AS-Level Mathematics

Edexcel

2024 Predicted Paper

Paper 1

Pure Mathematics

Scan me for walkthrough

Name:..

Date:..

2 hours allowed

You may use a calculator

Rough Grade Boundaries

These do not guarantee you the same mark in the exam.

A - 65%
B - 55%
C - 45%
D - 40%
E - 30%

Mark scored	
Total	**100**

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01 In a triangle ABC, side AB has length 24 cm and angle $B = 45^{\circ}$

a) Given that side AC has length 20 cm, find the two possible values for angle C, correct to 1 decimal place.

[3 marks]

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b) Given instead that the area of the triangle is $50\sqrt{2}$ cm^2, find the length of side BC.

[2 marks]

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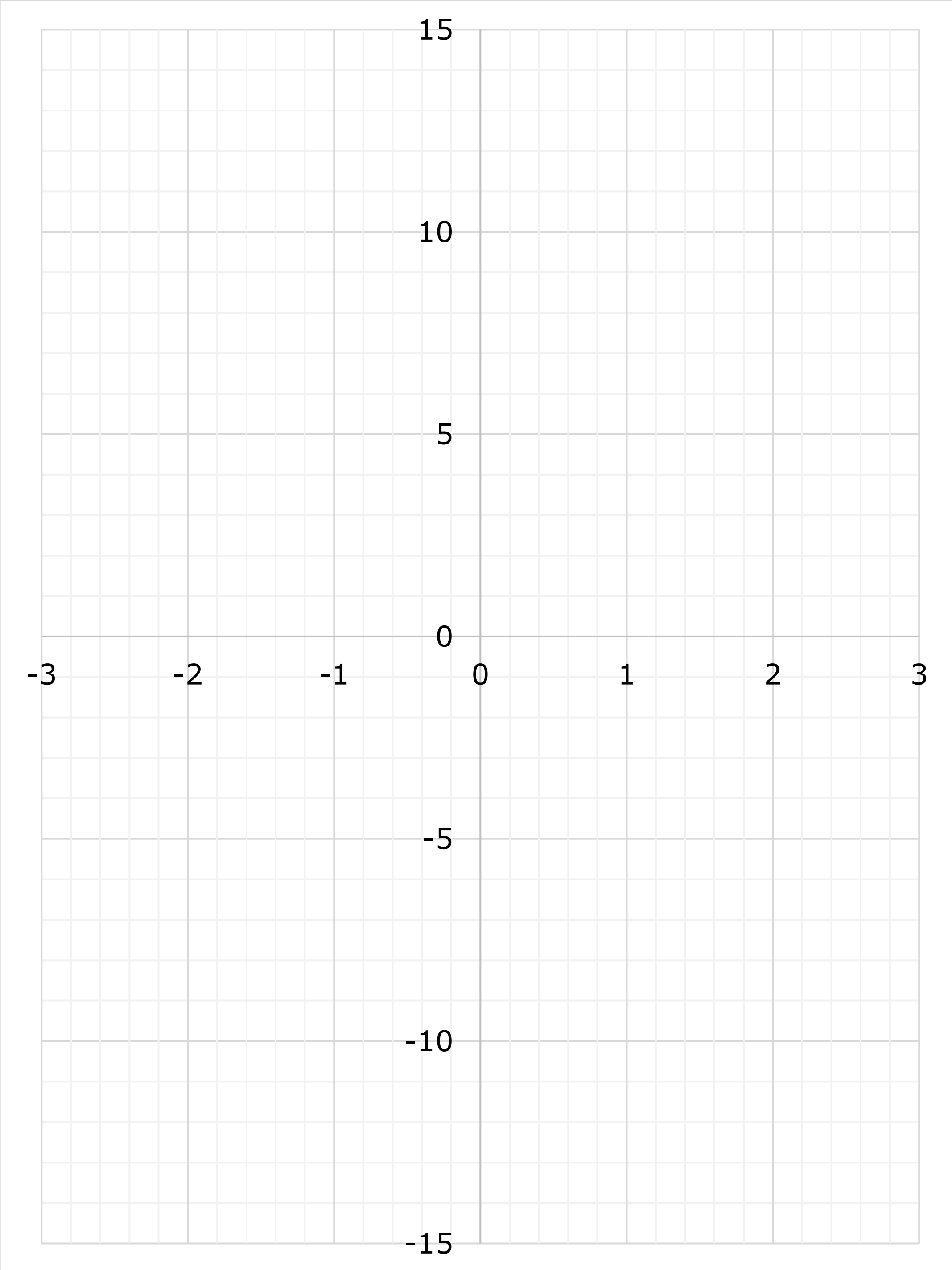
02

a) Sketch the curve $y = 2x^2 - x - 10$

[3 marks]



b) Solve $2x^2 - x - 3 < 0$

[2 marks]

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c) Given that the equation $2x^2 - x - 10 = k$ has no real roots, find the set of possible values of k.

[3 marks]

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03

a) Given that $log_2 a = 4$ state the value of a.

[1 mark]

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b) Solve the equation $log_2 4x - log_2(x - 1) = 6$.

[5 marks]

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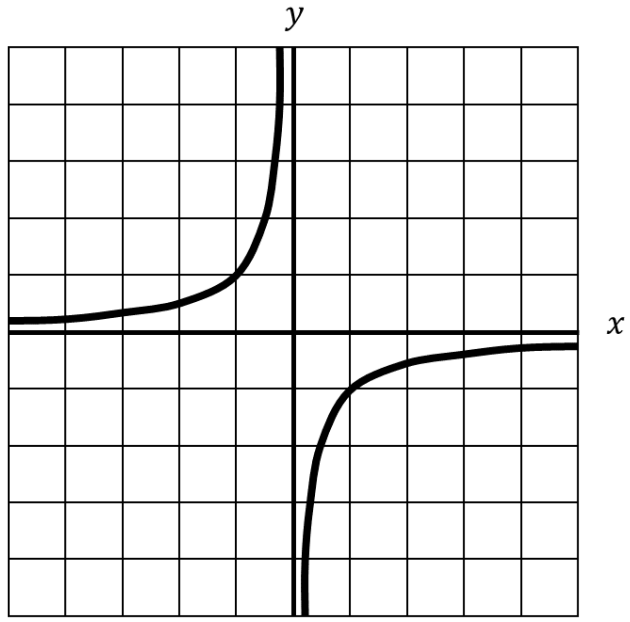
c) Find the exact solutions of the equation:

$$2^{4x} - 6 \times 2^{2x} + 8 = 0$$

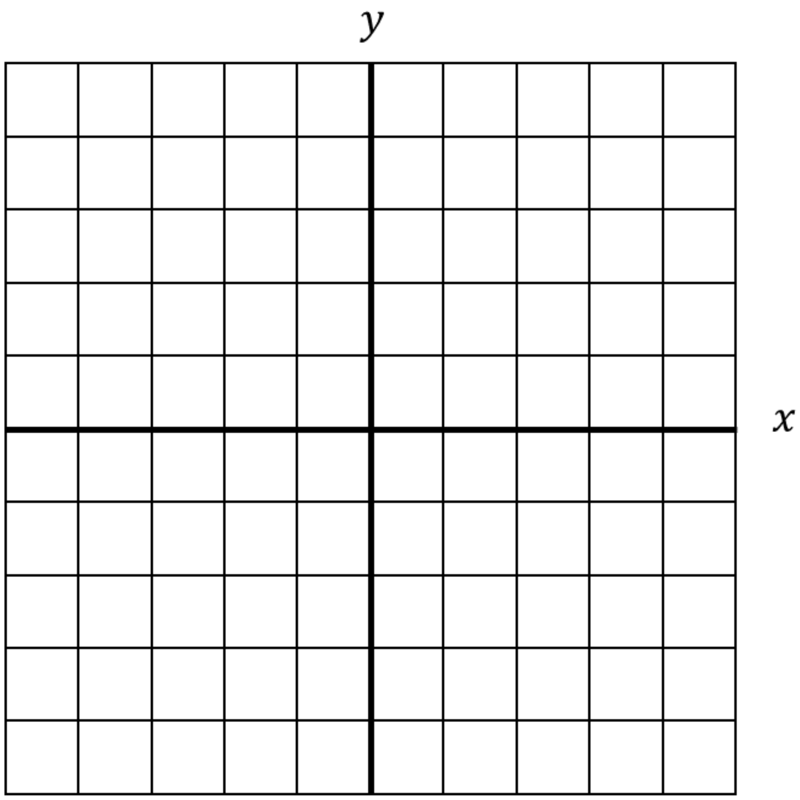
[4 marks]

04 The diagram below shows the graph $y = f(x)$



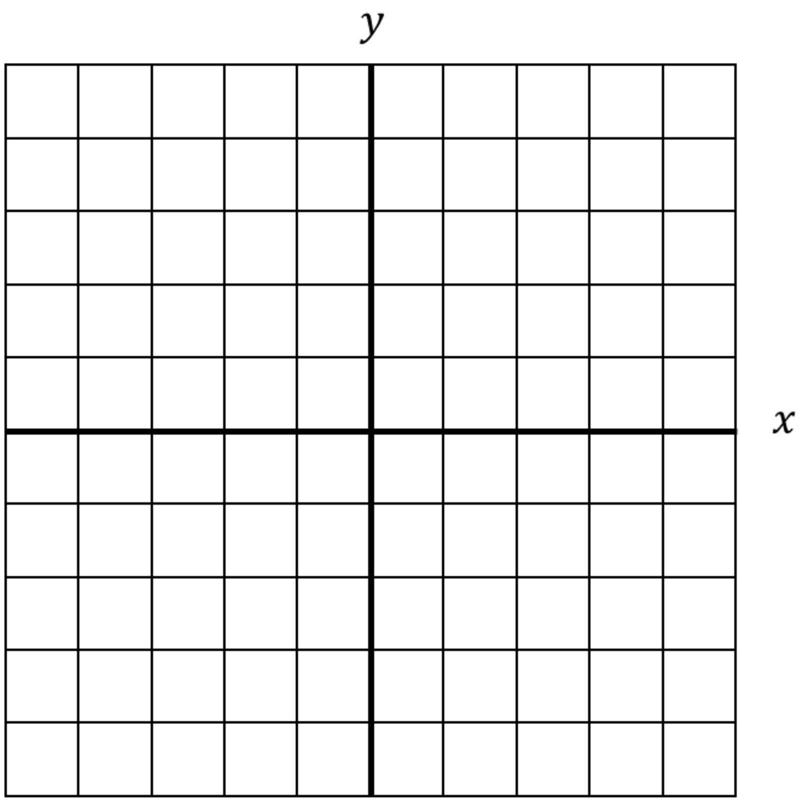
a) On the graph below, sketch the graph of $y = 3 + f(x)$

[2 marks]



b) On the graph below, sketch the graph of $y = f(x - 2)$

[2 marks]



05 Find $\int (10x^{\frac{3}{2}} + 18x^{-4} + 13) dx$

[3 marks]

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06 The annual profit made by a small company selling a unique gift is modelled using the equation:

$$P = -\frac{7}{2}x^2 + 63x + 2000$$

Where P is the profit in thousands of pounds and x is the number of gifts sold (in 100,000s).
The company wants to work out the maximum profit they should expect to make.

a) Find the maximum profit and the number of gifts sold to give this amount of profit.

[4 marks]

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b) If the company wants to make a profit of £100,000, find the minimum number of toys that must be sold.

[3 marks]

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c) Suggest why this model may not be suitable to model the profit from selling these unique gifts.

[1 mark]

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07 Prove, from first principles, that the derivative of $3x^2$ is $6x$.

[4 marks]

08 Find the coordinates, in terms of c, of the minimum point on the curve

$$y = x^2 + 5x + c$$

Fully justify your answer.

[3 marks]

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09

a) A student suggests that the sum of the squares of four consecutive positive integers can always be divided by 3.

For example, $1^2 + 2^2 + 3^2 + 4^2 = 30$

Show by counter example that this suggestion is false.

[2 marks]

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b) Prove that the sum of the squares of four consecutive positive integers can always be divided by 2.

[3 marks]

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10 Solve the equation $6\,cos^2\theta\ +\ sin\theta =\ 4$
Giving all values of θ between 0° and 360°.

[7 marks]

11 Given that:

$$\int_1^k (6\sqrt{x}\,)dx \;=\; 28$$

Find the value of k.

[6 marks]

12 Solve $2x^3 + x^2 - 8x - 4 = 0$

[5 marks]

13 In the binomial expansion of $(1 + x)^n$, where $n \geq 4$, the coefficient of x^4 is $\frac{5}{6}$ of the sum of the coefficients of x^2 and x^3.

Find the value of n.

[5 marks]

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14 A circle with centre $(-3, 5)$ passes through the point $(6, 17)$.

a) Show that circle also passes though the point $(6, -7)$.

[3 marks]

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The tangent to the circle at the point $(6, 17)$ meets the y axis at the point P and the tangent to the circle at the point $(6, -7)$ meets the y axis at the point Q.

b) Show that the distance PQ is 33, explaining your method clearly.

[7 marks]

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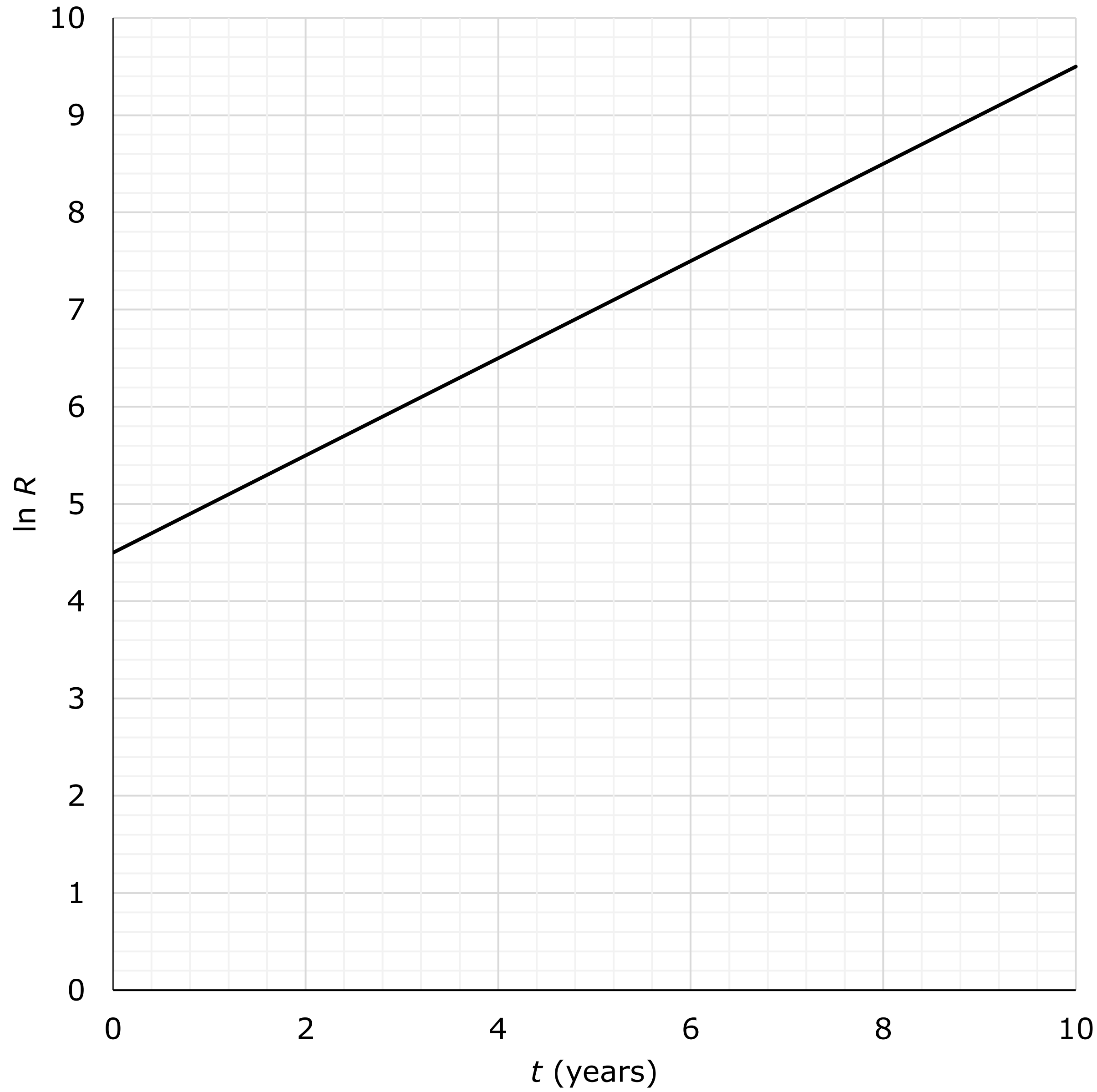
15 The population of rabbits on an island was investigated.
The population was recorded each year.
The graph of ln R against t is shown below, where R is the population of rabbits and t is the time in years from 2020.



A researcher suggested the model:

$$R = Ae^{kt}$$

Where A and k are constants.

a) Find A and k, giving your answers to 3 significant figures.

[5 marks]

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b) Find the population of rabbits on the island on 1st January 2020.

[1 mark]

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c) Predict the population of rabbits on the island on 1st January 2100.

[2 marks]

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d) Suggest a reason why the prediction of the population of rabbits on the island on 1st January 2100 may be incorrect.

[1 mark]

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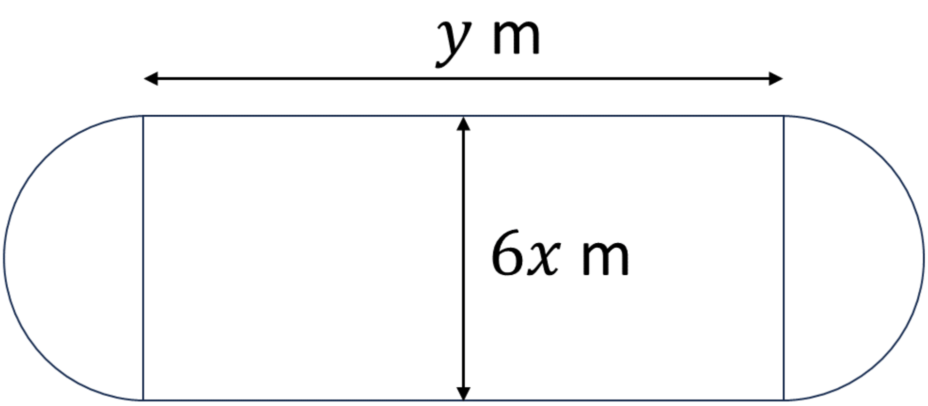
16 A landscape gardener designs a patio.



The patio has a perimeter of P metres.

The area of the patio is equal to 100 m^2.

a) Show that:

$$P = \frac{100}{3x} + 3\pi x$$

[4 marks]

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b) Using calculus, find the minimum perimeter of the patio.
Give your answer to the nearest metre.

[4 marks]

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END OF QUESTIONS

MARKING GUIDANCE

Question	Solution
1 (a)	A1M for using sin rule $\frac{sin\, x}{24} = \frac{sin\, 45}{20}$ A1M for rearranging to find $x = sin^{-1}(\frac{24 sin\, 45}{20})$ A1M for 58.1° and 121.9°
1 (b)	A1M using ½ × *BC* × 24 × sin 45 = $50\sqrt{2}$ A1M for *BC* = $\frac{25}{3}$cm
2 (a)	A1M for correct roots (−2, 0) and (2½, 0) A1M for y-intercept (0, −10) A1M for smooth curve, correctly labelled with minimum in fourth quadrant
2 (b)	A1M for correct factorisation $(2x-3)(2x+1) < 0$ A1M for $-1 < x < \frac{3}{2}$ (allow correct set notation)
2 (c)	A1M for stating that no real roots implies a negative discriminant A1M for substitution into $b^2 - 4ac$ $(-1)^2 - 4(2)(-10-k) = 81 + 8k < 0,$ A1M for $k < -\frac{81}{8}$
3 (a)	A1M for 16
3 (b)	A1M for correct use of laws of logs and A1M for correct equation $log_2(\frac{4x}{x-1}) = 6$ A1M for correct use of substitution and A1M for correct equation $\frac{4x}{x-1} = 64$ A1M for $x = \frac{16}{15}$
3 (c)	A2M for $(2^{2x}-4)(2^{2x}-2)$ A1M for $x = 1$ A1M for $x = 0.5$
4 (a)	A1M for correct curve moved upwards A1M for y = 3 and x = 0 as asymptotes
4 (b)	A1M for correct curve moved right A1M for y = 0 and x = 2 as asymptotes

5	A3M for correct integration (A1M for each term) $$4x^{\frac{5}{2}} - 6x^{-3} + 13x + c$$
6 (a)	A2M for completing the square $$P = -\frac{7}{2}(x-9)^2 + 2283.5$$ A1M for Maximum profit = £2,283,500 A1M for Number of gifts sold = 900,000
6 (b)	A2M for substitution and simplification (allow alternative methods) $$100 = -\frac{7}{2}(x-9)^2 + 2283.5$$ $$(x-9)^2 = 623.857142$$ $$x - 9 = \pm 24.9771324$$ $$x = \pm 24.9771324 + 9$$ A1M for $x = 3397713$
6 (c)	A profit would be made even if no gifts sold. Allow alternative correct arguments.
7	A1M for $\frac{3(x+h)^2 - 3x^2}{h}$ A1M for $\frac{3x^2 + 6xh + 3h^2 - 3x^2}{h}$ A1M for gradient = $\frac{6xh + 3h^2}{h} = 6x + 3h$ A1M for stating that as $h \rightarrow 0$, the gradient is $6x$
8	A1M for differentiating the curve $$\frac{dy}{dx} = 2x + 5$$ A1M for stating that the minimum is $2x + 5 = 0$ and solving to find $x = -2.5$ A1M for substitution to find y $$y = (-2.5)^2 + 5(-2.5) + c$$ $$y = c - 6.25$$
9 (a)	A1M for $3^2 + 4^2 + 5^2 + 6^2 = 86$ A1M for stating that 86 cannot be divided by 3
9 (b)	A1M for $(n)^2 + (n+1)^2 + (n+2)^2 + (n+3)^2$ A1M for $4n^2 + 12n + 14$ A1M for $2(2n^2 + 6n + 7)$ and 2 is a factor therefore it can be divided by 2

10	A2M for using $cos^2\theta = 1 - sin^2\theta$ and substitution to get $$6\,(1 - sin^2\theta) + sin\theta - 4 = 0$$ A1M for correct rearrangement $6\,sin^2\theta - sin\theta - 2 = 0$ A1M for factorising quadratic $(3\,sin\theta - 2)(2\,sin\theta + 1) = 0$ A1M for finding $sin\theta = \frac{2}{3}$ and $sin\theta = -\frac{1}{2}$ A1M for 41.81° and 138.2° A1M for 210° and 330°
11	A1M for correct integration of $6\sqrt{x}$ to $4x^{\frac{3}{2}}$ A1M for stating $\begin{matrix} k \\ 1 \end{matrix}[4x^{\frac{3}{2}}] = 28$ A2M for correct substitution (A1M for each of first two terms) $(4k^{\frac{3}{2}}) - (4 \times 1^{\frac{3}{2}}) = 28$ A1M for $k^{\frac{3}{2}} = 8$ A1M for $k = 4$
12	A1M for substitution into $f(x) = 2x^3 + x^2 - 8x - 4$ A1M for finding a factor using factor theorem $(x + 2)$ or $(x - 2)$ A2M for algebraic long division finding $2x^2 + 5x + 2$ or $2x^2 - 3x - 2$ A1M for full factorisation and solution $$(2x + 1)(x + 2)(x - 2) = 0$$ $$x = -2, \quad x = -\frac{1}{2}, \quad x = 2$$
13	A1M for use of ${}_nC_2$, ${}_nC_3$, ${}_nC_4$ A1M for forming equation $\frac{5}{6}({}_nC_2 + {}_nC_3) = {}_nC_4$ A1M for $\frac{5}{6}(\frac{n!}{(n-2)!2!} + \frac{n!}{(n-3)!3!}) = \frac{n!}{(n-4)!4!}$ $\frac{5}{6}(\frac{n(n-1)}{2} + \frac{n(n-1)(n-2)}{6}) = \frac{n(n-1)(n-2)(n-3)}{24}$ A1M for rearranging to get the quadratic $6n^2 - 50n + 16 = 0$ A1M for solving the quadratic to get $n = 8$
14 (a)	A1M for circle equation $(x+3)^2 + (y-5)^2 = r^2$ A1M for finding the length of $(-3, 5)$ to $(6, 17)$ $$\sqrt{(-3-6)^2 + (5-17)^2} = 15 = r$$ A1M for substitution of x = 6 and y = −7 into circle equation $$(6+3)^2 + (-7-5)^2 = 15^2$$

14 (b)	A1M for finding the gradient of the radius to a tangent $$\frac{-7-5}{6--3} = \frac{-12}{9} = -\frac{4}{3}$$ A1M for finding the gradient of the tangent using the negative reciprocal: $\frac{3}{4}$ A1M for using substitution of coordinate $(6, -7)$ to find the equation of the tangent $y = \frac{3}{4}x - 11\frac{1}{2}$ A1M for finding the gradient of the radius to the other tangent $$\frac{17-5}{6--3} = \frac{12}{9} = \frac{4}{3}$$ A1M for finding the gradient of the tangent using the negative reciprocal: $-\frac{3}{4}$ A2M for using substitution of coordinate $(6, 17)$ to find the equation of the tangent $y = -\frac{3}{4}x + 21\frac{1}{2}$ and $21\frac{1}{2} + 11\frac{1}{2} = 33$
15 (a)	A1M for correctly calculating gradient = 0.500 (allow range of answers 0.450-0.550) A1M for correctly identifying y-intercept = 4.5 A1M for stating k = 0.500 (or their gradient to 3 significant figures) A1M for $A = e^{4.5}$ A1M for A = 90.0 (to 3 significant figures)
15 (b)	A1M for 90
15 (c)	A1M for correct substitution into their equation using constants found in (i). $$R = 90.0 \times e^{0.500 \times 80}$$ A1M for t = 2.12 x 10^{19}
15 (d)	A1M for stating that there is no constraints on the number of rabbits (only so many can fit on the island) or that some factors may change after a few years (such as climate or disease)
16 (a)	A1M for using $9\pi x^2 + 6xy = 100$ from the area A1M for $y = \frac{100}{6x} - \frac{9\pi x}{6}$ or $y = \frac{50}{3x} - \frac{3\pi x}{2}$ A1M for substation of y into $P = 6\pi x + 2\left(\frac{50}{3x} - \frac{3\pi x}{2}\right)$ A1M for rearranging to $P = \frac{100}{3x} + 3\pi x$

16 (b)	A2M for differentiation of P $$\frac{dP}{dx} = -\frac{100}{3x^2} + 3\pi$$ A1M for using $\frac{dP}{dx} = 0$ and for making x the subject $$x = \sqrt{\frac{100}{9\pi}} = 1.880631945...$$ A1M for substitution of x into perimeter formula to find 35m
Total	**100**