NAME :

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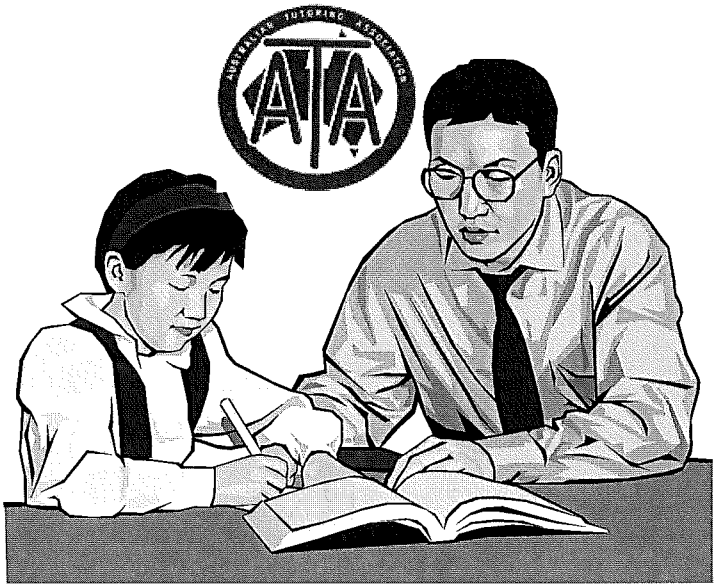


YEAR 12 – EXT 1 MATHS

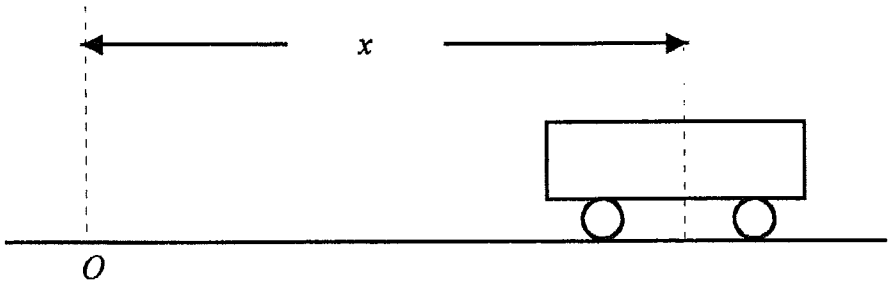
REVIEW TOPIC (SP1)

SIMPLE HARMONIC MOTION

PAST EXAMINATION QUESTIONS:

HSC '96

(6)



A trolley is moving in simple harmonic motion about the origin O. The displacement, x metres, of the centre of the trolley from O at time t seconds is given by

$$x = 6\sin\left(2t + \frac{\pi}{4}\right).$$

(a) State the period and amplitude of the motion. **2**

$\boxed{A = 6, P = \pi \text{ s}}$

(b) Sketch the graph of $x = 6\sin\left(2t + \frac{\pi}{4}\right)$ for $0 \le t \le 2\pi$. **2**

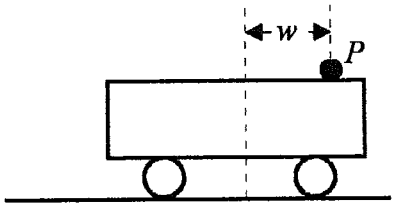
(c) Find the velocity of the trolley when $t = 0$. **2**

$\boxed{6\sqrt{2} \text{ m/s}}$

(d) Find the first time after $t = 0$ when the centre of the trolley is at $x = 3$.

$\boxed{\frac{7\pi}{24} \text{ s}}$

(e)



A particle P, on top of the trolley, is moving in simple harmonic motion about the centre of the trolley. Its displacement, w metres, from the centre of the trolley at time t seconds, is given by $w = \sin(2t)$.

The displacement, y metres, of P from the origin is the sum of the two displacements x and w, so that $y = 6\sin\left(2t + \frac{\pi}{4}\right) + \sin(2t)$.

(i) Show that P is moving in simple harmonic motion about O.

(ii) Find the amplitude of this motion.

$\sqrt{37+6\sqrt{2}}$

HSC '93

(3)(c) The velocity v m/s of a particle moving in simple harmonic motion along the x axis is given by

$$v^2 = 8 + 2x - x^2 .$$

(i) Between which two points is the particle oscillating ?

$-2 \le x \le 4$

(ii) What is the amplitude of the motion ?

3

(iii) Find the acceleration of the particle in terms of x .

$\ddot{x} = 1 - x$

(iv) Find the period of the oscillation.

2π

HSC '92

(2)(b) The displacement x metres of a particle moving in simple harmonic motion is given by $x = 3\cos \pi t$, where the time t is in seconds.

(i) What is the period of the oscillation ?

2 secs

(ii) What is the speed v of the particle as it moves through the equilibrium position ?

3π m/s

(iii) Show that the acceleration of the particle is proportional to the displacement from the equilibrium position.

HSC '90

(3)(b) The velocity v m/s of a particle moving in simple harmonic motion along the x axis is given by $v^2 = -5 + 6x - x^2$, where x is in metres.

(i) Between which two points is the particle oscillating ?

$\boxed{1 \leq x \leq 5}$

(ii) Find the centre of motion of the particle.

$\boxed{x = 3}$

(iii) Find the maximum speed of the particle.

$\boxed{2 \text{ m/s}}$

HSC '88

(3)(a) A particle undergoes simple harmonic motion about the origin O.
Its displacement x cm from O at time t seconds, is given by

$$x = 3\cos\left(2t + \frac{\pi}{3}\right).$$

(i) Express the acceleration as a function of displacement.

$\ddot{x} = -4x$

(ii) Write down the amplitude of the motion.

3 cm

(iii) Find the value of x for which the speed is a maximum and determine this speed.

When $x = 0$, $v = 6$ cm/s