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

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)

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)

**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.

OW –1,2  This is deducted from A or B marks when essential working is omitted.

PA –1  This is deducted from A or B marks in the case of premature approximation.

S –1  Occasionally used for persistent slackness – usually discussed at a meeting.

EX –1  Applied to A or B marks when extra solutions are offered to a particular equation. Again, this is usually discussed at the meeting.
1. (i) Correct diagram \(B1\)
(ii) Correct diagram \(B1\)
(iii) Correct diagram \(B1\) [3]

2. \((2x + 1)^2 > 8x + 9\)
\(4x^2 - 4x - 8 > 0\)
\(x^2 - x - 2 > 0\)
\((x + 1)(x - 2) > 0\)
Leads to critical values \(x = -1, 2\)
x < -1 and x > 2

\(x = -1, 2\)
\(x < -1\) and \(x > 2\)

3. \(LHS = \frac{\sin^2 A + 1 + \cos^2 A + 2 \cos A}{(1 + \cos A) \sin A}\)
\(= \frac{2 + 2 \cos A}{(1 + \cos A) \sin A}\)
\(= \frac{2}{\sin A}\) leading to \(2 \cos \text{cosec} A\)

\(M1\) for attempt to deal with fractions and attempt to obtain numerator
\(A1\) correct

\(M1\) for use of \(\sin^2 A + \cos^2 A = 1\)

4. Substitution of \(x = 1\)
leading to \(a + b + 4 = 0\)
Substitution of \(x = -\frac{1}{2}\)
leading to \(-a + 2b - 28 = 0\)

Leading to \(a = -12, b = 8\)

\(M1\) for solution
\(A1\) for both [5]

5. (i) \(2t^2 - 9t - 5 = 0\)
\((2t + 1)(t - 5) = 0\)
\(t = \frac{1}{2}, t = 5\)

\(M1\) for attempting to form a quadratic in \(t\)
\(DM1\) for attempt to solve a 3 term quadratic
\(A1\) both correct [3]

(ii) \(x^2 = -0.5, 5\)
x = 0.25, 25

\(M1\) for realising that \(x^{0.5}\) is equivalent to \(t\) (or valid attempt at solution)

\(A1, A1\) [3]

6. (i) \(a = \frac{1}{13}(5i - 12j)\)

\(M1, A1\) [2]

(ii) \(q(5i - 12j) + pi + j = 19i - 23j\)
\(5q + p = 19\)
\(-12q + 1 = -23\)

Leading to \(q = 2, p = 9\)

\(M1\) for equating like vectors
\(M1\) for solution of (simultaneous) equations
\(A1\) for both [3]
### Question 7

(i) \( y = 4x^2 - 12x + 3 \)
\( y = (2x - 3)^2 - 6 \)

(ii) \( \left( \frac{3}{2}, -6 \right) \)

(iii) \( f \geq -6 \)

B1 for 2 (part of linear factor)  
B1 for \(-3\) (part of linear factor)  
B1 [3]  
B1 for \(-6\)  

Follow through on their \( a, b \) and \( c \)  
Allow calculus method.

### Question 8

\( \frac{dy}{dx} = -2e^{-2x}(+c) \)

When \( \frac{dy}{dx} = 3, x = 0, \Rightarrow c_1 = 5 \)

\( \frac{dy}{dx} = -2e^{-2x} + 5 \)

\( y = e^{-2x} + 5x (+c_2) \)

When \( x = 2, y = e^{-4} \Rightarrow c_2 = -10 \)

\( y = e^{-2x} + 5x - 10 \)

B1 for \(-2e^{-2x}\)  
M1 for attempt to find \( c_1 \)  
A1  

B1 for \(-2e^{-2x}\)  
M1 for attempt to find \( c_2 \)  
\( \sqrt{A1} [6] \) \(-2\) times their \( c_i \)

### Question 9

(i) \( 2^3 + 5C_12^4(-3x) + 5C_22^3(-3x)^2 \)
\( 32 - 240x + 720x^2 \)

B1 for 32 or \( 2^5 \)  
B1 for \(-240\)  
B1 [3]  
B1 for 720.

(ii) \( 32a = 64, \quad a = 2 \)
\( 32b - 240a = -192, \quad b = 9 \)
\( -240b + 720a = c \)
\( c = -720 \)

B1 for \( a = 2 \)  
M1 for equation in \( a \) and \( b \) equated to \( \pm 192 \)  
A1 for \( b = 9 \)  
M1 for equation in \( a \) and \( b \) equated to \( c \)  
A1 for \( c = -720 \)

### Question 10

(a) (i) \( f_g(x) = f\left( \frac{x}{x + 2} \right) \)

\( = 3 - \frac{x}{x + 2} \)

M1 for order  
A1 [2]  

(ii) \( 3 - \frac{x}{x + 2} = 10 \)
leading to \( x = -1.75 \)

DM1 for dealing with fractions sensibly  
A1 [2]

(b) (i) \( h(x) > 4 \)

B1 [1]  

(ii) \( h^{-1}(x) = e^{x-4} \)
\( h^{-1}(9) = e^5 \quad (\approx 148) \)

or \( 4 + \ln x = 9 \),
leading to \( x = e^5 \)

M1 for attempting to obtain inverse function  
A1 [2]

(iii) correct graphs

B1  
B1 for each curve  
B1 [3]  
B1 for idea of symmetry
11 (i) \( \tan^2 2x = 3 \)
\[ \tan 2x = (\pm) \sqrt{3} \]
\( 2x = 60^\circ, 120^\circ, 240^\circ, 300^\circ \)
\( x = 30^\circ, 60^\circ, 120^\circ, 150^\circ \)

(ii) \( 2 \csc^2 y + \csc y - 3 = 0 \)
\( (2 \csc y + 3)(\csc y - 1) = 0 \)
\( \csc y = -\frac{3}{2}, 1 \)
\( \sin y = -\frac{2}{3}, 1 \)
\( y = 221.8^\circ, 318.2^\circ, y = 90^\circ \)

(iii) \( \cos \left( z + \frac{\pi}{2} \right) = -\frac{1}{2} \)
\( z + \frac{\pi}{2} = \frac{2\pi}{3}, \frac{4\pi}{3} \)
\( z = \frac{\pi}{6}, \frac{5\pi}{6} \), allow 0.52, 2.62 rads

12 (i) \( \frac{dy}{dx} = \frac{(x+1)2x - x^2}{(x+1)^2} \)
\[ = \frac{x(x+2)}{(x+1)^2} \]
\( \frac{dy}{dx} = 0 \), \( x = 0, -2 \)
\( y = 0, -4 \)

(ii) gradient of normal = \(-\frac{4}{3}\)
normal \( y = -\frac{4}{3} x + \frac{11}{6} \), leads to
\( M (1.375, 0) \)
\( N (0, -4) \)
Area = 2.75