| Question | Scheme | Marks | AOs |
|---|---|---|---|
| **5(i)** | $\int 2e^{-\frac{1}{2}x}\,dx = -4e^{-\frac{1}{2}x}$ | B1 | 1.1b |
| | $\int_1^{\infty} 2e^{-\frac{1}{2}x}\,dx = \lim_{t\to\infty}\left[\left(-4e^{-\frac{1}{2}t}\right)-\left(-4e^{-\frac{1}{2}}\right)\right]$ | M1 | 2.1 |
| | $= 4e^{-\frac{1}{2}}$ | A1 | 1.1b |
| | | **(3)** | |
| **(ii)(a)** | Mean temperature $= \frac{1}{24}\int_0^{24}\left(8-5\sin\left(\frac{\pi}{12}t\right)-\cos\left(\frac{\pi}{6}t\right)\right)dt$ | B1 | 1.2 |
| | $= \frac{1}{24}\left[\left(8t+\frac{60}{\pi}\cos\left(\frac{\pi}{12}t\right)-\frac{6}{\pi}\sin\left(\frac{\pi}{6}t\right)\right)\right]_0^{24} = \frac{1}{24}[...]$ | M1 | 1.1b |
| | $= \frac{1}{24}\left[\left(8(24)+\frac{60}{\pi}-\frac{6}{\pi}\times 0\right)-\left(\frac{60}{\pi}\right)\right] = 8$ * cso | A1* | 2.1 |
| | | **(3)** | |
| **(ii)(b)** | E.g. increase the value of the constant 8 / adapt the constant 8 to a function which takes values greater than 8. | B1 | 3.5c |
| | | **(1)** | |
| | | | **(7 marks)** |

**Notes:**

**(i)**

**B1:** Correct integration.

**M1**: Attempt to integrate to a form $\lambda e^{-\frac{1}{2}x}$ where $\lambda \neq 2$, and applies correct limits with some consideration of the infinite limit given (e.g. with the limit statement). Only allow with $\infty$ used as the limit if subsequent work shows the term is zero.

**A1:** Correct value

**(ii)(a)**

**B1:** Recalls the correct formula for finding the mean value of a function. You may see the division by "24" only at the end. No integration is necessary, just a correct statement with an integral.

**M1:** Integrates to a form $\alpha t + \beta\cos\left(\frac{\pi}{12}t\right)+\delta\sin\left(\frac{\pi}{6}t\right)$ and uses the limits of 0 and 24 (the correct way around). If no explicit substitution is seen, accept any value following the integral as an attempt. Answers from a calculator with no correct integral seen score M0 as the question requires calculus to be used.

**A1*cso:** Achieves 8 with no errors seen following a full attempt at the substitution. Must have seen some evidence of the limits used, minimum required for substitution is $\left[\left(8(24)+\frac{60}{\pi}\right)-\left(\frac{60}{\pi}\right)\right]$.

**(ii)(b)**

**B1:** Accept any reasonable adaptation to the equation that will increase the mean value. E.g. as in scheme, or introduce another positive term, or decrease the constant 5 etc. It must be clear which constant they are referring to in their reason, not just "increase the constant".