MARK SCHEME for the May/June 2010 question paper

for the guidance of teachers

9709 MATHEMATICS

9709/13

Paper 13, maximum raw mark 75

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

Mark schemes must be read in conjunction with the question papers and the report on the examination.

• CIE will not enter into discussions or correspondence in connection with these mark schemes.

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Mark Scheme Notes

Marks are of the following three types:

- M Method mark, awarded for a valid method applied to the problem. Method marks are not lost for numerical errors, algebraic slips or errors in units. However, it is not usually sufficient for a candidate just to indicate an intention of using some method or just to quote a formula; the formula or idea must be applied to the specific problem in hand, e.g. by substituting the relevant quantities into the formula. Correct application of a formula without the formula being quoted obviously earns the M mark and in some cases an M mark can be implied from a correct answer.
- A Accuracy mark, awarded for a correct answer or intermediate step correctly obtained. Accuracy marks cannot be given unless the associated method mark is earned (or implied).
- B Mark for a correct result or statement independent of method marks.
- When a part of a question has two or more "method" steps, the M marks are generally independent unless the scheme specifically says otherwise; and similarly when there are several B marks allocated. The notation DM or DB (or dep*) is used to indicate that a particular M or B mark is dependent on an earlier M or B (asterisked) mark in the scheme. When two or more steps are run together by the candidate, the earlier marks are implied and full credit is given.
- The symbol √ implies that the A or B mark indicated is allowed for work correctly following on from previously incorrect results. Otherwise, A or B marks are given for correct work only. A and B marks are not given for fortuitously "correct" answers or results obtained from incorrect working.
- Note: B2 or A2 means that the candidate can earn 2 or 0. B2/1/0 means that the candidate can earn anything from 0 to 2.

The marks indicated in the scheme may not be subdivided. If there is genuine doubt whether a candidate has earned a mark, allow the candidate the benefit of the doubt. Unless otherwise indicated, marks once gained cannot subsequently be lost, e.g. wrong working following a correct form of answer is ignored.

- Wrong or missing units in an answer should not lead to the loss of a mark unless the scheme specifically indicates otherwise.
- For a numerical answer, allow the A or B mark if a value is obtained which is correct to 3 s.f., or which would be correct to 3 s.f. if rounded (1 d.p. in the case of an angle). As stated above, an A or B mark is not given if a correct numerical answer arises fortuitously from incorrect working. For Mechanics questions, allow A or B marks for correct answers which arise from taking *g* equal to 9.8 or 9.81 instead of 10.

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The following abbreviations may be used in a mark scheme or used on the scripts:

- AEF Any Equivalent Form (of answer is equally acceptable)
- AG Answer Given on the question paper (so extra checking is needed to ensure that the detailed working leading to the result is valid)
- BOD Benefit of Doubt (allowed when the validity of a solution may not be absolutely clear)
- CAO Correct Answer Only (emphasising that no "follow through" from a previous error is allowed)
- CWO Correct Working Only often written by a 'fortuitous' answer
- ISW Ignore Subsequent Working
- MR Misread
- PA Premature Approximation (resulting in basically correct work that is insufficiently accurate)
- SOS See Other Solution (the candidate makes a better attempt at the same question)
- SR Special Ruling (detailing the mark to be given for a specific wrong solution, or a case where some standard marking practice is to be varied in the light of a particular circumstance)

Penalties

- MR –1 A penalty of MR –1 is deducted from A or B marks when the data of a question or part question are genuinely misread and the object and difficulty of the question remain unaltered. In this case all A and B marks then become "follow through √" marks. MR is not applied when the candidate misreads his own figures this is regarded as an error in accuracy. An MR–2 penalty may be applied in particular cases if agreed at the coordination meeting.
- PA –1 This is deducted from A or B marks in the case of premature approximation. The PA –1 penalty is usually discussed at the meeting.

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1	(i) $a = 12, ar = -6 \rightarrow r = -\frac{1}{2}$	M1	Attempt at <i>r</i> from " <i>ar</i> "
	$ar^9 = \frac{-3}{128}$	M1 A1	ar^9 must be correct. co
	120	[3]	
	(ii) $S_{\infty} = \frac{a}{1-r}$ used $\rightarrow 8$	M1 A1	Correct formula used. M1 needs $ r < 1$
		[2]	
2	(i) $\left(x-\frac{2}{x}\right)^6 = x^6 - 12x^4 + 60x^2$	B1 ×3 [3]	со
	(ii) $\times (1 + x^2) \rightarrow 60 - 12 = 48$	M1 A1√ [2]	Must be exactly 2 terms. $\sqrt{1}$ from his (i).
3	f: $x \mapsto a + b \cos x$		
	(i) $f(0) = 10, a + b = 10$		
	$f(^2/_3\pi) = 1, \ a - \frac{b}{2} = 1$	B1	EITHER OF THESE
	$\rightarrow a = 4, b = 6$	B1	both co
	(ii) Range is -2 to 10.	[2] B1√ [1]	\sqrt{a} for his " $a - b$ " to " $a + b$ "
	(iii) $\cos\left(\frac{5}{6}\pi\right) = -\cos\left(\frac{1}{6}\pi\right) = -\frac{\sqrt{3}}{2}$	B1	For $\cos 30^\circ = \frac{1}{2}\sqrt{3}$ used somewhere.
	$\rightarrow 4-3\sqrt{3}$	B1 [2]	со
4	(i) $2\sin x \tan x + 3 = 0$		
	$2\sin x \frac{\sin x}{\cos x} + 3 = 0$	M1	For using $\tan = \sin \div \cos$
	$2\frac{\left(1-\cos^2 x\right)}{\cos x} + 3 = 0$	M1	For using $\sin^2 + \cos^2 = 1$ and everything correct
	$\rightarrow 2\cos^2 x - 3\cos x - 2 = 0$	[2]	Answer given – check.
	(ii) $2\cos^2 x - 3\cos x - 2 = 0$ $\rightarrow \cos x = -\frac{1}{2} \text{ or } 2$ $x = 120^\circ \text{ or } 240^\circ$	M1 A1 B1√ [3]	Solution of quadratic. co. $\sqrt{1000}$ for 360 – his answer.

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$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$				1
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	5	$\frac{\mathrm{d}y}{\mathrm{d}x} = \frac{6}{\sqrt{3x-2}}$		
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$		(i) $x = 2$, tangent has gradient 3	M1	Use of $m_1m_2 = -1$ with dy/dx
(ii) Integrate $\rightarrow 6 \frac{\sqrt{3x-2}}{\frac{1}{2}} \div 3$ $\rightarrow y = 4\sqrt{3x-2} + c$ through (2,11) $\rightarrow y = 4\sqrt{3x-2} + 3$ (ii) $p = 4\sqrt{3x-2} + 3$ (iii) $p = 4\sqrt{3x-2} + 3$ (iii) $p = 4\sqrt{3x-2} + 3$ (i) $p = 1-2j + 4k$, $\overline{OB} = 3i + 2j + 8k$, $p = 1$ (i) $p = 2i + 4j + 4k$ $p = 63,6^{\circ}$ (ii) $p = 12 + 12 + 2 \times 10 \times angle BOD$ Angle $DOE = 1.287$ radians. (ii) $p = 12 + 12 + 2 \times 10 \times angle BOD$ Angle $BOD = (\pi - 1.287)$ $\rightarrow 61.1$ (iii) Sector $DOE = \frac{1}{2} \times 10^2 \times 1.287$ (iii) Sector $DOE = \frac{1}{2} \times 10^2 \times 1.287$ (iv) Sector $DOE = \frac{1}{2} \times 10^2 \times 1.287$ (iv) Sector $DOE = \frac{1}{2} \times 10^2 \times 1.287$ (iv) Sector $DOE = \frac{1}{2} \times 10^2 \times 1.287$ (v) Sector $DOE = \frac{1}{2} \times 10^2 \times$		\rightarrow normal has gradient $-\frac{1}{3}$	M1 A1	Correct form of line eqn. for normal
(ii) Integrate $\rightarrow 6 \frac{\sqrt{3} x - 2}{\frac{1}{2}} + 3$ $\rightarrow y = 4\sqrt{3x - 2} + c$ through (2,11) $\rightarrow y = 4\sqrt{3x - 2} + 3$ B1 For ± 3 , even if B0 above M1 Using (2, 11) for c co [4] G $\overrightarrow{OZ} = \mathbf{i} - 2\mathbf{j} + 4\mathbf{k}$, $\overrightarrow{OB} = 3\mathbf{i} + 2\mathbf{j} + 8\mathbf{k}$, $\overrightarrow{OC} = -\mathbf{i} - 2\mathbf{j} + 10\mathbf{k}$ B1 co $(\mathbf{i}) (\pm) 2\mathbf{i} + 4\mathbf{j} + 4\mathbf{k}$ $(\pm) 4\mathbf{i} + 4\mathbf{j} - 2\mathbf{k}$ B1 co $\overrightarrow{AB}.\overrightarrow{CB} = 16$ $\overrightarrow{AB}.\overrightarrow{CB} = 16$ $\overrightarrow{AB}.\overrightarrow{CB} = \sqrt{36}\sqrt{36}\cos\theta$ $\theta = 63.6^{\circ}$ M1 Needs to be scalar. For product of 2 moduli and cosine M1 A1 $correct$. [6] M1 A1 $correct$. [7 (i) $\sin \frac{1}{2}\theta = \frac{6}{10}$ Angle $DOE = 1.287$ radians. (ii) $P = 12 + 12 + 2 \times 10 \times \text{angle } BOD$ Angle $BOD = (\pi - 1.287)$ $\rightarrow 61.1$ [3] M1 [3] [3] [3] [3] [3] [3] [3] [3] [3] [3]		$\rightarrow y-11 = -\frac{1}{3}(x-2)$	[3]	
$ \rightarrow y = 4\sqrt{3x-2} + 3 $ Al [4] 6 $\overrightarrow{OA} = \mathbf{i} - 2\mathbf{j} + 4\mathbf{k}, \ \overrightarrow{OB} = 3\mathbf{i} + 2\mathbf{j} + 8\mathbf{k}, \ \overrightarrow{OC} = -\mathbf{i} - 2\mathbf{j} + 10\mathbf{k} $ (i) $(\pm) 2\mathbf{i} + 4\mathbf{j} + 4\mathbf{k} \ (\pm) 4\mathbf{i} + 4\mathbf{j} - 2\mathbf{k} $ Bl co co $ \overrightarrow{ABCB} = 16 \ \overrightarrow{ABCB} = 46 + \sqrt{40} \ \overrightarrow{ABCB} = \sqrt{36}\sqrt{36}\cos\theta $		(ii) Integrate $\rightarrow 6 \frac{\sqrt{3x-2}}{\frac{1}{2}} \div 3$		
$ \rightarrow y = 4\sqrt{3x-2} + 3 $ Al [4] 6 $\overrightarrow{OA} = \mathbf{i} - 2\mathbf{j} + 4\mathbf{k}, \ \overrightarrow{OB} = 3\mathbf{i} + 2\mathbf{j} + 8\mathbf{k}, \ \overrightarrow{OC} = -\mathbf{i} - 2\mathbf{j} + 10\mathbf{k} $ (i) $(\pm) 2\mathbf{i} + 4\mathbf{j} + 4\mathbf{k} \ (\pm) 4\mathbf{i} + 4\mathbf{j} - 2\mathbf{k} $ Bl co co $ \overrightarrow{ABCB} = 16 \ \overrightarrow{ABCB} = 46 + \sqrt{40} \ \overrightarrow{ABCB} = \sqrt{36}\sqrt{36}\cos\theta $		$\rightarrow y = 4\sqrt{3x-2} + c$ through (2,11)	M1	Using (2, 11) for <i>c</i>
Image: definition of the form of the			A1	со
$\overrightarrow{OC} = -\mathbf{i} - 2\mathbf{j} + 10\mathbf{k}$ (i) (±) $2\mathbf{i} + 4\mathbf{j} + 4\mathbf{k}$ (±) $4\mathbf{i} + 4\mathbf{j} - 2\mathbf{k}$ B1 co co co M1 B1 Needs to be scalar. For product of 2 moduli and cosine $\theta = 63.6^{\circ}$ M1 A1 Correct overall method for perimeter. (ii) Perimeter = $6 + 6 + \sqrt{40}$ or $6 + 6 + 6\sin 31.8^{\circ} \times 2$ $\rightarrow 18.32$ M1 Correct overall method for perimeter. (ii) $p = 12 + 12 + 2 \times 10 \times \text{angle } BOD$ Angle $BOD = (\pi - 1.287)$ $\rightarrow 61.1$ (iii) Sector $DOE = \frac{1}{2} \times 10^2 \times 1.287$ M1 Correct formula used with radians.		, , , , , , , , , , , , , , , , , , ,	[4]	
(i) $(\pm) 2\mathbf{i} + 4\mathbf{j} + 4\mathbf{k}$ $(\pm) 4\mathbf{i} + 4\mathbf{j} - 2\mathbf{k}$ $\overrightarrow{AB}.\overrightarrow{CB} = 16$ $\overrightarrow{AB}.\overrightarrow{CB} = \sqrt{36}\sqrt{36}\cos\theta$ $\theta = 63.6^{\circ}$ (ii) Perimeter = $6 + 6 + \sqrt{40}$ $\text{or } 6 + 6 + 6\sin 31.8^{\circ} \times 2$ $\rightarrow 18.32$ 7 (i) $\sin \frac{1}{2}\theta = \frac{6}{10}$ Angle $DOE = 1.287$ radians. (ii) $P = 12 + 12 + 2 \times 10 \times \text{angle } BOD$ Angle $BOD = (\pi - 1.287)$ $\rightarrow 61.1$ (iii) Sector $DOE = \frac{1}{2} \times 10^2 \times 1.287$ (ii) Sector $DOE = \frac{1}{2} \times 10^2 \times 1.287$ (iii) Sector $DOE = \frac{1}{2} \times 10^2 \times 1.287$ B1 Correct overall method for perimeter. Correct formula used with radians.	6			
$\begin{array}{c} \text{(i)} \begin{array}{c} (i) & 2i + i + j + i k \\ (i) & 4i + 4j - 2k \end{array} \end{array} \qquad B1 \qquad \text{co} \\ \hline \overrightarrow{AB}.\overrightarrow{CB} = 16 \\ \overrightarrow{AB}.\overrightarrow{CB} = \sqrt{36}\sqrt{36}\cos\theta \\ \theta = 63.6^{\circ} \end{array} \qquad M1 \qquad \text{Needs to be scalar.} \\ \hline \text{For product of 2 moduli and cosine} \\ \hline \text{M1 A1} \\ end{tabel{eq:A1}} \\ \text{(ii)} \begin{array}{c} \text{Perimeter} = 6 + 6 + \sqrt{40} \\ \text{or } 6 + 6 + 6\sin 31.8^{\circ} \times 2 \\ \rightarrow 18.32 \end{array} \qquad M1 \qquad \text{Correct overall method for perimeter.} \\ \hline \text{Correct overall method for perimeter.} \\ \text{co} \end{array} \\ \hline \begin{array}{c} \text{7} \text{(i)} \sin \frac{1}{2}\theta = \frac{6}{10} \\ \text{Angle } DOE = 1.287 \text{ radians.} \end{array} \qquad M1 \\ \text{Angle } BD = (\pi - 1.287) \\ \rightarrow 61.1 \end{array} \qquad M1 \\ \hline \begin{array}{c} \text{M1} \\ \text{M1} \\ \text{M2} \end{array} \qquad Use of trig with/without radians \\ \text{Correct angle } co \\ \text{Correct angle } co \\ \text{Correct angle } co \\ \text{Correct over all method for perimeter.} \end{array} \\ \hline \begin{array}{c} \text{M1} \\ \text{M1} \\ \text{M2} \\ \text{M3} \\ \text{M4} \end{array} \qquad Use of trig with/without radians \\ \text{Correct angle } co \\ \text{Correct angle } co \\ \text{Correct angle } co \\ \text{Correct over all method for perimeter.} \end{array}$		0C = -1 - 2j + 10k		
$\overrightarrow{AB.CB} = 16$ $\overrightarrow{AB.CB} = 36$ $\overrightarrow{AB.CB} = 46$ $\overrightarrow{AB.CB} = 4$				
AB.CB = 10MIFor product of 2 moduli and cosine $\overrightarrow{AB.CB} = \sqrt{36}\sqrt{36}\cos\theta$ M1For product of 2 moduli and cosine $\theta = 63.6^{\circ}$ M1A1(ii) Perimeter = 6 + 6 + $\sqrt{40}$ [6]or 6 + 6 + 6 \sin 31.8^{\circ} \times 2M1 $\rightarrow 18.32$ M17 (i) $\sin \frac{1}{2}\theta = \frac{6}{10}$ M1Angle $DOE = 1.287$ radians.M1(ii) $P = 12 + 12 + 2 \times 10 \times angle BOD$ M1Angle $BOD = (\pi - 1.287)$ M1 $\rightarrow 61.1$ M1(iii) Sector $DOE = \frac{1}{2} \times 10^2 \times 1.287$ M1(iii) Sector $DOE = \frac{1}{2} \times 10^2 \times 1.287$ M1		$(\pm) 4\mathbf{i} + 4\mathbf{j} - 2\mathbf{k}$	BI	60
$\theta = 63.6^{\circ}$ (ii) Perimeter = $6 + 6 + \sqrt{40}$ or $6 + 6 + 6\sin 31.8^{\circ} \times 2$ $\rightarrow 18.32$ (ii) $\sin \frac{1}{2}\theta = \frac{6}{10}$ Angle $DOE = 1.287$ radians. (ii) $P = 12 + 12 + 2 \times 10 \times \text{angle } BOD$ Angle $BOD = (\pi - 1.287)$ $\rightarrow 61.1$ (iii) Sector $DOE = \frac{1}{2} \times 10^2 \times 1.287$ (iii) Sector $DOE = \frac{1}{2} \times 10^2 \times 1.287$ (iii) Sector $DOE = \frac{1}{2} \times 10^2 \times 1.287$ (iii) Sector $DOE = \frac{1}{2} \times 10^2 \times 1.287$ (iii) Sector $DOE = \frac{1}{2} \times 10^2 \times 1.287$ (iii) Sector $DOE = \frac{1}{2} \times 10^2 \times 1.287$ (iii) Sector $DOE = \frac{1}{2} \times 10^2 \times 1.287$ (iii) Sector $DOE = \frac{1}{2} \times 10^2 \times 1.287$ (iii) Sector $DOE = \frac{1}{2} \times 10^2 \times 1.287$ (iii) Sector $DOE = \frac{1}{2} \times 10^2 \times 1.287$ (iv) Sector $DOE = \frac{1}{2} \times 10^2 \times 10^2 \times 10^2$ (iv) Sector $DOE = \frac{1}{2} \times 10^2 \times 1$		$\overrightarrow{AB.CB} = 16$	M1	Needs to be scalar.
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$		$\overrightarrow{AB}.\overrightarrow{CB} = \sqrt{36}\sqrt{36}\cos\theta$	M1	For product of 2 moduli and cosine
(ii) Perimeter = $6 + 6 + \sqrt{40}$ or $6 + 6 + 6 \sin 31.8^{\circ} \times 2$ $\rightarrow 18.32$ M1 A1Correct overall method for perimeter. co7(i) $\sin \frac{1}{2}\theta = \frac{6}{10}$ Angle $DOE = 1.287$ radians.M1 A1Use of trig with/without radians co - answer given.(ii) $P = 12 + 12 + 2 \times 10 \times$ angle BOD Angle $BOD = (\pi - 1.287)$ $\rightarrow 61.1$ M1 M1 A1 (iii) Sector $DOE = \frac{1}{2} \times 10^2 \times 1.287$ Use of $s = r\theta$ for arc length. Correct formula used with radians.		$\theta = 63.6^{\circ}$	M1 A1	All correct.
or $6+6+6\sin 31.8^{\circ} \times 2$ $\rightarrow 18.32$ M1 A1Correct overall method for perimeter. co7 (i) $\sin \frac{1}{2}\theta = \frac{6}{10}$ Angle $DOE = 1.287$ radians.M1 A1 (ii) $P = 12 + 12 + 2 \times 10 \times angle BOD$ Angle $BOD = (\pi - 1.287)$ $\rightarrow 61.1$ M1 A1 (iii) Sector $DOE = \frac{1}{2} \times 10^2 \times 1.287$ Use of trig with/without radians co - answer given.(iii) Sector $DOE = \frac{1}{2} \times 10^2 \times 1.287$ M1 M1 M1 M1Correct formula used with radians.			[6]	
$ \begin{array}{c} Order of control control control of the prime entrol of prime entrol$			M1	Correct overall method for perimeter
Image: Point				·
7(i) $\sin \frac{1}{2}\theta = \frac{6}{10}$ M1Use of trig with/without radiansAngle $DOE = 1.287$ radians.A1 $co - answer given.$ (ii) $P = 12 + 12 + 2 \times 10 \times angle BOD$ M1Use of $s = r\theta$ for arc length.Angle $BOD = (\pi - 1.287)$ M1Correct angle $\rightarrow 61.1$ [3]M1(iii) Sector $DOE = \frac{1}{2} \times 10^2 \times 1.287$ M1		10.02		
Angle $DOE = 1.287$ radians.A1co - answer given.(ii) $P = 12 + 12 + 2 \times 10 \times$ angle BOD Angle $BOD = (\pi - 1.287)$ $\rightarrow 61.1$ M1Use of $s = r\theta$ for arc length. Correct angle co(iii) Sector $DOE = \frac{1}{2} \times 10^2 \times 1.287$ M1Correct formula used with radians.				
(ii) $P = 12 + 12 + 2 \times 10 \times \text{angle } BOD$ Angle $BOD = (\pi - 1.287)$ $\rightarrow 61.1$ (iii) Sector $DOE = \frac{1}{2} \times 10^2 \times 1.287$ $\begin{bmatrix} 2 \\ M1 \\ M1 \\ Correct angle \\ co \\ [3] \end{bmatrix}$ $\begin{bmatrix} 2 \\ M1 \\ Correct formula used with radians. \end{bmatrix}$	7		M1	Use of trig with/without radians
(ii) $P = 12 + 12 + 2 \times 10 \times \text{angle } BOD$ Angle $BOD = (\pi - 1.287)$ $\rightarrow 61.1$ (iii) Sector $DOE = \frac{1}{2} \times 10^2 \times 1.287$ M1 Use of $s = r\theta$ for arc length. M1 Correct angle co [3] M1 Correct formula used with radians.		Angle $DOE = 1.287$ radians.		co – answer given.
Angle $BOD = (\pi - 1.287)$ $\rightarrow 61.1$ (iii) Sector $DOE = \frac{1}{2} \times 10^2 \times 1.287$ M1 Correct formula used with radians.		(ii) $P = 12 + 12 + 2 \times 10 \times \text{angle } BOD$		Use of $s = r\theta$ for arc length.
(iii) Sector $DOE = \frac{1}{2} \times 10^2 \times 1.287$ [3] Correct formula used with radians.		Angle <i>BOD</i> = $(\pi - 1.287)$	M1	Correct angle
(iii) Sector $DOE = \frac{1}{2} \times 10^2 \times 1.287$ M1 Correct formula used with radians.		$\rightarrow 61.1$		со
Triangle $DOF = \frac{1}{4} \times 10^2 \times \sin 1.287$ M1 Correct formula used with radians				Correct formula used with radians.
		Triangle $DOE = \frac{1}{2} \times 10^2 \times \sin 1.287$	M1	Correct formula used with radians.
Area = $\pi \times 10^2 - (2 \text{ sectors} - 2 \text{ triangles})$ (or $48 + 48 + 2 \times \frac{1}{2} \times 10^2 \times (\pi - 1.287)$				
M1 M1				
$\rightarrow 281 \text{ or } 282 \qquad \qquad A1 \qquad \qquad [3] \qquad co$		$\rightarrow 281 \text{ or } 282$		со

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					[
8	(i)		nt of $AC = (2, 3)$	B1	Co		
			$t \text{ of } AC = \frac{1}{3}$				
			t of $BD = -3$	M1	Use of m_1m_2	2 = -1	
		Equation	y - 3 = -3(x - 2)	A1	Co		
	(ii)	If $\mathbf{r} = 0$	y = 9, B(0, 9)	[3] B1√	$\sqrt{1000}$ on his equ	untion	
	(11)		nove $D(4, -3)$	M1 A1	Valid metho		
		,		[3]			
	(iii)	$AC = \sqrt{4}$	$\overline{40}$				
	()	$BD = \sqrt{1}$		M1	Correct use on either AC or BD,		
				M1 A1	Full and correct method. co		
		Area = 4		[3]	Full and correct method. co		
		(or by m	atrix method M2 A1)	[3]			
0		$x + \frac{4}{-}$					
9	<i>y</i> =	x + - x					
		4					
	(i)	$x + \frac{4}{-} =$	$5 \to A(1, 5), B(4, 5)$	B1 B1	co. co.		
		x					
		dy_{-1}	4	M1	Differentiat	25	
		$\frac{\mathrm{d}y}{\mathrm{d}x} = 1 - \frac{1}{2}$	$\frac{1}{x^2}$	1 v1 1	Setting to 0. co.		
		= 0 when	n $x = 2, M(2, 4).$	DM1 A1			
				[5]			
	(ii)	Volofe	ylinder = $\pi 5^2.3$	B1	Any valid method.		
	(11)		·	M1	Attempt at integrating y^2		
		v or unde	er curve = $\pi \int y^2 dx$	111	7 tuempt at 1	integrating y	
			r^{3} 16				
		Integral	$=\frac{x^{3}}{3}-\frac{16}{x}+8x$	A2, 1, 0	Allow if no	π present.	
			5 %	514	··· · · · ·		
			limits "1 to 4"		Using his limits.		
		$\rightarrow / 5\pi$	$-57\pi = 18\pi$	A1 [6]	co.		
				[0]	·]		
10	f: x	$x \mapsto 2x^2$ -	-8x + 14				
	(i)	y + kx =	12, Sim Eqns.	M1	Complete el	limination of y (or	(x)
		$\rightarrow 2x^2 -$ Use of b	8x + kx + 2 = 0	A1	TT 12 4	0	· · · · · · · · · · · · · · · · · · ·
			$(-4ac)^{2} = 16 \rightarrow k = 12 \text{ or } 4.$	M1] $\sqrt{1}$ for <i>c</i> or from calculus.		"x" in a, b, c .
		$\rightarrow (k - c)$	$5) -10 \rightarrow k - 12 \text{ or } 4.$	A1 [4]			
	(ii)	$2x^2 - 8x$	$+14 = 2(x-2)^2 + 6$	B1×3			
	()		_() _	[3]			
	(iii)	Range of	$f f \ge 6.$	B1√			
				[1]			
	(iv)	Smallest	A = 2	B1√	$\sqrt{1}$ to answer to (ii).		
	()	Malar	the subject	[1]			
	(V)		the subject	M1 M1	Could interchange <i>x</i> , <i>y</i> first. Order must be correct.		
		Order of	operations correct.	1 VI 1	Order must	de correct.	
		-1()	$\overline{x-6}$. 1			
		g'(x) =	$\sqrt{\frac{x-6}{2}+2}$	A1	со		
			· -	[3]			