Show that $f^{-1}(8)$ is not an integer.

[2 marks]

$$\begin{aligned}
 f(x) &= \frac{3x+9}{5} \\
 5f(x) &= 3x+9 \\
 3x &= 5f(x) - 9 \\
 x &= \frac{5f(x) - 9}{3} \\
 \Rightarrow f^{-1}(x) &= \frac{5x-9}{3} \\
 f^{-1}(8) &= \frac{5 \times 8 - 9}{3} \\
 &= \frac{40-9}{3} \\
 &= \frac{31}{3} \\
 &= 10\frac{1}{3} \text{ not an integer}
 \end{aligned}$$



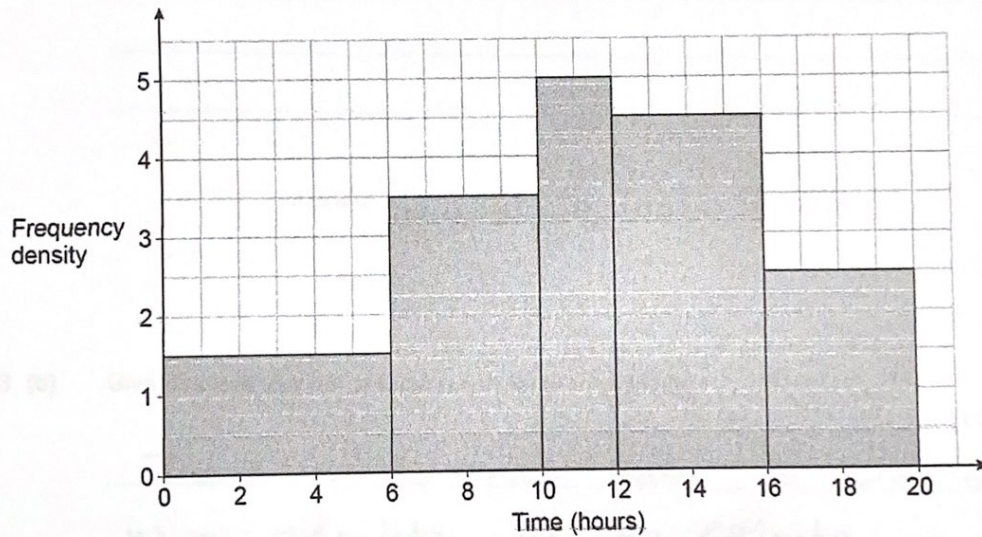
22 Factorise fully $x^3 - 49x$

[2 marks]

$$\begin{aligned}x^3 - 49x &= x(x^2 - 49) \\ &= x(x+7)(x-7)\end{aligned}$$

Answer $x(x+7)(x-7)$

23 61 students recorded how many hours they spent revising for a test.
The histogram represents the results.



- 23 (a) Work out an estimate of the mean time the 61 students spent revising.
You may use the table to help you.

[4 marks]

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Time, x (hours)	Frequency	Midpoint	$F \times m$
$0 \leq x < 6$	9	3	27
$6 \leq x < 10$	14	8	112
$10 \leq x < 12$	10	11	110
$12 \leq x < 16$	18	14	252
$16 \leq x < 20$	10	18	180

$$27 + 112 + 110 + 252 + 180 = 681$$

$$681 \div 61 = 11.16 \dots$$

Answer 11.16 hours

- 23 (b) Give a reason why the answer to part (a) is an estimate.

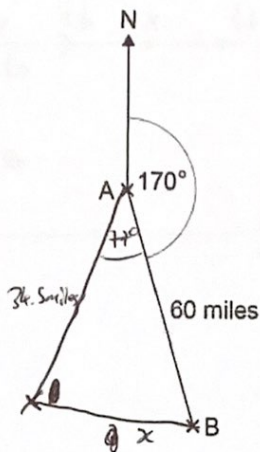
[1 mark]

There is no raw data, so we are using midpoints as an estimate.

Turn over ►



24

B is 60 miles from A on a bearing of 170° Not drawn
accuratelyDo not write
outside the
boxA ship sails from A on a bearing of 247° It travels at a constant speed of 23 mph for $1\frac{1}{2}$ hours.

Is the ship now closer to B than it was when it left A?

You **must** show your working.

[5 marks]

$$23 \times 1\frac{1}{2} = 34.5 \text{ miles}$$

$$x^2 = 60^2 + 34.5^2 - 2 \times 60 \times 34.5 \times \cos(77^\circ)$$

$$x^2 = 3600 + 1190.25 - 4140 \cos(77^\circ)$$

$$x^2 = 3858.95\dots$$

$$x = \sqrt{3858.95\dots}$$

$$x = 62.12\dots \text{ miles}$$

$$62.12\dots > 60$$

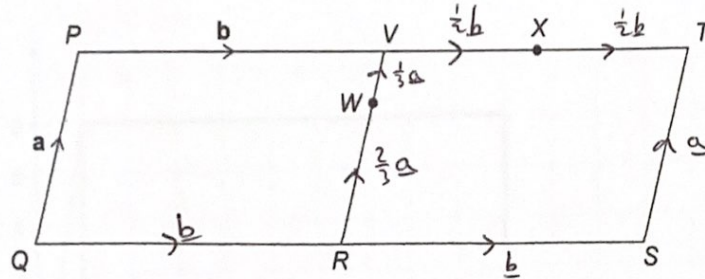
The ship is further from B
than when it left A



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25 Two congruent parallelograms, PQRV and VRST, are joined.

Not drawn accurately



$\overrightarrow{QP} = a \quad \overrightarrow{PV} = b$

X is the midpoint of VT.

$VW : WR = 1 : 2$

Prove that Q, W and X lie on a straight line.

[3 marks]

$\overrightarrow{QW} = b + \frac{2}{3}a = \frac{2}{3}a + b$

$\overrightarrow{QX} = a + b + \frac{1}{2}b = a + \frac{3}{2}b = \frac{3}{2}(\frac{2}{3}a + b)$

Hence $\overrightarrow{QX} = \frac{3}{2} \overrightarrow{QW}$

So Q, W and X must lie on a straight line.

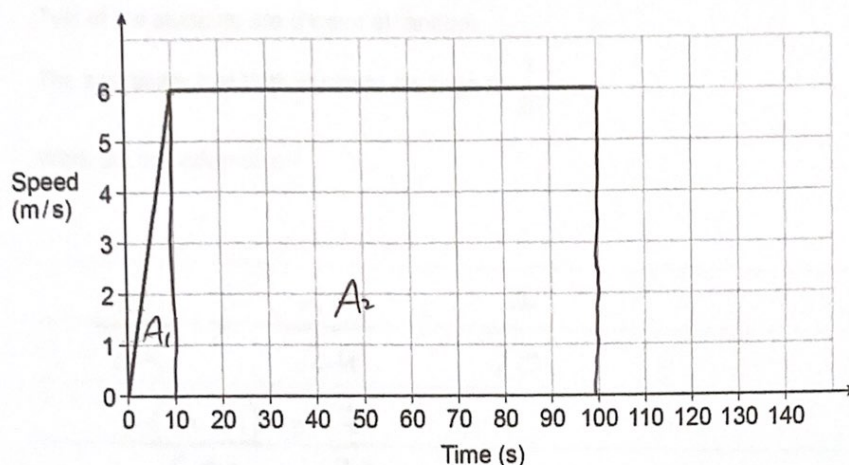
Turn over ►



26

Helena ran an 800-metre race in 140 seconds.

The speed-time graph represents the first 100 seconds of her run.



Helena ran the last 40 seconds with constant deceleration.

Work out her speed as she finished the race.

[4 marks]

$$A_1 = \frac{1}{2} \times 10 \times 6 = 30\text{m}$$

$$A_2 = 90 \times 6 = 540\text{m}$$

$$\text{Race left} = 800 - 540 - 30 = 230\text{m}$$

Final shape will be a trapezium with area 230, first height 6 and width $140 - 100 = 40$

$$\frac{1}{2} (6 + x) 40 = 230$$

$$20(6 + x) = 230$$

$$6 + x = \frac{230}{20}$$

$$6 + x = 11.5$$

$$x = 5.5\text{ m/s}$$

Answer 5.5 metres per second



27

In a class there are

 n boys

a total of 25 students.

Two of the students are chosen at random.

The probability that both students are boys is $\frac{7}{20}$ Work out the value of n .

[4 marks]

$$\frac{n}{25} \times \frac{n-1}{24} = \frac{7}{20}$$

$$\frac{n(n-1)}{600} = \frac{7}{20}$$

$$\frac{n(n-1)}{600} = \frac{210}{20}$$

$$n(n-1) = 210$$

$$15 \times 14 = 210$$

$$n = 15$$

$$n = 15$$

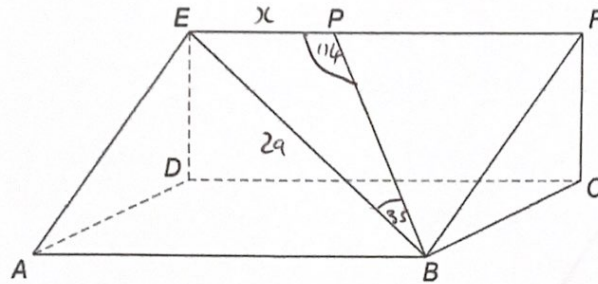


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28

$ABCDEF$ is a triangular prism.

P is a point on EF .



$EB = 29$ cm

Angle $EBP = 35^\circ$

Angle $EPB = 114^\circ$

Work out the length of EP .

[2 marks]

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ANSWER IN THE SPACES PROVIDED

$$\frac{x}{\sin(35^\circ)} = \frac{29}{\sin(114^\circ)}$$

$$x = \frac{29 \sin(35^\circ)}{\sin(114^\circ)}$$

$$x = 18.2 \text{ cm}$$

Answer 18.2 cm

END OF QUESTIONS

2

