| Question Number | Scheme | Marks |
|---|---|---|
| **6(a)** | $\left(\frac{3\pi}{2}, 0\right)$ | B1 |
| | | **(1)** |
| **(b)** | $f'(x) = \left(6\cos^2 x\right)e^{3\sin x} - \left(2\sin x\right)e^{3\sin x}$ | M1A1 |
| | $f'(x) = \left(6\cos^2 x\right)e^{3\sin x} - \left(2\sin x\right)e^{3\sin x}$<br>$\Rightarrow \left(6\left(1-\sin^2 x\right) - 2\sin x\right)\left(=0\right)$ | **d**M1 |
| | $\Rightarrow 3\sin^2 x + \sin x - 3 = 0$ oe | A1 |
| | | **(4)** |
| **(c)** | $\sin x = \frac{-1+\sqrt{37}}{6} \Rightarrow x = ...$ | M1 |
| | $x = 2.131$ | A1 |
| | | **(2)** |
| | | **(7 marks)** |

**(a)**

B1: $\left(\frac{3\pi}{2}, 0\right)$ or accept the identification that $x = \frac{3\pi}{2}$ at *R* e.g. cos *x* = 0 so $x = \frac{3\pi}{2}$

Accept $\frac{3\pi}{2}$ written on the diagram at the point *R* or just $\frac{3\pi}{2}$ seen as the answer as long as there is no evidence that *y* is anything other than zero. Must be exact.

**(b)**

M1: Attempts the product rule. Award for the form $f'(x) = \pm\alpha\cos^2 x e^{3\sin x} \pm \beta \sin x e^{3\sin x}$

A1: Correct derivative in any form

**d**M1: Attempts to use the identity $\pm\sin^2 x \pm \cos^2 x = \pm 1$ to produce a 3 term quadratic expression in sin *x* which may be seen embedded but with the $e^{3\sin x}$ factored.

e.g. $e^{3\sin x}\left(6\left(1-\sin^2 x\right) - 2\sin x\right)$

**Depends on the previous method mark.**

A1: $3\sin^2 x + \sin x - 3 = 0$ or any integer multiple of this equation e.g. $6 - 6\sin^2 x - 2\sin x = 0$ and apply isw once a correct equation is seen.

Must be "extracted" but allow if seen, used or implied in part (c) and allow recovery from missing brackets if the quadratic expression is extracted correctly.

**Beware:**

$f'(x) = \left(-6\cos^2 x\right)e^{3\sin x} + \left(2\sin x\right)e^{3\sin x} = 0$ leading to $3\sin^2 x + \sin x - 3 = 0$ scores

M1A0dM1A0

**But allow full recovery in (c)**

**(c)**

M1: Solves their 3-term quadratic in sin $x$ (allow any method including calculator) and proceeds to find a value of $x$ using $\sin^{-1}$(their sin $x$) where $|\sin x| < 1$. You may need to check their value.

The attempt to solve their quadratic may be implied by at least 1 correct value for sin $x$ (allow 2dp if inexact).

A1: awrt 2.131 only and no other values offered.

**Correct answer only scores no marks.**

| Question Number | Scheme | Marks |
|---|---|---|
| **7(a)** | $\left(\frac{\mathrm{d}y}{\mathrm{d}x}=\right)-\frac{16}{3}(3x-k)^{-2}$ | M1A1 |
| | | **(2)** |
| **(b)** | $-\frac{16}{3}(3x-k)^{-2}=-12\Rightarrow\left(3x-k\right)^{2}=...$ | M1 |
| | $3-k="\pm\frac{2}{3}"\Rightarrow k=...$ | **d**M1 |
| | $k=\frac{7}{3}\ ,\ \frac{11}{3}$ | A1 |
| | | **(3)** |
| **(c)** | $y=\frac{16}{9\left(3(1)-\frac{7}{3}\right)}$ | M1<br>(B1 on ePEN) |
| | $y-"\frac{8}{3}"=\frac{1}{12}(x-1)$ | **d**M1 |
| | $12y-x-31=0$ | A1 |
| | | **(3)** |
| **(d)** | $\int\frac{16}{9(3x-k)}\mathrm{d}x=\frac{16}{27}\left[\ln(3x-k)\right]$ | M1 |
| | $=\frac{16}{27}\left[\ln\left(3x-\frac{7}{3}\right)\right]$ | A1ft |
| | $\frac{16}{27}\left[\ln\left(3x-\frac{7}{3}\right)\right]_{1}^{3}=\frac{16}{27}\left(\ln\left(3(3)-\frac{7}{3}\right)-\ln\left(3(1)-\frac{7}{3}\right)\right)$ | **d**M1 |
| | $=\frac{16}{27}\ln(10)$ | A1 |
| | | **(4)** |
| | | **(12 marks)** |

**(a)**

M1: Attempts to differentiate to the form $A(3x-k)^{-2}$ oe e.g. $A(27x-9k)^{-2}$

A1: $\left(\frac{\mathrm{d}y}{\mathrm{d}x}=\right)-\frac{16}{3}(3x-k)^{-2}$ oe

e.g. $-\frac{16}{3(3x-k)^{2}}$ or $-\frac{16}{3(9x^{2}-6kx+k^{2})}$ or $-\frac{16}{27x^{2}-18kx+3k^{2}}$

but **not**

$-432(27x-9k)^{-2}$ or $-\frac{432}{(27x-9k)^{2}}$

as there is a common factor in the numerator and denominator.