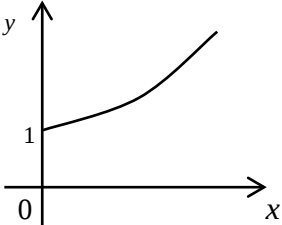


| Question number | Scheme                                                                                                                                                                                                                                                                   | Marks                                                            |
|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------|
| 1. (a)          | $f(-3) = -27 - 27 + 30 + 24 = 0 \Rightarrow (x + 3)$ is factor                                                                                                                                                                                                           | M1 A1 (2)                                                        |
| (b)             | $(x + 3)(x^2 - 6x + 8)$                                                                                                                                                                                                                                                  | M1 A1                                                            |
|                 | $(x + 3)(x - 2)(x - 4)$                                                                                                                                                                                                                                                  | M1 A1 (4)                                                        |
|                 |                                                                                                                                                                                                                                                                          | <b>(6 marks)</b>                                                 |
| 2. (a)          | Using $f(\pm 2) = 3$                                                                                                                                                                                                                                                     | M1                                                               |
| (b)             | Showing that $p = 6$ (*), with no wrong working seen.<br>S.C. If $p = 6$ used and the remainder is shown to be 3 award B1                                                                                                                                                | A1 (2)                                                           |
|                 | Attempt to find quotient when dividing $(n + 2)$ into $f(n)$ or attempting to equate coefficients.                                                                                                                                                                       | M1                                                               |
|                 | Quotient = $n^2 + 4n + 3$ , or finding either $q = 1$ or $r = 3$                                                                                                                                                                                                         | A1                                                               |
|                 | Finding both $q = 1$ and $r = 3$                                                                                                                                                                                                                                         | A1 (3)                                                           |
|                 | The product of three consecutive numbers must be divisible by 3                                                                                                                                                                                                          | M1                                                               |
|                 | Complete argument                                                                                                                                                                                                                                                        | A1 (2)                                                           |
|                 |                                                                                                                                                                                                                                                                          | <b>(7 marks)</b>                                                 |
| 3.              | $2 \sin^2 \theta - 2 \sin \theta = 1 - \sin \theta$<br>$3 \sin^2 \theta - 2 \sin \theta - 1 = 0$<br>$(3 \sin \theta + 1)(\sin \theta - 1) = 0$ (or attempt by formula)<br>$\sin \theta = \frac{1}{3}$ $\sin \theta = 1$<br>$\theta = -19.5^\circ - 160.5^\circ 90^\circ$ | M1<br>A1<br>M1 A1 ft<br>A1<br>A1 A1ft A1 (8)<br><b>(8 marks)</b> |
| 4. (a)          |  <div style="display: inline-block; vertical-align: middle; margin-left: 20px;">             shape<br/>domain, intercept           </div>                                             | B1<br>B1 (2)                                                     |
| (b)             | $\pounds 800 \times 1.04^{10} \approx \pounds 1184$ cao                                                                                                                                                                                                                  | M1 A1 (2)                                                        |
| (c)             | $1.04^x = 2$<br>$x = \frac{\ln 2}{\ln 1.04} \approx 18$ (years)                                                                                                                                                                                                          | M1<br>M1 A1 (3)                                                  |
|                 |                                                                                                                                                                                                                                                                          | <b>(7 marks)</b>                                                 |

| Question number | Scheme                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Marks                                                                                                                  |
|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|
| 5.              | <p>(a) <math>(0, 2)</math> on <math>C \Rightarrow 2 = p + q</math> Use of <math>(0, 2)</math> equation in <math>p</math> and <math>q</math></p> <p><math>\frac{dy}{dx} = qe^x</math>, at <math>p \Rightarrow 5 = 2q</math></p> <p>Solving <math>\Rightarrow q = 2.5, p = -0.5</math> (or <math>2 - q</math>)</p> <p>(b) Gradient of normal at <math>P</math> is <math>-\frac{1}{5}</math></p> <p>Equation of normal at <math>P</math> is: <math>y - (p + 2q) = -\frac{1}{5}(x - \ln 2)</math></p> <p>at <math>L</math> <math>y = 0 \quad \therefore x_L = 22.5 + \ln 2</math> or <math>5(p + 2q) + \ln 2</math> or <math>23.19\dots</math></p> <p>at <math>M</math> <math>x = 0 \quad \therefore y_M = 4.5 + \frac{1}{5} \ln 2</math> or <math>p + 2q + \frac{1}{5} \ln 2</math> or <math>4.639\dots</math></p> <p>Area of triangle <math>OLM</math> is: <math>\frac{1}{2} x_L \times y_M = 53.792\dots \approx 53.8</math></p> | <p>M1</p> <p>M1, A1</p> <p>A1, A1 (5)</p> <p>B1</p> <p>M1</p> <p>M1</p> <p>M1, A1 cso (5)</p> <p><b>(10 marks)</b></p> |
| 6.              | <p>(a) Solve <math>\frac{3}{2}x^2 - \frac{1}{4}x^3 = 0</math> to find <math>p = 6</math>, or verify: <math>\frac{3}{2} \times 6^2 - \frac{1}{4} \times 6^3 = 0</math> (*)</p> <p>(b) <math>\frac{dy}{dx} = 3x - \frac{3x^2}{4}</math></p> <p><math>m = -9</math>, <math>y - 0 = -9(x - 6)</math> (Any correct form)</p> <p>(c) <math>3x - \frac{3x^2}{4} = 0</math>, <math>x = 4</math></p> <p>(d) <math>\int \left( \frac{3x^2}{2} - \frac{x^3}{4} \right) dx = \frac{x^3}{2} - \frac{x^4}{16}</math> (Allow unsimplified versions)</p> <p><math>\left[ \dots \right]_0^6 = \frac{6^3}{2} - \frac{6^4}{16} = 27</math> M: Need 6 and 0 as limits.</p>                                                                                                                                                                                                                                                                          | <p>B1 (1)</p> <p>M1 A1</p> <p>M1 A1 (4)</p> <p>M1, A1ft (2)</p> <p>M1 A1</p> <p>M1 A1 (4)</p> <p><b>(11 marks)</b></p> |

| Question number | Scheme                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Marks                                                                                                                             |
|-----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|
| 7.              | <p>(a) Area of <math>X = 2d^2 + \frac{1}{2}\pi d^2</math>, Area of <math>Y = \frac{1}{2}(4d^2)\theta</math></p> <p>Equate and divide by <math>d^2</math>: <math>2 + \frac{1}{2}\pi = 2\theta</math>, <math>\theta = 1 + \frac{1}{4}\pi</math> *</p> <p>(b) <math>12 + 3\pi</math></p> <p>(c) <math>4d + r\theta = 12 + 6(1 + \frac{1}{4}\pi) = 18 + \frac{3}{2}\pi</math></p> <p>(d) X: <math>12 + 3\pi = 21.425</math> cm, Y: <math>18 + \frac{3}{2}\pi = 22.712</math> cm</p> <p>Difference = 13 mm (or 12.9 mm) or 12.88 mm</p>                                                                                                                                                                                                                                                | <p>B1, M1 A1</p> <p>M1 A1 (5)</p> <p>B1 B1 (2)</p> <p>M1, A1, A1 (3)</p> <p>M1 A1 (2)</p> <p><b>(12 marks)</b></p>                |
| 8.              | <p>(a) <math>f(x) = \dots + \binom{n}{2}\frac{x^2}{k^2} + \binom{n}{3}\frac{x^3}{k^3}</math></p> <p><math>2 \times \frac{n(n-1)}{2k^2} = \frac{n(n-1)(n-2)}{6k^3}</math></p> <p><math>6k = n - 2</math> or <math>n = 6k + 2</math> *</p> <p>(b) <math>\frac{n(n-1)(n-2)(n-3)}{4! k^4} = \frac{n(n-1)(n-2)(n-3)(n-4)}{5! k^5} \Rightarrow 5k = n - 4</math></p> <p>Solving: <math>5k = 6k + 2 - 4</math>, <math>\Rightarrow k = 2</math> and <math>n = 14</math> *</p> <p>(c) <math>(1 + \frac{x}{2})^{14} = 1 + 7x + \binom{14}{2}\frac{x^2}{2} + \binom{14}{3}\left(\frac{x^3}{3}\right) + \binom{14}{4}\frac{x^4}{16} + \binom{14}{5}\frac{x^5}{32} \dots</math></p> <p><math>= 1 + 7x + \frac{91}{4}x^2 + \frac{91}{2}x^3 + \frac{1001}{16}x^4 + \frac{1001}{16}x^5</math></p> | <p>M1</p> <p>M1</p> <p>A1 cso (3)</p> <p>M1 A1</p> <p>M1, A1 cso (4)</p> <p>M1</p> <p>B1, A1, A1 (4)</p> <p><b>(11 marks)</b></p> |