| Question | Answer | Marks |
|---|---|---|
| 1 | Commence division and reach a partial quotient $x^2 + kx$ | **M1** |
| | Obtain quotient $x^2 - 2x + 5$ | **A1** |
| | Obtain remainder $-12x + 5$ | **A1** |
| | | **3** |

| Question | Answer | Marks |
|---|---|---|
| 2 | Plot the four points and draw straight line | **B1** |
| | State or imply that $\ln y = \ln C + x \ln a$ | **B1** |
| | Carry out a completely correct method for finding $\ln C$ or $\ln a$ | **M1** |
| | Obtain answer $C = 3.7$ | **A1** |
| | Obtain answer $a = 1.5$ | **A1** |
| | | **5** |

| Question | Answer | Marks |
|---|---|---|
| 3(i) | Calculate value of a relevant expression or expressions at $x = 2$ and $x = 3$ | **M1** |
| | Complete the argument correctly with correct calculated values | **A1** |
| | | **2** |
| 3(ii) | Use an iterative formula correctly at least once | **M1** |
| | Show that ($B$) fails to converge | **A1** |
| | Using ($A$), obtain final answer 2.43 | **A1** |
| | Show sufficient iterations to justify 2.43 to 2 d.p., or show there is a sign change in (2.425, 2.435) | **A1** |
| | | **4** |

| Question | Answer | Marks |
|---|---|---|
| 4(i) | Use correct $\tan(A \pm B)$ formula and express the LHS in terms of $\tan x$ | **M1** |
| | Using $\tan 45° = 1$ express LHS as a single fraction | **A1** |
| | Use Pythagoras or correct double angle formula | **M1** |
| | Obtain given answer | **A1** |
| | | **4** |
| 4(ii) | Show correct sketch for one branch | **B1** |
| | Both branches correct and nothing else seen in the interval | **B1** |
| | Show asymptote at $x = 45°$ | **B1** |
| | | **3** |

| Question | Answer | Marks |
|---|---|---|
| 5(i) | State or imply $y^3 + 3xy^2 \dfrac{dy}{dx}$ as derivative of $xy^3$ | **B1** |
| | State or imply $4y^3 \dfrac{dy}{dx}$ as derivative of $y^4$ | **B1** |
| | Equate derivative of the LHS to zero and solve for $\dfrac{dy}{dx}$ | **M1** |
| | Obtain the given answer | **A1** |
| | | **4** |
| 5(ii) | Equate numerator to zero | ***M1** |
| | Obtain $y = -2x$, or equivalent | **A1** |
| | Obtain an equation in $x$ or $y$ | **DM1** |
| | Obtain final answer $x = -1$, $y = 2$ and $x = 1$, $y = -2$ | **A1** |
| | | **4** |

| Question | Answer | Marks |
|---|---|---|
| 6 | Separate variables correctly and attempt integration of one side | **B1** |
| | Obtain term $\tan y$, or equivalent | **B1** |
| | Obtain term of the form $k \ln \cos x$, or equivalent | **M1** |
| | Obtain term $-4 \ln \cos x$, or equivalent | **A1** |
| | Use $x = 0$ and $y = \frac{1}{4}\pi$ in solution containing $a \tan y$ and $b \ln \cos x$ to evaluate a constant, or as limits | **M1** |
| | Obtain correct solution in any form, e.g. $\tan y = 4 \ln \sec x + 1$ | **A1** |
| | Substitute $y = \frac{1}{3}\pi$ in solution containing terms $a \tan y$ and $b \ln \cos x$, and use correct method to find $x$ | **M1** |
| | Obtain answer $x = 0.587$ | **A1** |
| | | **8** |

| Question | Answer | Marks |
|---|---|---|
| 7(a) | Square $x + \mathrm{i}y$ and equate real and imaginary parts to 8 and $-15$ | **M1** |
| | Obtain $x^2 - y^2 = 8$ and $2xy = -15$ | **A1** |
| | Eliminate one unknown and find a horizontal equation in the other | **M1** |
| | Obtain $4x^4 - 32x^2 - 225 = 0$ or $4y^4 + 32y^2 - 225 = 0$, or three term equivalent | **A1** |
| | Obtain answers $\pm\frac{1}{\sqrt{2}}(5 - 3\mathrm{i})$ or equivalent | **A1** |
| | | **5** |
| 7(b) | Show a circle with centre $2 + \mathrm{i}$ in a relatively correct position | **B1** |
| | Show a circle with radius 2 and centre not at the origin | **B1** |
| | Show line through i at an angle of $\frac{1}{4}\pi$ to the real axis | **B1** |
| | Shade the correct region | **B1** |
| | | **4** |

| Question | Answer | Marks |
|---|---|---|
| 8(i) | Use a relevant method to determine a constant | **M1** |
| | Obtain one of the values $A = 2$, $B = 2$, $C = -1$ | **A1** |
| | Obtain a second value | **A1** |
| | Obtain the third value | **A1** |
| | | **4** |
| 8(ii) | Integrate and obtain terms $2x + 2\ln(x+2) - \frac{1}{2}\ln(2x-1)$ (deduct **B1** for each error or omission) [The FT is on $A$, $B$ and $C$] | **B2 FT** |
| | Substitute limits correctly in an integral containing terms $a\ln(x+2)$ and $b\ln(2x-1)$, where $ab \neq 0$ | ***M1** |
| | Use at least one law of logarithms correctly | **DM1** |
| | Obtain the given answer after full and correct working | **A1** |
| | | **5** |

| Question | Answer | Marks |
|---|---|---|
| 9(i) | Use correct product or quotient rule | **M1** |
| | Obtain correct derivative in any form | **A1** |
| | Equate derivative to zero and obtain a 3 term quadratic equation in $x$ | **M1** |
| | Obtain answers $x = 2 \pm \sqrt{3}$ | **A1** |
| | | **4** |
| 9(ii) | Integrate by parts and reach $k(1+x^2)e^{-\frac{1}{2}x} + l\int xe^{-\frac{1}{2}x}\,dx$ | ***M1** |
| | Obtain $-2(1+x^2)e^{-\frac{1}{2}x} + 4\int xe^{-\frac{1}{2}x}\,dx$, or equivalent | **A1** |
| | Complete the integration and obtain $(-18-8x-2x^2)e^{-\frac{1}{2}x}$, or equivalent | **A1** |
| | Use limits $x = 0$ and $x = 2$ correctly, having fully integrated twice by parts | **DM1** |
| | Obtain the given answer | **A1** |
| | | **5** |

| Question | Answer | Marks |
|---|---|---|
| 10(i) | Equate at least two pairs of components of general points on $l$ and $m$ and solve for $\lambda$ or for $\mu$ | M1 |
| | Obtain correct answer for $\lambda$ or $\mu$, e.g. $\lambda = 3$ or $\mu = -2$ ; $\lambda = 0$ or $\mu = -\frac{1}{2}$; or $\lambda = \frac{3}{2}$ or $\mu = -\frac{7}{2}$ | A1 |
| | Verify that not all three pairs of equations are satisfied and that the lines fail to intersect | A1 |
| | | 3 |
| 10(ii) | Carry out correct process for evaluating scalar product of direction vectors for $l$ and $m$ | *M1 |
| | Using the correct process for the moduli, divide the scalar product by the product of the moduli and evaluate the inverse cosine of the result | DM1 |
| | Obtain answer 45° or $\frac{1}{4}\pi$ (0.785) radians | A1 |
| | | 3 |
| 10(iii) | *EITHER:* Use scalar product to obtain a relevant equation in $a$, $b$ and $c$, e.g. $-a + b + 4c = 0$ | B1 |
| | Obtain a second equation, e.g. $2a + b - 2c = 0$ and solve for one ratio, e.g. $a : b$ | M1 |
| | Obtain $a : b : c = 2 : -2 : 1$, or equivalent | A1 |
| | Substitute (3, –2, –1) and values of $a$, $b$ and $c$ in general equation and find $d$ | M1 |
| | Obtain answer $2x - 2y + z = 9$ , or equivalent | A1 |
| | *OR*1: Attempt to calculate vector product of relevant vectors, e.g $(-\mathbf{i} + \mathbf{j} + 4\mathbf{k}) \times (2\mathbf{i} + \mathbf{j} - 2\mathbf{k})$ | (M1 |
| | Obtain two correct components | A1 |
| | Obtain correct answer, e.g. $-6\mathbf{i} + 6\mathbf{j} - 3\mathbf{k}$ | A1 |
| | Substitute (3, –2, –1) in $-6x + 6y - 3z = d$ , or equivalent, and find $d$ | M1 |
| | Obtain answer $-2x + 2y - z = -9$ , or equivalent | A1) |
| | *OR*2: Using the relevant point and relevant vectors, form a 2-parameter equation for the plane | (M1 |
| | State a correct equation, e.g. $\mathbf{r} = 3\mathbf{i} - 2\mathbf{j} - \mathbf{k} + \lambda(-\mathbf{i} + \mathbf{j} + 4\mathbf{k}) + \mu(2\mathbf{i} + \mathbf{j} - 2\mathbf{k})$ | A1 |
| | State three correct equations in $x$, $y$, $z$, $\lambda$ and $\mu$ | A1 |
| | Eliminate $\lambda$ and $\mu$ | M1 |

| Question | | Answer | Marks |
|---|---|---|---|
| | | Obtain answer $2x - 2y + z = 9$, or equivalent | **A1)** |
| | *OR*3: | Using the relevant point and relevant vectors, form a determinant equation for the plane | **(M1** |
| | | State a correct equation, e.g. $\begin{vmatrix} x-3 & y+2 & z+1 \\ -1 & 1 & 4 \\ 2 & 1 & -2 \end{vmatrix} = 0$ | **A1** |
| | | Attempt to expand the determinant | **M1** |
| | | Obtain two correct cofactors | **A1** |
| | | Obtain answer $-2x + 2y - z = -9$, or equivalent | **A1)** |
| | | | **5** |