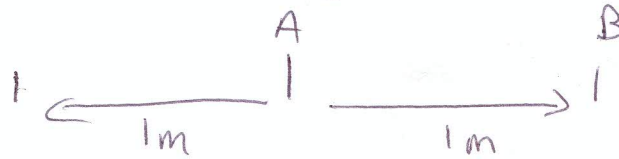


(ii) Time to travel C to B = Time to travel C (Extreme) to B (mean)

$$\begin{aligned} \therefore &= \frac{1}{4} T \\ &= \frac{1}{4} \left( \frac{2\pi}{\omega} \right) \\ &= \frac{1}{4} \left( \frac{2\pi}{\sqrt{7}} \right) \\ &= \frac{\pi}{2\sqrt{7}} \text{ seconds.} \end{aligned}$$

(iii) Particle will travel at constant speed for as long as the string is slack. = time to travel from B to A and then 1m (natural length of string) beyond A.



$$\text{Time} = \frac{2(BA)}{\text{Speed at B}} = \frac{2(1)}{v_B}$$

At point B:  $x=0 \Rightarrow v^2 = \omega^2(A^2 - x^2)$   
 $\Rightarrow v^2 = (\sqrt{7})^2((5)^2 - 0^2)$   
 $\Rightarrow v^2 = \frac{7}{4}$   
 $\Rightarrow v = \sqrt{\frac{7}{4}}$

$$\therefore \text{Time} = \frac{2}{\left(\frac{\sqrt{7}}{2}\right)} = \frac{4}{\sqrt{7}} \text{ seconds as required}$$

1942. (a) If the displacement of a moving particle at any time  $t$  is given by the equation

$$x = 5 \cos \omega t + 12 \sin \omega t$$

- (i) show that the motion is a simple harmonic motion.
- (ii) calculate the amplitude of the motion.

(i)  $x = 5 \cos \omega t + 12 \sin \omega t$   
 $\frac{dx}{dt} = -5\omega \sin \omega t + 12\omega \cos \omega t$   
 $\frac{d^2x}{dt^2} = -5\omega^2 \cos \omega t - 12\omega^2 \sin \omega t$   
 $\frac{d^2x}{dt^2} = -\omega^2 [5 \cos \omega t + 12 \sin \omega t]$   
 $\frac{d^2x}{dt^2} = -\omega^2 x$ , as required

(ii) To find A

$A = x_{\max}$  occurs where  $v = 0$ .

$$\begin{aligned} \Rightarrow \frac{dx}{dt} &= 0 \\ \Rightarrow -5\omega \sin \omega t + 12\omega \cos \omega t &= 0 \\ \Rightarrow 5 \sin \omega t &= 12 \cos \omega t \\ \Rightarrow \tan \omega t &= \frac{12}{5} \end{aligned}$$

$$\Rightarrow \begin{array}{c} 13 \\ \swarrow \quad \searrow \\ 5 \quad 12 \end{array} \Rightarrow \omega t = \frac{5}{13} \text{ or } \omega t = \frac{12}{13}$$

$$\therefore A = x_{\max} = 5 \left[ \frac{5}{13} \right] + 12 \left[ \frac{12}{13} \right] = 13$$

[or guess 5, 12  $\Rightarrow$  13!]