



**Surname** \_\_\_\_\_

**Other Names** \_\_\_\_\_

**Centre Number** \_\_\_\_\_

**Candidate Number** \_\_\_\_\_

**Candidate Signature** \_\_\_\_\_

**I declare this is my own work.**

**AS**

**MATHEMATICS**

**Paper 2**

**7356/2**

**Wednesday 20 May 2020      Morning**

**Time allowed: 1 hour 30 minutes**

**[Turn over]**



**At the top of page 1, write your surname and other names, your centre number, your candidate number and add your signature.**

**For this paper you must have:**

- **the AQA Formulae for A-level Mathematics booklet.**
- **You should have a graphical or scientific calculator that meets the requirements of the specification.**

## **INSTRUCTIONS**

- **Use black ink or black ball-point pen. Pencil should only be used for drawing.**
- **Answer ALL questions.**
- **You must answer each question in the space provided for that question.**
- **Show all necessary working; otherwise marks for method may be lost.**



- **Do all rough work in this book. Cross through any work that you do not want to be marked.**

## **INFORMATION**

- **The marks for questions are shown in brackets.**
- **The maximum mark for this paper is 80.**

## **ADVICE**

- **Unless stated otherwise, you may quote formulae, without proof, from the booklet.**
- **You do not necessarily need to use all the space provided.**

**DO NOT TURN OVER UNTIL TOLD  
TO DO SO**



**SECTION A**

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

- 1 Identify the expression below**  
**that is equivalent to  $e^{\frac{-2}{5}}$**

**Circle your answer. [1 mark]**

$$\frac{1}{\sqrt[5]{e^2}}$$

$$-\sqrt{e^5}$$

$$-\sqrt[5]{e^2}$$

$$\frac{1}{\sqrt{e^5}}$$



2

It is given that  $y = \frac{1}{x}$  and  $x < -1$

Determine which statement below fully describes the possible values of  $y$ .

Tick (✓) ONE box. [1 mark]

☐

$$-\infty < y < -1$$

☐

$$y > -1$$

☐

$$-1 < y < 0$$

☐

$$y < 0$$

[Turn over]



3

It is given that

$$y = 3x^4 + \frac{2}{x} - \frac{x}{4} + 1$$

Find an expression for  $\frac{d^2y}{dx^2}$

[3 marks]

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**[Turn over]**



**4 Find all the solutions of**  
 **$9 \sin^2 x - 6 \sin x + \cos^2 x = 0$**

**where  $0^\circ \leq x \leq 180^\circ$**

**Give your solutions to the  
nearest degree.**

**Fully justify your answer.  
[4 marks]**

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[illegible]

**[Turn over]**



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**[Turn over]**



**5 Joseph is expanding  $(2 - 3x)^7$  in ascending powers of  $x$ .**

**He states that the coefficient of the fourth term is 15 120**

**Joseph's teacher comments that his answer is almost correct.**

**Using a suitable calculation, explain the teacher's comment.  
[4 marks]**

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**6**            **A circle has equation**

$$x^2 + y^2 + 10x - 4y - 71 = 0$$

**6 (a)**        **Find the centre of the circle.**  
**[2 marks]**

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**[Turn over]**



6 (b)

Hence, find the equation of the tangent to the circle at the point  $(1, 10)$ , giving your answer in the form  $ax + by + c = 0$  where  $a$ ,  $b$  and  $c$  are integers.  
[4 marks]

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**[Turn over]**



**7      The population of a country was 3.6 million in 1989.**

**It grew exponentially to reach 6 million in 2019.**

**Estimate the population of the country in 2049 if the exponential growth continues unchanged. [2 marks]**

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[illegible]

**[Turn over]**



8 (a)

Using  $y = 2^{2x}$  as a substitution, show that

$$16^x - 2^{(2x+3)} - 9 = 0$$

can be written as

$$y^2 - 8y - 9 = 0$$

[2 marks]

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**[Turn over]**



**8 (b) Hence, show that the equation**

$$16^x - 2^{(2x+3)} - 9 = 0$$

**has  $x = \log_2 3$  as its only solution.**

**Fully justify your answer.  
[4 marks]**

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9 (a) (i) Find

$$\int (4x - x^3) \, dx$$

[2 marks]

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**[Turn over]**



9 (a) (ii) Evaluate

$$\int_{-2}^2 (4x - x^3) \, dx$$

[1 mark]

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**[Turn over]**



- 9 (b) Using a sketch, explain why the integral in part (a)(ii) does NOT give the area enclosed between the curve  $y = 4x - x^3$  and the  $x$ -axis. [2 marks]

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**[Turn over]**



9 (c)

Find the area enclosed  
between the curve  $y = 4x - x^3$   
and the  $x$ -axis. [2 marks]

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**[Turn over]**



**10**      **A curve has gradient function**

$$\frac{dy}{dx} = 3x^2 - 12x + c$$

**The curve has a turning point  
at  $(-1, 1)$**

**10 (a)      Find the coordinates of the  
other turning point of the  
curve.**

**Fully justify your answer.  
[6 marks]**

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[illegible]

**[Turn over]**



[illegible]

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[Turn over]



**10 (b)**

**Find the set of values of  $x$  for which  $y$  is increasing.  
[2 marks]**

[illegible]

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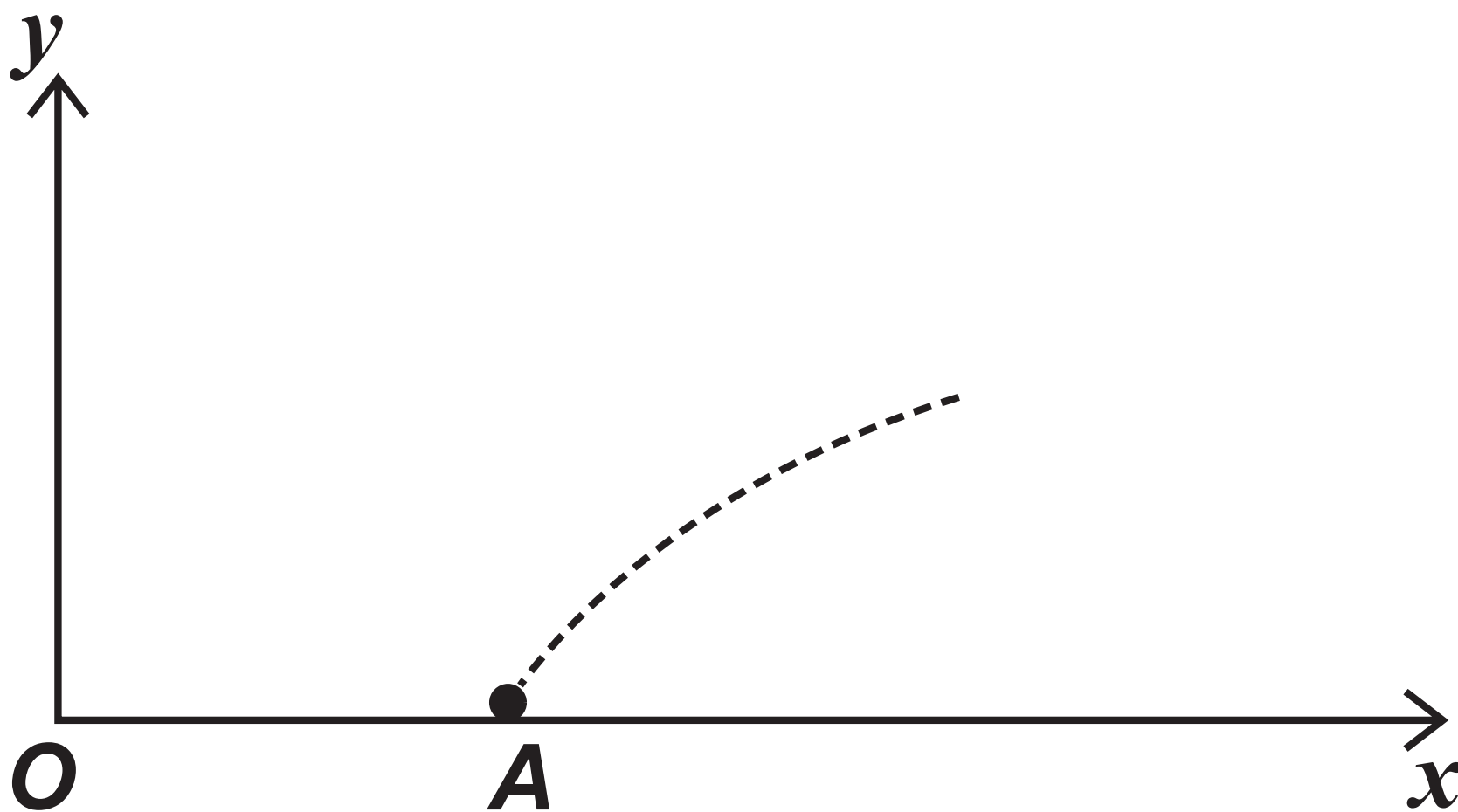
**[Turn over]**



11

A fire crew is tackling a grass fire on horizontal ground.

The crew directs a single jet of water which flows continuously from point  $A$ .



The path of the jet can be modelled by the equation

$$y = -0.0125x^2 + 0.5x - 2.55$$

where  $x$  metres is the horizontal distance of the jet from the fire truck at  $O$  and  $y$  metres is the height of the jet above the ground.

The coordinates of point  $A$  are  $(a, 0)$

**[Turn over]**



**11 (a) (i) Find the value of  $a$ . [3 marks]**

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**11 (a) (ii) Find the horizontal distance FROM *A* to the point where the jet hits the ground.  
[1 mark]**

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**[Turn over]**



**11 (b) Calculate the maximum vertical height reached by the jet. [4 marks]**

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**[Turn over]**



**11 (c) A vertical wall is located 11 metres horizontally from A in the direction of the jet. The height of the wall is 2.3 metres.**

**Using the model, determine whether the jet passes over the wall, stating any necessary modelling assumption.  
[3 marks]**

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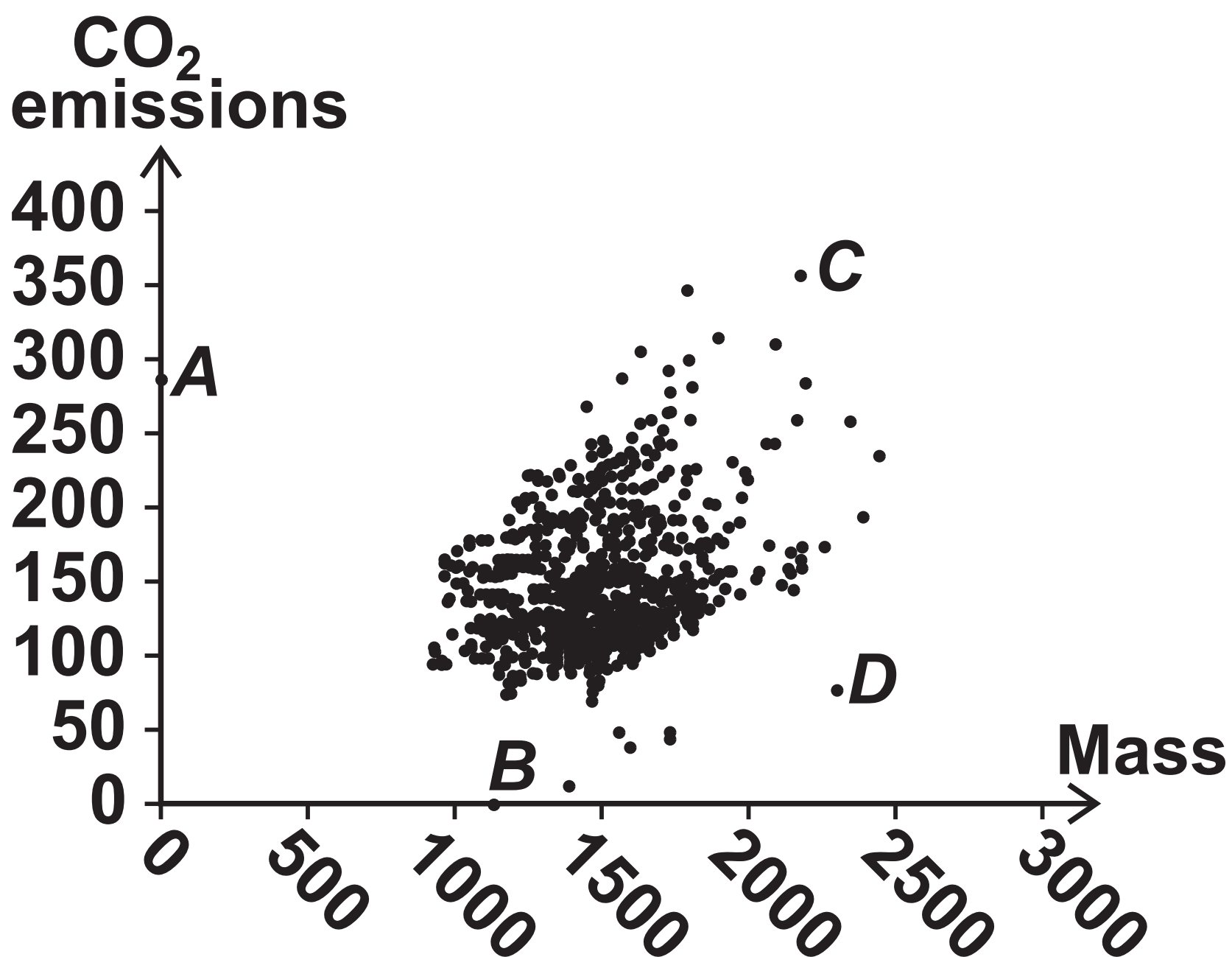
**[Turn over]**



**SECTION B**

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

- 12** A student plots the scatter diagram below showing the mass in kilograms against the CO<sub>2</sub> emissions in grams per kilogram for a sample of cars in the Large Data Set.



Their teacher tells them to remove an error to clean the data.

Identify the data point which should be removed.

Circle your answer below.  
[1 mark]

*A**B**C**D*

13

The random variable  $X$  is such

that  $X \sim B\left(n, \frac{1}{3}\right)$

The standard deviation of  $X$  is 4

Find the value of  $n$ .

Circle your answer below.  
[1 mark]

9

12

18

72



[Turn over]

14

**A retail company has 5200 employees in 100 stores throughout the United Kingdom.**

**The company recently introduced a new reward scheme for its staff.**

**The management team wanted to sample the staff to find out their opinions of the new scheme.**

**Three possible sampling methods were suggested:**

**Method A     Choose 100 people who work at the largest store**

**Method B     Choose one person at random from each of the 100 stores**





**Method C** List all employees in alphabetical order and assign each a number from 1 to 5200

**Choose a random number between 1 and 52**

**Choose this person and every 52nd person on the list thereafter.**

**[Turn over]**



**14 (a) Give one DISADVANTAGE of using Method A compared with using Method B. [1 mark]**

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**14 (b) Give one ADVANTAGE of using Method B compared with using Method C. [1 mark]**

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**[Turn over]**



**14 (c) (i) Identify the method of sampling used in Method C. [1 mark]**

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**14 (c) (ii) Give a reason why Method C does NOT provide a random sample. [1 mark]**

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**[Turn over]**



15

A random sample of ten CO<sub>2</sub> emissions was selected from the Large Data Set.

The emissions in grams per kilogram were:

13      45      45      0      49

77      49      49      49      78



**15 (a) Find the standard deviation of the sample. [1 mark]**

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**[Turn over]**



**15 (b)**      **An environmentalist calculated the average CO<sub>2</sub> emissions for cars in the Large Data Set registered in 2002 and in 2016.**

**The averages are listed below.**

|  |              |              |
|--|--------------|--------------|
| <b>Year of registration</b>            | <b>2002</b>  | <b>2016</b>  |
| <b>Average CO<sub>2</sub> emission</b> | <b>171.2</b> | <b>120.4</b> |

**The environmentalist claims that the average CO<sub>2</sub> emissions for 2002 and 2016 combined is 145.8**

**Determine whether this claim is correct.**

**Fully justify your answer.  
[2 marks]**

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16

**A mathematical puzzle is published every day in a newspaper.**

**Over a long period of time Paula is able to solve the puzzle correctly 60% of the time.**



**16 (a) For a randomly chosen 14-day period find the probability that:**

**16 (a) (i) Paula correctly solves exactly 8 puzzles [1 mark]**

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**[Turn over]**



16 (a) (ii) Paula correctly solves at least 7 but not more than 11 puzzles. [2 marks]

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**16 (b) State one assumption that is necessary for the distribution used in part (a) to be valid.  
[1 mark]**

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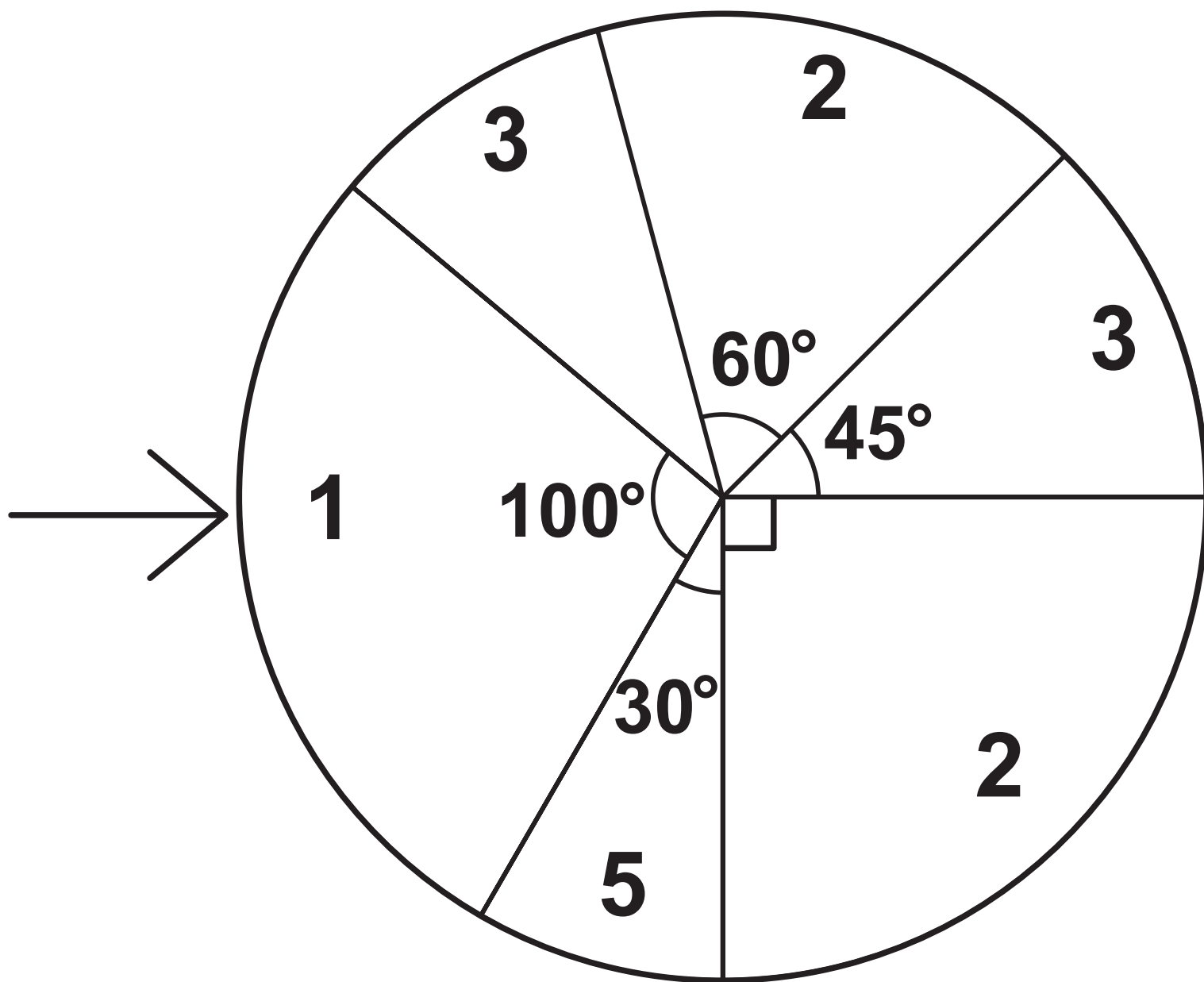
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**[Turn over]**



17

A game consists of spinning a circular wheel divided into numbered sectors as shown below.



On each spin the score,  $X$ , is the value shown in the sector that the arrow points to when the spinner stops.

The probability of the arrow pointing at a sector is proportional to the angle



subtended at the centre by that sector.

17 (a) Show that  $P(X = 1) = \frac{5}{18}$

[1 mark]

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[Turn over]



17 (b)      Complete the probability distribution for  $X$  in the table below. [2 marks]

|            |                |  |  |  |
|------------|----------------|--|--|--|
| $x$        | 1              |  |  |  |
| $P(X = x)$ | $\frac{5}{18}$ |  |  |  |



**[Turn over]**



**18 (a) Bag A contains 7 blue discs, 4 red discs and 1 yellow disc.**

**Two discs are drawn at random from bag A WITHOUT REPLACEMENT.**

**Find the probability that exactly ONE of the discs is blue. [2 marks]**

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[illegible]

**[Turn over]**



**18 (b) Bag A contains 7 blue discs,  
4 red discs and 1 yellow disc.**

**Bag B contains 3 blue discs  
and 6 red discs.**

**A disc is drawn at random  
from Bag A and placed in  
Bag B.**

**A disc is then drawn at random  
from Bag B.**

**Find the probability that the  
disc drawn from Bag B is red.  
[3 marks]**

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**[Turn over]**



19

It is known from historical data that 15% of the residents of a town buy the local weekly newspaper, 'Local News'.

A new free weekly paper is introduced into the town.

The owners of 'Local News' are interested to know whether the introduction of the free newspaper has changed the proportion of residents who buy their paper.

In a random sample of 50 residents of the town taken after the free newspaper was introduced, it was found that 3 of them purchased 'Local News' regularly.

Investigate, at the 5% significance level, whether this sample provides evidence that the proportion of local residents who buy 'Local News' has changed. [6 marks]







[illegible]

# END OF QUESTIONS



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| Question           | Mark |
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