



Mark Scheme (Results)

Mock Set 1

Pearson Edexcel GCE
In AS Mathematics (8MA0) Paper 01

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General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

Question	Scheme	Marks	AOs
1.	$\int \frac{2x^3 + 3}{x^2} dx = \int 2x + 3x^{-2} dx = px^2 + qx^{-1}$	M1	1.1b
	$= \frac{2x^2}{2} + \frac{3x^{-1}}{-1} (+c)$	A1	1.1b
	$= x^2 - 3x^{-1} + c$	A1 A1	1.1b 1.1b
		(4)	
(4 marks)			
Notes:			

M1: Complete attempt to integrate $\frac{2x^3 + 3}{x^2}$

Look for a sum of **two terms** with one having a correct index following integration

Score for either $px^2 + \dots$ or $\dots + qx^{-1}$.

Condone unprocessed terms for this mark. E.g px^{1+1} or qx^{-2+1}

A1: One term correct which may be unsimplified. So either $\frac{2x^2}{2}$ or $\frac{3x^{-1}}{-1}$ would be acceptable.

Allow in a list

A1: Two terms correct of x^2 , $-3x^{-1}$ and $+c$ simplified. Allow as a list

A1: $x^2 - 3x^{-1} + c$ or exact simplified equivalent on one line with no incorrect notation.

Eg. $\int x^2 - 3x^{-1} + c$ is A0

Question	Scheme	Marks	AOs
2	Attempts to use the correct formula $30 = \frac{1}{2} \times 12 \times 8 \sin(BAC)$	M1	1.1a
	$\sin(BAC) = \frac{5}{8}$	A1	1.1b
	angle $BAC = \arcsin\left(\frac{5}{8}\right) = \dots$	M1	1.1b
	38.7° and 141.3°	A1	1.1b
		(4)	
(4 marks)			
Notes:			

M1: Attempts to use the formula $\text{Area} = \frac{1}{2}ab\sin C$. Allow use of say θ for BAC

A1: Achieves $\sin(BAC) = \frac{5}{8}$ o.e. such as 0.625 Condone use of θ for BAC for example

M1: Attempts arcsin and proceeds to one angle to at least the nearest degree for their $\sin("BAC") = k$

Allow for an attempt leading to at least one radian answer to 1 decimal place. FYI 0.675 rads

A1: Achieves awrt 38.7° and awrt 141.3°

Condone use of $\theta = 38.7^\circ$ and 141.3°

.....
...

Methods exist in which the vertical height h of the triangle can be found.

E.g $\text{Area} = \frac{1}{2}bh \Rightarrow 30 = \frac{1}{2} \times 12 \times h \Rightarrow h = 5$

The M mark is not achieved until an attempt for $\sin("BAC")$ has been made

Question	Scheme	Marks	AOs
3	$2^{5k+3} = 3^{550} \Rightarrow (5k+3)\log 2 = 550\log 3$	M1	1.1b
	$\Rightarrow (5k+3) = \frac{550\log 3}{\log 2} \Rightarrow k = \dots$	dM1	2.1
	$\Rightarrow k = 173.7$	A1	1.1b
		(3)	
(3 marks)			
Notes:			

M1: Takes logs of both sides and applies the power law to both sides.

E.g. $2^{5k+3} = 3^{550} \Rightarrow (5k+3) = 550\log_2 3$. Condone a missing bracket.

The same base log must be applied to both sides, usually $\log = \log_{10}$, $\log_2$ or $\log_3$

dM1: Full and complete method to find the value of k .

The bracket must be present or working sufficient to imply its presence.

Correct **order** of operations to find k . So look for $(5k+3) = \frac{550\log 3}{\log 2} \Rightarrow 5k = \frac{550\log 3}{\log 2} \mp 3 \Rightarrow k = \dots$

A1: Awrt 173.7

Note the demand in the question. Trial and error and other such attempts are unlikely to score marks.

Question	Scheme	Marks	AOs
4	$\left(k + \frac{1}{2}x\right)^9$		
	Attempts correct coefficient ${}^9C_6 k^6 \left(\frac{1}{2}\right)^3$ or term ${}^9C_6 k^6 \left(\frac{1}{2}x\right)^3$	M1	1.1b
	Sets ${}^9C_6 k^6 \left(\frac{1}{2}\right)^3 = 70 \Rightarrow k =$ via the sixth root	dM1	2.1
	$k = 1.37$ only	A1	1.1b
		(3)	
(3 marks)			
Notes:			

M1: Attempts the correct term or coefficient. Condone a missing bracket around the $\left(\frac{1}{2}x\right)$

Look for a minimum of

- a correct binomial coefficient in any form
- k^6
- $\left(\frac{1}{2}\right)^3$ or $\left(\frac{1}{2}x\right)^3$ but condone $\frac{1}{2}x^3$

dM1: Full and complete method to find a value for k via the sixth root.

A1: CSO $k = 1.37$ only. Note that this is not awrt

Question	Scheme	Marks	AOs
5 (a)	$2 \times 4^x + 2^{x+3} = 1 + 2^{x-2}$		
	Uses an index law and states or implies any of $4^x = p^2, \quad 2^{x+3} = 8p \quad \text{or} \quad 2^{x-2} = \frac{p}{4}$	B1	1.1b
	Writes the given equation in terms of p $2 \times 4^x + 2^{x+3} = 1 + 2^{x-2} \Rightarrow 2p^2 + 2^3 \times p = 1 + \frac{p}{2^2}$	M1	1.1b
	Proceeds to $8p^2 + 31p - 4 = 0$ via $2p^2 + 8p = 1 + \frac{p}{4} \quad *$	A1*	2.1
		(3)	
(b)	$8p^2 + 31p - 4 = 0 \Rightarrow (8p - 1)(p + 4) = 0$	M1	1.1b
	Sets $2^x = \frac{1}{8}, \cancel{4} \Rightarrow x = \dots$	M1	1.1b
	$x = -3$ only cso	A1	2.3
		(3)	
(6 marks)			
Notes:			

(a)

B1: Uses an index law and states or implies any of $4^x = p^2, \quad 2^{x+3} = 8p \quad \text{or} \quad 2^{x-2} = \frac{p}{4}$

M1: Attempts to write the given equation in terms of p

$$2 \times 4^x + 2^{x+3} = 1 + 2^{x-2} \Rightarrow 2p^2 + 2^3 \times p = 1 + \frac{p}{2^2}$$

Condone slips on signs or the 2^3 if there was an attempt to process.

$$2 \times 4^x + 2^{x+3} = 1 + 2^{x-2} \Rightarrow 2p^2 + 6p = 1 + \frac{p}{2^2} \text{ would be fine for the M1}$$

A1*: Proceeds to the given answer of $8p^2 + 31p - 4 = 0$ with no errors or omissions.

An intermediate line of $2p^2 + 8p = 1 + \frac{p}{4}$ o.e. must be seen.

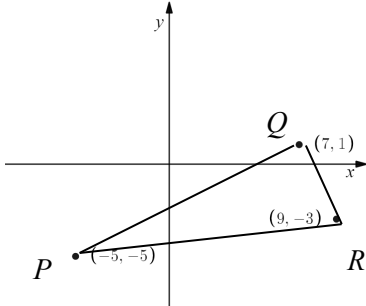
(b)

M1: Valid non calculator attempt at solving $8p^2 + 31p - 4 = 0$

M1: Valid non calculator attempt at solving an equation of the form $2^x = k, \quad k > 0$

Allow for this mark $2^x = k \Rightarrow x = \log_2 k$

A1: CSO $x = -3$ only. There should not be any solutions arising from $2^x = -4$

Question	Scheme	Marks	AOs
6.			
6(a)	Attempts gradient $PQ = \frac{1-5}{7-(-5)}$ AND gradient $QR = \frac{1-3}{7-9}$	M1	3.1a
	Attempts gradient $PQ \times$ gradient $QR = \frac{1}{2} \times \frac{-2}{1}$	dM1	1.1b
	States gradient $PQ \times$ gradient $QR = -1$, hence angle $PQR = 90^\circ$ *	A1*	2.4
		(3)	
(b)	Deduces that centre of circle is $(2, -4)$	B1	2.2a
	Correct method for finding radius, radius ² , diameter or diameter ² E.g. $\sqrt{(9-5)^2 + (-3-5)^2} = \sqrt{200}$	M1	1.1b
	Correct equation for C E.g. $(x-2)^2 + (y+4)^2 = 50$	A1	1.1b
		(3)	
(6 marks)			
Notes:			

(a)

M1: Selects a valid method that will enable the problem to be solved. See scheme.

It must be an attempt at $\frac{\delta y}{\delta x}$ but condone slips

Also allow an attempt at finding the three lengths PQ , QR and PR or the lengths²

Look for "a difference in coordinates" and "squaring" but condone slips

dM1: Correct attempt at proof. Attempts to multiply the gradients or similar

Also allow an attempt at finding $PQ^2 + QR^2$ and comparing it to PR^2

A1*: Full explanation with correct reason. All calculations must be correct. Condone a ✓ for conclusion

(b)

B1: Deduces that PR is the diameter of the circle thus giving the midpoint $(2, -4)$ as the centre of C .

May be implied from equation of circle

M1: Correct method for finding radius, radius², diameter or diameter²

E.g. Finds the distance² between their $(2, -4)$ and one of the given points

A1: $(x-2)^2 + (y+4)^2 = 50$ o.e.

Question	Scheme	Marks	AOs
7 (a)	(i) States 10 or $(10,0)$	B1	2.2a
	(ii) Uses $(4,24)$ in an equation of the form $y = k(x+2)(x-10) \Rightarrow k = \dots$	M1	3.1a
	$f(x) = -\frac{2}{3}(x+2)(x-10)$	A1	1.1b
		(3)	
(b)	Attempts gradient of $l = \frac{0-12}{-2-4} = (-2)$	M1	1.1b
	Correct method for equation of l $y+12 = -2(x-4)$	M1	1.1b
	$y = -2x - 4$	A1	1.1b
		(3)	
(c)	Identifies $x = 4$ as one of the boundaries	B1	1.1b
	Achieves two of the three inequalities defining R . $y > "-2x-4"$, $y < "-\frac{2}{3}(x+2)(x-10)"$, $x > 4$	M1	1.1b
	$\left\{ (x,y) : -2x-4 < y < -\frac{2}{3}(x+2)(x-10), x > 4 \right\}$ o.e	A1ft	2.1
		(3)	
(9 marks)			
Notes:			

(a)(i)

B1: Deduces the point where C cuts the positive x - axis. Allow 10 or $(10,0)$

(a)(ii)

M1: For a full attempt to find $f(x)$.

Score for using $(4,24)$ in an equation of the form $y = k(x+2)(x-10) \Rightarrow k = \dots$

Score for using $(-2,0)$ or $(10,0)$ in an equation of the form $y = 24 - k(x-4)^2 \Rightarrow k = \dots$

Score for using $(-2,0), (4,24)$ and $\frac{dy}{dx}\bigg|_{x=4} = 0$ in an equation of the form $y = ax^2 + bx + c \Rightarrow a, b, c = \dots$

A1: $f(x) = -\frac{2}{3}(x+2)(x-10)$ or exact equivalent. E.g $y = 24 - \frac{2}{3}(x-4)^2$

(b)

M1: Attempts gradient of $l = \frac{0-12}{-2-4} = (-2)$

M1: Correct method for equation of l $y+12 = "-2"(x-4)$

A1: $y = -2x - 4$

(c)

B1: Identifies $x = 4$ as one of the boundaries. You may not see an = so allow $x \dots 4$

M1: Achieves two of the three inequalities defining R . Allow consistent use of $\leq$ for $<$ and $\geq$ for $>$

A1ft: Correct use of inequalities to fully define R . Boundary lines may be included so allow

E.g $y \leq -\frac{2}{3}(x+2)(x-10)$, $y \geq -2x-4$, $4 \leq x \leq 13$

Question	Scheme	Marks	AOs
8	$g'(x) = 6x^2 + 5x + k \Rightarrow g(x) = 2x^3 + \frac{5}{2}x^2 + kx + c$	M1 A1	1.1b 1.1b
	Sets "c" = -10	B1	1.1b
	Sets $g(-4) = 0 \Rightarrow 2 \times -64 + \frac{5}{2} \times 16 - 4k - 10 = 0$	M1	3.1a
	Solves linear equation in k E.g. $2 \times -64 + \frac{5}{2} \times 16 - 4k - 10 = 0 \Rightarrow k = \dots$	M1	1.1b
	$g(x) = 2x^3 + \frac{5}{2}x^2 - \frac{49}{2}x - 10$	A1	2.1
		(6)	
(6 marks)			
Notes:			

M1: Integrates $g'(x)$ with **two** correct indices. There is no requirement for the $+c$

Condone unprocessed terms for this mark. E.g. px^{2+1}

A1: Fully correct integration. It may be unsimplified but the $+c$ must be seen (or implied by the -10)

B1: Sets the constant term = -10

M1: Dependent upon having done some correct integration (seen on at least one term).

It is for the setting up a linear equation in k by using $g(-4) = 0$

M1: Solves the linear equation in k .

It is dependent upon having attempted some integration and used $g(\pm 4) = 0$

A1: Accurate and careful work leading to $g(x) = 2x^3 + \frac{5}{2}x^2 - \frac{49}{2}x - 10$ or exact simplified equivalent

.....
It is possible to use the information about the factor first.

M1A1: Deduces $g(x) = (x+4)(Ax^2 + Bx + C)$

B1: $g(x) = Ax^3 + (4A+B)x^2 + (4B+C)x + 4C$ and deduces $C = -\frac{5}{2}$ (as intercept is -10)

M1: Differentiates $g'(x) = 3Ax^2 + 2(4A+B)x + (4B+C)$ and compares to $g'(x) = 6x^2 + 5x + k \Rightarrow A = \dots$

M1: Full method to get A , B and C

A1: Accurate and careful work leading to $g(x) = (x+4)\left(2x^2 - \frac{11}{2}x - \frac{5}{2}\right)$

.....

Question	Scheme		Marks	AOs
9 (a)	$\log_{10} y = \frac{2}{3} \log_{10} x - 1$ $\log_{10} y = \log_{10} x^{\frac{2}{3}} - 1$	$y = p x^q$ $\log_{10} y = \log_{10} p + \log_{10} x^q$	M1	1.1b
	$\log_{10} y = \log_{10} x^{\frac{2}{3}} - \log_{10} 10$	$\log_{10} y = \log_{10} p + q \log_{10} x$	A1	2.5
	$\log_{10} y = \log_{10} \frac{x^{\frac{2}{3}}}{10}$	States $\log_{10} p = -1$ and $q = \frac{2}{3}$	M1	1.1b
	$y = \frac{1}{10} x^{\frac{2}{3}}$		A1	2.1
			(4)	
(b)	Attempts $y = \frac{1}{10} \times 100^{\frac{2}{3}}$ OR attempts $\log_{10} y = \frac{2}{3} \log_{10} 100 - 1 \Rightarrow$		M1	1.1b
	$y = 10^{\frac{1}{3}}$		A1	1.1b
			(2)	
(6 marks)				
Notes:				

(a)

M1: For the application of one correct rule

Starting from $\log_{10} y = \frac{2}{3} \log_{10} x - 1$ look for

$$\frac{2}{3} \log_{10} x \rightarrow \log_{10} x^{\frac{2}{3}}, \quad -1 \rightarrow -\log_{10} 10 \text{ or } y = 10^{\frac{2}{3} \log_{10} x - 1} \text{ o.e.}$$

Starting from $y = p x^q$ look for work proceeding to $\log_{10} y = \log_{10} p + \log_{10} x^q$

This may be implied by one correct equation for either p or q

A1: Correct intermediate equation showing two correct applications of log rules

This may be implied by one correct value for either p or q

M1: Full method showing how $\log_{10} y = \frac{2}{3} \log_{10} x - 1$ can be written in the form $\log_{10} y = \log_{10} (p x^q)$

Or else how $y = p x^q$ can be written in the form $\log_{10} y = \frac{2}{3} \log_{10} x - 1$ with both constants p and q compared correctly.

This may be implied by correct equations for both p and q

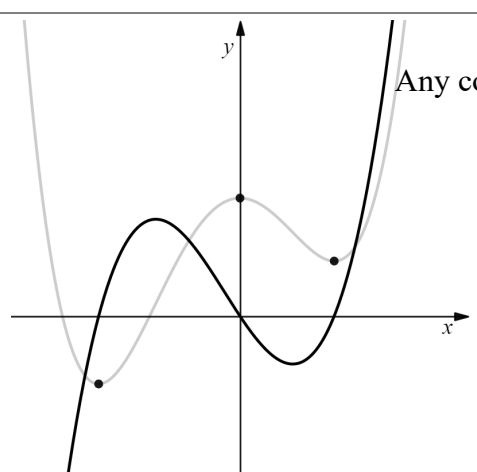
A1: Full and complete proof with no errors leading to correct equation $y = \frac{1}{10} x^{\frac{2}{3}}$

Note that it is possible to get correct values for p and q but not score all 4 marks due to the "proof" element here

(b)

M1: Substitutes $x = 100$ into either equation with an attempt to find y or $\log_{10} y$

A1: Presents the solution in the required form $y = 10^{\frac{1}{3}}$

Question	Scheme	Marks	AOs	
10 (a)	States either $x < -3$ or $0 < x < 2$	M1	1.1b	
	States $\{x \in \mathbb{R} : x < -3\} \cup \{x \in \mathbb{R} : 0 < x < 2\}$ oe using set notation	A1	2.5	
		(2)		
(b)	Point Q as $f''(x) < 0$ at maximum point	B1	2.4	
		(1)		
(c)	States either $k = 10$ or $k = 5$	B1	1.1b	
	States both $k = 10$ and $k = 5$	B1	3.1a	
		(2)		
(d)		Any correct point where $f'(x) = 0$	B1	1.1b
		Correct shape	M1	1.1b
		Correct shape and position	A1	1.1b
		(3)		
(8 marks)				
Notes:				

(a)

M1: States either region. Condone $\leq$ for $<$

A1: States given answer but condone $\{x \in \mathbb{R} : x < -3 \cup 0 < x < 2\}$ oe using set notation.

Allow $\{x \in \mathbb{R} : x < -3 \text{ or } 0 < x < 2\}$ or even $\{x < -3 \cup 0 < x < 2\}$ but not $\{x < -3 \cap 0 < x < 2\}$ or not $\{x < -3, 0 < x < 2\}$

(b)

B1: Gives valid reason. E.g $f''(x) < 0$ at maximum point

(c)

B1: Determines that $y = k$ crosses $y = f(x)$ 3 times only when $k = 10$ **or** when $k = 5$

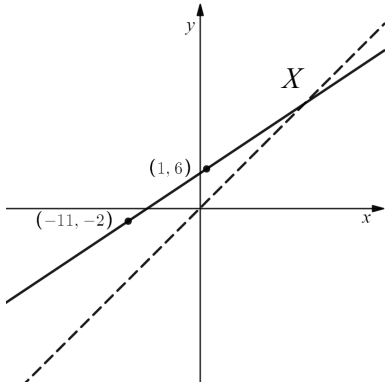
B1: Determines that $y = k$ crosses $y = f(x)$ 3 times only when $k = 10$ **and** when $k = 5$ only

(d)

B1: Graph crosses x -axis at any x value corresponding to point P , Q or R

M1: Correct shape

A1: Fully correct

Question	Scheme	Marks	AOs
11.			
(a)	Finds distance $\sqrt{12^2 + 8^2}$	M1	1.1b
	Full attempt to find speed = $\frac{\sqrt{12^2 + 8^2}}{1.5}$	dM1	1.1b
	Speed = $\frac{8}{3}\sqrt{13}$ (kmh ⁻¹)	A1	1.1b
		(3)	
(b)	Deduces that X has position vector $(\alpha\mathbf{i} + \alpha\mathbf{j})$	B1	2.2a
	Uses the fact that the points lie in a straight line E.g. $(\alpha + 11)\mathbf{i} + (\alpha + 2)\mathbf{j} = k \times \{12\mathbf{i} + 8\mathbf{j}\}$	M1	3.1b
	Complete method to find position of X. $(\alpha + 11) = 12k, (\alpha + 2) = 8k \Rightarrow \frac{\alpha + 11}{12} = \frac{\alpha + 2}{8} \Rightarrow \alpha = \dots$	M1	2.1
	$\alpha = 16 \Rightarrow \overrightarrow{OX} = 16\mathbf{i} + 16\mathbf{j}$	A1	1.1b
		(4)	
(7 marks)			
Notes:			

(a)

M1: Attempts to find the distance (or distance²) travelled. Must be using a difference in coordinates

dM1: Complete attempt to find the speed in kmh⁻¹

A1: $\frac{8}{3}\sqrt{13}$ (kmh⁻¹).

(b)

B1: Deduces that X has position vector $(\alpha\mathbf{i} + \alpha\mathbf{j})$ or lies on the line $y = x$

M1: Uses the fact that the points lie in a straight line.

See scheme or attempts to find the equation of the straight line through $(-11, -2)$ and $(1, 6)$

M1: Complete method to find position of X. See scheme.

Alternatively finds the simultaneous solution of their straight line $\left(y = \frac{2}{3}x + \frac{16}{3}\right)$ with the line $y = x$

A1: $\alpha = 16 \Rightarrow \overrightarrow{OX} = 16\mathbf{i} + 16\mathbf{j}$

Question	Scheme	Marks	AOs
12 (i)	Shows that statement is not true by use of a counter example E.g When $n = 5$, $n^2 - n + 5 = 25$ which is not a prime number	B1	2.4
		(1)	
(ii)	States $\tan \theta = \frac{\sin \theta}{\cos \theta}$	B1	1.2
	$\tan \theta + \frac{1}{\tan \theta} = \frac{\sin \theta}{\cos \theta} + \frac{\cos \theta}{\sin \theta} = \frac{\dots}{\sin \theta \cos \theta}$	M1	1.1b
	$= \frac{\sin^2 \theta + \cos^2 \theta}{\sin \theta \cos \theta} = \frac{1}{\sin \theta \cos \theta} *$	A1*	2.1
		(3)	
(4 marks)			
Notes:			

(i)

B1: Shows that statement is not true by use of a counter example.

A value of n must be stated or implied, the value of $n^2 - n + 5$ must be found and there must be a conclusion.

(ii)

B1: States $\tan \theta = \frac{\sin \theta}{\cos \theta}$ or $\frac{1}{\tan \theta} = \frac{\cos \theta}{\sin \theta}$

M1: Writes $\tan \theta + \frac{1}{\tan \theta}$ as $\frac{\sin \theta}{\cos \theta} + \frac{\cos \theta}{\sin \theta}$ and attempts to combine as a single fraction.

A1*: Completes proof using $\sin^2 \theta + \cos^2 \theta = 1$ with no errors or omissions.

An omission is $\tan = \frac{\sin}{\cos}$

Question	Scheme	Marks	AOs
13 (a)	Substitutes $t = 8 \Rightarrow N = 65 - 3e^{0.8} = (58.32)$	M1	3.4
	Reduction in level of nitrate in first 8 hours = $62 - 58.32$	dM1	3.1b
	$= 3.68$ (ppm)	A1	1.1b
		(3)	
(b)	Substitutes $N = 20 \Rightarrow 20 = 65 - 3e^{0.1t} \Rightarrow 3e^{0.1t} = 45$	M1	3.4
	Correct use of ln's $\Rightarrow 0.1t = \ln(15) \Rightarrow t = \dots$	dM1	1.1b
	$t =$ awrt 27.1 hours	A1	1.1b
		(3)	
(c)	Any valid limitation e.g. - If it rains then the concentration will be reduced naturally - The treatment might not be uniform throughout the pond so the fish may not be safe in some areas of the pond even after 27.1 hours - When $t > 30.76$ the concentration becomes negative which cannot happen - The model predicts negative concentration levels for certain values of t. E.g. $t = 40 \Rightarrow N \approx -99$ ppm	B1	3.5b
		(1)	
(7 marks)			
Notes:			

(a)

M1: Substitutes $t = 8 \Rightarrow N = 65 - 3e^{0.8} = (58.3)$

dM1: Attempts $N_{t=8} - N_{t=0}$ but accept $N_{t=0} - N_{t=8}$

A1: Awrt 3.68 (ppm)

(b)

M1: Substitutes $N = 20$ and proceeds to a form $Pe^{0.1t} = Q$

dM1: Uses correct ln work and proceeds to a value for t .

A1: For awrt 27.1 (hours)

(c)

B1: For stating any valid limitation of the model

Solutions in (b) via trial and improvement or other numerical methods.

Any correct answer following a solution not involving lns can be awarded SC 100

E.g. $N = 20 \Rightarrow 20 = 65 - 3e^{0.1t} \Rightarrow 3e^{0.1t} = 45 \Rightarrow t = 27.1$

Question	Scheme	Marks	AOs
14 (a)	$x > -4$	B1	1.1b
		(1)	
(b)	$(x+4)(2x^2+x+7)=2x^3+9x^2+11x+28$	M1	1.1b
		A1	1.1b
		(2)	
(c)	Deduces that equation of l is $y = kx + 28$	B1ft	1.1b
	Sets $2x^3 + 9x^2 + 11x + 28 = kx + 28$ and proceeds to quadratic eqn.	M1	3.1a
	$2x^2 + 9x + (11 - k) = 0$	A1	1.1b
	Uses $b^2 - 4ac = 0 \Rightarrow 81 - 8(11 - k) = 0$	M1	2.1
	$k = \frac{7}{8}$	A1	1.1b
		(5)	
(8 marks)			
Notes:			

(a)

B1: As scheme. Allow in words

(b)

M1: For an attempt to expand.

Award for a cubic with the "first term" $2x^3$, constant term 28 and some intermediate term(s)

A1: Fully correct (any order) but must be simplified

(c)

B1ft: Deduces that l has equation $y = kx + 28$ following through on their "28"

M1: Sets their $2x^3 + 9x^2 + 11x + 28 = kx + 28$ and proceeds to quadratic eqn.

They may just take out a factor of x which is acceptable

A1: Correct quadratic $2x^2 + 9x + (11 - k) = 0$

M1: For the key step in realising that it is a tangent when $b^2 - 4ac = 0$ and uses it to forming a linear equation in k .

A1: $k = \frac{7}{8}$ o.e.

Question	Scheme	Marks	AOs
15 (a)	$y = \frac{3x}{2} + 32x^{-\frac{3}{2}} \Rightarrow \frac{dy}{dx} = \frac{3}{2} - 48x^{-\frac{5}{2}}$	M1 A1	1.1b 1.1b
	Substitute $x = 4 \Rightarrow \frac{dy}{dx} = \frac{3}{2} - 48 \times 4^{-\frac{5}{2}}$	M1	1.1b
	$\frac{dy}{dx} = \frac{3}{2} - 48 \times \frac{1}{32} = 0 \Rightarrow$ stationary point at $x = 4$ *	A1*	2.1
		(4)	
(b)	$\int \frac{3x}{2} + 32x^{-\frac{3}{2}} dx = \frac{3x^2}{4} - 64x^{-\frac{1}{2}}$	M1 A1	1.1b 1.1b
	States or uses $y = 10$ as the equation for l	B1	1.1b
	Area $R = \left[\frac{3x^2}{4} - 64x^{-\frac{1}{2}} \right]_4^8 - 4 \times y_{x=4}$	dM1	3.1a
	$= 28 - 16\sqrt{2}$	A1	1.1b
		(5)	
(9 marks)			
Notes:			

(a)

M1: Attempts to differentiate. Look for either $\frac{3x}{2} \rightarrow \frac{3}{2}$ or $x^{-\frac{3}{2}} \rightarrow x^{-\frac{5}{2}}$

Condone unprocessed terms for this mark

A1: Correct differentiation. This may be left unsimplified

M1: Either substitutes $x = 4$ into their $\frac{dy}{dx}$ and finds its value

Or alternatively attempts to solve $\frac{dy}{dx} = 0$

A1*: Complete proof showing that the stationary point is at $x = 4$

This requires (1) correct differentiation (2) correct calculations shown (see scheme) (3) reason given

(b)

M1: Attempts to integrate. Look for one correct index (which may be left unprocessed)

If they attempt $\int (y_1 - y_2) dx$ where $y_2 = "10"$ just consider $\int y_1 dx$

A1: Correct integration which may be left unsimplified. No requirement for $+ c$

B1: States or uses $y = 10$ as the equation for l . This is implied by sight of 4×10 in area calculation

dM1: Full method to find area for R .

See scheme but may also be scored for $\left[\frac{3x^2}{4} - 64x^{\frac{1}{2}} - 10x \right]_4^8$

A1: $28 - 16\sqrt{2}$

Question	Scheme	Marks	AOs
16 (a)	$(30t - 70) = 0 \Rightarrow t = \dots$	M1	3.1a
	Time is 02:20	A1	3.2a
		(2)	
(b)	(i) $2 = 0.8 + k \Rightarrow k =$	M1	3.1a
	$H = 0.8 + 1.2 \cos(30t - 70)^\circ$	A1	3.3
	(ii) -0.4 m or alternative such as 40 cm below the level of the path	B1 ft	3.4
		(3)	
(c)	$-0.1 = 0.8 + 1.2 \cos(30t - 70)^\circ \Rightarrow \cos(30t - 70)^\circ = \beta$	M1	3.4
	$(30t - 70)^\circ = \arccos \beta \Rightarrow t = \dots$	dM1	1.1b
	$t = \text{awrt } 6.95$ or $t = \text{awrt } 9.71$	A1	1.1b
	Correct method to find a second value for t for their $\cos(30t - 70)^\circ = \beta$	ddM1	2.1
	Safe to cross between 06: 57(58) and 09:42(43)	A1	3.2a
		(5)	
(10 marks)			
Notes:			

(a)

M1: Uses the key fact that the max value of cosine occurs at 0° and solves $(30t - 70) = 0$

Condone for this mark an attempt at solving $(30t - 70) = 360$

A1: Converts the answer $t = \frac{7}{3}$ into a time of day.

Accept 02:20, 2:20 am or 2hours 20 mins after midnight. Accept any of these for both marks

(b)(i)

M1: Uses the fact that $\cos(30t - 70)$ has a maximum value of 1 to find the value of k .

A1: Equation of model is $H = 0.8 + 1.2 \cos(30t - 70)^\circ$.

Both sides of the equation must be seen. It is not scored for a correct value of k .

(b)(ii)

B1ft: For finding $0.8 - "k"$ and writing as a height with correct units

(c)

M1: Sets $H = -0.1$ and proceeds to $\cos(30t - 70)^\circ = \beta$ Score for an equivalent inequality

dM1: Correct order of operations to find one value for t

A1: One correct value for t

ddM1: Correct method to find a second value for t for their $\cos(30t - 70)^\circ = \beta$

A1: Safe to cross between 06: 57(58) and 09:42(43)

Answers with minimal working in (c)

$$\cos(30t - 70)^\circ = -\frac{3}{4} \Rightarrow t = \text{awrt } 6.95 \text{ and } t = \text{awrt } 9.71 \Rightarrow \text{Safe to cross between 06:57(58) and 09:42(43)}$$

Score SC 11110

