



2003
HIGHER SCHOOL CERTIFICATE
TRIAL EXAMINATION

Mathematics

General Instructions

- Reading time – 5 minutes
- Working time – 3 hours
- Write using black or blue pen
- Board-approved calculators and templates may be used
- A table of standard integrals is provided at the back of this paper
- All necessary working should be shown in every question

Total marks – 120

- Attempt Questions 1-10
- All questions are of equal value
- Start each question in a new writing booklet

Question 1 (12 marks) Use a separate writing booklet.

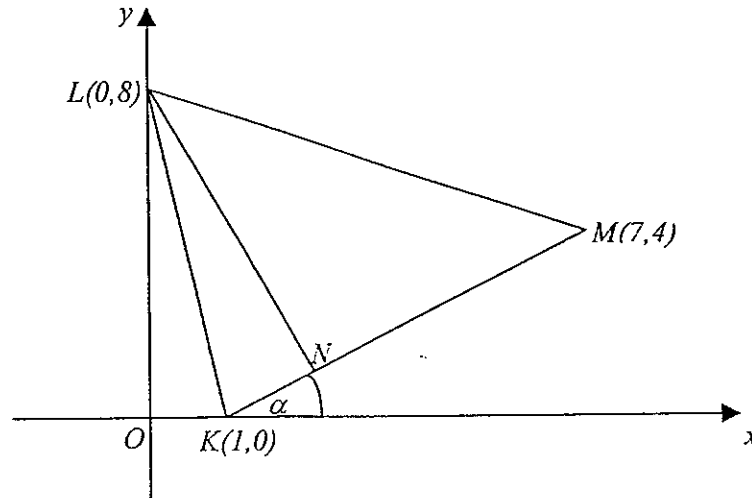
Marks

- (a) Evaluate $2\pi\sqrt{\frac{T}{f}}$ where $T = 0.02$ and $f = 150.8$, correct to two significant figures. 2
- (b) Find $\int (x+1) dx$ 2
- (c) If $8^x = 8000$, find x correct to two decimal places. 2
- (d) Differentiate $(3x^2 + 2)^3$, with respect to x . 2
- (e) Solve $x(8-x) = 3x - 24$ 2
- (f) Solve the pair of simultaneous equations: $2x - y - 7 = 0$ 2
 $x + y + 1 = 0$

Question 2 (12 marks) Use a separate writing booklet.

Marks

In the diagram below, the points K, L, M have coordinates $(1, 0), (0, 8)$ and $(7, 4)$ respectively and the angle between KM and the x -axis is α .
The equation of the line LN is $3x + 2y = 3$.



Copy this diagram into your writing booklet.

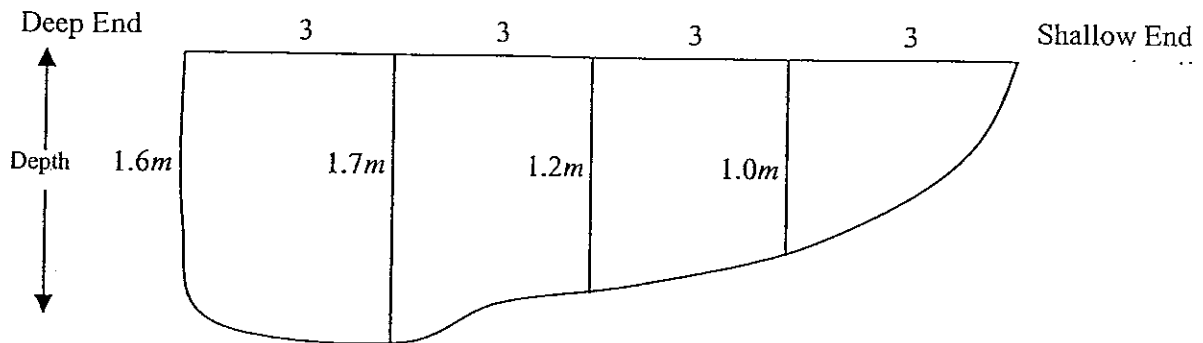
- | | | |
|-----|---|---|
| (a) | Find the gradient of KM and hence determine the size of the angle α , correct to the nearest degree. | 2 |
| (b) | Show that the equation of the line KM is $2x - 3y - 2 = 0$. | 2 |
| (c) | Find the gradient of LN and hence show that LN is perpendicular to KM . | 2 |
| (d) | Show that the length of KM is $2\sqrt{13}$ units. | 1 |
| (e) | Find the exact perpendicular distance from L to KM . | 2 |
| (f) | Find the coordinates of P such that $KLMP$ is a parallelogram. | 1 |
| (g) | Determine the exact area of $KLMP$. | 2 |

Question 3 (12 marks) Use a separate writing booklet.

Marks

- (a) $\frac{1}{5 - \sqrt{11}} = a + b\sqrt{11}$. Find the value of a and b . 3
- (b) Solve for real values of x 3

$$9^x - 12(3^x) + 27 = 0$$
- (c) If $x = \log_e 2$ and $y = \log_e 3$, find $\log_e 6e$ in terms of x and y . 2
- (d) The diagram below shows the cross-section of a swimming pool from deep end to shallow end. The pool is 12 metres long and depths of the swimming pool are given at 3 metre intervals.
- (i) Use Simpson's rule and 5 values to find an approximate value for the area of the cross-section. 3
- (ii) The volume of water in the swimming pool is $80m^3$, find the width of the pool in metres, correct to 1 decimal place. 1



NOT TO SCALE

Question 4 (12 marks) Use a separate writing booklet.

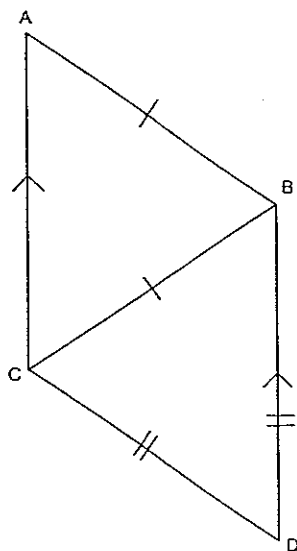
Marks

(a) In a right triangle, find α , if $\sec\alpha = \operatorname{cosec}2\alpha$.
(α and 2α are acute) 1

(b) (i) Show that $\sin^2\theta - 3\cos^2\theta = 4\sin^2\theta - 3$ 2

(ii) Hence, or otherwise, solve the equation,
 $\sin^2\theta = 3\cos^2\theta$ for $0^\circ \leq \theta \leq 360^\circ$. 3

(c)



In the diagram above, $AB = BC$, $BD = CD$ and $AC \parallel BD$.

Copy the diagram into your writing booklet.

(i) Show that $\angle DBC = \angle BAC$ (giving reasons). 2

(ii) Prove that $\triangle ABC \parallel\parallel \triangle BDC$. 2

(iii) If $AB = 7\text{cm}$ and $BD = 4\text{cm}$, find AC . 2

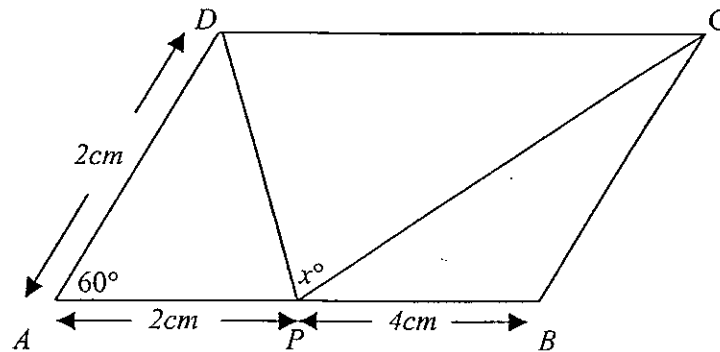
Question 5 (12 marks) Use a separate writing booklet.

Marks

(a) If $a(x-1)^2 + b(x-1) + c \equiv x^2$, find the values of a, b and c . 3

(b) Determine the equation of the normal to the curve $y = e^x + 2$ at $x = 0$. 3

(c)



NOT TO SCALE

In the figure, $ABCD$ is a parallelogram in which $AB = 6\text{ cm}$, $AD = 2\text{ cm}$ and $\angle DAB = 60^\circ$. The point P on AB is such that $AP = 2\text{ cm}$ and $\angle DPC = x^\circ$.

(i) Explain why the length of DP is 2 cm . 1

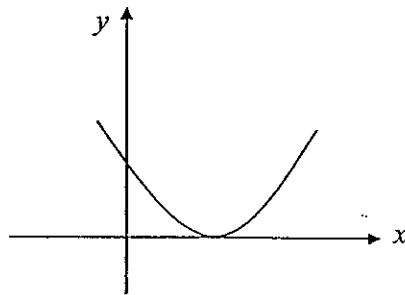
(ii) Use the cosine rule in triangle PBC , to show that the length of PC is $2\sqrt{7}$. 2

(iii) Hence, find the exact value for $\cos x^\circ$. 3

Question 6 (12 marks) Use a separate writing booklet.

Marks

- (a) (i) For what values of k does the quadratic equation $(1+k)x^2 - 2kx + (3-2k) = 0$ have reciprocal roots. 2
- (ii) For any quadratic function the discriminant is either $\Delta = 0, \Delta < 0$ or $\Delta > 0$. State, which is the case for the function below. Hence describe the roots of the function. 2



- (b) Find $\int 2e^{\frac{x}{2}} dx$ 2
- (c) The line $y = x$ cuts the y -axis at A and the curve $y = x^3$ at B and C .
- (i) On the same set of axes, sketch the two functions, and determine the co-ordinates of A, B and C . 3
- (ii) Find the area bounded by the line and the curve. 3

Question 7 (12 marks) Use a separate writing booklet.

Marks

- (a) (i) Find $\int \frac{1}{(3x-2)^3} dx$ 2
- (ii) Give the exact value of $\int_1^3 \frac{dx}{3x-2}$ in simplest form. 2
- (b) Find the equation of the curve which passes through the point (1, 2) and whose gradient at any point (x, y) is given by $y' = 3x - 2$. 2
- (c) For the curve $y = x^3 - 3x + 5$:
- (i) Find the stationary points and determine their nature. 3
- (ii) Find the co-ordinates of the inflexion point. 1
- (iii) Is this function increasing or decreasing at $x = 2$? 1
- (iv) Sketch the curve. 1

Question 8 (12 marks) Use a separate writing booklet.

Marks

- (a) The weekly wages of 100 employees in Virgin Red are listed in increasing order from cleaner to Managing Director, forming the sequence:

\$280, \$335, \$390,

- (i) What is the highest pay per week? 2
- (ii) Calculate the total payroll for one week. 1

- (b) $A = (1, 1)$, $B = (4, 7)$ and $P = (x, y)$.

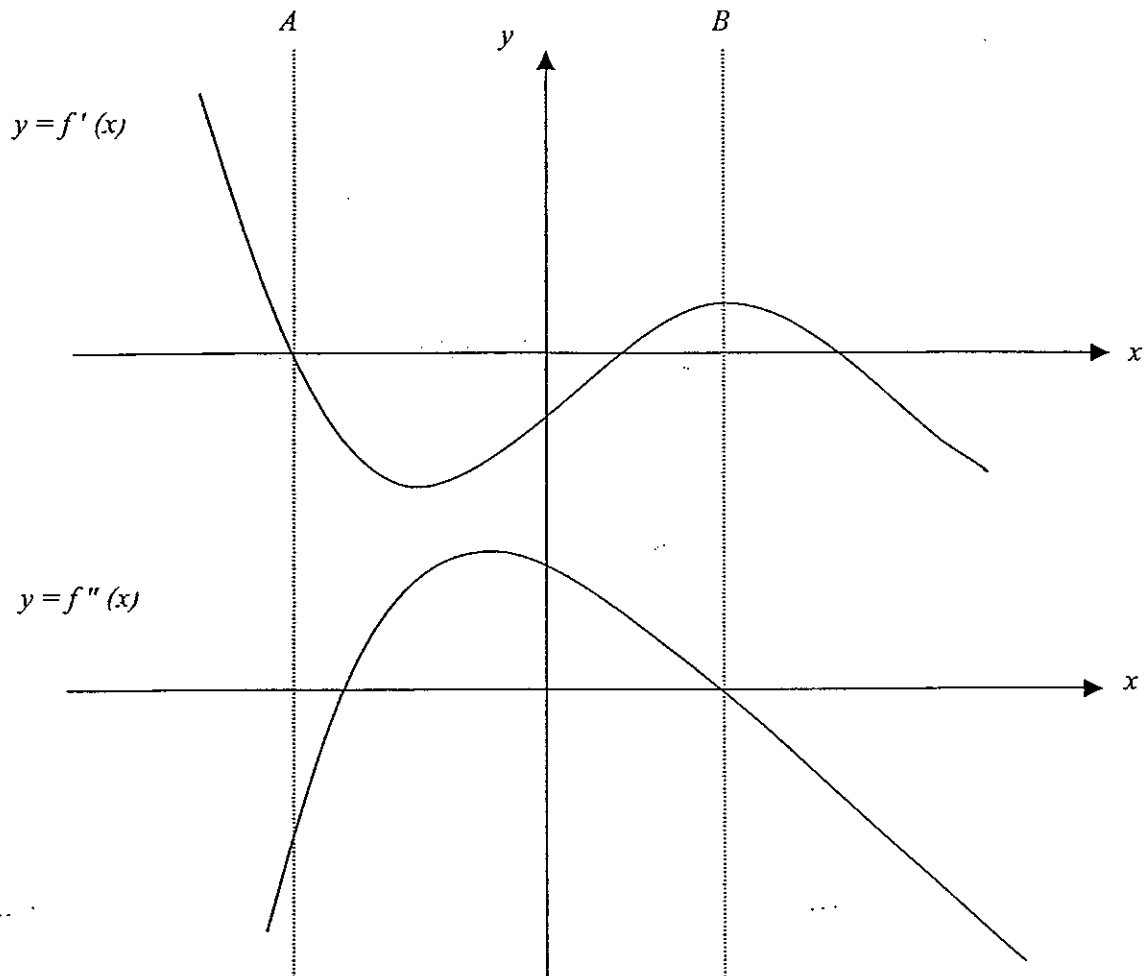
- (i) Write expressions for the lengths of PA and PB . 1
- (ii) P moves so that $PA = 2 \times PB$. 2
Show that the locus of P is the circle: $x^2 - 10x + y^2 - 18y + 86 = 0$.
- (iii) Find the centre and radius of this circle. 2

Question 8 (continued)

Marks

- (c) Below are the graphs of $y = f'(x)$ and $y = f''(x)$ for the function $y = f(x)$. Describe what is happening on the original curve $y = f(x)$ at A and B . You must justify your answers.

4



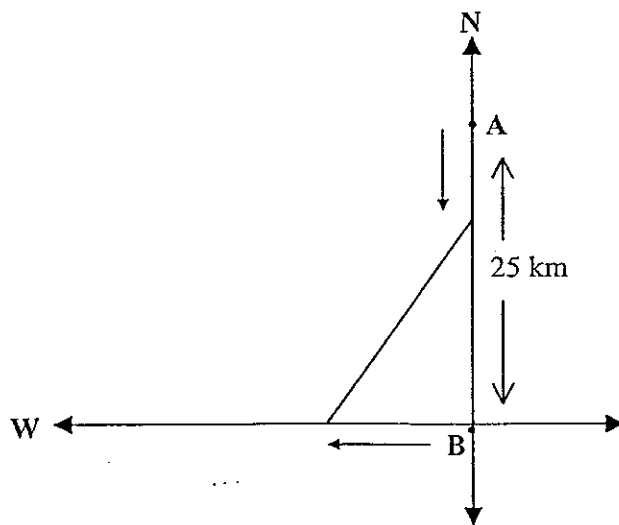
Question 10 (12 marks) Use a separate writing booklet.

Marks

(a) Find the value of $\sum_{n=1}^{\infty} \left(\frac{1}{3}\right)^n$ 2

(b) $y = \frac{1}{\sqrt{x}}$ is rotated about the x -axis from $x = 3$ to $x = a$. 4
The volume of the resulting solid is 2π cubic units.
What is the exact value of a ?

(c) On the compass diagram below, Mary is at A, 25 km due north of position B.
John is at B.
Mary walks towards B at 4 km/h. John moves due west at 6 km/h.



(i) Show that the distance between Mary and John after t hours is given by: 2

$$d^2 = 52t^2 - 200t + 625$$

(ii) Letting $L = d^2$, find the time when L is minimum. 3

(iii) Hence find the minimum distance between John and Mary, correct to the nearest kilometre. 1

End of Examination.



Mathematics Trial 2003 Marking Criteria

Question 1 (a)

Criteria	Marks
<ul style="list-style-type: none"> Gives correct answer, 0.72 	2
<ul style="list-style-type: none"> Gives correct answer but rounds incorrectly, OR <ul style="list-style-type: none"> Correctly rounds incorrect simplification 	1

Question 1 (b)

Criteria	Marks
<ul style="list-style-type: none"> Gives correct answer, $\frac{x^2}{2} + x + c$ 	2
<ul style="list-style-type: none"> correctly integrates either x or 1 (ignore constant of integration) 	1

Question 1 (c)

Criteria	Marks
<ul style="list-style-type: none"> Gives correct answer, 4.32 	2
<ul style="list-style-type: none"> Attempts to solve using logarithms but makes subsequent error OR <ul style="list-style-type: none"> Gives correct answer but fails to round correctly 	1

Question 1 (d)

Criteria	Marks
<ul style="list-style-type: none"> Gives correct answer, $18x(3x^2 + 2)^2$ or $18x(9x^4 + 12x^2 + 4)$ 	2
<ul style="list-style-type: none"> Fails to find derivative of $(3x^2 + 2)$ OR <ul style="list-style-type: none"> Fails to use appropriate notation 	1

Question 1 (e)

Criteria	Marks
<ul style="list-style-type: none"> Correctly finds both solutions for $x = 8, -3$ 	2
<ul style="list-style-type: none"> Sets up correct quadratics equation OR <ul style="list-style-type: none"> Finds only one solution 	1

Question 1 (f)

Criteria	Marks
<ul style="list-style-type: none"> Correctly finds that $x=2$ and $y=-1$ 	2
<ul style="list-style-type: none"> Attempts a method of solution to isolate x or y OR <ul style="list-style-type: none"> Correctly solves for only one of x or y 	1

Question 2 (a)

Criteria	Marks
<ul style="list-style-type: none"> Gives correct answer, $m = \frac{2}{3}$ $\theta = 34^\circ$ 	2
<ul style="list-style-type: none"> Finds correct gradient OR <ul style="list-style-type: none"> Finds correct θ, from incorrect gradient 	1

Question 2 (b)

Criteria	Marks
<ul style="list-style-type: none"> Gives correct answer, $2x - 3y - 2 = 0$ 	2
<ul style="list-style-type: none"> Correct substitution but makes subsequent error 	1

Question 2 (c)

Criteria	Marks
<ul style="list-style-type: none"> Gives correct answer, $m = -\frac{3}{2}$ and shows gradients are negative reciprocals 	2
<ul style="list-style-type: none"> Finds correct gradient but fails to show perpendicularity. 	1

Question 2 (d)

Criteria	Marks
<ul style="list-style-type: none"> Uses distance formula with correct substitution to get $KM = 2\sqrt{13}$ units 	1

Question 2 (e)

Criteria	Marks
<ul style="list-style-type: none"> Gives correct answer, <i>perpendicular distance</i> = $2\sqrt{13}$ units (ignore rationalising) 	2
<ul style="list-style-type: none"> Uses correct formula but makes subsequent error. 	1

Question 2 (f)

Criteria	Marks
<ul style="list-style-type: none"> Gives correct answer, P(8, -4) 	1

Question 2 (g)

Criteria	Marks
<ul style="list-style-type: none"> Gives correct answer, Area = 52 sq. units 	2
<ul style="list-style-type: none"> Recognises to use perpendicular height and distance <i>KM</i>, but makes subsequent error. OR Finds the area of only one triangle. Ignore units. 	1

Question 3 (a)

Criteria	Marks
<ul style="list-style-type: none"> Gives correct answer, $a = \frac{5}{14}$, $b = \frac{1}{14}$ 	3
<ul style="list-style-type: none"> Multiplies by correct conjugate and simplifies but fails to give <i>a</i> or <i>b</i>. OR Obtains correct answer for either <i>a</i> or <i>b</i>. 	2
<ul style="list-style-type: none"> Multiplies by correct conjugate only. 	1

Question 3 (b)

Criteria	Marks
<ul style="list-style-type: none"> Gives correct answer, $x = 2, x = 1$ 	3
<ul style="list-style-type: none"> Obtains correct quadratic equation, but fails to find both values of x. OR <ul style="list-style-type: none"> Obtains correct x values with no working shown. 	2
<ul style="list-style-type: none"> Obtains one correct value for x with no working shown. OR <ul style="list-style-type: none"> Obtains correct quadratic equation only. OR <ul style="list-style-type: none"> Finds values for "u" only. 	1

Question 3 (c)

Criteria	Marks
<ul style="list-style-type: none"> Gives correct answer, $x + y + 1$ 	2
<ul style="list-style-type: none"> Rewrites logarithm as $\log_e 2 + \log_e 3 + \log_e e$, but makes subsequent error. OR <ul style="list-style-type: none"> Obtains part of correct answer from correct expression. 	1

Question 3 (d)(i)

Criteria	Marks
<ul style="list-style-type: none"> Gives correct answer, $Area = 14.8m^2$ 	3
<ul style="list-style-type: none"> Finds correct "h" and uses correct substitutions but makes subsequent error. OR <ul style="list-style-type: none"> Finds correct "h" but makes one error in substitutions. 	2
<ul style="list-style-type: none"> Finds correct "h", uses incorrect formula. 	1

Question 3 (d)(ii)

Criteria	Marks
<ul style="list-style-type: none"> Gives correct answer, $width = 5.4m$. Ignore rounding. OR <ul style="list-style-type: none"> Finds correct width using incorrect answer from (i) 	1

Question 4 (a)

Criteria	Marks
<ul style="list-style-type: none"> Gives correct answer, $\alpha = 30$. 	1

Question 4 (b)(i)

Criteria	Marks
<ul style="list-style-type: none"> Correctly substitutes $\cos^2 \theta = 1 - \sin^2 \theta$ and simplifies to find RHS. 	2
<ul style="list-style-type: none"> Uses correct substitution but makes subsequent error <p>OR</p> <ul style="list-style-type: none"> Uses poor setting out. 	1

Question 4 (b)(ii)

Criteria	Marks
<ul style="list-style-type: none"> Gives all four correct answers $60^\circ, 120^\circ, 240^\circ, 300^\circ$. 	3
<ul style="list-style-type: none"> Finds two of the four answers by not finding $\sin \theta = \pm \frac{\sqrt{3}}{2}$ 	2
<ul style="list-style-type: none"> Correctly rewrites equation as $4\sin^2 \theta - 3 = 0$ but cannot go further. 	1

Question 4 (c)(i)

Criteria	Marks
<ul style="list-style-type: none"> States that $\angle DBC = \angle BCA$ (alternate angles $AC \parallel BD$) $\angle BAC = \angle BCA$ (base angles isosceles Δ) 	2
<ul style="list-style-type: none"> No reasons given 	1

Question 4 (c)(ii)

Criteria	Marks
<ul style="list-style-type: none"> Shows two pairs of corresponding angles equal. 	2
<ul style="list-style-type: none"> Shows a pair of corresponding angles equal. 	1

Question 4 (c)(iii)

Criteria	Marks
<ul style="list-style-type: none"> Gives correct answer, $AC = 12.25\text{cm}$. 	2
<ul style="list-style-type: none"> Uses correct corresponding sides but incorrect substitution OR <ul style="list-style-type: none"> Uses correct corresponding sides but makes subsequent error 	1

Question 5 (a)

Criteria	Marks
<ul style="list-style-type: none"> Gives correct answer, $a = 1, b = 2, c = 1$. 	3
<ul style="list-style-type: none"> Gives two correct answers. 	2
<ul style="list-style-type: none"> Gives one correct answer. 	1

Question 5 (b)

Criteria	Marks
<ul style="list-style-type: none"> Gives correct answer, $x + y - 3 = 0$. 	3
<ul style="list-style-type: none"> Finds gradient of normal but makes subsequent error in equation. OR <ul style="list-style-type: none"> Finds correct gradient of normal only. OR <ul style="list-style-type: none"> Finds gradient of tangent and uses this to find equation. 	2
<ul style="list-style-type: none"> Finds gradient of tangent only. 	1

Question 5 (c)(i)

Criteria	Marks
<ul style="list-style-type: none"> Shows clearly why DP is 2 cm. 	1

Question 5 (c)(ii)

Criteria	Marks
<ul style="list-style-type: none"> Gives correct substitution into correct cosine rule and shows working to obtain answer. 	2
<ul style="list-style-type: none"> Uses incorrect substitution into correct cosine rule. 	1

Question 5 (c)(iii)

Criteria	Marks
<ul style="list-style-type: none"> Gives correct answer, $\frac{-\sqrt{7}}{14}$. 	3
<ul style="list-style-type: none"> Finds correct value for $\cos x^\circ$, but subsequently finds x. OR Finds correct decimal for $\cos x^\circ = -0.378$ OR Finds correct answer without rationalising the denominator. 	2
<ul style="list-style-type: none"> Correct substitution only. 	1

Question 6 (a)(i)

Criteria	Marks
<ul style="list-style-type: none"> Gives correct answer, $k = \frac{2}{3}$. 	2
<ul style="list-style-type: none"> Gives correct criterion, i.e. $\alpha\beta = 1$. and subsequent error. 	1

Question 6 (a)(ii)

Criteria	Marks
<ul style="list-style-type: none"> Gives correct answer, $\Delta = 0$ (1 mark), two real <u>equal</u> roots (1 mark). 	2
<ul style="list-style-type: none"> Gives one or other of above. 	1

Question 6 (b)

Criteria	Marks
<ul style="list-style-type: none"> Gives correct answer, $4e^{\frac{x}{2}} + c$. 	2
<ul style="list-style-type: none"> Gives answer as $ke^{\frac{x}{2}} + c$, where $k \neq 4$ OR <ul style="list-style-type: none"> Gives answer as $4e^{\frac{x}{2}}$, without "c". 	1

Question 6 (c)(i)

Criteria	Marks
<ul style="list-style-type: none"> Gives correct graph (1 mark) and values for $x = 0, -1, 1$ (1 mark) and $y = 0, -1, 1$ (1 mark) respectively. 	3
<ul style="list-style-type: none"> Correct graph, incorrect with one point OR <ul style="list-style-type: none"> Incorrect graph, correct x and y values from graph 	2
<ul style="list-style-type: none"> Correct graph, no x and y values given OR <ul style="list-style-type: none"> Incorrect graph for 1 function, some correct x and y values 	1

Question 6 (c)(ii)

Criteria	Marks
<ul style="list-style-type: none"> Gives correct answer, $A = \frac{1}{2}u^2$ (ignore units) 	3
<ul style="list-style-type: none"> Correct integral and substitution, subsequent calculation error 	2
<ul style="list-style-type: none"> Correct integral only OR <ul style="list-style-type: none"> Recognition of odd functions, therefore double area 	1

Question 7 (a)(i)

Criteria	Marks
<ul style="list-style-type: none"> Gives correct answer, $\frac{-1}{6(3x-2)^2} + c$ (ignore "c") 	2
<ul style="list-style-type: none"> Writes integral as $(3x-2)^{-3}$ OR Integrates $(3x-2)^{-3}$ but fails to divide by correct constant 	1

Question 7 (a)(ii)

Criteria	Marks
<ul style="list-style-type: none"> Gives correct answer, $\frac{\ln 7}{3}$ 	2
<ul style="list-style-type: none"> Correct integral only OR Correct decimal answer, 0.649 	1

Question 7 (b)

Criteria	Marks
<ul style="list-style-type: none"> Gives correct answer, $y = \frac{3}{2}x^2 - 2x + \frac{5}{2}$ 	2
<ul style="list-style-type: none"> Correct integral only, fails to find c 	1

Question 7 (c)(i)

Criteria	Marks
<ul style="list-style-type: none"> Gives correct answer, (1, 3) is a minimum turning point and (-1, 7) is a maximum turning point. With working to support answer. (ignore y values) 	3
<ul style="list-style-type: none"> Finds correct derivative, equates with zero, finds points without nature OR Correctly finds only one point and its nature 	2
<ul style="list-style-type: none"> Finds correct derivative 	1

Question 7 (c)(ii)

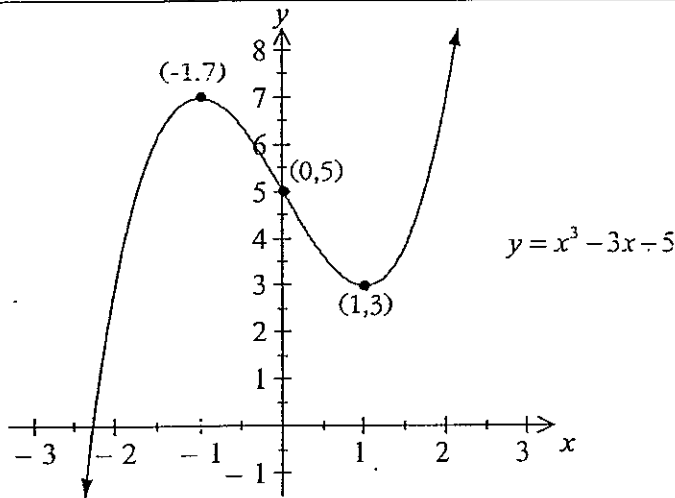
Criteria	Marks
<ul style="list-style-type: none"> Finds correct inflexion point, (0,5) 	1

Question 7 (c)(iii)

Criteria	Marks
<ul style="list-style-type: none"> Gives correct condition, function is increasing 	1

Question 7 (c)(iv)

Criteria	Marks
<ul style="list-style-type: none"> Correct graph to go with answers to previous parts 	1



Question 8 (a)(i)

Criteria	Marks
<ul style="list-style-type: none"> Correct answer, \$5 725 	2
<ul style="list-style-type: none"> Correct value for $d = \\$55$ 	1

Question 8 (a)(ii)

Criteria	Marks
<ul style="list-style-type: none"> Correct answer, \$300 250 	1

Question 8 (b)(i)

Criteria	Marks
<ul style="list-style-type: none"> Correct expressions, $PA = \sqrt{(x-1)^2 + (y-1)^2}$, $PB = \sqrt{(x-4)^2 + (y-7)^2}$ 	1

Question 8 (b)(ii)

Criteria	Marks
<ul style="list-style-type: none"> Correctly equates $PA = 2 \times PB$, correct expansion and simplification 	2
<ul style="list-style-type: none"> Correctly equating $PA^2 = 4 \times PB^2$, making subsequent error 	1

Question 8 (b)(iii)

Criteria	Marks
<ul style="list-style-type: none"> Correct answer, centre $(5, 9)$ and radius $= 2\sqrt{5}$ units 	2
<ul style="list-style-type: none"> Correctly finding centre or radius OR <ul style="list-style-type: none"> Correctly completing the square on both variables 	1

Question 8 (c)

Criteria	Marks
<ul style="list-style-type: none"> Correct answer: At A, $y' = 0$, and $y'' < 0$ \therefore maximum stationary point At B, $y' > 0$ and $y'' = 0$, \therefore point of inflexion and y'' changes sign 	4
<ul style="list-style-type: none"> Gives 3 out of 4 criteria 	3
<ul style="list-style-type: none"> Gives minimum turning point at A and point of inflexion at B with no support OR <ul style="list-style-type: none"> Gives At A, $y' = 0$, and $y'' < 0$ At B, $y' > 0$ and $y'' = 0$, with only one conclusion 	2
<ul style="list-style-type: none"> Finds only A or B 	1

Question 9 (a)(i)

Criteria	Marks
<ul style="list-style-type: none"> Correctly setting up simultaneous equations and solving showing all working 	3

<ul style="list-style-type: none"> • Correctly setting up simultaneous equations then making subsequent error 	2
<ul style="list-style-type: none"> • Giving $T_4 = 6$ and $T_9 = \frac{64}{81}$ without further solution. 	1

Question 9 (a)(ii)

Criteria	Marks
<ul style="list-style-type: none"> • Giving correct answer, $n = 11$, showing all necessary working 	4
<ul style="list-style-type: none"> • Finding that $n > 10.8\dots$, with correct working • Finding that $n < 10.8\dots$, with correct working and stating $n = 10$ 	3
<ul style="list-style-type: none"> • Obtaining $\frac{1}{81} > \left(\frac{2}{3}\right)^n$ then not using logarithms or trial and error to find n 	2
<ul style="list-style-type: none"> • Correct substitution into correct formula, i.e. $S_n = \frac{a(1-r^n)}{1-r}$ $\frac{81}{4} \left(1 - \frac{2^n}{3}\right) > 60$ $1 - \frac{2^n}{3}$ 	1

Question 9 (b)(i)

Criteria	Marks
<ul style="list-style-type: none"> • Correct answer: $y' = \frac{1}{x \log_e x}$, with correct notation 	2
	1

<ul style="list-style-type: none"> Giving answer as $y' = \frac{1}{\log_e x}$ <p>OR</p> <ul style="list-style-type: none"> Giving correct answer without correct notation 	
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Question 9 (b)(i)

Criteria	Marks
<ul style="list-style-type: none"> Correct answer: $\log_e 2$, with correct notation 	3
<ul style="list-style-type: none"> Giving correct answer that is not exact, 0.693 <p>OR</p> <ul style="list-style-type: none"> Giving correct integral and substitution, e.g. $\log_e 2 - \log_e 1$ 	2
<ul style="list-style-type: none"> Giving correct integral, $\log_e(\log_e x)$ 	1

Question 10 (a)

Criteria	Marks
<ul style="list-style-type: none"> Correct answer: $\sum_{n=1}^{\infty} \left(\frac{1}{3}\right)^n = \frac{1}{2}$, with working 	2
<ul style="list-style-type: none"> Giving $a = \frac{1}{3}$ and $r = \frac{1}{3}$ 	1

Question 10 (b)

Criteria	Marks
<ul style="list-style-type: none"> Correct answer: $a = 3e^2$, with all working 	4
<ul style="list-style-type: none"> Gives decimal answer: $a = 22.17$ <p>OR</p> <ul style="list-style-type: none"> Equates $\pi \int_3^a \frac{1}{x} dx = 2\pi$ and integrates correctly but makes subsequent error 	3
<ul style="list-style-type: none"> Finds $y^2 = \frac{1}{x}$ and equates $\pi \int_3^a \frac{1}{x} dx = 2\pi$ 	2

- Finds $y^2 = \frac{1}{x}$

1

Question 10 (c)(i)

Criteria	Marks
<ul style="list-style-type: none"> Correctly uses Pythagoras' theorem with Mary's distance $(25 - 4t)$ and John's distance $(6t)$, to obtain answer 	2
<ul style="list-style-type: none"> Uses Pythagoras' theorem but uses incorrect distance for Mary or John OR <ul style="list-style-type: none"> Uses correct distances but does not show enough working 	1

Question 10 (c)(ii)

Criteria	Marks
<ul style="list-style-type: none"> Finds correct time, $\frac{25}{12} = 1.92$ hours and includes check of minimum 	3
<ul style="list-style-type: none"> Finds $\frac{dL}{dt} = 104t - 200$, correctly finds t but does not check minimum Finds incorrect value for t from correct derivative and checks minimum 	2
<ul style="list-style-type: none"> Finds $\frac{dL}{dt} = 104t - 200$, does not go further 	1

Question 10 (c)(iii)

Criteria	Marks
<ul style="list-style-type: none"> Finds correct distance, 21 kilometres (ignore rounding) OR <ul style="list-style-type: none"> Finds correct distance from previous error 	1