| Question | Answer | Marks | Guidance |
|---|---|---|---|
| 2 | **Alternative method** | | |
| | $2x + 2k$ | **(M1)** | |
| | $k = -x - 1$ or $x = -k - 1$ oe | **(A1)** | |
| | $-2(-k - 1) - 6k - 1 = (-k - 1)^2 + 2k(-k - 1)$ oe<br>or $-2x - 6(-1 - x) - 1 = x\,(x + 2(-1 - x))$ oe | **(M1)** | **FT** *their k* of the form $ax + b$ where $a$ and $b$ are non-zero constants<br>or *their x* of the form $ck + d$ where $c$ and $d$ are non-zero constants |
| | $k^2 - 4k$ [= 0]<br>or $x^2 + 6x + 5$ [= 0] and $x = -5$ [ $x = -1$] nfww | **(A1)** | |
| | $k = 4$ | **(A1)** | **dep** on all previous marks awarded |
| 3 | $\dfrac{16 + 9\sqrt{3}}{(2 + \sqrt{3})^2}$ | **B1** | |
| | $\dfrac{(16 + 9\sqrt{3})(7 - 4\sqrt{3})}{(7 + 4\sqrt{3})(7 - 4\sqrt{3})}$<br>or $\dfrac{16 + 9\sqrt{3}}{7 + 4\sqrt{3}} \times \dfrac{7 - 4\sqrt{3}}{7 - 4\sqrt{3}}$ | **M1** | **FT** $\dfrac{c(16 + 9\sqrt{3})}{a + b\sqrt{3}}$ where $a$, $b$ and $c$ are non-zero constants |
| | $112 - 64\sqrt{3} + 63\sqrt{3} - 108$<br>or $\dfrac{-112 + 64\sqrt{3} - 63\sqrt{3} + 108}{-1}$ | **A1** | |
| | $4 - \sqrt{3}$ or $-\sqrt{3} + 4$ cao, nfww | **A1** | |
| | **Alternative method** | | |
| | $\dfrac{16 + 9\sqrt{3}}{(2 + \sqrt{3})^2}$ | **(B1)** | |
| | $\dfrac{(16 + 9\sqrt{3})(2 - \sqrt{3})^2}{(2 + \sqrt{3})^2(2 - \sqrt{3})^2}$ or $\dfrac{16 + 9\sqrt{3}}{(2 + \sqrt{3})^2} \times \dfrac{(2 - \sqrt{3})^2}{(2 - \sqrt{3})^2}$ | **(M1)** | |
| | $112 - 64\sqrt{3} + 63\sqrt{3} - 108$<br>or $64 - 32\sqrt{3} - 32\sqrt{3} + 48 + 36\sqrt{3} - 54 - 54 + 27\sqrt{3}$ | **(A1)** | |
| | $4 - \sqrt{3}$ or $-\sqrt{3} + 4$ cao, nfww | **(A1)** | |

| Question | Answer | Marks | Guidance |
|---|---|---|---|
| 4(a) | $\frac{e^{2x+2}}{e^{\frac{x}{2}}} = 10$ oe, soi | **B1** | |
| | $e^{1.5x+2} = 10$ oe | **M1** | **FT** $\frac{e^{2x+k}}{e^{\frac{x}{2}}} = 10$ oe or $\frac{e^{kx+2}}{e^{\frac{x}{2}}} = 10$ oe<br>where $k$ is an integer and $k > 0$<br>or $\frac{e^{2x+2}}{e^{\frac{x}{n}}} = 10$ oe<br>where $n$ is an integer and $n > 1$ or $n = -2$ |
| | $1.5x + 2 = \ln 10$ oe | **M1** | **FT** an expression of, or equivalent to, the form $e^{ax+b} = 10$ oe where $a$ and $b$ are non-zero constants |
| | $x = \frac{2}{3}(\ln 10 - 2)$ oe, isw or 0.202<br>or 0.2017[23…] rot to 4 or more dp isw | **A1** | |
| 4(b) | $\frac{y^2}{4y-9} = 9^{\frac{1}{2}}$ nfww<br>or $\log_9 \frac{y^2}{4y-9} = \log_9 9^{\frac{1}{2}}$ oe | **M2** | **M1** for at least one correct log law used in a correct equation e.g.<br>$\log_9 y^2 - \log_9(4y-9) = \frac{1}{2}$<br>or $\log_9 \frac{y^2}{4y-9} = \frac{1}{2}$<br>or $2\log_9 y - \log_9(4y-9) = \frac{1}{2}\log_9 9$ |
| | $y^2 - 12y + 27$ [= 0] nfww | **A1** | |
| | $(y-3)(y-9) = 0$ | **DM1** | **dep** on at least **M1** previously awarded |
| | $y = 3, y = 9$ nfww | **A1** | |
| 5(a) | Correct first derivative:<br>$3x^2 - 14x + 12$ | **M2** | **M1** for two terms of $x^3 - 7x^2 + 12x - 5$ differentiated correctly |
| | [At $x = 1$] gradient of tangent: 1 | **A1** | |
| | $y - 1 = their(-1)(x - 1)$ oe<br>or $y = -x + c$ **and** $1 = -1 + c$ soi | **M1** | **FT** $\frac{-1}{their \left.\frac{dy}{dx}\right\|_{x=1}}$ |
| | $y - 1 = -1(x - 1)$ or $y = -x + 2$ oe, isw | **A1** | |