| Question | Answer | Marks | Guidance |
|---|---|---|---|
| 1 | Express first term as $2\sin\theta\cos 30 + 2\cos\theta\sin 30$ | **B1** | |
| | Divide by $\cos\theta$ to produce linear equation in $\tan\theta$ | **M1** | |
| | Obtain $\tan\theta = \frac{6}{2-\sqrt{3}}$ or 22.39… | **A1** | |
| | Obtain 87.4 | **A1** | Or greater accuracy 87.44297… |
| | | **4** | |

| Question | Answer | Marks | Guidance |
|---|---|---|---|
| 2(a) | Carry out division as far as $4x + k$ | **M1** | |
| | Obtain quotient $4x - 3$ | **A1** | |
| | Confirm remainder is 18 | **A1** | AG necessary detail needed |
| | | **3** | |
| 2(b) | State or imply equation is $(4x-3)(x^2+5x+6)=0$ | **B1FT** | Following *their* quotient from part **(a)** |
| | Attempt solution of cubic equation to find three real roots | **M1** | |
| | Obtain $-3,\ -2,\ \frac{3}{4}$ | **A1** | |
| | | **3** | |

| Question | Answer | Marks | Guidance |
|---|---|---|---|
| 3 | Integrate to obtain $k\ln(2x-5)$ | *M1 | For non-zero constant $k$ |
| | Apply limits to obtain $\ln(6a-5)-\ln(2a-5)=\ln\frac{7}{2}$ | A1 | |
| | Apply subtraction law for logarithms | *M1 | OE |
| | Obtain equation $\frac{6a-5}{2a-5}=\frac{7}{2}$ | A1 | OE without logarithms |
| | Solve equation for $a$ | DM1 | |
| | Obtain $a=\frac{25}{2}$ | A1 | |
| | | 6 | |

| Question | Answer | Marks | Guidance |
|---|---|---|---|
| 4 | Differentiate $-y^2$ to obtain $-2y\dfrac{dy}{dx}$ | **B1** | |
| | Differentiate $-4\ln(2y+3)$ to obtain $\dfrac{-8}{2y+3}\dfrac{dy}{dx}$ | **B1** | |
| | Attempt differentiation of all terms | **M1** | Dependent on appearance of at least one $\dfrac{dy}{dx}$ |
| | Substitute $x=3,\ y=-1$ to find numerical value of $\dfrac{dy}{dx}$ | **M1** | |
| | Obtain $\dfrac{dy}{dx}=3$ | **A1** | |
| | Obtain equation $y=3x-10$ | **A1** | OE |
| | | **6** | |

| Question | Answer | Marks | Guidance |
|---|---|---|---|
| 5(a) | Draw two V-shaped graphs with one vertex on negative $x$-axis and one vertex on positive $x$-axis | **M1** | |
| | Draw correct graphs related correctly to each other | **A1** | |
| | State correct coordinates $-2k,\ 2k,\ \frac{3}{2}k,\ 3k$ | **A1** | Either given on axes or stated separately |
| | | **3** | |
| 5(b) | State or imply non-modulus equation $(x+2k)^2=(2x-3k)^2$ or pair of linear equations | **B1** | |
| | Attempt solution of 3-term quadratic equation or pair of linear equations | **M1** | |
| | Obtain $x=\frac{1}{3}k, \quad x=5k$ | **A1** | |
| | Obtain $y=\frac{7}{3}k, \quad y=7k$ | **A1** | If A0A0, award A1 for one pair of correct coordinates |
| | | **4** | |
| 5(c) | Relate $2^t$ to larger value of $x$ from part **(b)** | **M1** | |
| | Apply logarithms to obtain $t=\dfrac{\ln(5k)}{\ln 2}$ | **A1** | OE such as $\dfrac{\log_{10}(5k)}{\log_{10} 2}$ or $\log_2(5k)$ |
| | | **2** | |

| Question | Answer | Marks | Guidance |
|---|---|---|---|
| 6(a) | Differentiate using the product rule | ***M1** | |
| | Obtain $3x^2e^{0.2x}+0.2x^3e^{0.2x}$ | **A1** | OE |
| | Equate first derivative to 15 and rearrange to $x=...$ | **DM1** | |
| | Confirm $x=\sqrt{\dfrac{75e^{-0.2x}}{15+x}}$ | **A1** | AG – necessary detail needed |
| | | **4** | |
| 6(b) | Consider sign of $x-\sqrt{\dfrac{75e^{-0.2x}}{15+x}}$ or equivalent for 1.7 and 1.8 | **M1** | |
| | Obtain $-0.08...$ and $0.03...$ or equivalents and justify conclusion | **A1** | |
| | | **2** | |
| 6(c) | Use iterative process correctly at least once | **M1** | Answer required to exactly 4 sf |
| | Obtain final answer 1.771 | **A1** | |
| | Show sufficient iterations to 6 sf to justify answer or show a sign change in the interval [1.7705, 1.7715] | **A1** | |
| | | **3** | |

| Question | Answer | Marks | Guidance |
|---|---|---|---|
| 7(a) | Solve equation $y = 0$ to find value of $x$ | **M1** | |
| | Obtain $\frac{7}{6}\pi$ | **A1** | |
| | | **2** | |
| 7(b) | Attempt first derivative using chain rule | **M1** | OE |
| | Obtain $\frac{dy}{dx} = 8\sin x\cos x + 8\cos x$ | **A1** | OE |
| | Substitute value from part **(a)** to find gradient $-2\sqrt{3}$ | **A1** | Or exact equivalent |
| | | **3** | |
| 7(c) | Express integrand in the form $k_1 + k_2\cos 2x + k_3\sin x$ | ***M1** | |
| | Obtain correct $5 - 2\cos 2x + 8\sin x$ | **A1** | OE. Allow unsimplified |
| | Integrate to obtain $5x - \sin 2x - 8\cos x$ | **A1** | |
| | Apply limits 0 and *their* value from part **(a)** correctly | **DM1** | |
| | Obtain $\frac{35}{6}\pi + \frac{7}{2}\sqrt{3} + 8$ or exact equivalent | **A1** | |
| | | **5** | |