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 should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

Cambridge will not enter into discussions about these mark schemes.

Cambridge is publishing the mark schemes for the October/November 2012 series for most IGCSE, GCE Advanced Level and Advanced Subsidiary Level components and some Ordinary Level components.
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.
The following abbreviations may be used in a mark scheme or used on the scripts:

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AEF</td>
<td>Any Equivalent Form (of answer is equally acceptable)</td>
</tr>
<tr>
<td>AG</td>
<td>Answer Given on the question paper (so extra checking is needed to ensure that the detailed working leading to the result is valid)</td>
</tr>
<tr>
<td>BOD</td>
<td>Benefit of Doubt (allowed when the validity of a solution may not be absolutely clear)</td>
</tr>
<tr>
<td>CAO</td>
<td>Correct Answer Only (emphasising that no “follow through” from a previous error is allowed)</td>
</tr>
<tr>
<td>CWO</td>
<td>Correct Working Only – often written by a ‘fortuitous’ answer</td>
</tr>
<tr>
<td>ISW</td>
<td>Ignore Subsequent Working</td>
</tr>
<tr>
<td>MR</td>
<td>Misread</td>
</tr>
<tr>
<td>PA</td>
<td>Premature Approximation (resulting in basically correct work that is insufficiently accurate)</td>
</tr>
<tr>
<td>SOS</td>
<td>See Other Solution (the candidate makes a better attempt at the same question)</td>
</tr>
<tr>
<td>SR</td>
<td>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)</td>
</tr>
</tbody>
</table>

**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.
<table>
<thead>
<tr>
<th></th>
<th>Mark Scheme</th>
<th>Syllabus</th>
<th>Paper</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>GCE AS/A LEVEL – October/November 2012</td>
<td>9709</td>
</tr>
</tbody>
</table>

1. \( \left( \frac{x^2 - \frac{a}{x}}{x} \right)^7 \)
   - Term in \( x^5 \) is \( \frac{7}{3} \times (x^2)^4 \times (-a/x)^3 \)
   - This term isolated
   - Equated to \(-280\) → \( a = 2 \).

   - Allow on own or in an expansion.
   - Correct term in \( x^5 \) selected.
   - Equated to \(-280\) [3]

2. (i) \( f(x) = \sqrt{\frac{x+3}{2}} + 1 \), for \( x \geq -3 \)
   - Make \( x \) the subject or interchanges \( x,y \)
     → \( 2(x-1)^2 - 3 \)
     → \( 2x^2 - 4x - 1 \)
   - Attempt at \( x \) as subject and removes +1
   - Squares both sides and deals with "+3" and "-2".
   - Co

   (ii) domain of \( f^{-1} \) is \( \geq 1 \).

   - Co. condone > 1 [1]

3. (i) \( A = 2400 - 20(60 - 2x) - x(40 - x) - 30x \)
   → \( A = x^3 - 30x + 1200. \)
   - (could be trapezium – triangle)

   (ii) \( \frac{dA}{dx} = 2x - 30 \) or \( (x-15)^2 + 975 \)
   = 0 when \( x = 15 \) or Min at \( x = 15 \)
   → \( A = 975 \).

   - Needs attempts at all areas
   - Co answer given

   - Co - either method okay
   - Sets differential to 0 + solution. Co

4. \( y = \frac{x}{k} + k \quad 4y = x^2 \)

   (i) \( \frac{x^2}{4} = \frac{x}{k} + k \)
   → \( kx^2 - 4x - 4k^2 = 0 \)
   - Uses \( b^2 - 4ac \) → \( k = -1 \)
   - Eliminates \( x \) or \( y \) completely.
   - Uses \( b^2 - 4ac \) for a quadratic = 0
   - Co nb \( a,b,c \) must not be \( f(x) \)

   (calculus \( \frac{1}{k} = \frac{2x}{4} \) B1
   → \( x = \frac{2}{k}, \ y = \frac{1}{k^2} \) M1 → \( k = -1 \) A1)

   (ii) \( y = -x - 1, \ 4y = x^2 \)
   → \( x^2 + 4x + 4 = 0 \)
   → \( P(-2, 1) \)

   - Elimination of \( x \) or \( y \)
   - Soln of eqn. Co

   - M1 A1 [3]
### Question 5

**A (1, 3), B (5, 11), X (4, 4)**

(i) Gradient of \(AB\) = 2

Gradient of \(BC\) = \(-\frac{1}{2}\)

→ Eqn of \(BC\) is \(y - 11 = -\frac{1}{2}(x - 5)\)

(ii) Gradient of \(AC\) (or \(AX\)) is \(\frac{1}{3}\)

→ Eqn of \(AC\) is \(y - 3 = \frac{1}{3}(x - 1)\)

or \(y - 4 = \frac{1}{3}(x - 4)\)

Sim equations → \(C (13, 7)\)

**Mark Scheme**

- B1 for use of \(m_1, m_2 = -1\)
- M1 for \(m_1, m_2 = -1\)
- A1 for co–ununsimplified is fine

**Total** [3]

### Question 6

\(2 \cos x = 3 \tan x\)

(i) Replaces \(\tan x\) by \(\sin x / \cos x\)

→ \(2c^2 = 3s \rightarrow 2s^2 + 3s - 2 = 0\)

(ii) Soln of quadratic

→ \(y = 15^\circ\)

\(2y\) can also be \(180 - 30\)

→ \(y = 75^\circ\).

**Mark Scheme**

- M1 for \(t = s + c\)
- M1 A1 for \(s^2 + c^2 = 1\). Correct eqn.

**Total** [3]

### Question 7

\[\overrightarrow{OA} = \begin{pmatrix} 0 \\ 0 \\ 1 \end{pmatrix}, \quad \overrightarrow{OB} = \begin{pmatrix} -k \\ 2k \\ k \end{pmatrix}\]

(i) \(\begin{pmatrix} 1 \\ 0 \\ 2 \end{pmatrix}, \begin{pmatrix} 2 \\ -2 \\ 4 \end{pmatrix} = 10\)

\[= \sqrt{5} \times \sqrt{24} \cos \theta\]

→ \(\theta = 24.1^\circ\)

(ii) \(\overrightarrow{AB} = \begin{pmatrix} k-1 \\ -k \\ 2k-2 \end{pmatrix}\) allow each cpt ±

\[(k - 1)^2 + k^2 + (2k - 2)^2\]

→ \(6k^2 - 10k + 4 = 0\)

→ \(k = 1\) or \(\frac{2}{3}\)

**Mark Scheme**

- M1 for use of \(x_1x_2 + y_1y_2 + z_1z_2\)
- M1 A1 for product of 2 moduli
- A1 for all connected correctly. co

**Total** [4]
8  (a)  (i)  \( ar = 24, \ ar^3 = 13\frac{1}{2} \)
Eliminates \( a \) (or \( r \))  \( \rightarrow r = \frac{3}{4} \)
\( \rightarrow a = 32 \)
(b)  \( a = 3, \ d = 2 \)
\( \frac{n}{2} (6 + (n - 1)2) = 360 \)
\( \rightarrow 2n^2 + 4n - 720 = 0 \)
\( \rightarrow n = 18 \)

Both needed
Method of Solution.

A1

[3]

Correct formula used. √ on value of \( r \)

M1A1

[2]

Correct value for \( d \)

M1

Correct \( S_n \) used. no need for 360 here.

A1

Correct quadratic

A1

co

9  \( y = \frac{9}{2x + 3} \)  \( A (3, 1) \)  \( B (0, 3) \)

(i)  \( \frac{dy}{dx} = \frac{-9}{(2x + 3)^2} \times 2 \)
\( \rightarrow m = \frac{-3}{2} \)
\( \rightarrow y - 1 = \frac{-3}{2}(x - 3) \)

Correct without the \( \times 2 \). For \( \times 2 \),
independent of first part.

B1 B1

M1

For his \( m \) following use of \( \frac{dy}{dx} \).
(normal → max 2/4, no calculus 0/4)

A1√

[4]

Sets \( x \) to 0 in his tangent.

B1

[1]

The 1½ and part (i) must be correct.

(ii)  Meets the \( y \)-axis when \( x = 0, \ y = 1\frac{1}{2} \)
This is nearer to \( B \) than to \( O \).

(iii) Integral of \( \frac{81}{(2x + 3)^2} = \frac{-81}{2x + 3} \)
Uses limits 0 to 3  \( \rightarrow \frac{-81}{2} - \frac{-81}{6} = 9\pi \)

Correct without the \( \div 2 \). For \( \div 2 \),

B1 B1

M1

Use of limits with integral of \( x^2 \) only
no \( \pi \) – max ¾. Use of area - 0/4,
### Question 10

\[ \frac{dy}{dx} = x + \frac{4}{x^2} \text{ and } P(4,8) \]

(i) \[ y = \frac{x^2}{2} - \frac{4}{x} + (c) \]

Uses \((4,8)\) \rightarrow \(c = 1\)

(ii) \[ \frac{d^2y}{dx^2} = 1 - \frac{8}{x^3} \]

\[ = 0 \text{ when } x = 2 \]

\[ \rightarrow \text{gradient of } 3 \]

\[ \frac{d/dx(1-8/x^3)}{x^4} = \frac{24}{x^4} \rightarrow +ve \rightarrow \text{Min.} \]

**Mark Scheme**

- B1 B1 co.co (ignore +c at this stage)
- M1 A1 Uses the point after integration for c
- [4]

**Co.**

**Sets to 0 + solution or verifies and states a conclusion (stationary or min)**

- B1 Allow for \(x = 2\) into \(dy/dx\).
- B1 Any valid method - 3rd differential +ve
- 2nd diff goes −0+, or 1st goes >3,3,>3

**Mark Scheme**

- [4]

### Question 11

(i) \(OQ = x + OC = 20\)

\[ \sin 0.6 = \frac{x}{OC} \rightarrow OC = \frac{x}{\sin 0.6} \]

\[ x + \frac{x}{\sin 0.6} = 20 \rightarrow x = 7.218 \]

(ii) Area = \(\frac{1}{2} \times 20^2 \times 1.2 - \pi \times 7.218^2\)

\[ = 76.3 \]

(iii) Angle \(PCR = \pi - 1.2\)

\[ \text{Arc } PR = 7.218 \times (\pi - 1.2) = (14.01) \]

\[ OP = OR = \frac{x}{\tan 0.6} \]

\[ \rightarrow \text{Perimeter of 35.1 cm} \]

**Mark Scheme**

- B1 Used somewhere – needs “20”.
- M1 Use of trig in 90º triangle
- M1 A1 Soln of linear equation. (answer given, ensure there is a correct method)
- [4]

- B1 Use of \(\frac{1}{2}r^2\theta\) - needs \(r=20\) and \(\theta = 1.2\)
- A1 co

- B1 Use of \(s=r\theta\) with \(r = 7.218\) -any \(\theta\) -even \(2\pi/3\)
- M1 Correct use of trig or Pythagoras

- A1 co