



Please write clearly in block capitals.

Centre number

Candidate number

Surname _____

Forename(s) _____

Candidate signature _____

I declare this is my own work.

GCSE MATHEMATICS

H

Higher Tier Paper 2 Calculator

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	

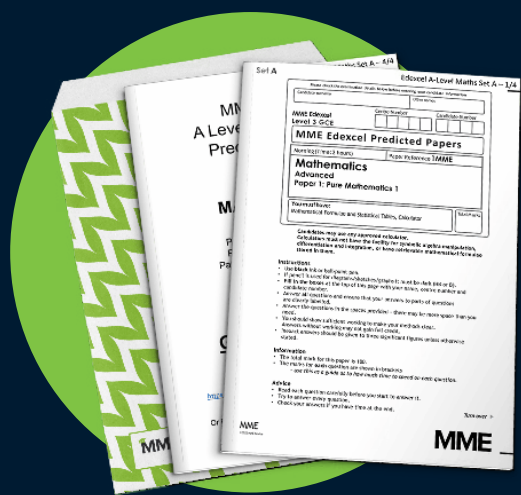


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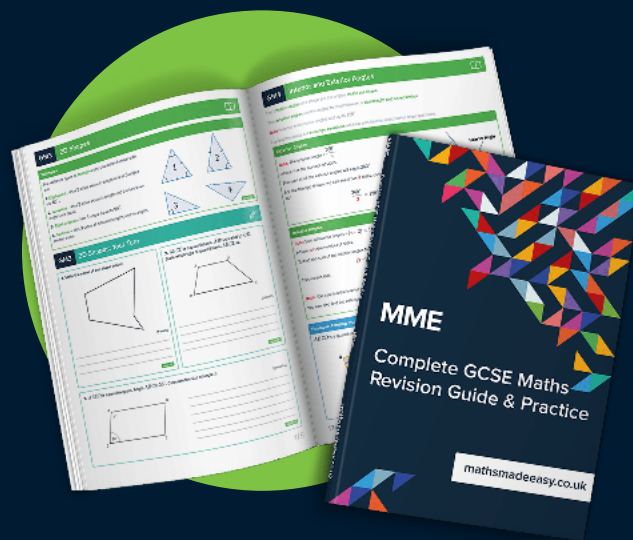
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Answer all questions in the spaces provided.

Do not write
outside the
box

- 1 Circle the fraction that is equal to 1.25% [1 mark]

$\frac{1}{8}$

$\frac{1}{25}$

$\frac{1}{80}$

$\frac{1}{125}$

- 2 Circle the expression that means the probability of A and not B. [1 mark]

$P(A \cup B)$

$P(A \cup B')$

$P(A' \cap B)$

$P(A \cap B')$

- 3 Circle the triangular number. [1 mark]

9

12

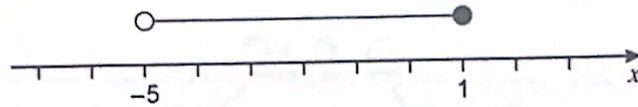
15

18



Do not write outside the box

4 Circle the inequality represented by the diagram.



[1 mark]

$-5 < x < 1$

$-5 < x \leq 1$

$-5 \leq x < 1$

$5 < x < 1$

5 Solve $5(2x - 1) = 6x + 9$

[3 marks]

$$\begin{aligned}
 5(2x - 1) &= 6x + 9 \\
 10x - 5 &= 6x + 9 \quad \downarrow -6x + 5 \\
 10x - 6x &= 9 + 5 \\
 4x &= 14 \\
 x &= 14/4 \\
 x &= 7/2
 \end{aligned}$$

7

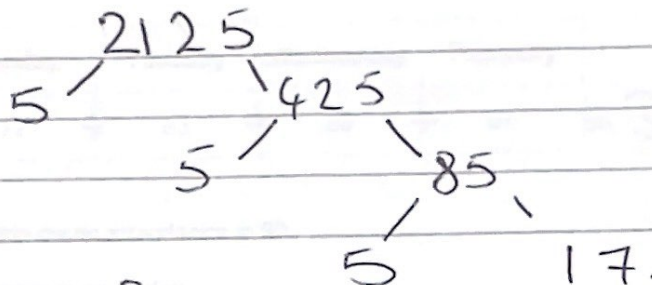
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6

Show that 2125 can be written as
a cube number multiplied by a prime number between 10 and 20

[2 marks]



$$2125 = 5^3 \times 17.$$

7

Sam types a constant number of words per minute.
He takes 8 minutes to type a report of 416 words.

How long does it take him to type an essay of 1534 words?
Give your answer in minutes and seconds.

[3 marks]

$$\begin{aligned}
 416 \div 8 &= 52 \text{ words per minute.} \\
 1534 \div 52 &= 29.5 \text{ minutes for 1534 words.} \\
 0.5 \text{ minutes} &= 30 \text{ seconds.}
 \end{aligned}$$

So 29 minutes and 30 seconds.

Answer 29 minutes 30 seconds



8

A school play takes place each day from Monday to Friday.

Here are the attendances on four of the days.

Monday	Tuesday	Wednesday	Thursday
72	83	88	97

$= 340$

For all five days, the mean attendance is 90

Work out the attendance on Friday.

[3 marks]

Friday's attendance = x .

$$\frac{340 + x}{5} = 90, \quad 340 + x = 9 \times 5$$

$$= 450.$$

$$x = 450 - 340 = 110.$$

Answer 110 was Friday's attendance.

Turn over for the next question

Turn over ►



- 9 Rosie makes phone calls to try to sell broadband.
Today, she made 120 calls.
The table shows the results.

Result of call	Frequency
Not answered	33
Answered but sale not made	81
Answered and sale made	6

- 9 (a) Write down the relative frequency that a call was **not answered**.

[1 mark]

Answer $\frac{33}{120} = \frac{11}{40}$

- 9 (b) During the **rest of the week**, Rosie will make 500 calls.

Using the results in the table, how many sales does she expect to make during the **rest of the week**?

[2 marks]

$$\frac{6}{120} \times 500 = 25$$

Answer 25 sales.



10

Harry and Ellie each bought a printer and a hard drive.
Here is some information about how much they paid.

	Printer	Hard drive
Harry	£80	£25
Ellie	10% less than Harry	20% more than Harry

Ellie says,

"In total, I paid more than Harry because 20% is greater than 10%"

Is she correct?

Tick a box.

Yes

No

Show calculations to support your answer.

[2 marks]

$$\text{Ellie's printer: } 0.9 \times 80 = \pounds 72.$$

$$\text{Ellie's hard drive: } 1.2 \times 25 = \pounds 30.$$

$$\text{Ellie's total: } 72 + 30 = \pounds 102.$$

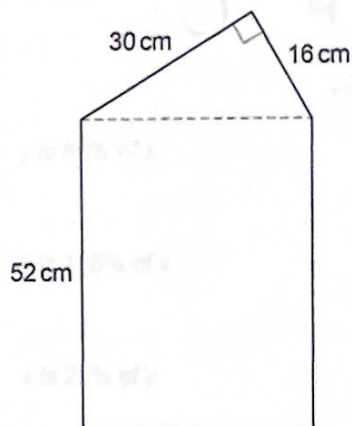
$$\text{Harry's total: } 80 + 25 = \pounds 105.$$

Ellie paid less and so she is wrong.



11

A shape is made by joining a right-angled triangle to a rectangle.

Not drawn
accurately

Work out the area of the shape.

[5 marks]

$$\text{Area of triangle} = \frac{1}{2} \times 30 \times 16 = 240 \text{ cm}^2.$$

Width of the rectangle = hypotenuse of triangle.

$$\text{Width} = \sqrt{16^2 + 30^2} = 34 \text{ cm.}$$

$$\text{Area of Rectangle} = 52 \times 34 = 1768 \text{ cm}^2.$$

$$\text{Total area} = 240 + 1768 = 2008 \text{ cm}^2.$$

Answer 2008 cm²

Do not write outside the box

12

$4y = 5x$

Which statement is correct?

Tick one box.

$y = \frac{5}{4}x$

$\frac{5}{4} = \frac{125}{100}$

[1 mark]

y is 80% of x

y is 125% of x

x is 20% of y

x is 400% of y

The two hemispheres each have radius 24 cm
The solid figure is a cone.

Volume of a cone = $\frac{1}{3}\pi r^2 h$
 r is the radius
 h is the perpendicular height

Volume of a hemisphere = $\frac{2}{3}\pi r^3$
 r is the radius

12 (a)

Work out the total volume of the solid.

[4 marks]

$r = 24 \text{ cm}, h = 117$
 Volume of cone = $\frac{1}{3} \times 24^2 \times 117 \times \pi$
 $= 22464 \pi \text{ cm}^3$
 Volume of hemisphere = $\frac{2}{3} \times 24^3 \times \pi$
 $= 9216 \pi \text{ cm}^3$
 Total: $22464 \pi + 9216 \pi = 31680 \pi \text{ cm}^3$

Turn over for the next question

6

Turn over ►



- 13 Outside a cafe there is a large plastic ice cream cornet.
The cornet is a hemisphere on top of a cone.



The cone and the hemisphere each have radius 24 cm

The cone has perpendicular height 117 cm

$$\text{Volume of a cone} = \frac{1}{3} \pi r^2 h$$

r is the radius

h is the perpendicular height

$$\text{Volume of a hemisphere} = \frac{2}{3} \pi r^3$$

r is the radius

- 13 (a) Work out the total volume of the cornet.

[4 marks]

$$r = 24 \text{ cm}, h = 117.$$

$$\begin{aligned} \text{Volume of cone} &= \frac{1}{3} \times 24^2 \times 117 \times \pi \\ &= 22464 \pi \text{ cm}^3. \end{aligned}$$

$$\begin{aligned} \text{Volume of hemisphere} &= \frac{2}{3} \times 24^3 \times \pi \\ &= 9216 \pi \text{ cm}^3. \end{aligned}$$

$$\text{Total} = 22464 \pi + 9216 \pi = 31680 \pi \text{ cm}^3.$$

$$\text{Answer } \underline{31680 \pi \approx 99526} \text{ cm}^3$$



Do not write
outside the
box

- 13 (b) The actual cornets that the cafe sells are similar to the plastic one.
For the actual cornets, the cone and the hemisphere each have radius 2 cm
How many times greater is the volume of the plastic cornet than an actual cornet?

[3 marks]

$$\text{Length scale factor} = 24 \div 2 = 12.$$

$$\text{Volume scale factor} = (12)^3 = 1728.$$

14 (a)

The total number of people in the sample is 375. Estimate how many people in the town would have a family which is very important. Assume that the sample is representative of the town.

Answer

1728.

Estimate how many people in the town would have a family which is very important. Assume that the sample is representative of the town.

[3 marks]

$$\text{People surveyed} = 375 \times \frac{1475}{2750} = 19175$$

$$\text{Fraction of people reporting this} = \frac{1475}{2750}$$

$$\text{Number of people} = \frac{1475}{2750} \times 29250 = 19175$$

Answer

19175

Turn over for the next question

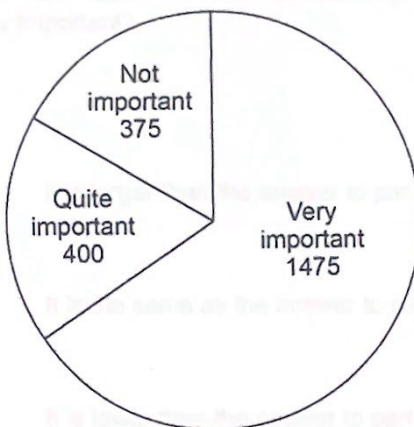
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- 14 A survey was held in a football stadium.
 A sample of the crowd was asked about the importance of a family area.
 The pie chart represents the answers.



- 14 (a) The total number of people in the crowd was 29 250

Estimate how many people in the crowd think that a family area is **very important**.

Assume that the sample is representative of the crowd.

[3 marks]

$$\begin{aligned} \text{People surveyed} &= 375 + 400 + 1475 \\ &= 2250. \\ \text{Fraction of people responding Very} &: 1475/2250. \\ \text{Number of people} &: \frac{1475}{2250} \times 29250 = 19175 \end{aligned}$$

Answer 19175.



Do not write outside the box

- 14 (b) In fact,
- 50% of the **sample** were sitting in the family area
 - 10% of the **crowd** were sitting in the family area.

What is this likely to mean about the actual number of people in the crowd who think that a family area is very important?

Tick **one** box.

[1 mark]

It is larger than the answer to part (a)

It is the same as the answer to part (a)

It is lower than the answer to part (a)

- 15 In the grid, the **product** of each row, column and diagonal is 1

8	$\frac{1}{4}$	$\frac{1}{2}$
$\frac{1}{16}$	1	16
2	4	$\frac{1}{8}$

Complete the grid.

[2 marks]

6

Turn over ►



- 16 Amol owns a sandwich shop.
The shop is open from Monday to Saturday.
In June, Amol sold 3000 sandwiches.

- 16 (a) Amol wants to work out the mean number of sandwiches he sold per day in June.
His method is $3000 \div 30 = 100$

Make **one** criticism of Amol's method.

[1 mark]

The shop wasn't open for 30 days,
he didn't account for Sundays.

- 16 (b) Amol received £6660 from selling the 3000 sandwiches in June.
The numbers of sandwiches sold were in the ratio

$$\text{meat} : \text{cheese} : \text{vegan} = 9 : 4 : 7$$

The price of a meat sandwich is £2.39

The price of a cheese sandwich is £1.89

Work out the price of a vegan sandwich.

[4 marks]

$$9 + 4 + 7 = 20, \quad 3000 \div 20 = 150$$

$$(9 \times 2.39 + 1.89 \times 4 + 7 \times v) \times 150 = 6660$$

(where v = cost of vegan sandwich).

$$(21.51 + 7.56 + 7v) \times 150 = 6660$$

$$7v \times 150 + 3226.5 + 1134 = 6660$$

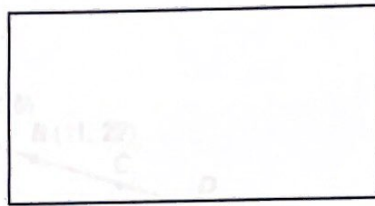
$$1050v = 4507.5 \quad 2299.5$$

$$v = \pounds 2.19$$

Answer £ 2.19



- 17 Here is the plan of a solid. *Give straight line*



Circle the solid that it could be.

[1 mark]

sphere

cone

hemisphere

cylinder

18

Solve $x^2 + 7x - 11 = 0$

Give your solutions as decimals.

[2 marks]

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}, \quad a=1, b=7, c=-11.$$

$$x = \frac{-7 \pm \sqrt{7^2 - 4 \times -11}}{2}$$

$$x = -3.5 \pm \sqrt{23.25}$$

$$x = 1.3218\dots$$

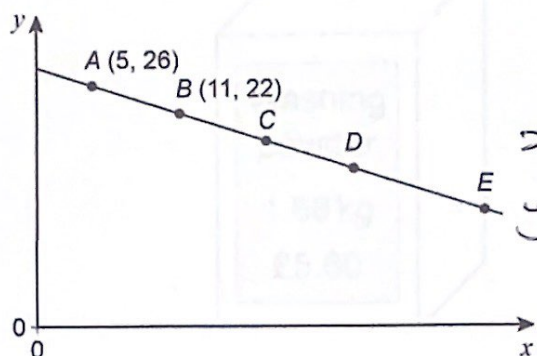
$$x = -8.3218\dots$$

Answer $x = 1.32$ and $x = -8.32$.



Do not write outside the box

19 A, B, C, D and E are points on a straight line.



Not drawn accurately

$$x: 11 - 5 = +6$$

$$y: 22 - 26 = -4.$$

A, B, C and D are equally spaced.

$$AD : DE = 2 : 1$$

Work out the coordinates of E.

[3 marks]

$$AD = 4 \times AB. \quad \text{AB}$$

$$C = (17, 18), \quad D = (23, 14).$$

$$A \rightarrow D (x+18, y-12)$$

$$D \rightarrow E (x+9, y-6)$$

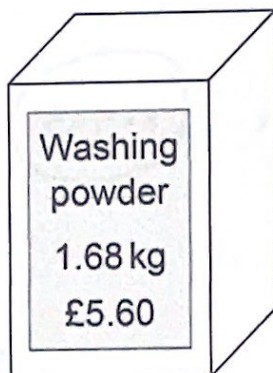
$$E = (32, 8)$$

Answer (32 , 8)



20

A company makes and sells boxes of washing powder.

The company wants to increase the amount of money it receives **per kg** of powder.

To get the required increase it can

increase the price to £5.88

or

reduce the mass of powder in the box by $x\%$ Work out the value of x to 2 decimal places.

[4 marks]

$$\text{Current } \pounds/\text{kg} = 5.6 \div 1.68 = \pounds 3.33/\text{kg}$$

$$\text{Increased } \pounds/\text{kg} = 5.88 \div 1.68 = \pounds 3.5/\text{kg}$$

$$\text{Weight for improved } \pounds/\text{kg} : 5.6 \div 3.5 = 1.6 \text{ kg}$$

$$\frac{(100-x)}{100} \times 1.68 = 1.6$$

$$100-x = \frac{1.6}{1.68} \times 100 = 95.238\dots$$

$$x = 100 - 95.238\dots$$

$$x = 4.76\%$$

$$x = 4.76\%$$

7

Turn over ►



1 7

Do not write outside the box

21 Which of these is the equation of a circle?

Circle your answer.

[1 mark]

$x^2 - y^2 = 6$

$x^2 + y^2 = 6$

$y = x^2 - 6$

$y = x^2 + 6$

22 Circle the reciprocal of 8^5

[1 mark]

8^{-5}

5^{-8}

-8^5

5^8

23 Factorise $3x^2 - 16x - 12$

[2 marks]

~~3x~~ $(3x + 2)(x - 6)$

Check: $3x^2 - 18x + 2x - 12$ ✓

Answer $(3x + 2)(x - 6)$



24

A straight line

is perpendicular to the straight line through (2, 8) and (6, 15)

and

passes through (0, 9) and (x, 17)

Work out the value of x.

[4 marks]

$$\text{Gradient of perpendicular} = \frac{15-8}{6-2} = \frac{7}{4}$$

$$\text{Gradient of the line is } -4/7.$$

$$y = -\frac{4}{7}x + c$$

$$c = 9 \text{ (as } (0, 9) \text{ is on the line).}$$

$$y = -\frac{4}{7}x + 9$$

$$\text{when } y = 17:$$

$$17 = -\frac{4}{7}x + 9$$

$$8 = -\frac{4}{7}x$$

$$x = 8 \times -\frac{7}{4} = -14.$$

$$x = -14.$$



25

$$f(x) = 2x + 5$$

Show that $3f(x) - 12f^{-1}(x)$ simplifies to an integer.

[4 marks]

$$f(x) = 2x + 5. \quad \text{Let } y = f^{-1}(x).$$

$$x = 2y + 5$$

$$\frac{x-5}{2} = y, \quad f^{-1}(x) = \frac{x-5}{2}.$$

$$3f(x) - 12 \times f^{-1}(x)$$

$$= 3(2x+5) - 12 \times \left(\frac{x-5}{2}\right)$$

$$= 6x + 15 - 6(x-5)$$

$$= 6x + 15 - 6x + 30$$

$$= 30 + 15 = 45$$

Hence it is an integer.



26

Two objects, J and K, are applying pressure to areas of ground.

$$\text{pressure} = \frac{\text{force}}{\text{area}}$$

For J, the force is 18.9 newtons and the area is 0.45 m^2

$$\text{pressure for J} : \text{pressure for K} = 7 : 8$$

$$\text{area for J} : \text{area for K} = 9 : 5$$

Work out the force for K.

[4 marks]

$$0.45 : \text{Area}_K = 9 : 5 \quad \div 20$$

$$= 0.45 : 0.25$$

$$\text{Area}_K = 0.25 \text{ m}^2$$

$$\text{Pressure}_J = 18.9 \div 0.45 = 42 \text{ N/m}^2$$

$$42 : \text{Pressure}_K = 7 : 8 \quad \times 6$$

$$= 42 : 48$$

$$\text{Pressure}_K = 48 \text{ N/m}^2$$

$$48 = \text{force}_K \div 0.25$$

$$\text{force}_K = 48 \times 0.25$$

$$= 12 \text{ N}$$

Answer 12 newtons

8

Turn over ►



27

To be rented, a bedroom must have a floor area of at least 6.51 m^2

A bedroom has a rectangular floor.

The floor measures 2.4 m by 2.9 m , each correct to 2 significant figures.

Show that the bedroom can be rented.

[3 marks]

Lower bounds: 2.35 m by 2.85 m .

$$\begin{aligned} \text{Minimum area: } & 2.35 \times 2.85 \\ & = 6.6975 \text{ m}^2 > 6.51 \text{ m}^2 \end{aligned}$$

So even at the lowest possible area,
the room can be rented.

Exterior angle: $180 - 50 = 130$

$$\angle BCN = 30 + 90 = 120$$

As $BC = CN$, BCN forms an isosceles

triangle, $\angle CBN = \angle CNB$

$$120 + \angle CBN + 2 = 180$$

$$2\angle CBN = 60, \angle CBN = 30$$

$$\angle ABC + \angle CBN = 150 + 30 = 180$$

So ABN must be a straight

line.

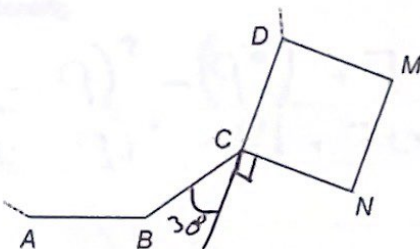


28

AB , BC and CD are sides of a regular 12-sided polygon.

$CDMN$ is a square.

Not drawn
accurately



Prove that points A , B and N lie on a straight line.

[4 marks]

$$\text{Interior angle} = (12-2) \times 180 \div 12$$

$$= 150^\circ$$

$$\text{Exterior angle} = 180 - 150 = 30^\circ$$

$$\angle BCN = 30 + 90 = 120^\circ$$

As $BC = CN$, BCN forms an isosceles triangle, $\angle CBN = \angle CNB$.

$$120 + \angle CBN \times 2 = 180^\circ$$

$$2 \angle CBN = 60^\circ, \quad \angle CBN = 30^\circ$$

$$\angle ABC + \angle CBN = 150 + 30 = 180^\circ$$

So ABN must be a straight line.



29

The equation of a curve is $y = x^2 - 18x + 70$

By completing the square, work out the coordinates of the turning point.

You must show your working.

[3 marks]

$$y = (x-9)^2 - (9^2) + 70$$
$$= (x-9)^2 - 81 + 70$$

$$y = (x-9)^2 - 11.$$

Answer (9 , -11)

END OF QUESTIONS

3

