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.

CIE is publishing the mark schemes for the October/November 2009 question papers for most IGCSE,
GCE Advanced Level and Advanced Subsidiary Level syllabuses and some Ordinary Level
syllabuses.
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.
### Question 1

\[
\frac{dy}{dx} = \frac{3}{\sqrt{x}} - x
\]

\[
(y) = 6\sqrt{x} - \frac{x^2}{2} + c
\]

(4, 6) fits \(6 = 12 - 8 + c\)

\[
\rightarrow c = 2
\]

- **B1, B1**: B1 for each term
- **M1, A1**: Uses (4, 6) in an integration with +c

### Question 2

\[(x + k)^3\]

- **B3, 2, 1**: Loses 1 for each error. He can gain these marks if appropriate in (ii).

#### (i)

\[k^8 + 8k^7x + 28k^6x^2 + 56k^5x^3\]

- **M1, A1**: Correct method of solving. co.

#### (ii)

\[28k^6 = 56k^5\]

\[
\rightarrow k = 2
\]

### Question 3

- **B1, MA1**: For both expressions. Correct method of solution. co (nb no working, \(d\) correct, \(a\) wrong 0/3)

#### (i)

\[a + d = 96\] and \[a + 3d = 54\]

\[
\rightarrow d = -21 \quad a = 117
\]

- **B1, MA1**: For both expressions. Correct method of solution.

#### (ii)

\[ar = 96\] and \[ar^3 = 54\]

\[
\rightarrow r^2 = \frac{54}{96} \rightarrow r = \frac{3}{4}
\]

\[
\rightarrow a = 128
\]

- **B1, M1, A1**: For both expressions. Correct method of solution. co. \(r = \pm \frac{3}{4}\), no penalty.

### Question 4

- **B1, B1**: B1 for 2, B1 for 8. Must be stated, not on graph.

#### (i)

\[2 \leq f(x) \leq 8\]

- **B1, MA1**: 1 complete oscillation

#### (ii)

\[x \mapsto 5 - 3\sin 2x\]

- **B1**: 1 complete oscillation

#### (iii)

No inverse – not 1 : 1.

- **B1**: co. Independent of graph.
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| 5 | (i) \((\sin x + \cos x)(1 - \sin x \cos x)\)  | M1 | Needs 4 terms from the product.  
|   | \(= \sin x + \cos x - \sin^2 x \cos x - \cos^2 x \sin x\)  | M1 | Needs to be used once.  
|   | \(\sin^2 x = 1 - \cos^2 x\) and \(\cos^2 x = 1 - \sin^2 x\)  | A1 | All ok.  
|   | \(\rightarrow \sin^3 x + \cos^3 x\)  |   |   |
| (ii) | \((\sin x + \cos x)(1 - \sin x \cos x) = 9 \sin^3 x\)  | M1 | Uses \(\tan^3 x = \frac{\sin x}{\cos x}\) \(\rightarrow \tan^3 x = k\).  
|   | Uses part (i) \(\rightarrow 8 \sin^3 x = \cos^3 x\)  | A1 | Co. \(\sqrt{180^\circ + \text{first answer}}\) and providing there are no other answers in range.  
|   | \(\rightarrow \tan x = \frac{1}{2}\)  | B1√ | [3] |
|   | \(\rightarrow x = 26.6^\circ\) and \(206.6^\circ\)  |   |   |
| 6 | (i) \(\overrightarrow{OQ} = 3i + 3j + 6k\)  | B1 | co  
|   | \(\overrightarrow{PQ} = -3i + j + 6k\)  | B2, 1 | Loses one for each error.  
| (ii) | \((3i + 3j + 6k) \cdot (-3i + j + 6k)\)  | M1 | Use of \(x_1x_2 + y_1y_2 + z_1z_2\) co.  
|   | \(= -9 + 3 + 36 = 30\)  | M1 | Correct method for modulus (once) and all correctly linked. co.  
|   | \(\theta = 53.0^\circ\)  | M1A1 | nb \(\overrightarrow{OQ} \cdot \overrightarrow{OP}\) can gain 4/4.  
|   | Cosine rule M1 modulus  |   | but \(\overrightarrow{OQ} \cdot \overrightarrow{PO}\) can only gain 3/4.  
|   | M1 attempt at 3 sides  |   | Use of other vectors (e.g. \(\overrightarrow{OP} \cdot \overrightarrow{OQ}\)) M3 ok.  
|   | M1 A1 answer.  |   |   |
| 7 | (i) \(2r + r\theta = 50\)  | M1 | Must use \(s = r\theta\) and link with perimeter  
|   | \(\theta = \frac{1}{r} (50 - 2r)\)  | A1 | co  
|   | \(A = \frac{1}{2} r^2 \theta\)  | M1 | Used with \(\theta\) as \(f(r)\)  
|   | \(\rightarrow A = 25r - r^2\)  | A1 | co (answer given)  
| (ii) | \(\frac{dA}{dr} = 25 - 2r\)  | B1 | [4] |
|   | \(= 0\) when \(r = 12.5\)  | M1 | sets differential to 0 + solution  
|   | \(A = 156\frac{1}{4}\)  | A1 | co  
|   | \(2^{nd}\) differential negative \(\rightarrow\) Maximum  | B1 | Could be quoted directly from quadratic.  
|   |   |   |   |
### Question 8

\( x \mapsto \frac{3}{2x+5} \)

(i) \( f'(x) = -3(2x + 5)^{-2} \times 2 \)

\( f'(x) \) is negative → decreasing

\[ \text{B1 B1 [3] B1 for } -3(2x + 5)^{-2}. \text{ B1 for } \times 2 \]

\( \text{√ providing bracket is squared. (using value or values only B0) } \]

(ii) \( y = \frac{3}{2x+5} \rightarrow 2x + 5 = \frac{3}{y} \)

\( \rightarrow f^{-1}(x) = \frac{1}{2} \left( \frac{3}{x} - 5 \right) \) or \( \frac{3-5x}{2x} \)

\[ \text{M1 A1 [2] co including } f(x) \text{ not } f(y) \]

(iii) \[ \int \pi \frac{9}{(2x+5)^{\frac{3}{2}}} \, dx \]

\[ = \left( -9\pi(2x + 5)^{-\frac{1}{2}} \right) + 2 \]

\( \text{Limits } 0 \text{ to } 2 \rightarrow \pi \left( -\frac{1}{2} - 0.9 \right) \)

\( \rightarrow = 0.4\pi \) (or 1.26)

\[ \text{B1 M1 [4] B1 for } -9(2x + 5)^{-\frac{1}{2}} \]

\( \text{B1 for } \div 2 \text{ in } \int \text{ of } y^2 \)

\( \text{M1 Use of correct limits with } \int \text{ of } y^2. \)

\( \text{co} \)

### Question 9

(i) \( y\)-coordinate same as the \( y\)-coordinate of the mid-point of \( AC \).

\[ \text{B1 co} \]

(ii) \( m \text{ of } AD = \frac{8}{h} \) or \( \frac{h-12}{8} \)

\( m \text{ of } CD = \frac{8}{12-h} \) or \( \frac{-h}{8} \)

\[ \text{M1 A1 [3] any use of } y\text{-step } \div x\text{-step for M mark} \]

\( \text{A1 co} \)

\( \text{nb } AC = 20, M(6, 6) \) \( MD = 10 \rightarrow \)

\( D(16, 6) \) and \( B(-4, 6) \)

(iii) \( \text{Product of gradients } = -1 \)

\( \rightarrow h^2 - 12h - 64 = 0 \)

\( \rightarrow h = 16 \text{ or } -4 \)

so \( x_D = 16 \) and \( x_B = -4 \)

\( \text{or Pyth } h^2 + 8^2 + 8^2 + (12 - h)^2 = 400 \)

\[ \text{M1 Used correctly with the two gradients} \]

\( \text{M1 Forming a quadratic equation} \)

\( \text{DM1A1 Solution of equation. co} \]

(iv) \( \text{Area } = \sqrt{320} \times \sqrt{80} \)

\( \rightarrow 160 \)

\( \text{M1 M1 co M1 for method for one of the lengths} \)

\( \text{M1 for base } \times \text{ height. co} \)

\( \text{or Area } = 2 \times \text{area of a triangle} \)

\( \text{with base } = BD, \rightarrow 2 \times \frac{1}{2} \times 20 \times 8 = 160 \)

\( \text{or matrix method} \)

\[ \text{[3]} \]
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<tr>
<td><strong>10</strong></td>
<td><strong>(i)</strong></td>
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<tr>
<td></td>
<td><strong>(a)</strong></td>
<td>$2y = x + 5, y = x^2 - 4x + 7$</td>
<td>Sim equations $→ 2x^2 - 9x + 9 = 0$</td>
<td>$→ x = 3$ or $x = 1\frac{1}{2}$.</td>
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<td></td>
<td><strong>(b)</strong></td>
<td>$\frac{dy}{dx} = 2x - 4$</td>
<td>$→ y - 4 = 2(x - 3)$</td>
<td>nb use of $y + 4$ or $x, y$ interchanged M1 A0</td>
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<td><strong>(c)</strong></td>
<td>$m = 2$ $→$ angle of 63.4º</td>
<td>$m = \frac{1}{2}$ $→$ angle of 26.6º</td>
<td>$→$ angle between $= 37º$</td>
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<td><strong>(ii)</strong></td>
<td>$y = x^2 - 4x + 7, 2y = x + k$</td>
<td>Sim eqns $→ 2x^2 - 9x + 14 - k = 0$</td>
<td>Uses $b^2 - 4ac$, $81 - 8(14 - k)$</td>
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<td>Key value is $k = 3.875$ or $31/8$.</td>
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<td>$k &lt; 3.875$</td>
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<tr>
<td></td>
<td>Complete elimination of $x$ or $y$</td>
<td>Correct method for quadratic. co.</td>
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<tr>
<td></td>
<td>M1</td>
<td>DM1 A1</td>
<td>[3]</td>
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<td>B1</td>
<td>co</td>
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<td>M1 A1</td>
<td>[3]</td>
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<td>Correct form of eqn with $m$ numeric. co</td>
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<td>M1</td>
<td>Finds angle with $x$-axis once.</td>
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<td>M1A1</td>
<td>Subtracts two angles. co.</td>
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<td>[3]</td>
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<td></td>
<td>M1</td>
<td>Eliminates $y$ or $x$ completely. Co ($= 0$)</td>
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<td></td>
<td></td>
<td>M1</td>
<td>Uses $b^2 - 4ac = 0$, or $&lt; 0$ or $&gt; 0$</td>
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<td></td>
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<td>A1</td>
<td>Co condone $\leq$.</td>
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<td>[4]</td>
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