

| Q | Marking instructions | AO | Marks | Typical solution |
|---------|--|------|----------|--|
| 9(a)(i) | Differentiates $f(x)$ at least one correct term May be unsimplified | 1.1a | M1 | $f'(x) = 4x^3 + 15x^2$ $f''(x) = 12x^2 + 30x$ |
| | Obtains $f''(x) = 12x^2 + 30x$ | 1.1b | A1 | |
| | Subtotal | | 2 | |

| Q | Marking instructions | AO | Marks | Typical solution |
|----------|--|------|----------|--|
| 9(a)(ii) | Substitutes $x = -\frac{15}{4}$ into their $f''(x)$ or uses gradient test both sides of $x = -\frac{15}{4}$ | 1.1a | M1 | $f''\left(-\frac{15}{4}\right) = 12\left(-\frac{15}{4}\right)^2 + 30\left(-\frac{15}{4}\right)$ $= \frac{225}{4} > 0$ |
| | Completes rigorous justification for minimum at $x = -\frac{15}{4}$ This must be correctly deduced using shape of graph or $f''\left(-\frac{15}{4}\right) = \frac{225}{4} > 0$ | 2.1 | R1 | Hence there is a minimum at $x = -\frac{15}{4}$ $f''(0) = 0$ $f''(1) = 12 + 30 > 0$ and $f''(-1) = 12 - 30 < 0$ |
| | Substitutes two values either side of $x = 0$ into their $f''(x)$ or uses gradient test both sides of $x = 0$ or argues using the shape of a quartic curve with two stationary points | 1.1a | M1 | hence point of inflection at $x = 0$ |
| | Completes rigorous justification for point of inflection at $x = 0$ This must be correctly deduced using the shape of the graph or a completely correct test both sides of the point Other explanation eg quartic with two stationary points, one of the points must be a point of inflection | 2.2a | R1 | |
| | Subtotal | | 4 | |

| Q | Marking instructions | AO | Marks | Typical solution |
|-----------------|--|------|----------|---------------------|
| 9(b) | Deduces $x > -\frac{15}{4}$ OE Condone use of ' \geq ' | 2.2a | B1 | $x > -\frac{15}{4}$ |
| Subtotal | | | 1 | |

| Q | Marking instructions | AO | Marks | Typical solution |
|-----------------|---|------|----------|-----------------------------|
| 9(c)(i) | Deduces the transformation is a reflection in the y -axis OE | 2.2a | B1 | Reflection in the y -axis |
| Subtotal | | | 1 | |

| Q | Marking instructions | AO | Marks | Typical solution |
|-----------------|---|------|----------|--------------------|
| 9(c)(ii) | Deduces $x > \frac{15}{4}$ Condone use of ' \geq ' FT their answer in part (b) only if their value in (b) is negative | 2.2a | B1F | $x > \frac{15}{4}$ |
| Subtotal | | | 1 | |

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|-----------------------|--|--|----------|--|
| Question Total | | | 9 | |
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