



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

Wednesday 7 June 2023

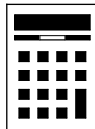
Morning

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.

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	
24–25	
26	
TOTAL	

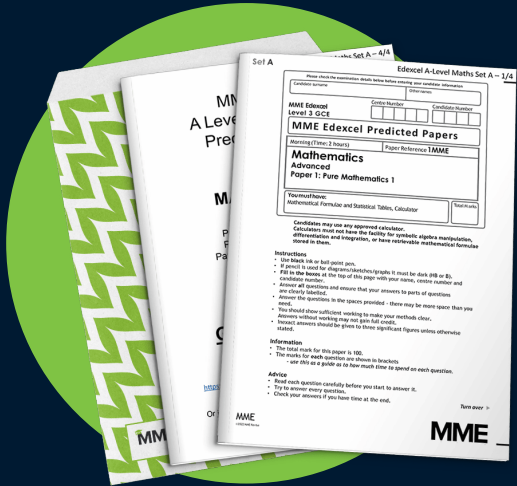
Advice

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

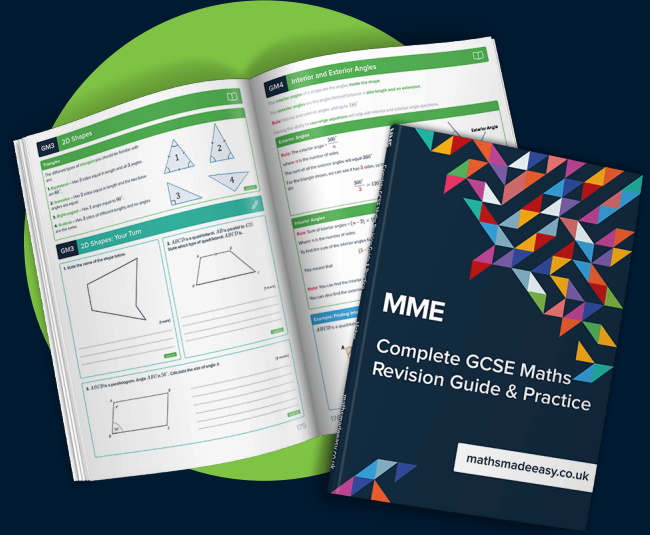


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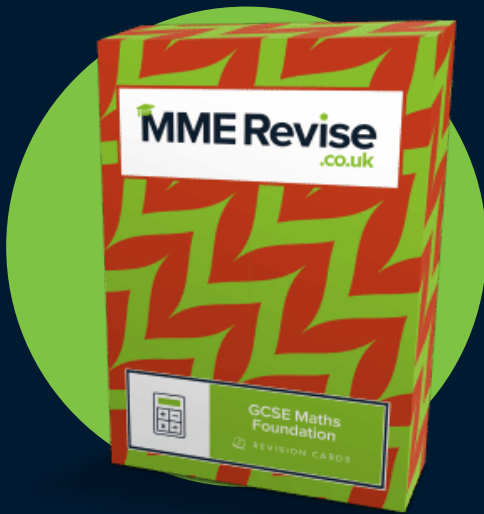
MME. GCSE Revision - GCSE Maths



GCSE Maths Predicted Papers 2024



GCSE Maths Revision Guide



GCSE Maths Revision Cards



Course in a Box – GCSE Maths (Guaranteed Pass)

Answer **all** questions in the spaces provided.1 Write $30 : 12$ in the form $n : 1$

$$\begin{array}{c} \div 12 \quad \left(\begin{array}{c} \div 12 \\ \div 12 \end{array} \right) \\ \hline 2 \cdot 5 : 1 \end{array}$$

[1 mark]

Answer 2 · 5 : 1

2 Four consecutive triangular numbers are

$$6 \quad 10 \quad 15 \quad 21 \quad 28$$

$\overset{+4}{\curvearrowright}$ $\overset{+5}{\curvearrowright}$ $\overset{+6}{\curvearrowright}$ $\overset{+7}{\curvearrowright}$

Write down the next triangular number.

[1 mark]

Answer 28

- 3 Write down the reciprocal of $\frac{4}{7}$ [1 mark]

Answer $\frac{7}{4}$

- 4 The price of a toy increases by 12.5% to £19.53
Work out the **original** price of the toy. [2 marks]

$$\begin{aligned} & \leftarrow 100\% + 12.5\% \\ & = 112.5\% \\ & = 1.125 \end{aligned}$$

$$19.53 \div 1.125 = \pounds 17.36$$

Answer £ 17.36

Turn over for the next question



5 Jess saves 2p, 5p and 10p coins.

She has

- 45 10p coins
- 8 times as many 2p coins as **10p coins**
- £17.70 in total.

Work out total **value** of 2p coins : total **value** of 5p coins

Give your answer in its simplest form.

[4 marks]

45 10p coins worth 450p or £4.50

$8 \times 45 = 360$ 2p coins, worth $360 \times 2p = 720p$ or £7.20

She has £17.70 in total so $£17.70 - £4.50 - £7.20 = £6$ worth of 5p coins

value of 2p coins : value of 5p coins = £7.20 : £6

720 : 600

72 : 60

6 : 5

Answer 6 : 5



6 (a) Part of a regular polygon is shown.



Not drawn accurately

Assume that the polygon is an octagon.

Work out the size of an **exterior** angle.

[2 marks]

$$360 \div 8 = 45$$

Answer _____ 45°

6 (b) In fact, the polygon has **more** sides than an octagon.

What does this mean about the size of an exterior angle?

Tick **one** box.

[1 mark]

It is more than the answer to part (a)

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

It is less than the answer to part (a)

It could be any of the above

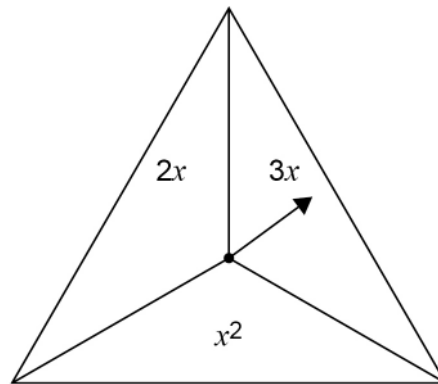
7

Turn over ►



7 In a game,

- an ordinary fair six-sided dice is rolled
- the fair spinner shown is spun.



The score is the dice number **substituted** into the spinner expression.

7 (a) Complete the table to show all of the possible scores.

[2 marks]

	1	2	3	4	5	6
$2x$	2	4	6	8	10	12
$3x$	3	6	9	12	15	18
x^2	1	4	9	16	25	36



- 7 (b) A player wins the game if their score is 10 or more.

Work out the probability that they win the game.

[1 mark]

8 options for 10 or more

18 options in total so $\frac{8}{18} = \frac{4}{9}$

Answer $\frac{4}{9}$

- 7 (c) The game is played 711 times.

Estimate the number of games that are won.

[2 marks]

$$\frac{4}{9} \times 711 = 316$$

Answer 316

8 $(a - 3)x^2 + 2b \equiv 5x^2 + 12$

Work out the values of a and b .

[2 marks]

compare x^2 : $a - 3 = 5$

compare units: $2b = 12$

$$a = 8$$

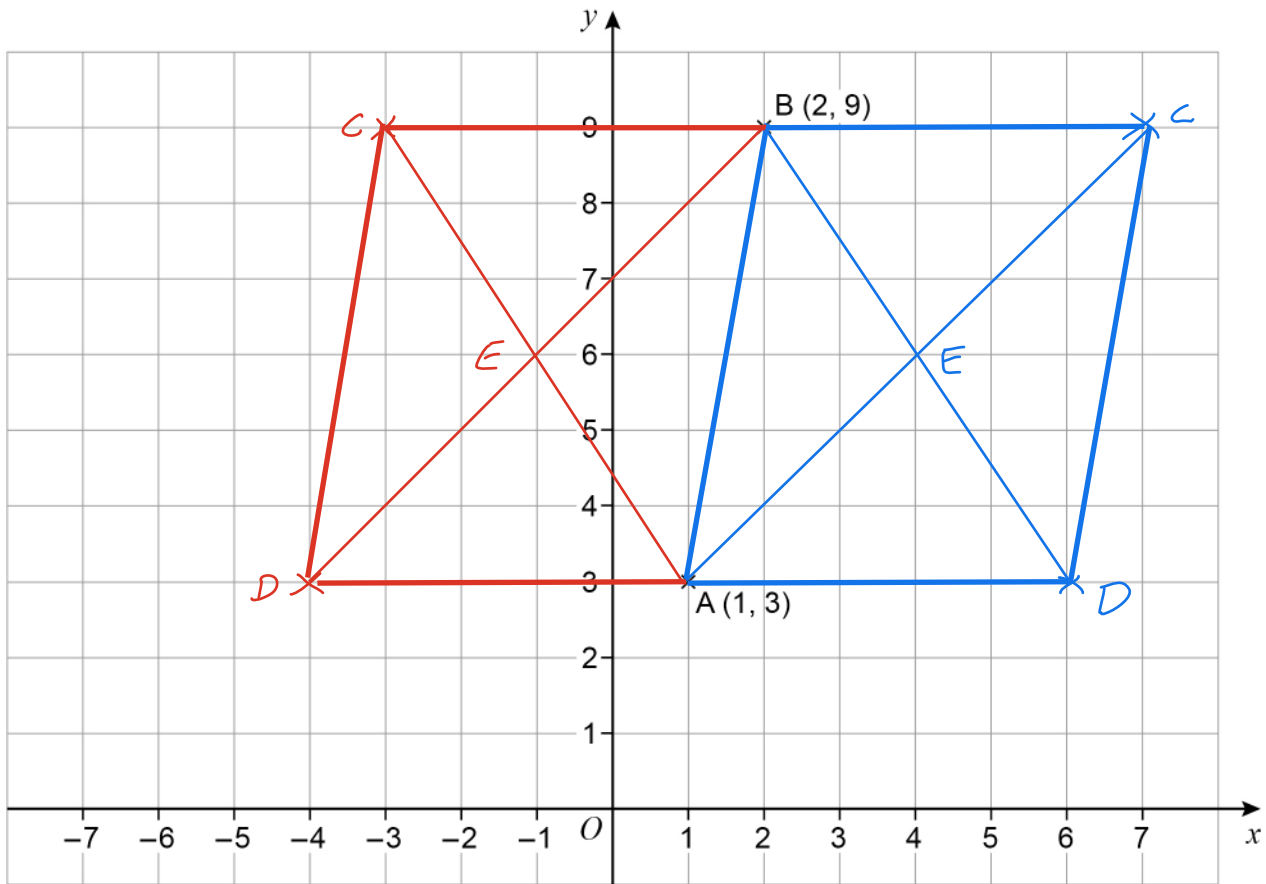
$$b = 6$$

$$a = 8$$

$$b = 6$$



9 A (1, 3) and B (2, 9) are points on a centimetre grid.



ABCD is a parallelogram.

AD and BC are **horizontal** and each has length 5 cm

The diagonals of ABCD cross at E.

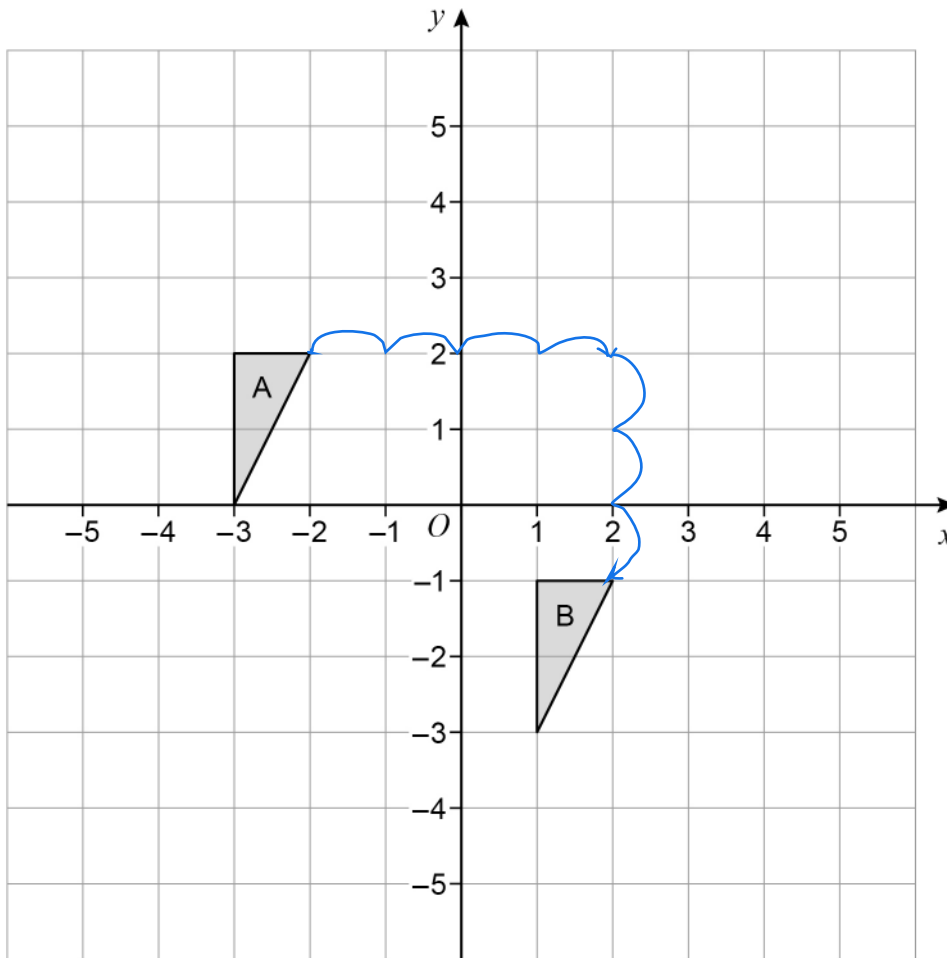
Work out the **two** possible pairs of coordinates of E.

[4 marks]

Answer (-1 , 6) and (4 , 6)



- 10 Write down the translation vector that maps shape A onto shape B. [2 marks]



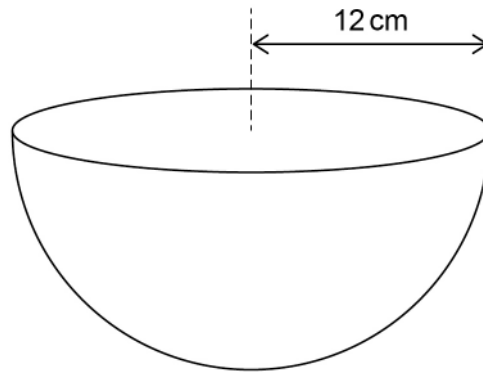
Answer $\begin{pmatrix} 4 \\ -3 \end{pmatrix}$



11

$$\text{Volume of a sphere} = \frac{4}{3} \pi r^3$$

A bowl is a hemisphere with radius 12 cm



Water is poured into the bowl
at a rate of 325 cm^3 per second
for 8 seconds.

Does the water fill **more than** 70% of the bowl?

You **must** show your working.

[4 marks]

$$\text{Volume of bowl} = \frac{\frac{4}{3} \times \pi \times 12^3}{2} = 1152\pi \text{ cm}^3$$

$$70\% \text{ of the bowl is } 0.7 \times 1152\pi = 2533.38 \text{ cm}^3$$

$$\text{Volume of water} = 325 \times 8 = 2600 \text{ cm}^3$$

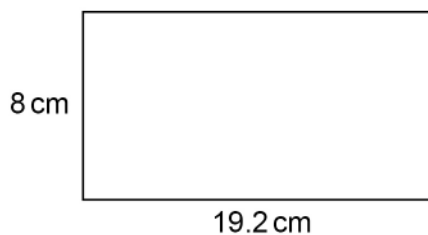
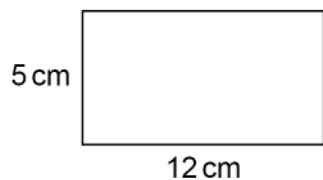
Yes, this is more than 70% of the bowl



12 Show that these two rectangles are similar.

[2 marks]

Not drawn
accurately



$$8 \div 5 = 1.6$$

Height and width in same

$$19.2 \div 12 = 1.6$$

proportion so similar

13 A factory packs x boxes of teabags per hour.
Each box contains 80 teabags.

Show that the factory packs $\frac{4x}{3}$ teabags per minute.

[2 marks]

$$\begin{array}{l} 80x \text{ teabags per hour} \\ \div 60 \left(\frac{80x}{60} \text{ teabags per minute} \right) \div 60 \end{array}$$

$$\frac{80x}{60} = \frac{8x}{6} = \frac{4x}{3}$$

Turn over for the next question



14 A company has 123 employees.
Information about their hourly rates of pay is shown in the table.

Hourly rate, £ p	Number of employees	mid point	midpoint \times frequency
$10 \leq p < 14$	66	12	$12 \times 66 = 792$
$14 \leq p < 20$	32	17	$17 \times 32 = 544$
$20 \leq p < 40$	15	30	$30 \times 15 = 450$
$40 \leq p < 100$	10	70	$70 \times 10 = 700$
Total = 123			total : 2486

The owner of the company uses the data to make two statements.

Statement A
"Over 30% of employees have an hourly rate that is more than £17"

Statement B
"The average hourly rate of pay is more than £20"

14 (a) Show working that supports **Statement A**.

[3 marks]

$\pounds 17$ is half way into second category, so $\frac{32}{2} + 15 + 10 = 41$
employees earn more than $\pounds 17$ per hour

$\frac{41}{123} = \frac{1}{3} \approx 33.3\%$ so more than 30% earn above
 $\pounds 17$ per hour



14 (b) Why might **Statement A** not be true?

[1 mark]

All employees in second category could earn less than £17 per hour

14 (c) Work out an estimate of the mean to support **Statement B**.

[3 marks]

$$\text{mean} = \frac{2486}{123} = £20.21 \text{ so more than } £20$$

14 (d) Why is the mean **not** the best average to represent the data?

[1 mark]

Most employees earned less than £20



15 Expand $(x^2 - 9xy)(2x + 5y)$

[2 marks]

$$2x^3 + 5x^2y - 18x^2y - 45xy^2$$

$$2x^3 - 13x^2y - 45xy^2$$

Answer $2x^3 - 13x^2y - 45xy^2$

16 Line A

has equation $y = ax - 1$

passes through the point (7, 13)

Line B has equation $5y - 3x = 4$

Show that line A has a greater gradient than line B.

[3 marks]

Line A

$$y = ax - 1 \text{ through } (7, 13) \text{ so } 13 = 7a - 1$$

$$14 = 7a$$

$$2 = a$$

So line A has equation $y = 2x - 1$ which has gradient 2

Line B

$$5y - 3x = 4$$

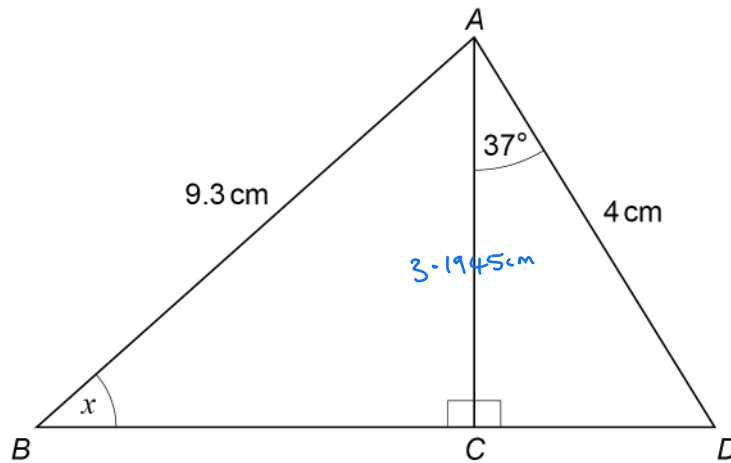
$$5y = 3x + 4$$

$$y = \frac{3}{5}x + \frac{4}{5} \text{ which has gradient } \frac{3}{5}$$

2 is greater than $\frac{3}{5}$ so line A has greater gradient



17

Not drawn
accuratelyWork out the size of angle x .**[4 marks]**

$$\cos 37 = \frac{AC}{4}$$

$$4 \times \cos 37 = AC$$

$$AC = 3.1945 \text{ cm}$$

$$\sin x = \frac{3.1945}{9.3}$$

$$x = \sin^{-1} \left(\frac{3.1945}{9.3} \right) = 20.09^\circ \quad (2 \text{ dp})$$

$$x = \underline{20.09}^\circ$$

Turn over ►



18 Rearrange $y = \frac{x+8}{x}$ to make x the subject.

[3 marks]

$$yx = x + 8$$

$$yx - x = 8$$

$$x(y-1) = 8$$

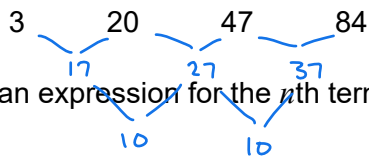
$$x = \frac{8}{y-1}$$

Answer $x = \frac{8}{y-1}$



19

Here are the first four terms of a quadratic sequence.

Work out an expression for the n th term of the sequence.**[4 marks]**

Second difference = 10 so must start with $\frac{10}{2}n^2 = 5n^2$

$5n^2$ would give sequence 5×1^2 5×2^2 5×3^2 5×4^2
5 20 45 80

Subtract this from original sequence: $3-5$ $20-20$ $47-45$ $84-80$
-2 0 2 4
 2 2 2

Difference between these terms is 2, so sequence must start $5n^2 + 2n$

$5n^2 + 2n$ would give sequence $5+2 \times 1$ $20+2 \times 2$ $45+2 \times 3$ $80+2 \times 4$
7 24 51 88

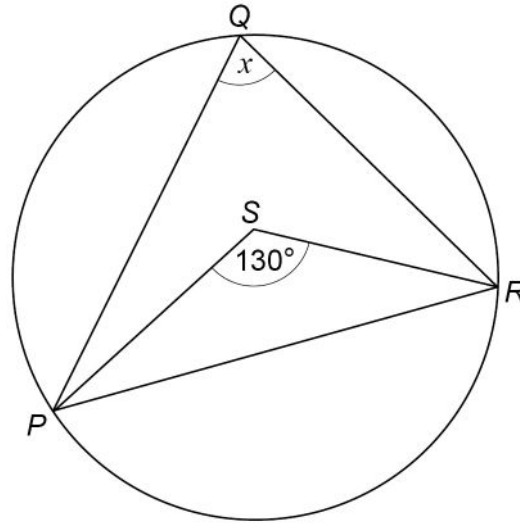
We need to subtract 4 from each term to get the sequence in the question, so $5n^2 + 2n - 4$

Answer $5n^2 + 2n - 4$



20 (a) P , Q and R are points on a circle.
 S is a point inside triangle PQR .

Not drawn
accurately



Assume that S is the centre of the circle.

Work out the size of angle x .

[1 mark]

$$130 \div 2 = 65$$

$$x = \underline{\hspace{2cm} 65 \text{ }^\circ}$$

20 (b) In fact, the centre of the circle is on PS but **not** at S .

What does this mean about the size of angle x ?

Tick **one** box.

[1 mark]

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

It is greater than the answer to part (a)

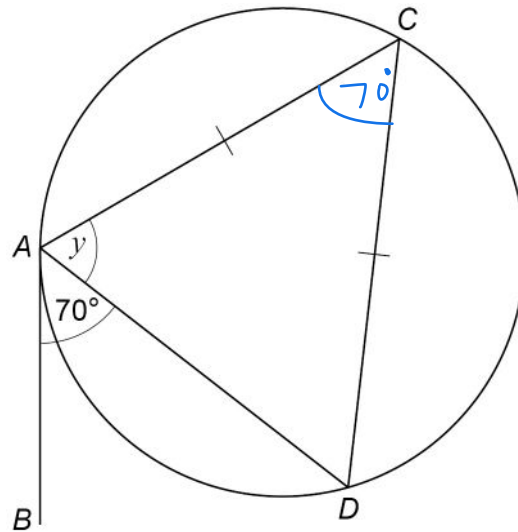
It is smaller than the answer to part (a)

It is impossible to tell



- 20 (c) For a different circle,
 AB is a tangent at A
 C and D are on the circumference of the circle
 $AC = CD$

Not drawn
accurately



Here is Simon's method to work out the size of angle y .

Angle $ADC = 70^\circ$ (alternate segment theorem)
 Therefore $y = 70^\circ$ (angles in an isosceles triangle)

Is he correct?

Give a reason for your answer.

[1 mark]

No - it is angle ACD that is 70° , not angle ADC



21

Magana decides to put £500 into an account that pays compound interest.
She wants to have **at least** £560 in the account after 3 years.

Work out to 1 decimal place the **minimum** annual interest rate she needs.

[3 marks]

Need x such that $500 \times x^3 = 560$

$$x^3 = \frac{560}{500}$$

$$x = \sqrt[3]{\frac{560}{500}}$$

$$x = 1.0385\dots$$

↑
so increase by 3.85%

or 3.9% to 1dp

Answer _____ 3.9 %



- 22** An approximate value of a root of an equation, x , can be found using the iterative formula

$$x_{n+1} = \sqrt[3]{5(x_n)^2 - 2x_n - 3}$$

The starting value is $x_1 = 4$

- 22 (a)** Work out the values of x_2 and x_3

[2 marks]

$$x_2 = 4.10$$

$$x_3 = 4.18$$

- 22 (b)** By continuing the iteration, show that the value of x is more than 4.25

[1 mark]

$$x_4 = 4.23$$

$$x_5 = 4.28 \quad \leftarrow \text{always more than 4.25 from here}$$

$$x_6 = 4.31$$

$$x_7 = 4.33$$

$$x_8 = 4.35$$



23

Here are three sets of cards.

Set A

1

1

3

5

5

5

6

8

Set B

1

2

4

6

8

8

9

Set C

3

4

5

6

In a game, a player has two options.

Option 1
Pick two cards from Set A

Option 2
Pick one card from Set B
and
pick one card from Set C

The cards are picked at random.

The player wins if the total of their two cards is exactly 10



Which option gives a better chance of winning?

Option 1



Option 2



Show working to support your answer.

[4 marks]

Option 1

need 5 then another 5 so probability $\frac{3}{8} \times \frac{2}{7} = \frac{6}{56} = 0.107$
 \uparrow
 out of 7 as first card not replaced

Option 2

need 4 then 6 - probability $\frac{1}{7} \times \frac{1}{4} = \frac{1}{28} = 0.0357$
 or 6 then 4 - probability $\frac{1}{7} \times \frac{1}{4} = \frac{1}{28} = 0.0357$ } $0.0357 + 0.0357 = 0.0714$

Option 1 has higher probability

Turn over for the next question

Turn over ►



24

 $a = 65$ to the nearest integer $b = 30$ to 1 significant figureWork out the **upper bound** for $2a^2 - b^2$ You **must** show your working.**[3 marks]**

$$a = 65 \begin{cases} 65.5 \\ 64.5 \end{cases}$$

$$b = 30 \begin{cases} 35 \\ 25 \end{cases}$$

For maximum $2a^2 - b^2$ need biggest $2a^2$ and smallest b^2

$$\text{Biggest } 2a^2 \text{ is } 2 \times 65.5^2 = 8580.5$$

$$\text{Smallest } b^2 \text{ is } 25^2 = 625$$

$$8580.5 - 625 = 7955.5$$

Answer 7955.5

25

Show that $\frac{x-5}{x-2} + \frac{x+5}{x+2}$

simplifies to $\frac{ax^2-b}{x^2-4}$ where a and b are integers.

[3 marks]

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

$$= \frac{x^2 - 3x - 10 + x^2 + 3x - 10}{x^2 - 2x + 2x - 4}$$

$$= \frac{2x^2 - 20}{x^2 - 4}$$

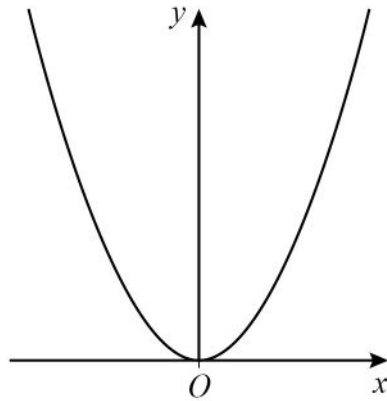
So $a = 2$, $b = 20$

Turn over for the next question

Turn over ►



26 Here is a sketch of $y = x^2$



26 (a) The minimum point of $y = x^2$ is at $(0, 0)$

Write down the coordinates of the minimum point of $y = x^2 + 2$

[1 mark]

Answer (0 , 2)

26 (b) The graph $y = x^2$ is reflected in the x axis.

Write down the equation of the graph after this transformation.

[1 mark]

Answer $y = -x^2$

26 (c) $y = x^2$ is now transformed to give $y = (x + 3)^2$

Describe fully this single transformation.

[2 marks]

Translation of $\begin{pmatrix} -3 \\ 0 \end{pmatrix}$ (so shifted left by 3)

END OF QUESTIONS

