| Question | | | Answer | Marks | AOs | | Guidance |
|---|---|---|---|---|---|---|---|
| 13 | (i) | | $f'(x) = \frac{1}{3}\left(27-8x^3\right)^{-\frac{2}{3}} \times (-24x^2)$<br>$\left[= \frac{-8x^2}{\left(27-8x^3\right)^{\frac{2}{3}}}\right]$<br>$f'(1.5) = -\frac{8\times 1.5^2}{0}$ and dividing by zero zgives the error. | **M1**<br>**A1**<br><br><br><br>**E1**<br>**[3]** | **1.1a**<br>**1.1**<br><br><br><br>**2.4** | Using the chain rule<br>Allow unsimplified<br><br><br><br>Sufficient to say "can't divide by zero" oe | |
| | (ii) | | $\left(27-8x^3\right)^{\frac{1}{3}} = 27^{\frac{1}{3}}\left(1-\frac{8}{27}x^3\right)^{\frac{1}{3}}$<br>$= 3\left(1+\left(\frac{1}{3}\right)\left(-\frac{8x^3}{27}\right)+\frac{\left(\frac{1}{3}\right)\left(-\frac{2}{3}\right)}{2!}\left(-\frac{8x^3}{27}\right)^2+\ldots\right)$<br>$= 3-\frac{8x^3}{27}-\frac{64x^6}{2187}+\ldots$ | **B1**<br><br><br>**M1**<br><br><br><br>**A1**<br>**[3]** | **3.1a**<br><br><br>**1.1a**<br><br><br><br>**1.1b** | Dealing with the 27 correctly<br><br><br>Using the Binomial expansion substantially correctly<br><br><br><br>Cao | |
| | (iii) | | The binomial expansion is valid for $\left\lvert -8\frac{x^3}{27}\right\rvert < 1$<br>$\lvert x\rvert < 1.5$ and the limits of the integral are completely in this interval. | **B1**<br><br>**E1**<br>**[2]** | **2.4**<br><br>**2.3** | Allow unsimplified but must use correct modulus notation or equivalent<br>Must indicate that the limits of the integral lie in their interval for which the expansion is valid. | |
| | (iv) | | $\frac{0.25}{2}\left(3+2.6684+2\left(2.9954+2.9625+2.8694\right)\right)$<br>$= \frac{0.25}{2}\times 23.3224 = 2.9153$ | **B1**<br>**M1**<br><br>**A1**<br>**[3]** | **1.1a**<br>**1.1b**<br><br>**1.1b** | $h = 0.25$ used<br>For sum in the bracket – condone one slip.<br>Allow for 2.92 or better | Values from candidates own calculators may differ in the last decimal place. |
| | (v) | | There is area between the curve and the top of the trapezia, so some area is missing from the estimate. | **E1**<br>**[1]** | **2.4** | Allow for any sensible explanation eg the trapezia are under the curve | "The curve is concave downwards" on its own is not quite enough |