Mark Scheme for June 2010
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Any enquiries about publications should be addressed to:

OCR Publications
PO Box 5050
Annesley
NOTTINGHAM
NG15 0DL

Telephone: 0870 770 6622
Facsimile: 01223 552610
E-mail: publications@ocr.org.uk
1 (i) 

\[ \text{B1} \quad 1 \]

(ii) \[ \frac{1}{3} \]

\[ \text{M1} \quad \frac{1}{9^2} \text{ or } \frac{1}{\sqrt{9}} \text{ soi} \]

\[ \text{A1} \quad \frac{2}{3} \]

2 (i)

\[ \text{B1}^* \text{ Reasonably correct curve for } y = \frac{1}{x^2} \text{ in 3rd and 4th quadrants only} \]

\[ \text{B1} \quad \frac{2}{\text{dep}^*} \text{ Very good curves in curve for } y = \frac{1}{x^2} \text{ in 3rd and 4th quadrants} \]

\[ \text{SC If 0, very good single curve in either 3rd or 4th quadrant and nothing in other three quadrants. B1} \]

(ii)

\[ \text{M1} \text{ Translation of their } y = -\frac{1}{x^2} \text{ vertically} \]

\[ \text{A1} \quad 2 \text{ Reasonably correct curve, horizontal asymptote soi at } y = 3 \]

(iii) \[ y = -\frac{2}{x^2} \]

\[ \text{B1} \quad 1 \]

3 (i) \[ \frac{12(3 - \sqrt{5})}{(3 + \sqrt{5})(3 - \sqrt{5})} \]

\[ = \frac{12(3 - \sqrt{5})}{9 - 5} \]

\[ = \frac{9 - 3\sqrt{5}}{A1} 3 \]

\[ \text{M1} \quad \text{Multiply numerator and denom by } 3 - \sqrt{5} \]

\[ = 3(\sqrt{5})(3 - \sqrt{5}) = 9 - 5 \]

(ii) \[ 3\sqrt{2} - \sqrt{2} \]

\[ = 2\sqrt{2} \]

\[ \text{M1} \quad \text{Attempt to express } \sqrt{18} \text{ as } k\sqrt{2} \]

\[ \text{A1} \quad 2 \]

\[ \text{[5]} \]
4 (i) \((x^2 - 4x + 4)(x + 1)\)  
\[= x^3 - 3x^2 + 4\]  
M1 Attempt to multiply a 3 term quadratic by a linear factor or to expand all 3 brackets with an appropriate number of terms (including an \(x^3\) term)  
A1 Expansion with at most 1 incorrect term  
A1 3 Correct, simplified answer

(ii)  
[Graph of a cubic function with x-intercepts at (0, 4) and (2, 0), and a turning point at (2, 0).]  
B1 +ve cubic with 2 or 3 roots  
B1 Intercept of curve labelled (0, 4) or indicated on y-axis  
B1 3 (-1, 0) and turning point at (2, 0) labelled or indicated on x-axis and no other x intercepts

5 \[k = x^2\]  
\[4k^2 + 3k - 1 = 0\]  
\[(4k - 1)(k + 1) = 0\]  
\[k = \frac{1}{4}\] (or \(k = -1\))  
\[x = \pm \frac{1}{2}\]  
M1* Use a substitution to obtain a quadratic or factorise into 2 brackets each containing \(x^2\)  
M1 dep Correct method to solve a quadratic  
A1 Attempt to square root to obtain \(x\)  
A1 \(\frac{1}{2}\) and no other values  
5

6 \[y = 2x + 6x^{\frac{3}{2}}\]  
\[\frac{dy}{dx} = 2 - 3x^{\frac{1}{2}}\]  
M1 Attempt to differentiate  
A1 \[kx^{\frac{3}{2}}\]  
A1 Completely correct expression (no +c)  

When \(x = 4\), gradient = \[2 - \frac{3}{\sqrt{4^3}}\] = \[\frac{13}{8}\]  
M1 Correct evaluation of either \(4^{\frac{3}{2}}\) or \(4^{\frac{1}{2}}\)  
A1 5

7 \[2(6 - 2y)^2 + y^2 = 57\]  
\[2(36 - 24y + 4y^2) + y^2 = 57\]  
\[9y^2 - 48y + 15 = 0\]  
\[3y^2 - 16y + 5 = 0\]  
\[(3y - 1)(y - 5) = 0\]  
\[y = \frac{1}{3}\] or \(y = 5\)  
\[x = \frac{16}{3}\] or \(x = -4\)  
M1* substitute for \(x/y\) or attempt to get an equation in 1 variable only  
A1 correct unsimplified expression  
A1 obtain correct 3 term quadratic  
M1 dep correct method to solve 3 term quadratic  
A1 6 SC If A0 A0, one correct pair of values, spotted or from correct factorisation  
B1
### Question 8

**Part (i)**

\[ 2 \left( x^2 + \frac{5}{2} x \right) \]

\[ = 2 \left[ \left( x + \frac{5}{4} \right)^2 - \frac{25}{16} \right] \]

\[ = 2 \left( x + \frac{5}{4} \right)^2 - \frac{25}{8} \]

- **B1**

**Part (ii)**

\[ \left( -\frac{5}{4}, -\frac{25}{8} \right) \]

- **B1√** 2

**Part (iii)**

\[ x = -\frac{5}{4} \]

- **B1** 1

**Part (iv)**

\[ x(2x + 5) > 0 \]

- **M1**

\[ x < -\frac{5}{2}, \ x > 0 \]

- **M1**

\[ 0, -\frac{5}{2} \] seen

### Question 9

**Part (i)**

\[ \frac{4 + p}{2} = -1, \quad \frac{5 + q}{2} = 3 \]

- **M1**

\[ p = -6 \]

- **A1**

\[ q = 1 \]

- **A1** 3

**Part (ii)**

\[ r^2 = (4 - 1)^2 + (5 - 3)^2 \]

\[ r = \sqrt{29} \]

- **M1**

\[ r^2 \] uses \( (x + 1)^2 + (y - 3)^2 \) seen

- **A1** 2

**Part (iii)**

\[ (x + 1)^2 + (y - 3)^2 = 29 \]

\[ x^2 + y^2 + 2x - 6y - 19 = 0 \]

- **M1**

\[ (x + 1)^2 + (y - 3)^2 \] seen

- **M1**

\[ (x \pm 1)^2 + (y \pm 3)^2 \] = their \( r^2 \)

- **A1** 3

Correct equation in correct form

**Part (iv)**

\[ \text{gradient of radius } = \frac{3 - 5}{-1 - 4} \]

\[ = \frac{2}{5} \]

\[ \text{gradient of tangent } = -\frac{5}{2} \]

- **B1√**

\[ y - 5 = -\frac{5}{2}(x - 4) \]

- **M1**

\[ y = -\frac{5}{2}x + 15 \]

- **A1** 5

Correct equation of straight line through (4, 5), any non-zero gradient

\[ \text{oe 3 term equation e.g. } 5x + 2y = 30 \]
10(i) \( \frac{dy}{dx} = 6x^2 + 10x - 4 \)
\[ 6x^2 + 10x - 4 = 0 \]
\[ 2(3x^2 + 5x - 2) = 0 \]
\[ (3x-1)(x+2) = 0 \]
\[ x = \frac{1}{3} \text{ or } x = -2 \]
\[ y = -\frac{19}{27} \text{ or } y = 12 \]
- B1 1 term correct
- B1 Completely correct (no +c)
- M1* Sets their \( \frac{dy}{dx} = 0 \)
- M1* Correct method to solve quadratic

(ii) \(-2 < x < \frac{1}{3}\)
- M1 Any inequality (or inequalities) involving both their \( x \) values from part (i)
- A1 2 Allow \( \leq \) and \( \geq \)

(iii) When \( x = \frac{1}{2} \),
\[ 6x^2 + 10x - 4 = \frac{5}{2} \] and \( 2x^3 + 5x^2 - 4x = -\frac{1}{2} \)
\[ y + \frac{1}{2} = 5 \left( \frac{1}{2} \left( x - \frac{1}{2} \right) \right) \]
\[ 10x - 4y - 7 = 0 \]
- M1 Substitute \( x = \frac{1}{2} \) into their \( \frac{dy}{dx} \)
- B1 Correct \( y \) coordinate
- M1 Correct equation of straight line using their values. Must use their \( \frac{dy}{dx} \) value not e.g. the negative reciprocal
- A1 Shows rearrangement to given equation
- A1 4 CWO throughout for A1

(iv) Sketch of a cubic with a tangent which meets it at 2 points only

- B1 2 +ve cubic with max/min points and line with +ve gradient as tangent to the curve to the right of the min

SC1
- B1 Convincing algebra to show that the cubic
\[ 8x^3 + 20x^2 - 26x + 7 = 0 \] factorises into \( (2x - 1)(2x - 1)(x + 7) \)
- B1 Correct argument to say there are 2 distinct roots

SC2
- B1 Recognising \( y = 2.5x - \frac{7}{4} \) is tangent from part (iii)
- B1 As second B1 on main scheme