<table>
<thead>
<tr>
<th></th>
<th>(i)</th>
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<th>(ii)</th>
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<tbody>
<tr>
<td>1</td>
<td>( \left[ \frac{dy}{dx} \right] = 4 \times 2 + 3 ) or ( 11 ) isw</td>
<td>( 9 = \text{their} \ (4 \times 2 + 3) \times 2 + c )</td>
<td>( 4x^2 + 3x )</td>
<td>( \frac{4x^2 + 3x}{2} )</td>
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<tr>
<td></td>
<td>( y = 11x - 13 ) or ( y = 11x + c ) and ( c = -13 ) stated isw</td>
<td>( 2x^2 + 3x + c )</td>
<td>( y = 2x^2 + 3x + c )</td>
<td>( y = 2x^2 + 3x + c )</td>
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<td></td>
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<td></td>
<td>( 2 \times 2^2 + 3 \times 2 + c )</td>
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<td></td>
<td></td>
<td></td>
<td>( y = 2x^2 + 3x - 5 ) cao</td>
<td>(1, 0) and ((-2.5, 0)) oe cao</td>
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<td>( x = \frac{-3}{4} )</td>
<td></td>
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<td></td>
<td>( y = \frac{-49}{8} )</td>
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<tr>
<th></th>
<th>M1*</th>
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<tbody>
<tr>
<td></td>
<td>or ( y - 9 = \text{their} \ (4 \times 2 + 3) \times (x - 2) )</td>
<td></td>
<td>or see “2” and “+ c”; may be earned later eg after attempt to find ( c )</td>
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<td>M1dep*</td>
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<td>M1dep*</td>
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<td>( A1 )</td>
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<td>( A1 )</td>
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<tr>
<td></td>
<td>or ( y - 9 = 11(x - 2) ) isw</td>
<td></td>
<td>must include constant, which may be implied by answer</td>
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<td>A1</td>
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<td></td>
<td>allow first 4 marks for ( y = 2x^2 + 3x + c ) and ( c = -5 ) stated</td>
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<td>B1</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>or for ( x = 1, y = 0 ) and ( x = -2.5, y = 0 )</td>
<td></td>
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<td>B0 for just stating ( x = 1 ) and ( x = -2.5 )</td>
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|   |   |   |   |   |
### Question 1

**Part (iii)**

**Substitution to obtain**

\[ y = f(2x) \text{ in polynomial form} \]

\[ y = (2x - 1)(4x + 5) \text{ or } y = 8x^2 + 6x - 5 \]

\[ y = 2\left(2x + \frac{3}{4}\right)^2 - \frac{49}{8} \]

\[ \left(-\frac{3}{8}, -\frac{49}{8}\right) \text{ o.e.} \]

**M1**

- \( f(x) \) must be the quadratic in \( x \) with linear and constant term obtained in part (ii), may be in factorised form

**A1FT**

- must be simplified to one of these forms, **FT** their quadratic in \( x \) with linear and constant term obtained in part (ii)

**B1**

- or **FT** their (both non-zero) co-ordinates for minimum point or their quadratic in \( x \) with linear and constant term obtained in part (ii)

-or their \( x = 1 \rightarrow \) their 0.5 and their \( x = -2.5 \rightarrow \) their \( x = -1.25 \)

**oe**

---

### Question 2

\[ \frac{dy}{dx} = 32x^3 \text{ c.a.o.} \]

**M1**

\[ \frac{dy}{dx} = \frac{-1}{\text{their}^4} \]

**M1**

\[ \text{grad normal} = \frac{-1}{\text{their}^4} \]

**M1**

- when \( x = \frac{1}{2} \), \( y = 4\frac{1}{2} \text{ o.e.} \)

**B1**

\[ y - 4\frac{1}{2} = -\frac{1}{4}(x - \frac{1}{2}) \text{ i.s.w} \]

**A1**

\[ y = -\frac{1}{4}x + 4\frac{5}{8} \text{ o.e.} \]

**[3]**

\[ \frac{dy}{dx} = 32x^3 \text{ c.a.o.} \]

must see \( kx^3 \)

their 4 must be obtained by calculus
### Question 3

**Part (i)**
\[
\frac{dy}{dx} = 4x^3
\]
when \(x = 2\), \(\frac{dy}{dx} = 32\) s.o.i.

when \(x = 2\), \(y = 16\) s.o.i.

\(y = 32x - 48\) c.a.o.

- **Marking Scheme:**
  - M1 for correct approach
  - A1 for correct working
  - B1 for correct final answer
  - A1 for correct final answer
  - i.s.w.

**Part (ii)**
\[
34.481
\]

- **Marking Scheme:**
  - M1 for \(\frac{2.1^2 - 2^2}{0.1}\)

**Part (iii)**

(A)
\[
16 + 32h + 24h^2 + 8h^3 + h^4\text{ c.a.o.}
\]

- **Marking Scheme:**
  - B2 for 4 terms correct
  - B1 for 3 terms correct

(B)
\[
32 + 24h + 8h^2 + h^3\text{ or ft}
\]

- **Marking Scheme:**
  - B1 if one error

(C)
\[
as h \to 0, \text{ result } \to \text{ their } 32 \text{ from } (iii) (B)
\]

- **Marking Scheme:**
  - 1

Gradient of tangent is limit of gradient of chord

### Question 4

**Part (i)**
\[
6.1
\]

**Part (ii)**
\[
\frac{(3 + h)^2 - 7 - (3^2 - 7)}{h}
\]

- Marking Scheme:
  - M1 for correct numerator
  - A1 for correct working

Numerator = \(6h + h^2\)

\(6 + h\)

**Part (iii)**

- Marking Scheme:
  - M1 for correct working
  - A1 for correct final answer

As \(h\) tends to 0,

Gradient tends to \(6\) o.e.

**Part (iv)**
\[
y - 2 = "6" (x - 3) \text{ o.e.}
\]
\[
y = 6x - 16
\]

- **Marking Scheme:**
  - M1 for correct working
  - A1 for correct final answer

6 may be obtained from 3

**Part (v)**

At \(P\), \(x = 16/6\) o.e. or ft

At \(Q\), \(x = \sqrt{7}\)

0.021 cao

- **Marking Scheme:**
  - M1 for correct working
  - M1 for correct working
  - A1 for correct working
  - 2

- **Marking Scheme:**
  - 3
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</table>
| 5 | (i) ad of chord = \((2^{3.1} - 2^{3})/0.1\) o.e.  
    = 5.74 c.a.o.  

(ii) correct use of A and C where  
    for C, \(2.9 < x < 3.1\)  
    answer in range (5.36, 5.74)  
| M1 | M1 | s.c.1 for consistent use of reciprocal of gradient formula in parts (i) and (ii)  
   | A1 | A1 |  
   |   |   | 4  

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