| Question Number | Scheme | Marks |
|---|---|---|
| **5.(a)** | Attempts $480+13\times-15$<br>$=285$ tonnes | M1<br>A1<br>**(2)** |
| **(b)** | Sets $\frac{N}{2}\{2\times480+(N-1)\times-15\}=7770$ | M1A1 |
| | $\frac{N}{2}\{960-15N+15\}=7770\Rightarrow N^2-65N+1036=0$ * | A1*<br>**(3)** |
| **(c)** | States 28 only | B1<br>**(1)**<br>**(6 marks)** |

| Question Number | Scheme | Marks |
|---|---|---|
| **1 (a)** | Attempts $u_3=3u_2-2u_1\Rightarrow4=3u_2-2\times7\Rightarrow u_2=...$<br>$\Rightarrow u_2=6$ | M1<br>A1 |
| | | **(2)** |
| **(b)** | Attempts $u_4=3u_3-2u_2=3\times4-2\times"6"=(0)$ | M1 |
| | $\sum_{r=1}^{4}(u_r+2r)=(7+2\times1)+("6"+2\times2)+(4+2\times3)+("0"+2\times4)$ | dM1 |
| | $=37$ | A1 |
| | | **(3)** |
| | | **Total 5** |

| Question Number | Scheme | Marks |
|---|---|---|
| **2 (a)** | Strip width = 1.5 | B1 |
| | $\frac{3}{4}\{4.16+2.28+2\times(2.91+a+1.73+1.37+1.43)\}=19.3\Rightarrow a=...$ | M1 |
| | $a=$ awrt 2.21 | A1 |
| | | **(3)** |
| **(b)** | $\int_{-4}^{5}(2\,f(x)-3)\,dx=2\times19.3-[3x]_{-4}^{5}$ | M1 |
| | $=11.6$ | A1 |
| | | **(2)** |
| | | **Total 5** |

| Question Number | Scheme | Marks |
|---|---|---|
| **6 (a)** | Centre of circle is midpoint of $(-2,18)$ and $(14,6) = (6,12)$ | B1 |
| | Attempts radius$^2$ or diameter$^2$. E.g. $D^2 = (14--2)^2 + (6-18)^2 = 400$ | M1 |
| | Radius$^2 = 100$ | A1 |
| | $(x-6)^2 + (y-12)^2 = 100$ | M1, A1 |
| | | **(5)** |
| **(b)** | Recognises equation of $C_2$ is $x^2 + y^2 = k^2$ | B1 |
| | Attempts to find one value of $k$ or $k^2$ Look for $\sqrt{"6"^2 + "12"^2} \pm \sqrt{"100"}$ | M1 |
| | $x^2 + y^2 = \left(6\sqrt{5} + 10\right)^2$ or $x^2 + y^2 = \left(6\sqrt{5} - 10\right)^2$ o.e. | A1 |
| | $x^2 + y^2 = \left(6\sqrt{5} + 10\right)^2$ and $x^2 + y^2 = \left(6\sqrt{5} - 10\right)^2$ o.e. | A1 |
| | | **(4)** |
| | | **(9 marks)** |

| Question Number | Scheme | Marks |
|---|---|---|
| **10 (a)** | $y = 2x + \frac{64}{x^2} - 3$ | |
| | $\frac{dy}{dx} = 2 - \frac{128}{x^3}$ | M1, A1 |
| | Attempts to solve $\frac{dy}{dx} \Rightarrow x^3 = 64 \Rightarrow x = 4$ * | dM1, A1* |
| | | **(4)** |
| **(b)** | $\int 2x + \frac{64}{x^2} - 3\,dx = x^2 - \frac{64}{x} - 3x \quad (+c)$ | M1, A1 |
| | Finds the $y$ values at both $x = 2$ and $x = 4$. $M = (0, 17)$ and $N = (0, 9)$ | B1 |
| | Full attempt at area = $\left[x^2 - \frac{64}{x} - 3x\right]_2^4 - 9 \times 2 + 2 \times (17 - 9) = 22 - 18 + 16 = 20$ | dM1, A1 |
| | | **(5)** |
| | | **(9 marks)** |

| Question Number | Scheme | Marks |
|---|---|---|
| **2.(a)** | E.g. $64 \times \left(-\frac{1}{2}\right)^3 = -8$ ✓ * | M1, A1* |
| | | **(2)** |
| **(b)** | Finds the value of $a$. E.g. $64 \div \left(-\frac{1}{2}\right)^2 = 256$ | M1, A1 |
| | Uses $S_\infty = \frac{a}{1-r} = \frac{256}{1-\left(-\frac{1}{2}\right)} = \frac{512}{3}$ | M1, A1 |
| | | **(4)** |
| | | **(6 marks)** |

| Question Number | Scheme | Marks |
|---|---|---|
| **11a** | $u_2 = b - 3a$<br>$u_3 = b - a(b-3a) \quad \left(= b - ab + 3a^2\right)$ | B1<br>B1 |
| | | (2) |
| **b** | $3 + b - 3a + b - a(b-3a) = 153$ oe<br>$3 + (a+9) - 3a + (a+9) - a((a+9) - 3a) = 153 \Rightarrow 2a^2 - 10a - 132 = 0$<br>$\Rightarrow a^2 - 5a - 66 = 0$ * | M1<br>dM1A1* |
| | | (3) |
| **c** | $a = -6$<br>$b = 9 - 6 = 3 \Rightarrow u_2 = 3 - 3(-6) = 21$ or $u_2 = 9 - 2a = 9 - 2\times -6 = 21$ | B1<br>M1A1 |
| | | (3) |
| | | **(8 marks)** |

| Question Number | Scheme | Marks |
|---|---|---|
| **5.(a)** | $\frac{dP}{dx} = 12 - \frac{3}{2}x^{\frac{1}{2}}$ | M1A1 |
| | Sets $\frac{dP}{dx} = 0 \rightarrow 12 - \frac{3}{2}x^{\frac{1}{2}} = 0 \rightarrow x^n = ...$ | dM1 |
| | $x = 64$ | A1 |
| | When $x = 64 \Rightarrow P = 12\times 64 - 64^{\frac{3}{2}} - 120 = ...$ | M1 |
| | Profit = (£) 136 000 | A1 |
| | | **(6)** |
| **(b)** | $\left(\frac{d^2P}{dx^2}\right) = -\frac{3}{4}x^{-\frac{1}{2}}$ and substitutes in their $x = 64$ to find its value or state its sign | M1 |
| | At $x = 64 \quad \frac{d^2P}{dx^2} = -0.09375 < 0 \Rightarrow$ maximum | A1 |
| | | **(2)** |
| | | **(8 marks)** |

| Question Number | Scheme | Marks |
|---|---|---|
| **10 (a)** | Uses $\tan\theta = \frac{\sin\theta}{\cos\theta}$ o.e. E.g. $\cos\theta\left(3\tan\theta + \frac{2}{\tan\theta}\right) \equiv \cos\theta\left(3\frac{\sin\theta}{\cos\theta} + \frac{2\cos\theta}{\sin\theta}\right)$ | M1 |
| | Uses $\sin^2\theta + \cos^2\theta = 1$ E.g. $\equiv 3\sin\theta + \frac{2\cos^2\theta}{\sin\theta} \equiv 3\sin\theta + \frac{2\left(1-\sin^2\theta\right)}{\sin\theta}$ | dM1, A1 |
| | $\equiv 3\sin\theta + \frac{2}{\sin\theta} - 2\sin\theta \equiv \sin\theta + \frac{2}{\sin\theta}$ | A1* |
| | | **(4)** |
| **(b)** | $\sin x + \frac{2}{\sin x} = 4\sin x - 5 \Rightarrow 3\sin^2 x - 5\sin x - 2 = 0$ | M1, A1 |
| | $\Rightarrow \sin x = 2, -\frac{1}{3} \Rightarrow x = 3.5$ for example. | dM1 |
| | $\Rightarrow x = 3.48, 5.94$ | A1 |
| | | **(4)** |
| | | **(8 marks)** |

| Question Number | Scheme | Marks |
|---|---|---|
| **1(a)** | $(u_2 =)\ k-\frac{8}{1}$ and $(u_3 =)\ k-\frac{8}{k-8}$ $\left(=\frac{k^2-8k-8}{k-8}\right)$ oe | M1A1 **(2)** |
| **(b)** | $u_3 = 6 \Rightarrow k-\frac{8}{k-8}=6 \Rightarrow k^2-14k+40=0$ | M1 |
| | $(k-4)(k-10)=0 \Rightarrow k=...$ | |
| | or | |
| | $(k=)\ \frac{14\pm\sqrt{14^2-4\times1\times40}}{2\times1}$ | dM1 |
| | $(k=)\ 4,\ 10$ | A1 **(3)** |
| | | **(5 marks)** |

| Question Number | Scheme | Marks |
|---|---|---|
| **6. (i)** | $2\log_2(4-x)=3+\log_2\left(\frac{x+11}{2}\right)$ | |
| | One correct law applied – examples (not exhaustive): | |
| | $2\log_2(4-x)=\log_2(4-x)^2$, $\log_2\left(\frac{x+11}{2}\right)=\log_2(x+11)-\log_2 2$ | B1 |
| | $3=\log_2 8$ | |
| | Correctly combines two original terms e.g. $2\log_2(4-x)=\log_2(4x+44)$ | M1 |
| | Correct equation not involving logs $(4-x)^2=4x+44$ | A1 |
| | $x^2-12x-28=0 \Rightarrow (x-14)(x+2)=0 \Rightarrow x=...$ | dM1 |
| | $\Rightarrow x=-2$ only | A1 **(5)** |
| **(ii)** | Combines $y=6\times3^x$ and $y=3^{2x+1} \Rightarrow 3^{2x+1}=6\times3^x$ | M1 |
| | $\Rightarrow 3^x\times3=6$ | |
| | $\Rightarrow 3^x=2 \Rightarrow x=\log_3 2$ | dM1, A1 |
| | $y=6\times3^{\log_3"2"}=6\times"2"$ | ddM1 |
| | coordinates of $P$ are: $(\log_3 2,\ 12)$ | A1 **(5)** |
| | | **(10 marks)** |

| Question Number | Scheme | Marks |
|---|---|---|
| **5. (i)** | $\log_a x+\log_a 3=\log_a 27-1 \Rightarrow \log_a \frac{3x}{27}=-1$ | M1A1 |
| | $\Rightarrow \frac{3x}{27}=a^{-1}$ | dM1 |
| | $\Rightarrow x=9a^{-1}$ or $x=\frac{9}{a}$ | A1 **(4)** |
| **(ii)** | $p^2-7p+12=0$ and attempt to solve to give $p=$ or $\log_5 y=$ | M1 |
| | $p$ (or $\log_5 y$) = 3 or 4 | B1 |
| | $y=5^3$ or $5^4$ | M1 |
| | $y=125$ and $625$ | A1 **(4)** |
| | | **8 marks** |

| Question Number | Scheme | Marks |
|---|---|---|
| **8 (i)** | $\int \frac{8\sqrt{x}-5}{2x^2}\,dx=\int 4x^{-\frac{3}{2}}-\frac{5}{2}x^{-2}\,dx$ | B1 |
| | $=-8x^{-\frac{1}{2}}+\frac{5}{2}x^{-1}\ (+C)$ | M1 A1 |
| | $\int_2^4\left(4x^{-\frac{3}{2}}-\frac{5}{2}x^{-2}\right)dx=\left(-4+\frac{5}{8}\right)-\left(-4\sqrt{2}+\frac{5}{4}\right)=4\sqrt{2}-\frac{37}{8}$ | dM1 A1 **(5)** |
| **(ii)** | $\int\left(\frac{1}{2}x^2+k\right)dx=\left[\frac{1}{6}x^3+kx\right]$ | M1 A1 |
| | $\int_{-3}^{6}\left(\frac{1}{2}x^2+k\right)dx=55 \Rightarrow \left[\frac{1}{6}x^3+kx\right]_{-3}^{6}=55\Rightarrow(36+6k)-\left(-\frac{9}{2}-3k\right)=55\Rightarrow k=\ldots$ | dM1 |
| | $k=\frac{29}{18}$ | A1 **(4)** |
| | | **(9 marks)** |