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10	**7a**	The acceleration of a particle is given by $\ddot{x} = 4\cos 2t$, where x is displacement in metres and t is time in seconds. Initially the particle is at the origin with a velocity of 1 m s^{-1}. (i) Show that the velocity of the particle is given by $\dot{x} = 2\sin 2t + 1$. (ii) Find the time when the particle first comes to rest. (iii) Find the displacement, x, of the particle in terms of t.	 **2** **2** **2**

(i) $\dot{x} = \int 4\cos 2t \; dt$

$\therefore \dot{x} = 2\sin 2t + c$

Subs $t = 0$, $v = \dot{x} = 1$:

$1 = 2\sin 0 + c$

$\therefore c = 1$

$\therefore \dot{x} = 2\sin 2t + 1$

(ii) Subs $v = \dot{x} = 0$:

$0 = 2\sin 2t + 1$

$2\sin 2t = -1$

$\sin 2t = -\frac{1}{2}$

$2t = \frac{7\pi}{6}$

$t = \frac{7\pi}{12}$

$\therefore$ after $\frac{7\pi}{12}$ seconds

(iii) $x = \int 2\sin 2t + 1 \; dt$

$\therefore x = -\cos 2t + t + c$

Subs $t = 0$, $x = 0$:

$0 = -\cos 0 + 0 + c$

$0 = -1 + c$

$c = 1$

$\therefore x = -\cos 2t + t + 1$

$\therefore$ displacement is $x = 1 - \cos 2t + t$

State Mean:
1.64/2
1.04/2
1.18/2

* These solutions have been provided by *projectmaths* and are not supplied or endorsed by the Board of Studies

Board of Studies: Notes from the Marking Centre

(i) Most candidates gained full marks for this part. Virtually all of these integrated the acceleration and used the initial condition to determine the value of the constant of integration. Of the small number of candidates that differentiated the velocity, most failed to show that the velocity function satisfied the given initial condition. The most common error in this part was not explaining why the constant of integration was 1.

(ii) Most candidates realised that the particle is at rest when the velocity is zero. Most errors occurred in solving the resulting trigonometric equation.

Common errors included: working in degrees instead of radians; working with the 4th quadrant answer $2t = -\frac{\pi}{6}$ during their working; trying to convert their answer to a 3rd quadrant solution by adding π to their answer for t rather to their answer for $2t$; and not being able to correctly make t the subject of the equation.

(iii) Better responses showed all of the steps in the derivation of the displacement, including the evaluation of the constant of integration. The most common errors included: not finding the correct primitive; forgetting to integrate the constant 1; many candidates found the primitive of 1 to be x rather than t; not including the constant of integration; and not evaluating the constant of integration.

Source: http://www.boardofstudies.nsw.edu.au/hsc_exams/