This mark scheme is published as an aid to teachers and students, 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.

All Examiners are instructed that alternative correct answers and unexpected approaches in candidates’ scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

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

The grade thresholds for various grades are published in the report on the examination for most IGCSE, GCE Advanced Level and Advanced Subsidiary Level syllabuses.

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

CIE is publishing the mark schemes for the October/November 2006 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.
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
The term in $x^2$ has

$$6C_2 \times (x)^4 \times (2/x)^2$$

$\rightarrow$ 60 (needs selecting)

(first 2 marks can be obtained from expansion only)

**Binsomial coeff.**

Needs $2^5 = 2x^2$ gets B1. Needs ( ) co.

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### Question 2
\[
2. x = \sin^{-1} \frac{3}{4} \rightarrow \sin x = \frac{3}{4} \\
(i) \quad \cos^2 x = 1 - \sin^2 x = \frac{11}{16} \\
(ii) \quad \tan^2 x = \frac{\sin^2 x}{\cos^2 x} = \frac{9}{11}
\]

**M1 A1**

Formula only-use of 90° triangle ok co – loses if decimals blatantly used
Formula only – or use of triangle ok Correct from his answer to (i).

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### Question 3
\[
OC = 6\sqrt{3} \text{ and } AC = 6 \\
\text{Sector area} = \frac{1}{2} r^2 \theta \quad [= 24\pi] \\
\text{Area of rectangle} = 12 \times 6\sqrt{3} \\
\text{Area of triangle} = \frac{1}{2} \times 6 \times 6\sqrt{3} \\
\rightarrow 54\sqrt{3} - 24\pi
\]

**B1 B1**

Wherever these come. (must have $\sqrt{3}$)
Use of correct formula with radians.
Use of base x height (not for $12 \times 12$)
Use of $\frac{1}{2}$ base x height (needs trig)
co. Ok without stating $a=54$, $b=24$.

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### Question 4
\[
a = \begin{bmatrix} -3 \\ 6 \\ 3 \end{bmatrix}, \quad b = \begin{bmatrix} -1 \\ 2 \\ 4 \end{bmatrix}
\]

\[
(i) \quad a \cdot b = 3 + 12 + 12 = 27 \\
\quad a \cdot b = \sqrt{54} \times \sqrt{21} \cos \theta \\
\quad \rightarrow \theta = 36.7° \text{ or } 0.641 \text{ radians}
\]

\[
(ii) \quad \text{Vector } AB = b - a = \begin{bmatrix} 2 \\ -4 \\ 1 \end{bmatrix}
\]

\[
\text{Vector } OC = \begin{bmatrix} -3 \\ 6 \\ 3 \end{bmatrix} + 3 \begin{bmatrix} 2 \\ -4 \\ 1 \end{bmatrix} = \begin{bmatrix} 3 \\ -6 \\ 6 \end{bmatrix}
\]

\[
\text{Unit vector } = \text{Vector } OC + \theta = \frac{\pi}{3} \text{ or } \frac{\pi}{3} \hat{j} + \frac{\pi}{3} \hat{k}
\]

**Ok to work throughout with column vectors or with $i,j,k$.**

Use of $x_1x_2+y_1y_2+z_1z_2$

Use of $\sqrt{\cos \theta}$

In either degrees or in radians.

For use of $b - a$.

For $a + 3(b - a)$ or equivalent

For division by Modulus of $OC$. Co.
5. (i) \( m_{\text{of AB}} = \frac{8}{12} \)
   \( m_{\text{of perpendicular}} = -\frac{12}{8} \)
   eqn of \( CD \): \( y - 15 = -\frac{1}{2}(x - 6) \)
   
(ii) eqn of \( AB \): \( y - 3 = \frac{4}{3}(x - 1) \)
   Sim eqns 2y + 3x = 48 and 3y = 2x + 7
   \[ D(10, 9) \]
   
   M1
   M1 A1 [3]
   Use of \( m_1m_2 = -1 \) and \( y\)-step/x-step
   Correct form of eqn of line. co.

   M1 A1 √
   DM1
   Could be given in (i)
   Needs both M marks from (i). co.

6. (a) \( a = 105 \)
   Either \( I = 399 \) or \( d = 7 \)
   \( n = 43 \)
   \[ \rightarrow 10836 \]
   
(b) \( r^2 = \frac{64}{144} \rightarrow r = \frac{2}{3} \)

(i) Either \( x = ar \rightarrow x = 96 \)
   or \( \frac{144}{x} = \frac{x}{64} \rightarrow x = 96 \)
   
(ii) Use of \( S_n = \frac{\frac{a}{1-r}}{} \)
   \[ \rightarrow 432 \]
   
   B1
   B1
   B1
   B1 [4]
   co
   co
   co
   co

   M1
   M1 A1
   either method ok

   M1
   Used with his \( a \) and \( r \)

   Co
   (nb do not penalise if \( r \) and \( I \) or \( x \)
   negative as well as positive.)

7. (i) \( y = x^3 - 3x^2 + 2x \)
   \[ \frac{dy}{dx} = 3x^2 - 6x + 2 \]
   At \( A(1, 0) \), \( m = -1 \rightarrow y = -1(x - 1) \)
   At \( B(2, 0) \), \( m = 2 \rightarrow y = 2(x - 2) \)
   Sim equations \[ \rightarrow x = \frac{2}{3} \]

   M1 A1
   Attempt at differentiation. co.

   M1 once
   Correct form of eqn of tangent – not normal.

   M1 A1 [5]
   Solution of Sim Eqns – even if normals.

   M1
   Attempt at integration.

   A1 √
   DM1
   Integration correct for his cubic
   Correct use of limits once.

   Both correct (allow ± in either/both
   cases) \((0 \text{ to } 2 \rightarrow 0 + \text{ reason ok})\
   Ignore errors over ±
8. \( y = \frac{6}{5 - 2x^2} \)

(i) \( \frac{dy}{dx} = -6(5 - 2x)^{-2} \times (-2) = \frac{12}{(5 - 2x)^2} \rightarrow \frac{4}{3} \)

(ii) Use of chain rule.
\( \frac{dx}{dt} = 0.02 + (i) = 0.015 \)

(iii) \( V = \pi \int \left( \frac{36}{(5 - 2x)^2} \right) dx \)
\( = 36\pi \left[ \frac{(5 - 2x)^{-1}}{-1} \right] + (-2) \)
\( [1] - [0] = \frac{12\pi}{5} \)

B1 M1 B1 for \( \frac{dy}{dx} = -6(5 - 2x)^{-2} \). M1 for \((-2)\)
A1 Co.

9. (i) Height = 3x.
\( 10xy + \frac{1}{2} 8x.3x = 200 \)
\( 
\rightarrow \frac{y}{10x} = 200 - 24x^2 
\)

(ii) \( V = \frac{1}{2} 8x.3xy = 240x - 28.8x^3 \)

(iii) \( \frac{dV}{dx} = 240 - 86.4x^2 \)
\( = 0 \) when \( x = 1.5 \).

(iv) \( \frac{d^2V}{dx^2} = -172.8x \)
\( \rightarrow \text{ve} \rightarrow \text{Maximum} \)

B1 M1 Anywhere in the question.
A1 Linking 200 with 4/5 areas. Allow slight slip in formulae (particularly with 1/2).
A1 co. Answer given.

M1 A1 M1 for statement "V=area x y". co ag.

M1 Attempt at differentiating.

DM1 A1 Sets to 0 and attempts to solve. co.

M1 Looks at sign of 2nd differential.
A1 + Correct deduction from correct diff.

10. (i) \( x^2 - 3x - 4 \rightarrow -1 \) and 4
\( \rightarrow x < -1 \) and \( x > 4 \)

(ii) \( x^2 - 3x = (x - \frac{1}{2})^2 - \frac{9}{4} \)

(iii) \( f(x) \) (or \( y \)) \( \geq -\frac{9}{4} \)

(iv) No inverse – not 1 : 1.

(v) Quadratic in \( \sqrt{x} \).
Solution \( \sqrt{x} = 5 \) or \(-2 \)
\( \rightarrow x = 25 \)

M1 A1 Solving Quadratic = 0. Correct values. co. – allow s and/or \( z \). 4<x<-1 ok
A1

B1 B1 B1 for \( \frac{1}{2} \). B1 for \( \frac{9}{4} \).

B1 + \( \sqrt{f(x)} \geq "-\text{b}" \)

B1 Independent of previous working.

M1 DM1 A1 Recognition of "Quadratic in \( \sqrt{x} \)"
Method of solution.
co. Loses this mark if other answers given. Nb ans only full marks.