



Edexcel AQA AS Mathematics

7356/2 - Pure Mathematics and Statistics

Friday 23 May 2025

Questions and Fully Worked Model Solutions

This booklet places the **question and the solution together**. The mathematics is set out using proper fractions, powers, roots and exact notation, with extra written explanation so that a student can see *why* each step is being taken.

Solutions have been checked against the Pearson Edexcel Summer 2025 mark scheme. The aim is a clear **full-mark model response**, not merely a list of final answers.

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Question 1

Question 1

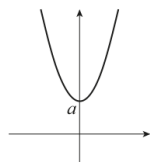
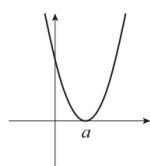
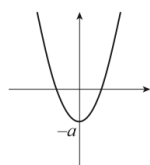
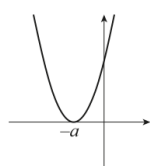
A curve C has equation $y = (x + a)^2$, where a is a positive constant. Identify the graph representing C.

where a is a positive constant.

Identify which **one** of the graphs represents C

Tick (✓) **one** box.

[1 mark]


☐

☐

☐

☐


0 2

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Model solution

The $+a$ inside the bracket translates $y = x^2$ left by a , so its vertex is $(-a, 0)$, and the parabola opens upwards.

The fourth graph.

(1)

Question 2

Question 2

Given $f'(x) = 3x^2$, find $f''(x)$.

Model solution

Differentiate the given first derivative once more.

$$f''(x) = \frac{d}{dx}(3x^2) = 6x.$$

$$6x$$

(1)

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Question 3

Question 3

ABC is the cross-section of a triangular prism. $AB = 6$ cm, $AC = 10$ cm, the prism length is 20 cm and its volume is 500 cm^3 . Find the obtuse angle CAB, to the nearest degree.

20 cm and volume 500 cm^3

obtuse angle CAB

to the nearest degree.

Model solution

Volume equals cross-sectional area times prism length, so first find the area of triangle ABC. Then the two known sides and included angle make the triangle-area formula appropriate.

$$\text{Area of ABC} = \frac{500}{20} = 25 \text{ cm}^2.$$

$$25 = \frac{1}{2}(6)(10) \sin \angle CAB, \quad \sin \angle CAB = \frac{5}{6}.$$

The inverse sine gives the acute angle, but the question specifies the obtuse alternative.

$$\angle CAB = 180^\circ - \sin^{-1}\left(\frac{5}{6}\right) = 123.6 \dots^\circ.$$

$$\angle CAB = 124^\circ \text{ (nearest degree).}$$

(4)

Question 4

Question 4

The line L has equation $2x + 3y = 24$.

(a) Find its gradient.

(b) $A = (2, -2)$, $B = (10, p)$, where p is an integer, and L is the perpendicular bisector of AB. (i) Find p . (ii) Find the intersection of AB and L.

Model solution

(a) Put the line into $y = mx + c$ form, where m is the gradient.

$$3y = 24 - 2x \Rightarrow y = 8 - \frac{2}{3}x.$$

$$(a) \text{ Gradient} = -\frac{2}{3}.$$

(1)

(b)(i) A perpendicular bisector is perpendicular to AB. Therefore the gradient of AB is the negative reciprocal of $-\frac{2}{3}$, namely $\frac{3}{2}$.

$$\frac{p - (-2)}{10 - 2} = \frac{3}{2} \Rightarrow \frac{p + 2}{8} = \frac{3}{2} \Rightarrow p + 2 = 12.$$

$$(b)(i) p = 10.$$

(3)

(b)(ii) The perpendicular bisector meets AB at its midpoint.

$$\left(\frac{2 + 10}{2}, \frac{-2 + 10}{2} \right) = (6, 4).$$

$$(b)(ii) (6, 4).$$

(1)

Question 5

Question 5

Use $u = 4^x$ to solve $16(4^{2x}) - 33(4^x) + 2 = 0$.

Model solution

The powers 4^{2x} and 4^x are related, so the stated substitution turns the equation into a quadratic.

$$4^{2x} = (4^x)^2 = u^2, \quad 16u^2 - 33u + 2 = 0.$$

$$(16u - 1)(u - 2) = 0, \quad u = \frac{1}{16} \text{ or } u = 2.$$

Now replace u by 4^x .

$$4^x = \frac{1}{16} = 4^{-2} \Rightarrow x = -2, \quad 4^x = 2 = 4^{1/2} \Rightarrow x = \frac{1}{2}.$$

$$x = -2 \text{ or } x = \frac{1}{2}.$$

(4)

Question 6

Question 6

Solve $x = 2y - 11$ and $y = 2x^2 - 4x + 1$. Fully justify your answer.

Model solution

Substitute the linear expression for y , $y = (x + 11)/2$, into the quadratic equation. This leaves one equation in x .

$$\frac{x + 11}{2} = 2x^2 - 4x + 1 \Rightarrow x + 11 = 4x^2 - 8x + 2 \Rightarrow 4x^2 - 9x - 9 = 0.$$

$$(4x + 3)(x - 3) = 0, \quad x = -\frac{3}{4} \text{ or } x = 3.$$

Substituting each value into $y = 2x^2 - 4x + 1$ gives the corresponding coordinate, so both simultaneous equations are satisfied.

$$x = 3 \Rightarrow y = 7, \quad x = -\frac{3}{4} \Rightarrow y = \frac{41}{8}.$$

$$(x, y) = (3, 7) \text{ or } \left(-\frac{3}{4}, \frac{41}{8}\right).$$

(4)

Question 7

Question 7

$f(x) = 3x^2 + 3x - 8$. (a) Express $f(x)$ as $a(x + b)^2 + c$.

(b) (i) State the minimum value of $3 \sin^2 \theta + 3 \sin \theta - 8$. (ii) Find the smallest positive θ for which it occurs.

Model solution

(a) Complete the square. Factor out 3 first so that the coefficient of x^2 inside the bracket is 1.

$$f(x) = 3(x^2 + x) - 8 = 3 \left[\left(x + \frac{1}{2} \right)^2 - \frac{1}{4} \right] - 8 = 3 \left(x + \frac{1}{2} \right)^2 - \frac{35}{4}.$$

$$(a) \ f(x) = 3 \left(x + \frac{1}{2} \right)^2 - \frac{35}{4}.$$

(3)

(b)(i) Put $x = \sin \theta$. Since the completed-square form has a positive coefficient, its minimum is $-35/4$, provided $x = -1/2$ is an allowed sine value. It is.

$$(b)(i) \ -\frac{35}{4}.$$

(1)

(b)(ii) The minimum occurs when $\sin \theta = -\frac{1}{2}$. The smallest positive angle with this sine value is in quadrant III.

$$\theta = 180^\circ + 30^\circ = 210^\circ.$$

$$(b)(ii) \ 210^\circ.$$

(2)

Question 8

Question 8

Find the coordinates of the minimum point of $y = x^3 - 5x^2 - 8x + 2$. Fully justify your answer.

Model solution

A minimum of a differentiable curve occurs at a stationary point, so find where the first derivative is zero and use the second derivative to classify both stationary points.

$$\frac{dy}{dx} = 3x^2 - 10x - 8.$$

$$3x^2 - 10x - 8 = 0 \Rightarrow (3x + 2)(x - 4) = 0 \Rightarrow x = -\frac{2}{3} \text{ or } x = 4.$$

$$\frac{d^2y}{dx^2} = 6x - 10.$$

$$\left. \frac{d^2y}{dx^2} \right|_{x=-2/3} = -14 < 0 \quad (\text{maximum}), \quad \left. \frac{d^2y}{dx^2} \right|_{x=4} = 14 > 0 \quad (\text{minimum}).$$

Substitute the minimum's x -coordinate into the original equation to find its height.

$$y = 4^3 - 5(4^2) - 8(4) + 2 = 64 - 80 - 32 + 2 = -46.$$

Minimum point $(4, -46)$.

(8)

Question 9

Question 9

Given $\int_1^3 f(x) \, dx = 8$, find (a) $\int_1^3 2f(x) \, dx$, (b) $\int_1^3 (f(x) + 2) \, dx$, and (c) $\int_2^4 f(x-1) \, dx$.

Model solution

(a) A constant factor can be taken outside a definite integral.

$$\int_1^3 2f(x) \, dx = 2 \int_1^3 f(x) \, dx = 2(8).$$

(a) 16.

(1)

(b) Split the integral, noting that the integral of 2 over an interval of width $3-1$ is $2(3-1)$.

$$\int_1^3 (f(x) + 2) \, dx = 8 + 2(3-1) = 12.$$

(b) 12.

(1)

(c) Use $u = x - 1$; the limits $x = 2, 4$ become $u = 1, 3$, exactly the given integral.

$$\int_2^4 f(x-1) \, dx = \int_1^3 f(u) \, du = 8.$$

(c) 8.

(1)

Question 10

Question 10

- (a) Show that $\frac{1}{\sqrt{k} + \sqrt{k+1}} \equiv \sqrt{k+1} - \sqrt{k}, k > 0$.
- (b) Hence find exactly $\frac{1}{\sqrt{1} + \sqrt{2}} + \frac{1}{\sqrt{2} + \sqrt{3}} + \frac{1}{\sqrt{3} + \sqrt{4}}$.

Model solution

(a) *Rationalise the denominator: multiplying by the conjugate creates a difference of two squares.*

$$\frac{1}{\sqrt{k} + \sqrt{k+1}} \times \frac{\sqrt{k+1} - \sqrt{k}}{\sqrt{k+1} - \sqrt{k}} = \frac{\sqrt{k+1} - \sqrt{k}}{(k+1) - k} = \sqrt{k+1} - \sqrt{k}.$$

$$(a) \frac{1}{\sqrt{k} + \sqrt{k+1}} \equiv \sqrt{k+1} - \sqrt{k}.$$

(2)

(b) *Apply part (a) to each term. The resulting sum telescopes: consecutive positive and negative terms cancel.*

$$\begin{aligned} & (\sqrt{2} - 1) + (\sqrt{3} - \sqrt{2}) + (2 - \sqrt{3}) \\ &= 1. \end{aligned}$$

$$(b) \ 1.$$

(2)

Question 11

Question 11

The equation $x^2 + (2k - 1)x + 4 - 2k = 0$ has two distinct real roots. Find the range of k .

Model solution

For a quadratic to have two distinct real roots, its discriminant must be strictly positive. Here $a = 1$, $b = 2k - 1$, and $c = 4 - 2k$.

$$b^2 - 4ac = (2k - 1)^2 - 4(1)(4 - 2k) > 0.$$

$$4k^2 - 4k + 1 - 16 + 8k > 0 \Rightarrow 4k^2 + 4k - 15 > 0.$$

$$(2k + 5)(2k - 3) > 0.$$

A product of two linear factors is positive outside its roots $-5/2$ and $3/2$.

$$k < -\frac{5}{2} \text{ or } k > \frac{3}{2}.$$

(4)

Question 12

Question 12

In right-angled triangle ABC, $AB = 12$ cm and $\angle BAC = \theta$. Point D lies on AC and $BD \perp AC$.



$$\frac{12}{\cos \theta}$$

- (a) Show $AC = 12/\cos \theta$. (b) Write AD in terms of $\cos \theta$. (c) Hence show $CD = (12 - 12 \cos^2 \theta)/\cos \theta$.
 (d) Given $CD = 8\sqrt{3}$ cm, find θ to the nearest degree, fully justifying your answer.

Model solution

(a) In right-angled triangle ABC, AB is adjacent to θ and AC is the hypotenuse, so use cosine.

$$\cos \theta = \frac{AB}{AC} = \frac{12}{AC} \Rightarrow AC = \frac{12}{\cos \theta}.$$

$$(a) AC = \frac{12}{\cos \theta}.$$

(1)

(b) In right-angled triangle ABD, AD is adjacent to the same angle θ , with hypotenuse $AB = 12$.

$$AD = 12 \cos \theta.$$

$$(b) AD = 12 \cos \theta.$$

(1)

(c) Since D lies on AC, $CD = AC - AD$. Substitute the two results above and combine the fractions.

$$CD = \frac{12}{\cos \theta} - 12 \cos \theta = \frac{12 - 12 \cos^2 \theta}{\cos \theta}.$$

$$(c) CD = \frac{12 - 12 \cos^2 \theta}{\cos \theta}.$$

(2)

(d) Substitute the given length into the expression from part (c). Let $c = \cos \theta$, which turns it into a quadratic.

$$8\sqrt{3} = \frac{12 - 12c^2}{c} \Rightarrow 12c^2 + 8\sqrt{3}c - 12 = 0 \Rightarrow 3c^2 + 2\sqrt{3}c - 3 = 0.$$

$$c = \frac{-2\sqrt{3} \pm \sqrt{(2\sqrt{3})^2 - 4(3)(-3)}}{6} = \frac{-2\sqrt{3} \pm 4\sqrt{3}}{6}.$$

This gives $c = \sqrt{3}/3$ or $c = -\sqrt{3}$. The latter is less than -1 , so cannot be a cosine. Thus $\cos \theta = \sqrt{3}/3$.

$$\theta = \cos^{-1}\left(\frac{\sqrt{3}}{3}\right) = 54.7356 \dots^\circ.$$

(d) $\theta = 55^\circ$ (nearest degree).

(5)

Question 13

Question 13

The favourite sports table is

	football	rugby	netball	tennis	Total
Year 12	57	30	36	2	125
Year 13	33	11	19	12	75
Total	90	41	55	14	200

A student is chosen at random. Find $P(\text{Year 12 and netball})$.

Model solution

An "and" event here means one cell of the two-way table: 36 students out of the 200 students in total.

$$P(\text{Year 12 and netball}) = \frac{36}{200} = 0.18.$$

0.18.

(1)

Question 14

Question 14

Events A and B are independent, with $P(A) = 0.25$ and $P(B) = 0.6$. Find $P(A \cap B)$.

Model solution

Independence means the probability of both events is the product of their probabilities.

$$P(A \cap B) = P(A)P(B) = 0.25 \times 0.6 = 0.15.$$

0.15.

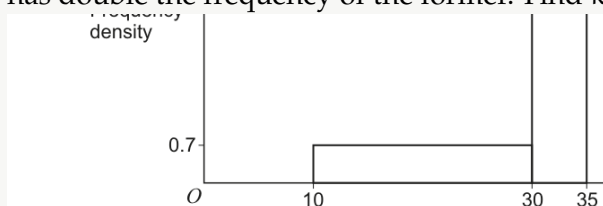
(1)

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Question 15

Question 15

The histogram has frequency density 0.7 for $10 < x \leq 30$, and k for $30 < x \leq 35$. The latter class has double the frequency of the former. Find k .



The frequency density for the class $10 < x \leq 30$ is 0.7

Model solution

Histogram frequency is area, so multiply each frequency density by its class width.

$$\text{Frequency for } 10 < x \leq 30 = 20(0.7) = 14.$$

The next frequency is double this, or 28; its class width is 5.

$$5k = 28 \Rightarrow k = \frac{28}{5}.$$

$$k = \frac{28}{5}.$$

(2)

Question 16

Question 16

For discrete random variable X , the probabilities for $x = 0, 1, 2, 3, 4$ are respectively $0.2 - p$, $0.05 + 3p$, $4p$, $2p$, $2p$. Find p .

Model solution

All probabilities in a probability distribution sum to 1.

$$(0.2 - p) + (0.05 + 3p) + 4p + 2p + 2p = 1.$$

$$0.25 + 10p = 1 \Rightarrow 10p = 0.75 \Rightarrow p = 0.075.$$

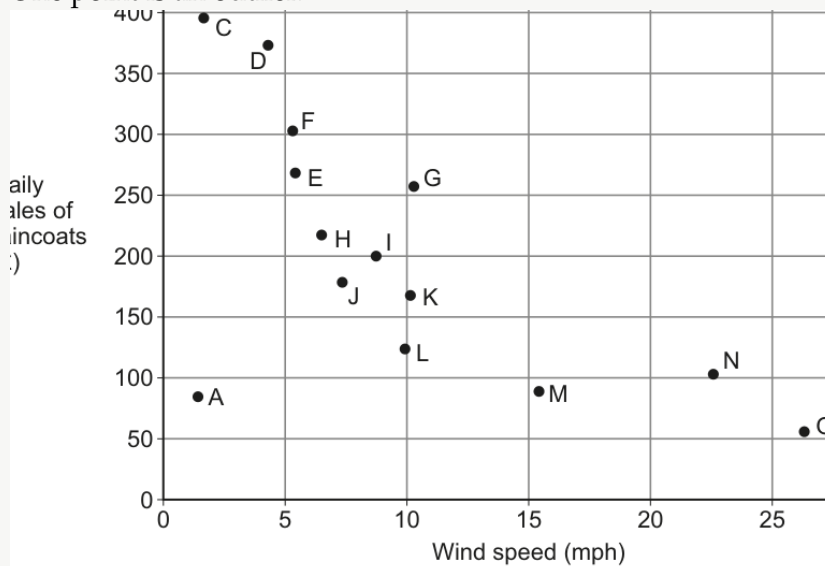
$$p = 0.075.$$

(2)

Question 17

Question 17

The scatter diagram shows average daily wind speed and daily raincoat sales for 15 sampled days. One point is an outlier.



One of the points on the scatter diagram is an outlier.

State the letter from the diagram which corresponds to this outlier.

- (a) State the letter of the outlier. (b) State the effect on the numerical correlation coefficient if it were removed.
 (c) Describe the correlation in context. (d) The owner says the diagram proves windier days cause lower raincoat sales. Comment.

Model solution

(a) Most points follow a downward pattern. Point A is visibly separated from that pattern, so it is the outlier.

(a) A.

(1)

(b) Point A weakens the downward linear pattern. Removing it would make the negative association stronger.

(b) The coefficient would become more negative (decrease).

(1)

(c) Read the overall direction of the cloud, using the variables and their units in context.

(c) There is negative correlation: as wind speed increases, daily sales of raincoats tend to decrease.

(1)

(d) Correlation from an observational scatter diagram does not establish causation; other factors, such as rainfall, could affect raincoat sales.

(d) The claim is not valid: the diagram cannot prove that wind causes the lower sales.

(1)

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Question 18

Question 18

Three percent of supermarket batteries are faulty. A pack contains 12 batteries and the number faulty is modelled by a binomial distribution.

- (a) State one assumption in context. (b) Find the probability that exactly one battery in a pack is faulty.
(c) Ten packs are chosen. Find the probability that at least two packs have exactly one faulty battery.

Model solution

(a) A binomial model requires independent trials with a constant probability of success. One valid contextual assumption is independence.

(a) Whether one battery is faulty is independent of whether any other battery is faulty.

(1)

(b) Let X be the number of faulty batteries in one pack. The given fixed number of batteries and constant fault probability give $X \sim B(12, 0.03)$. Use the binomial probability formula for exactly one success.

$$P(X = 1) = \binom{12}{1} (0.03)(0.97)^{11} = 0.2575 \dots$$

(b) 0.2575 (approximately).

(1)

(c) Let Y count, out of 10 independently chosen packs, those with exactly one faulty battery. From part (b), $Y \sim B(10, 0.2575 \dots)$. "At least two" is most simply found using the complement of 0 or 1.

$$P(Y \geq 2) = 1 - P(Y \leq 1) = 1 - \left[(1 - p)^{10} + \binom{10}{1} p(1 - p)^9 \right], \quad p = 0.2575 \dots$$

$$P(Y \geq 2) = 0.772 \dots$$

(c) 0.772 (approximately).

(2)

Question 19

Question 19

For electric and electric/petrol BMW cars registered in the South-West in 2016, the CO₂ emissions x (g/km) have distribution

x	0	13	45	49	77	78
Frequency	1	2	3	9	2	2

- (a) State the number of electric cars. (b) Find the mean. (c) Find the standard deviation.
 (d) Explain why these cannot validly be compared with the mean and standard deviation for the corresponding 2002 data.

Model solution

(a) A fully electric car has zero CO₂ emissions, so read the frequency at $x = 0$.

(a) 1.

(1)

(b) Use the frequency mean $\sum fx / \sum f$.

$$\sum f = 19, \quad \sum fx = 0(1) + 13(2) + 45(3) + 49(9) + 77(2) + 78(2) = 912.$$

$$\bar{x} = \frac{912}{19} = 48.$$

(b) 48 g/km.

(1)

(c) Use the population standard deviation for this complete distribution, $\sqrt{\sum fx^2 / \sum f - \bar{x}^2}$.

$$s = \sqrt{\frac{1(0)^2 + 2(13)^2 + 3(45)^2 + 9(49)^2 + 2(77)^2 + 2(78)^2}{19} - 48^2} = 20.9 \dots$$

(c) 20.9 g/km (approximately).

(1)

(d) A comparison must be between like populations. The 2002 Large Data Set contains neither electric nor electric/petrol cars.

(d) The 2002 data has no electric or electric/petrol BMW cars, so the populations are not comparable.

(1)

Question 20

Question 20

The probabilities that four independent sets of traffic lights are red are 0.54, 0.6, 0.7, and 0.8, respectively.

(a) Find the probability the driver stops at all four. (b) Find the probability the driver stops at exactly one.

Model solution

(a) Independence means multiply the four red probabilities.

$$0.54 \times 0.6 \times 0.7 \times 0.8 = 0.18144.$$

(a) 0.181 (approximately).

(1)

(b) Exactly one red can occur in four mutually exclusive ways. In each term, use the red probability for that one set and the non-red probabilities for the other three.

$$\begin{aligned} P(\text{exactly one red}) &= 0.54(0.4)(0.3)(0.2) + 0.46(0.6)(0.3)(0.2) \\ &\quad + 0.46(0.4)(0.7)(0.2) + 0.46(0.4)(0.3)(0.8) \\ &= 0.01296 + 0.01656 + 0.02576 + 0.04416 = 0.09944. \end{aligned}$$

(b) 0.0994 (approximately).

(3)

Question 21

Question 21

An organiser claims that 80% of concert attendees had an excellent experience. In a random sample of 60, 42 said their experience was excellent. At the 5% level, investigate whether the population proportion is less than 80%.

Model solution

This is a one-tailed binomial test because each person either did or did not report an excellent experience, and the question asks whether the proportion is less than the claimed value. Let p be the population proportion.

$$H_0 : p = 0.8, \quad H_1 : p < 0.8.$$

Under H_0 , if X is the number in a sample of 60 reporting an excellent experience, then $X \sim B(60, 0.8)$. The observed value is $x = 42$, so the one-tailed p -value is

$$P(X \leq 42) = 0.0427 \dots$$

Since $0.0427 < 0.05$, this outcome is sufficiently unlikely under H_0 , so reject H_0 .

There is sufficient evidence at the 5% level that the proportion of attendees who had

(5)