AQA

Please write clearly in block capitals.

Centre number | | | | | | Candidate number | | | | |

Surname _____

Forename(s) _____

Candidate signature _____

I declare this is my own work.

AS MATHEMATICS

Paper 2

Time allowed: 1 hour 30 minutes

Materials
- 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.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer each question in the space provided for that question. 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 **not** write outside the box around each page or 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 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.

For Examiner's Use	
Question	Mark
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TOTAL	

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Section A

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

1 Find $\int 12x^3 \, \mathrm{d}x$

Circle your answer.

[1 mark]

$36x^2 + c$ $3x^4 + c$ $3x^2 + c$ $36x^4 + c$

2 Given that

$$\cos(\theta - 20°) = \cos 60°$$

which one of the following is a possible value for θ?

Circle your answer.

[1 mark]

40° 140° 280° 320°

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3 A curve has equation $y = k\sqrt{x}$ where k is a constant.

Find $\frac{\mathrm{d}^2y}{\mathrm{d}x^2}$ at the point (4, 2k) on the curve, giving your answer as an expression in terms of k.

[5 marks]

Turn over for the next question

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4 The equation $9x^2 + 4x + p^2 = 0$ has no real solutions for x.

Find the set of possible values of p.

Fully justify your answer.

[4 marks]

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5 Kaya is investigating the function

$$f(x) = 2x^3 - 7x^2 - 12x + 45$$

Kaya makes two statements.

Statement 1: $f(3) = 0$

Statement 2: this shows that $(x + 3)$ must be a factor of $f(x)$.

5 (a) State, with a reason, whether each of Kaya's statements is correct.

[2 marks]

Statement 1: _____

_____

_____

_____

Statement 2: _____

_____

_____

_____

5 (b) Fully factorise $f(x)$.

[3 marks]

_____

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6 An on-line science website states:

'To find a dog's equivalent human age in years, multiply the natural logarithm of the dog's age in years by 16 then add 31.'

6 (a) Calculate the equivalent age to the nearest human year of a dog aged 5 years.

[1 mark]

6 (b) A dog's equivalent age in human years is 40 years. Find the dog's actual age to the nearest month.

[3 marks]

6 (c) Explain why the behaviour of the natural logarithm for values close to zero means that the formula given on the website cannot be true for very young dogs.

[2 marks]

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7 The expression

$$\frac{3-\sqrt{n}}{2+\sqrt{n}}$$

can be written in the form $a+b\sqrt{n}$, where a and b and n are rational but $\sqrt{n}$ is irrational.

Find expressions for a and b in terms of n.

[4 marks]

Turn over for the next question

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8 Triangle *ABC* has sides of length $(m - n)$, m and $(m + n)$ where $0 < 2n < m$

Angle *A* is the largest angle in the triangle.

8 (a) (i) Explain why angle *A* must be opposite the side of length $(m + n)$.

[1 mark]

8 (a) (ii) Using the cosine rule, show that $\cos A = \dfrac{m - 4n}{2(m - n)}$

[3 marks]

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8 (b) You are given that *BC* is the diameter of a circle, and *A* lies on the circumference of the circle. The value of m is 8

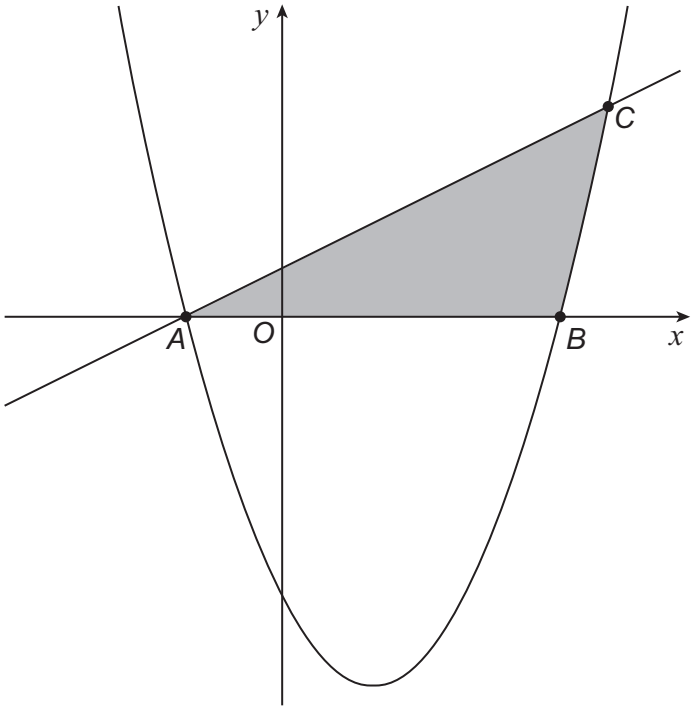
Calculate the value of n.

[3 marks]

Turn over for the next question

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9 The diagram below shows the graphs of $y = x^2 - 4x - 12$ and $y = x + 2$



9 (a) Write down three inequalities which together describe the shaded region.

[2 marks]

9 (b) Find the coordinates of the points *A*, *B* and *C*.

[4 marks]

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9 (c) Find the exact area of the shaded region.

Fully justify your answer.

[6 marks]

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10 A bottle of water has a temperature of 6 °C when it is removed from a refrigerator.

It is placed in a room where the temperature is 20 °C

10 minutes later, the temperature of the water is 12 °C

The temperature of the water, T °C, at time t minutes after it is removed from the refrigerator, may be modelled by the equation

$$T = 20 - a\mathrm{e}^{-kt}$$

10 (a) Find the value of a.

[1 mark]

10 (b) Calculate the value of k, giving your answer to two significant figures.

[3 marks]

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10 (c) Using this model, estimate how long it takes the water to reach a temperature of 18 °C after it is taken out of the refrigerator.

[3 marks]

10 (d) Explain why the model may not be appropriate to predict the temperature of the water three hours after it is taken out of the refrigerator.

[1 mark]

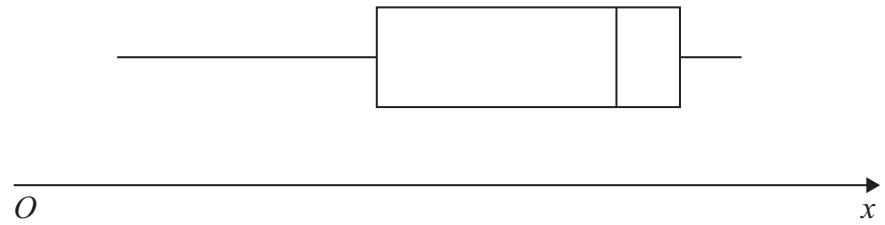
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Section B

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

11 Which of the terms below best describes the distribution represented by the boxplot shown in **Figure 1**?

Figure 1



Circle your answer.

[1 mark]

even negatively skewed positively skewed symmetric

12 Shelly organised an activity weekend for 15 groups of 10 people.

She decided to collect a sample to obtain feedback about the weekend.

To collect the sample Shelly selected two groups at random and then interviewed each member of these two groups.

State the name of this sampling method.

Circle your answer.

[1 mark]

Cluster Opportunity Stratified Systematic

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13 Two random samples of 12 NOX emissions (in g/km) were taken from the Large Data Set.

One sample was taken from the 2002 data and the other sample from the 2016 data.

The sample data are shown below:

2002	0.031	0.019	0.091	0.025	0.030	0.061
	0.047	0.029	0.059	0.363	0.330	0.376

2016	0.005	0.047	0.053	0.063	0.026	0.013
	0.058	0.012	0.010	0.010	0.008	0.008

The mean and standard deviation of the **2002** sample data are 0.122 and 0.137 respectively.

13 (a) Find the mean and standard deviation of the **2016** sample data giving your answers correct to three decimal places.

[2 marks]

13 (b) Siti claims these samples show that, on average, the NOX emissions across all makes of car in all areas of the UK have fallen by over 75% between 2002 and 2016.

13 (b) (i) Show how Siti's claim of 'over 75%' has been obtained.

[2 marks]

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13 (b) (ii) Using your knowledge of the Large Data Set, make two comments on the validity of Siti's claim.

[2 marks]

Comment 1

Comment 2

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14 Yingtai visits her local gym regularly.

After each visit she chooses one item to eat from the gym's cafe.

This could be an apple, a banana or a piece of cake.

She chooses the item independently each time.

The probability that Yingtai chooses each of these items on any visit is given by:

$$P(\text{Apple}) = 0.2$$

$$P(\text{Banana}) = 0.35$$

$$P(\text{Cake}) = 0.45$$

For any **four** randomly selected visits to the gym, find the probability that Yingtai chose:

14 (a) at least one banana.

[2 marks]

14 (b) the same item each time.

[2 marks]

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14 (c) apple twice and cake twice.

[3 marks]

Turn over for the next question

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15 The discrete random variable X is modelled by the probability distribution defined by:

$$\mathrm{P}(X = x) = \begin{cases} cx & x = 1, 2 \\ kx^2 & x = 3, 4 \\ 0 & \text{otherwise} \end{cases}$$

where k and c are constants.

15 (a) State, in terms of k, the probability that $X = 3$

[1 mark]

15 (b) Given that $\mathrm{P}(X \geq 3) = 3 \times \mathrm{P}(X \leq 2)$

Find the exact value of k and the exact value of c.

[4 marks]

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16 It is believed that a coin is biased so that the probability of obtaining a head when the coin is tossed is 0.7

16 (a) Assume that the probability of obtaining a head when the coin is tossed is indeed 0.7

16 (a) (i) Find the probability of obtaining exactly 6 heads from 7 tosses of the coin.

[1 mark]

16 (a) (ii) Find the mean number of heads obtained from 7 tosses of the coin.

[1 mark]

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16 (b) Harry believes that the probability of obtaining a head for this coin is actually greater than 0.7

To test this belief he tosses the coin 35 times and obtains 28 heads.

Carry out a hypothesis test at the 10% significance level to investigate Harry's belief.

[5 marks]

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