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I declare this is my own work.

**A-level
MATHEMATICS**

Paper 3

7357/3

Time allowed: 2 hours

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

[Turn over]



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.**
- **Do NOT write on blank pages.**
- **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 100.**

ADVICE

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

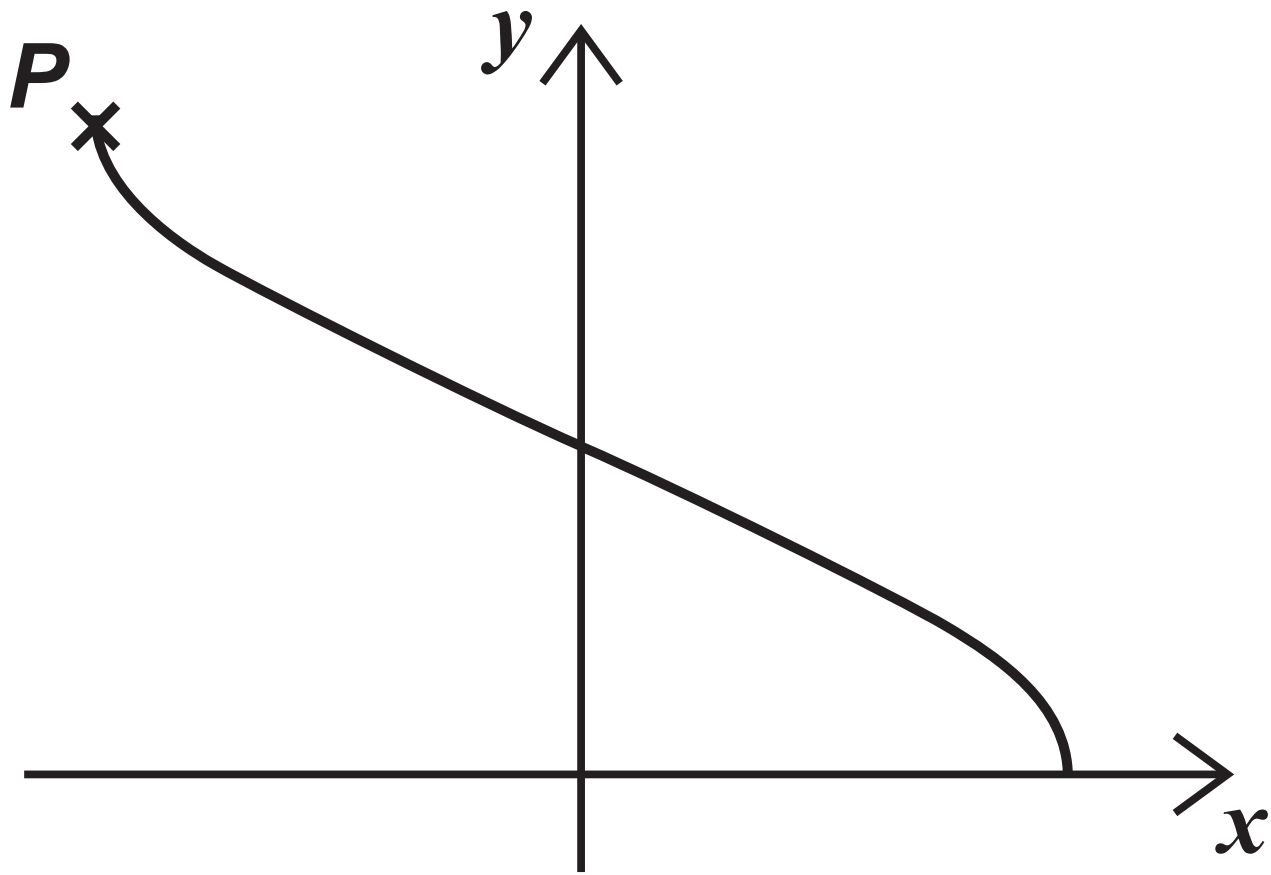
DO NOT TURN OVER UNTIL TOLD TO DO SO



SECTION A

Answer ALL questions in the spaces provided.

- 1 The graph of $y = \arccos x$ is shown.



5

State the coordinates of the end point P .

Circle your answer. [1 mark]

$$(-\pi, 1)$$

$$(-1, \pi)$$

$$\left(-\frac{\pi}{2}, 1\right)$$

$$\left(-1, \frac{\pi}{2}\right)$$

[Turn over]



2 Simplify fully

$$\frac{(x + 3)(6 - 2x)}{(x - 3)(3 + x)}$$

for $x \neq \pm 3$

Circle your answer. [1 mark]

-2

2

$$\frac{(6 - 2x)}{(x - 3)}$$

$$\frac{(2x - 6)}{(x - 3)}$$

3 $f(x) = 3x^2$

Obtain $\lim_{h \rightarrow 0} \frac{f(x+h) - f(x)}{h}$

Circle your answer. [1 mark]

$$\frac{3h^2}{h}$$

$$x^3$$

$$\frac{3(x+h)^2 - 3x^2}{h}$$

$$6x$$

[Turn over]



4 (a) Show that the first three terms, in descending powers of x , of the expansion of

$$(2x - 3)^{10}$$

are given by

$$1024x^{10} + px^9 + qx^8$$

where p and q are integers to be found. [3 marks]

[Turn over]



4(b) Find the constant term in the expansion of

$$\left(2x - \frac{3}{x}\right)^{10}$$

[2 marks]



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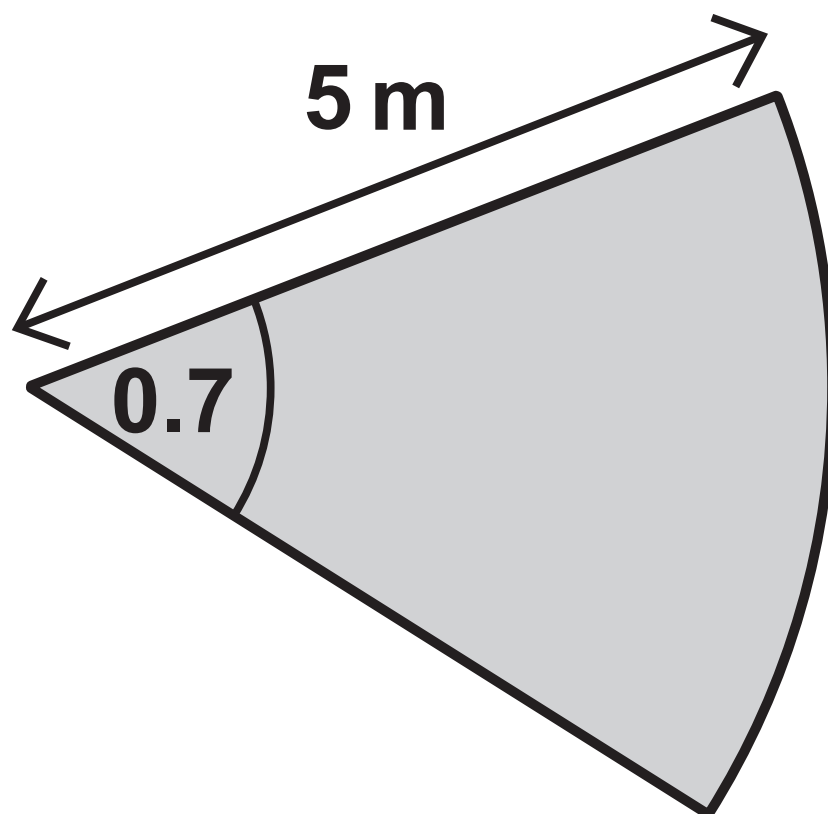


5 A gardener is creating flowerbeds in the shape of sectors of circles.

The gardener uses an edging strip around the perimeter of each of the flowerbeds.

The cost of the edging strip is £1.80 per metre and can be purchased for any length.

One of the flowerbeds has a radius of 5 metres and an angle at the centre of 0.7 radians as shown in the diagram below.



**5 (a) (i) Find the area of this flowerbed.
[2 marks]**

[Turn over]

**5 (a) (ii) Find the cost of the edging strip required for this flowerbed.
[3 marks]**

5(b) A flowerbed is to be made with an area of 20 m^2

5(b) (i) Show that the cost, £ C , of the edging strip required for this flowerbed is given by

$$C = \frac{18}{5} \left(\frac{20}{r} + r \right)$$

where r is the radius measured in metres. [3 marks]

[Turn over]



[Turn over]



5(b) (ii) Hence, show that the minimum cost of the edging strip for this flowerbed occurs when $r \approx 4.5$

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

[Turn over]

- 6 Given that $x > 0$ and $x \neq 25$,
fully simplify

$$\frac{10 + 5x - 2x^{\frac{1}{2}} - x^{\frac{3}{2}}}{5 - \sqrt{x}}$$

Fully justify your answer.
[4 marks]



[Turn over]

7 A building has a leaking roof and, while it is raining, water drips into a 12 litre bucket.

When the rain stops, the bucket is one third full.

Water continues to drip into the bucket from a puddle on the roof.

In the first minute after the rain stops, 30 millilitres of water drips into the bucket.

In each subsequent minute, the amount of water that drips into the bucket reduces by 2%.

During the n th minute after the rain stops, the volume of water that drips into the bucket is W_n millilitres.



7 (a) Find W_2 [1 mark]

[Turn over]



7(b) Explain why

$$W_n = A \times 0.98^{n-1}$$

and state the value of A .
[2 marks]

7 (c) Find the increase in the water in the bucket 15 minutes after the rain stops.

Give your answer to the nearest millilitre. [2 marks]

[Turn over]

7(d) Assuming it does not start to rain again, find the maximum amount of water in the bucket. [3 marks]



7 (e) After several hours the water has stopped dripping.

Give TWO reasons why the amount of water in the bucket is not as much as the answer found in part (d). [2 marks]

[Turn over]

8

Given that

$$\int_{\frac{\pi}{4}}^{\frac{\pi}{3}} x \cos x \, dx = a\pi + b$$

find the exact value of a and the exact value of b .

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





[Turn over]



9 A function f is defined for all real values of x as

$$f(x) = x^4 + 5x^3$$

The function has exactly two stationary points when $x = 0$

and $x = -\frac{15}{4}$

9 (a) (i) Find $f''(x)$ [2 marks]



[Turn over]



9(b) State the range of values of x for which

$$f(x) = x^4 + 5x^3$$

**is an increasing function.
[1 mark]**

9 (c) A second function g is defined for all real values of x as

$$g(x) = x^4 - 5x^3$$

9 (c) (i) State the single transformation which maps f onto g . [1 mark]

[Turn over]



**9(c) (ii) State the range of values of x for which g is an increasing function.
[1 mark]**

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[Turn over]



SECTION B

Answer ALL questions in the spaces provided.

- 10** **Anke has collected data from 30 similar-sized cars to investigate any correlation between the age of the car and the current market value.**
- She calculates the correlation coefficient.**



41

Which of the following statements best describes her answer of -1.2 ?

Tick (✓) ONE box. [1 mark]

Definitely incorrect

Probably incorrect

Probably correct

Definitely correct

[Turn over]



11 The random variable X is such that $X \sim B(n, p)$

The mean value of X is 225

The variance of X is 144

Find p .

Circle your answer. [1 mark]

0.36

0.6

0.64

0.8



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[Turn over]



12

An electoral register contains 8000 names.

A researcher decides to select a systematic sample of 100 names from the register.

**Explain how the researcher should select such a sample.
[3 marks]**

[Turn over]



The table below is an extract from the Large Data Set.

Propulsion Type	Region	Engine Size	Mass	CO ₂	Particulate Emissions
2	London	1896	1533	154	0.04
2	North West	1896	1423	146	0.029
2	North West	1896	1353	138	0.025
2	South West	1998	1547	159	0.026
2	London	1896	1388	138	0.025
2	South West	1896	1214	130	0.011
2	South West	1896	1480	146	0.029
2	South West	1896	1413	146	0.024
2	South West	2496	1695	192	0.034
2	South West	1422	1251	122	0.025



Table continued.

2	South West	1995	2075	175	0.034
2	London	1896	1285	140	0.036
2	North West	1896	0	146	

[Turn over]



13(a) (i) Calculate the mean and standard deviation of CO₂ emissions in the table. [2 marks]



4 9

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[Question 13 continues on next page]



13 (a) (ii) Any value more than 2 standard deviations from the mean can be identified as an outlier.

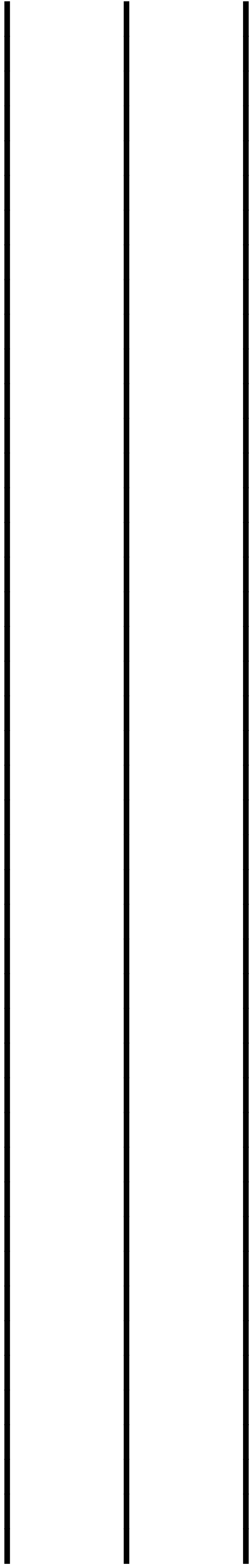
Determine, using this definition of an outlier, if there are any outliers in this sample of CO₂ emissions.

Fully justify your answer. [2 marks]

50



5 1



[Turn over]

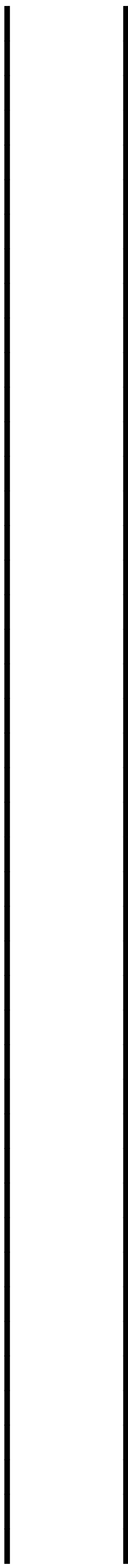
51



13(b)

Maria claims that the last line in the table must contain two errors.

Use your knowledge of the Large Data Set to comment on Maria's claim. [2 marks]



[Turn over]

14 A and B are two events such that

$$P(A \cap B) = 0.1$$

$$P(A' \cap B') = 0.2$$

$$P(B) = 2P(A)$$

14 (a) Find $P(A)$ [4 marks]

[Turn over]



14(b)

Find $P(B|A)$ [2 marks]



14 (c) Determine if A and B are independent events. [1 mark]

[Turn over]



15 A team game involves solving puzzles to escape from a room.

Using data from the past, the mean time to solve the puzzles and escape from one of these rooms is 65 minutes with a standard deviation of 11.3 minutes.

After recent changes to the puzzles in the room, it is claimed that the mean time to solve the puzzles and escape has changed.

To test this claim, a random sample of 100 teams is selected.

The total time to solve the puzzles and escape for the 100 teams is 6780 minutes.

Assuming that the times are normally distributed, test at the 2% level the claim that the mean time has changed. [7 marks]

[Turn over]



The discrete random variable X has the probability function

$$P(X = x) = \begin{cases} c(7 - 2x) & x = 0, 1, 2, 3 \\ k & x = 4 \\ 0 & \text{otherwise} \end{cases}$$

where c and k are constants.



16(a) Show that $16c + k = 1$ [2 marks]

[Turn over]



16(b)

Given that $P(X \geq 3) = \frac{5}{8}$

find the value of c and the value of k . [2 marks]



[Turn over]

17 James is playing a mathematical game on his computer.

The probability that he wins is 0.6

As part of an online tournament, James plays the game 10 times.

Let Y be the number of games that James wins.

17 (a) State two assumptions, in context, for Y to be modelled as $B(10, 0.6)$ [2 marks]

17 (b) Find $P(Y = 4)$ [1 mark]

[Turn over]

17 (c)

Find $P(Y \geq 4)$ [2 marks]



17(d)

After practising the game, James claims that he has increased his probability of winning the game.

In a random sample of 15 subsequent games, he wins 12 of them.

Test a 5% significance level whether James's claim is correct.
[6 marks]

[Turn over]





[Turn over]



- 18** A factory produces jars of jam and jars of marmalade.
- 18 (a)** The weight, X grams, of jam in a jar can be modelled as a normal variable with mean 372 and a standard deviation of 3.5
- 18 (a) (i)** Find the probability that the weight of jam in a jar is equal to 372 grams. [1 mark]



18 (a) (ii) Find the probability that the weight of jam in a jar is greater than 368 grams. [2 marks]

[Turn over]



18 (b) The weight, Y grams, of marmalade in a jar can be modelled as a normal variable with mean μ and standard deviation σ

18 (b) (i) Given that $P(Y < 346) = 0.975$, show that

$$346 - \mu = 1.96 \sigma$$

Fully justify your answer.
[3 marks]



[Turn over]



18 (b) (ii) Given further that

$$P(Y < 336) = 0.14$$

find μ and σ [4 marks]



END OF QUESTIONS



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