viii) $E = U + T$ 1

$E = \frac{1}{2}|x_A - x_B|^2 + \frac{1}{2} m_A |v_A|^2 + \frac{1}{2} m_B |v_B|^2$

$= \frac{1}{2}|(2\cos 2t, \sin 2t, 0)|^2 + \frac{1}{2}\times\frac{1}{2}|(-2\sin 2t, \cos 2t, 0)|^2$

$+ \frac{1}{2}\times\frac{1}{2}|(2\sin 2t, -\cos 2t, 0)|^2$

$= \frac{1}{2}(4\cos^2 2t + \sin^2 2t) + \frac{1}{4}(4\sin^2 2t + \cos^2 2t) + \frac{1}{4}(4\sin^2 2t + \cos^2 2t)$

$= 2\cos^2 2t + \frac{1}{2}\sin^2 2t + \sin^2 2t + \frac{1}{4}\cos^2 2t + \sin^2 2t + \frac{1}{4}\cos^2 2t$

$= 2\cos^2 2t + 2\sin^2 2t + \frac{1}{2}\sin^2 2t + \frac{1}{2}\cos^2 2t = 5/2$ UNIT! 9

(10)

ix) $P' = m_A v_A' + m_B v_B'$

$= \frac{1}{2}\frac{d}{dt}(2\cos 2t, \frac{1}{2}\sin 2t, t^2) + \frac{1}{2}\frac{d}{dt}(0, -\frac{1}{2}\sin 2t, t^2)$

$= \frac{1}{2}(-4\sin 2t, \cos 2t, 2t) + \frac{1}{2}(0, -\cos 2t, 2t)$

$= (-2\sin 2t, 0, 2t)$ 3.

$J' = x_A' \times (m_A v_A') + x_B' \times (m_B v_B')$

$= (2\cos 2t, \frac{1}{2}\sin 2t, t^2) \times (\frac{1}{2}(-4\sin 2t, \cos 2t, 2t)$

$+ (0, -\frac{1}{2}\sin 2t, t^2) \times (\frac{1}{2}(0, -\cos 2t, 2t)$

$= (2\cos 2t, \frac{1}{2}\sin 2t, t^2) \times (-2\sin 2t, \frac{1}{2}\cos 2t, t)$

$+ (0, -\frac{1}{2}\sin 2t, t^2) \times (0, -\frac{1}{2}\cos 2t, t)$

$= (\frac{t}{2}\sin 2t - \frac{t^2}{2}\cos 2t, -2t^2\sin 2t - 2t\cos 2t, \cos^2 2t + \sin^2 2t)$

$+ (-\frac{t}{2}\sin 2t + \frac{t^2}{2}\cos 2t, 0, 0)$

$= (0, -2t^2\sin 2t - 2t\cos 2t, 1)$ JS 3.

$E' = \frac{1}{2}|x_A' - x_B'|^2 + \frac{1}{2} m_A |v_A'|^2 + \frac{1}{2} m_B |v_B'|^2$

$= \frac{1}{2}|(2\cos 2t, \frac{1}{2}\sin 2t, t^2) - (0, -\frac{1}{2}\sin 2t, t^2)|^2$

$+ \frac{1}{2}\times\frac{1}{2}\left|\frac{d}{dt}(2\cos 2t, \frac{1}{2}\sin 2t, t^2)\right|^2 + \frac{1}{2}\times\frac{1}{2}\left|\frac{d}{dt}(0, -\frac{1}{2}\sin 2t, t^2)\right|^2$

$= \frac{1}{2}|(2\cos 2t, \sin 2t, 0)|^2 + \frac{1}{4}|(-4\sin 2t, \cos 2t, 2t)|^2$

$+ \frac{1}{4}|(0, -\cos 2t, 2t)|^2$

$= \frac{1}{2}(4\cos^2 2t + \sin^2 2t) + \frac{1}{4}(16\sin^2 2t + \cos^2 2t + 4t^2)$

$+ \frac{1}{4}(\cos^2 2t + 4t^2)$

$= 2\cos^2 2t + \frac{1}{2}\sin^2 2t + 4\sin^2 2t + \frac{1}{4}\cos^2 2t + t^2 + \frac{1}{4}\cos^2 2t + t^2$

$= 2 + 2\sin^2 2t + \frac{1}{2}2t^2 = 2\sin^2 2t + 2t^2$ 5/2 4