

Section B

<p>7(i) (A) $9 / 1.5 = 6$ hours (B) $18/1.5 = 12$ hours</p>	B1 B1 [2]	
<p>(ii) $\frac{d\theta}{dt} = -k(\theta - \theta_0)$ $\Rightarrow \int \frac{d\theta}{\theta - \theta_0} = \int -k dt$ $\Rightarrow \ln(\theta - \theta_0) = -kt + c$</p> $\theta - \theta_0 = e^{-kt+c}$ $\theta = \theta_0 + Ae^{-kt} *$	M1 A1 A1 M1 E1 [5]	separating variables $\ln(\theta - \theta_0)$ $-kt + c$ anti-logging correctly (with c) $A = e^c$
<p>(iii) $98 = 50 + Ae^0$ $\Rightarrow A = 48$ Initially $\frac{d\theta}{dt} = -k(98 - 50) = -48k = -1.5$ $\Rightarrow k = 0.03125 *$</p>	M1 A1 M1 E1 [4]	
<p>(iv) (A) $89 = 50 + 48e^{-0.03125t}$ $\Rightarrow 39/48 = e^{-0.03125t}$ $\Rightarrow t = \ln(39/48)/(-0.03125) = 6.64$ hours</p> <p>(B) $80 = 50 + 48e^{-0.03125t}$ $\Rightarrow 30/48 = e^{-0.03125t}$ $\Rightarrow t = \ln(30/48)/(-0.03125) = 15$ hours</p>	M1 M1 A1 M1 A1 [5]	equating taking lns correctly for either
<p>(v) Models disagree more for greater temperature loss</p>	B1 [1]	

8(i) $\frac{dy}{d\theta} = 2\cos 2\theta - 2\sin \theta, \frac{dx}{d\theta} = 2\cos \theta$ $\frac{dy}{dx} = \frac{dy/d\theta}{dx/d\theta}$ $\frac{dy}{dx} = \frac{2\cos 2\theta - 2\sin \theta}{2\cos \theta} = \frac{\cos 2\theta - \sin \theta}{\cos \theta}$	B1, B1 M1 A1 [4]	substituting for theirs oe
(ii) When $\theta = \pi/6$, $\frac{dy}{dx} = \frac{\cos \pi/3 - \sin \pi/6}{\cos \pi/6}$ $= \frac{1/2 - 1/2}{\sqrt{3}/2} = 0$ Coords of B: $x = 2 + 2\sin(\pi/6) = 3$ $y = 2\cos(\pi/6) + \sin(\pi/3) = 3\sqrt{3}/2$ $BC = 2 \times 3\sqrt{3}/2 = 3\sqrt{3}$	E1 M1 A1,A1 B1ft [5]	for either exact
(iii) (A) $y = 2\cos \theta + \sin 2\theta$ $= 2\cos \theta + 2\sin \theta \cos \theta$ $= 2\cos \theta(1 + \sin \theta)$ $= x\cos \theta *$ (B) $\sin \theta = \frac{1}{2}(x - 2)$ $\cos^2 \theta = 1 - \sin^2 \theta$ $= 1 - \frac{1}{4}(x - 2)^2$ $= 1 - \frac{1}{4}x^2 + x - 1$ $= (x - \frac{1}{4}x^2) *$ (C) Cartesian equation is $y^2 = x^2 \cos^2 \theta$ $= x^2(x - \frac{1}{4}x^2)$ $= x^3 - \frac{1}{4}x^4 *$	M1 E1 B1 M1 E1 M1 E1 [7]	$\sin 2\theta = 2\sin \theta \cos \theta$ squaring and substituting for x
(iv) $V = \int_0^4 \pi y^2 dx$ $= \pi \int_0^4 (x^3 - \frac{1}{4}x^4) dx$ $= \pi \left[\frac{1}{4}x^4 - \frac{1}{20}x^5 \right]_0^4$ $= \pi(64 - 51.2)$ $= 12.8\pi = 40.2 (\text{m}^3)$	M1 B1 A1 [3]	need limits $\left[\frac{1}{4}x^4 - \frac{1}{20}x^5 \right]$ 12.8 π or 40 or better.