AQA

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
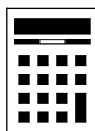

Wednesday 7 June 2023   Morning   Time allowed: 1 hour 30 minutes

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.

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	
24–25	
26	
TOTAL	

Answer **all** questions in the spaces provided.

1 Write 30 : 12 in the form $n : 1$

[1 mark]

$$\frac{30}{12} = 2.5$$

Answer _____ 2.5 ⓵ _____ : 1

2 Four consecutive triangular numbers are   6   10   15   21   28
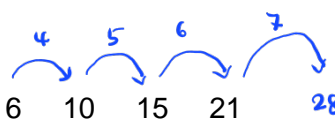
Write down the next triangular number.

[1 mark]

Answer _____ 28   ⓵ _____

Do not write outside the box

3   Write down the reciprocal of $\dfrac{4}{7}$ $= \dfrac{7}{4} = 1.75$

[1 mark]

Answer _____1.75___ ①

4   The price of a toy increases by 12.5% to £19.53

Work out the **original** price of the toy.

[2 marks]

$1.125 \times x = 19.53$

$x = \dfrac{19.53}{1.125} = 17.36$ ①

Answer £ ____17.36____ ①

Turn over for the next question

5

Turn over ▶

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]

2p : 45 × 8 = 360   coins ①

5p : 17.70 − (45 × 0.10) − (360 × 0.20)

   : 17.70 − 4.50 − 7.20 ①

   : 6.00 ①

2p : 7.20

2p : 5p = 7.20 : 6.00 } ÷ 12

   =   6   : 5   ①

Answer _____6_____ : _____5_____

Do not write outside the box

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]

$360 \div 8 = 135$ ①

$180 - 135 = 45$ ①

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)

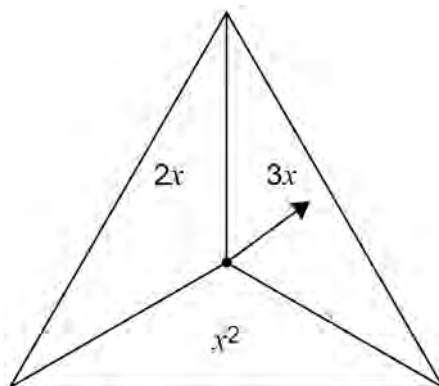☐ It is the same as the answer to part (a)

☑ ① It is less than the answer to part (a)

☐ It could be any of the above

7

Turn over ▶

IB/M/Jun23/8300/2H

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

②

Do not write outside the box

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]

$$\frac{8}{18}$$

Answer $\frac{8}{18}$ ①

7 (c) The game is played 711 times.

Estimate the number of games that are won.

[2 marks]

$$\frac{8}{18} \times 711 \ ① \quad = 316 \ ①$$

Answer 316

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

Work out the values of a and b.

[2 marks]

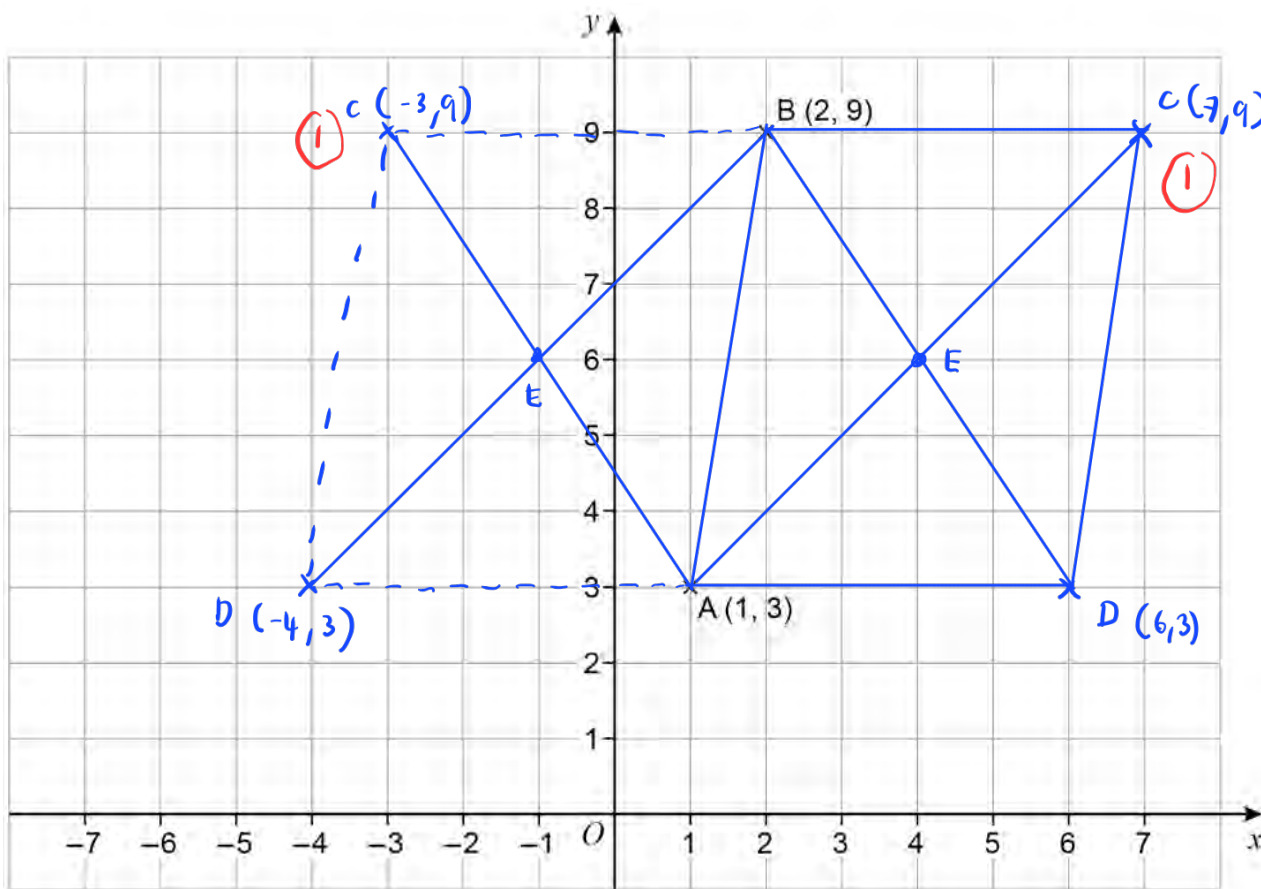$a - 3 = 5 \qquad 2b = 12$

$a = 8 \qquad b = 6$

$a = \underline{\quad 8 \quad}$ ① $\qquad b = \underline{\quad 6 \quad}$ ①

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]
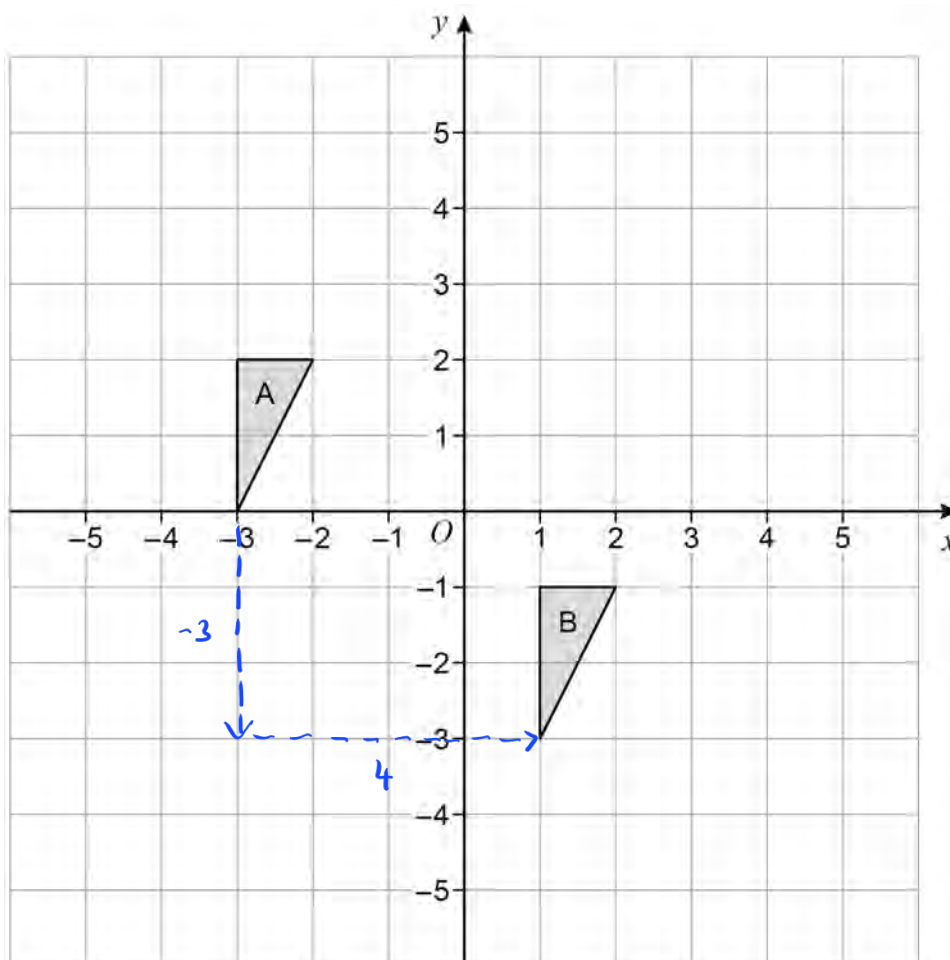
Answer (____4____ , ____6____) and (____−1____ , ____6____)

10   Write down the translation vector that maps shape A onto shape B.

[2 marks]

Answer $\begin{pmatrix} 4 \\ -3 \end{pmatrix}$ ②
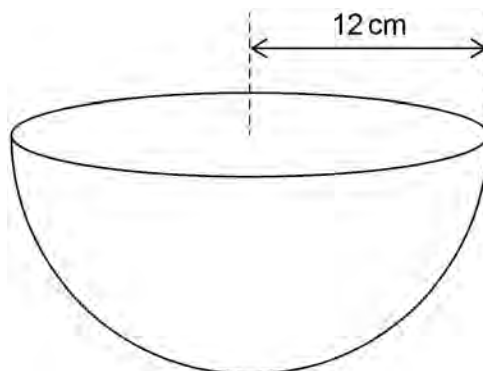
6

Turn over ▶

Do not write outside the box

11

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

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]

Volume of water = 325 × 8 = 2600 ①

volume of hemisphere = $\frac{1}{2_1} \times \frac{4^2}{3} \times \pi \times 12^3$

= 3620 ①

$\frac{2600}{3620}$ × 100% = 71.8% ①

Yes. The water fills 71.8% of the bowl. ①

Do not write outside the box

12 Show that these two rectangles are similar.

[2 marks]

Not drawn accurately

5 cm 12 cm

8 cm 19.2 cm
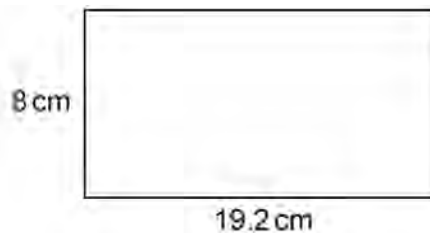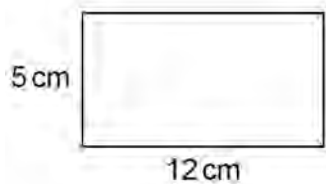
$$\frac{8}{5} = 1.6 \quad ①$$

$$\frac{19.2}{12} = 1.6$$

$$\frac{8}{5} = \frac{19.2}{12} = 1.6 \quad ①$$

13 A factory packs x boxes of teabags per hour.

Each box contains 80 teabags.

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

[2 marks]

$$80 \times x = 80x \quad ①$$

$$\frac{80x}{1 \text{ hour}} \times \frac{1 \text{ hour}}{60 \text{ mins}} = \frac{80}{60} x \text{ per mins} \quad ①$$

$$= \frac{4x}{3} \text{ per mins}$$

Turn over for the next question

8

Turn over ▶

PMT

Do not write outside the box

14 A company has 123 employees.

Information about their hourly rates of pay is shown in the table.

Hourly rate, £p	Number of employees
$10 \leqslant p < 14$	66
$14 \leqslant p < 20$	32
$20 \leqslant p < 40$	15
$40 \leqslant p < 100$	10
	Total = 123

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]

$66 + \frac{1}{2}(32)$ ①

$= 66 + 16$

$= 82$

①

$\frac{82}{123} \times 100\% = 66.67\%$ (less than £17)

$= 100 - 66.67 = 33.33\%$ (more than £17)

①

Do not write outside the box

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

[1 mark]

All employees in the second interval might earn less than £17 ①

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

[3 marks]

$$mean = \frac{(66 \times 12) + (32 \times 17) + (15 \times 30) + (10 \times 70)}{123} \text{ ①}$$

$$= \frac{792 + 544 + 450 + 700}{123}$$

$$= \frac{2486}{123} \text{ ①}$$

$$= £20.21 \text{ ①}$$

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

[1 mark]

Less than half earned more than £20. ①

8

Turn over ▶

1 3

*Do not write
outside the
box*

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

[2 marks]

$2x^3 + 5x^2y - 18x^2y - 45xy^2$ ①

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

Answer $\underline{\quad 2x^3 - 13x^2y - 45xy^2 \quad}$ ①

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: $13 = a(7) - 1$ ①

$14 = 7a$

$a = 2$ (gradient) ①

Line B: $5y = 4 + 3x$

$y = \frac{3}{5}x + \frac{4}{5}$

gradient $= \frac{3}{5}$ ①

Do not write outside the box

17

Not drawn accurately
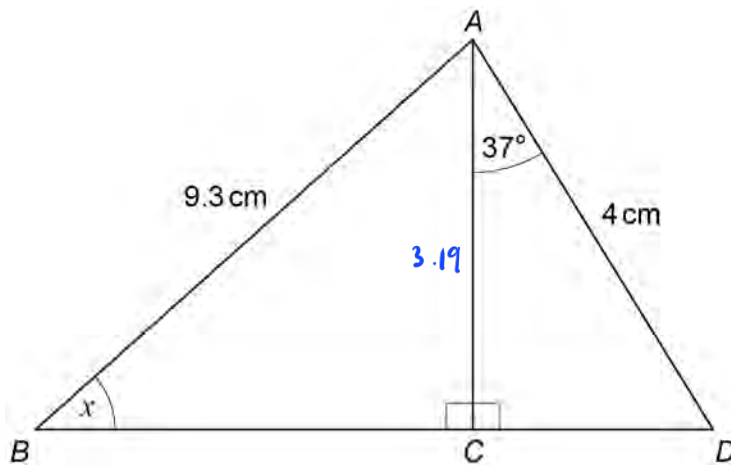
Work out the size of angle x.

[4 marks]

$\cos 37° = \dfrac{AC}{4}$ ①

$AC = 4\cos 37°$

$\quad = 3.19$ cm ①

$\dfrac{\sin x}{3.19} = \dfrac{\sin 90°}{9.3}$

$\sin x = \dfrac{1}{9.3} \times 3.19$

$x = \sin^{-1} 0.34$ ①

$\quad = 19.87$

①

$x = \underline{\quad 19.87 \quad}$ °

9

Turn over ▶

Do not write outside the box

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

[3 marks]

$$yx = x + 8 \quad ①$$

$$yx - x = 8$$

$$x(y-1) = 8 \quad ①$$

$$x = \frac{8}{y-1} \quad ①$$

Answer $\qquad x = \dfrac{8}{y-1} \qquad$

1 6

Do not write outside the box

19 Here are the first four terms of a quadratic sequence.

$$3 \qquad 20 \qquad 47 \qquad 84$$

Work out an expression for the nth term of the sequence.

[4 marks]

$$\text{nth term} = an^2 + bn + c$$

$$3 \qquad 20 \qquad 47 \qquad 84$$

1st diff : $\qquad 17 \qquad 27 \qquad 37$

2nd diff : $\qquad 10 \qquad 10$

a : $\qquad a = \dfrac{10}{2} = 5$ ① $\therefore 5n^2$

b : $3 \times 5 + b = 17$

$\qquad b = 2$ ① $\therefore 2n$

c : $5 \times 1^2 + 2 \times 1 + c = 3$

$\qquad c = -4$ ①

$\qquad \text{nth term} : 5n^2 + 2n - 4$ ①

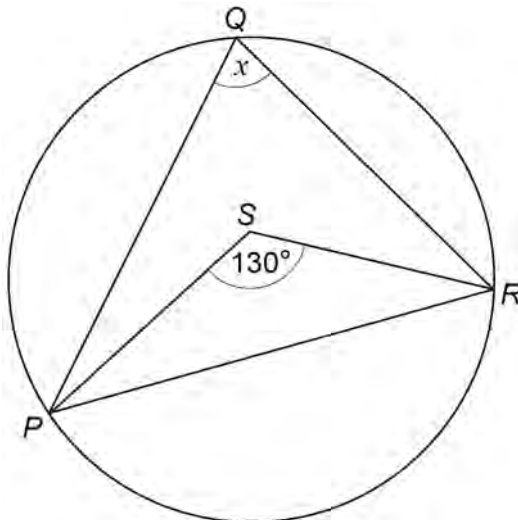Answer $\qquad 5n^2 + 2n - 4$

7

Turn over ▶

Do not write outside the box

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]

$$x = \frac{130}{2} = 65 \quad \text{①}$$

$$x = \underline{\quad 65 \quad} \degree$$

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)

✔ ① It is greater than the answer to part (a)

☐ It is smaller than the answer to part (a)

☐ It is impossible to tell

Do not write outside the box
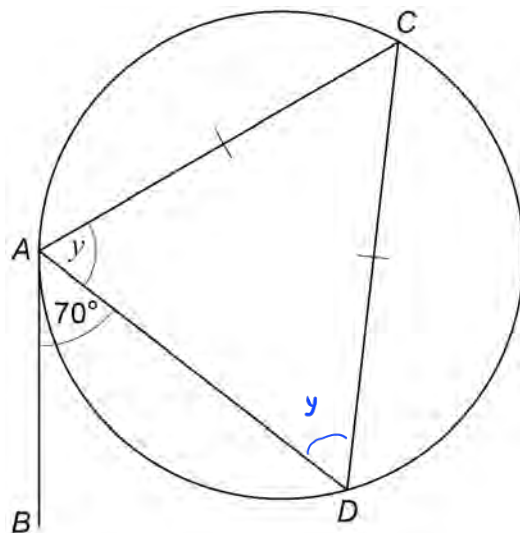
20 (c) For a different circle,

        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° (alternate segment theorem)
>
> Therefore *y* = 70° (angles in an isosceles triangle)

Is he correct?

Give a reason for your answer.

[1 mark]

No. He is wrong. angle ADC is not 70°. ①

3

Turn over ►

Do not write outside the box

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]

$$500\,x^3 = 560$$

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

$$x^3 = 1.12 \quad ①$$

$$x = 1.0385 \quad ①$$

$$= 3.85\%$$

$$= 3.9\% \ (1\ d.p.)$$

$$①$$

Answer $\underline{\qquad 3.9 \qquad}$ %

2 0

Do not write outside the box

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]

$x_2 = \sqrt[3]{5(4)^2 - 2(4) - 3}$ $= 4.10$ ①

$x_3 = \sqrt[3]{5(4.1)^2 - 2(4.1) - 3}$ $= 4.176$ $= 4.18$ (2 d.p)
①

$x_2 =$ _____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]

$x_4 = 4.23$ $x_7 = 4.33$ $x_{10} = 4.37$

$x_5 = 4.28$ $x_8 = 4.34$ $x_{11} = 4.37$

$x_6 = 4.31$ $x_9 = 4.36$ ①

6

Turn over ▶

IB/M/Jun23/8300/2H

PMT

Do not write outside the box

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	**Option 2**
Pick two cards from Set A	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

Do not write outside the box

Which option gives a better chance of winning?

Option 1 ☑ ①   Option 2 ☐

Show working to support your answer.

[4 marks]

Option 1 : $\frac{3}{8} \times \frac{2}{7} = \frac{6}{56}$ ①

(both 5)

Option 2 : (4 and 6)   (6 and 4)

$$\frac{1}{7} \times \frac{1}{4} \quad + \quad \frac{1}{7} \times \frac{1}{4}$$

$$= \frac{1 \times 4}{14 \times 4} = \frac{4}{56} \; ①$$

①

Turn over for the next question

4

Turn over ▶

Do not write outside the box

24 $a = 65$ to the nearest integer

$b = 30$ to 1 significant figure

Work out the **upper bound** for $2a^2 - b^2$

You **must** show your working.

[3 marks]

$a_{UB} = 65.5$, $a_{LB} = 64.5$, $b_{UB} = 35$, $b_{LB} = 25$

①

U_B of $2a^2 - b^2 = 2(65.5)^2 - 25^2$ ①

$= 2(4290.25) - 625$

$= 8580.5 - 625$

$= 7955.5$ ①

Answer   7955.5

*Do not write
outside the
box*

25 Show that $\dfrac{x-5}{x-2} + \dfrac{x+5}{x+2}$

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

[3 marks]

$$\frac{(x-5)(x+2)}{(x-2)(x+2)} + \frac{(x+5)(x-2)}{(x+2)(x-2)} \quad \textcircled{1}$$

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

$$= \frac{x^2 + x^2 - 3x + 3x - 10 - 10}{x^2 - 4} \quad \textcircled{1}$$

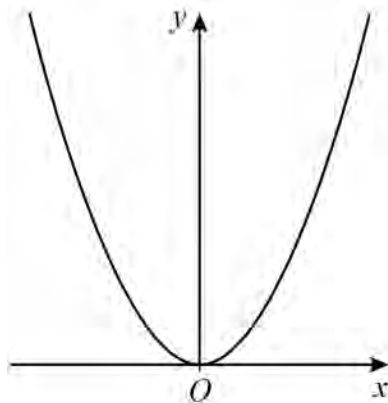$$= \frac{2x^2 - 20}{x^2 - 4} \quad \textcircled{1}$$

Turn over for the next question

6

Turn over ▶

Do not write outside the box

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 with vector $\begin{pmatrix} -3 \\ 0 \end{pmatrix}$

END OF QUESTIONS

4

There are no questions printed on this page

Do not write outside the box

**DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED**

Do not write outside the box

Question number	**Additional page, if required.** **Write the question numbers in the left-hand margin.**

Do not write outside the box

Question number	Additional page, if required. Write the question numbers in the left-hand margin.

*Do not write
outside the
box*

Question number	**Additional page, if required.** **Write the question numbers in the left-hand margin.**

Question number	Additional page, if required. Write the question numbers in the left-hand margin.

Do not write outside the box

There are no questions printed on this page

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

Copyright information