

- (iii) $x = 12 \cos t + 5 \sin t$
 $A = \sqrt{12^2 + 5^2} = 13$
 $T = 2\pi$
- (iv) $x = 3 \cos \pi t + \sqrt{7} \sin \pi t$
 $A = \sqrt{3^2 + \sqrt{7}^2} = 4$
 $T = \frac{2\pi}{\pi} = 2$
- (v) $x = \sin 3t + \cos 3t$
 $A = \sqrt{1^2 + 1^2} = \sqrt{2}$
 $T = \frac{2\pi}{3}$
- (vi) $x = 21 \sin 2\pi t + 20 \cos 2\pi t$
 $A = \sqrt{21^2 + 20^2} = 29$
 $T = \frac{2\pi}{2\pi} = 1$
- (vii) $x = \sqrt{3} \sin 5t - \cos 5t$
 $A = \sqrt{\sqrt{3}^2 + 1^2} = 2$
 $T = \frac{2\pi}{5}$
- (viii) $x = 2 \sin \frac{t}{2} + 3 \cos \frac{t}{2}$
 $A = \sqrt{2^2 + 3^2} = \sqrt{13}$
 $T = \frac{2\pi}{\left(\frac{1}{2}\right)} = 4\pi$
- (ix) $x = 24 \sin \frac{t}{4} - 7 \cos \frac{t}{4}$
 $A = \sqrt{24^2 + 7^2} = 25$
 $T = \frac{2\pi}{\left(\frac{1}{4}\right)} = 8\pi$
- (x) $x = 2 \sin \frac{t}{3} + \cos \frac{t}{3}$
 $A = \sqrt{2^2 + 1^2} = \sqrt{5}$
 $T = \frac{2\pi}{\left(\frac{1}{3}\right)} = 6\pi$

- Q. 6.** $x = 12 \cos t + 35 \sin t$
 $\Rightarrow \dot{x} = -12(1) \sin t + 35(1) \cos t$
 $\Rightarrow \ddot{x} = -12(1)^2 \cos t - 35(1)^2 \sin t$
 $\Rightarrow \ddot{x} = -12 \cos t - 35 \sin t$
- (i) $\Rightarrow \ddot{x} = -x$
 \Rightarrow SHM with $\omega = 1$ rad/s
- (ii) $T = \frac{2\pi}{\omega}$
 $\Rightarrow T = \frac{2\pi}{1}$
 $\Rightarrow T = 2\pi$ s

- (iii) $A = \sqrt{12^2 + 35^2}$
 $\Rightarrow A = 37$ m
- (iv) For $x = 0$;
 $12 \cos t + 35 \sin t = 0$
 $\Rightarrow 35 \sin t = -12 \cos t$
 $\Rightarrow \tan t = \frac{-12}{35}$
 $\Rightarrow t = -0.3303, -0.3303 + \pi, \text{ etc.}$
 $\Rightarrow t = -0.3303 + \pi$
 for first positive value.
 $\Rightarrow t = 2.811$ s

- Q. 7.** $x = 12 \sin 2t + 5 \cos 2t$
 $\dot{x} = 12(2) \cos 2t - 5(2) \sin 2t$
 $\ddot{x} = -12(2)^2 \sin 2t - 5(2)^2 \cos 2t$
 $\Rightarrow \ddot{x} = -48 \sin 2t - 20 \cos 2t$
- (i) $\Rightarrow \ddot{x} = -4x$
 \Rightarrow SHM with $\omega = 2$ rad/s
- (ii) $T = \frac{2\pi}{\omega}$
 $\Rightarrow T = \frac{2\pi}{2}$
 $\Rightarrow T = \pi$ s
- (iii) $A = \sqrt{12^2 + 5^2}$
 $\Rightarrow A = 13$ m
- (iv) For $x = 0$
 $12 \sin 2t + 5 \cos 2t = 0$
 $\Rightarrow \sin 2t = \frac{-5}{12} \cos 2t$
 $\Rightarrow \tan 2t = \frac{-5}{12}$
 $\Rightarrow 2t = \tan^{-1} \frac{-5}{12} + n\pi$
 for all solutions
 $\Rightarrow 2t = -0.3948 + n\pi$
 $\Rightarrow t = -0.1974 + \frac{n\pi}{2}$
 $\Rightarrow n = 1$ gives $t_1 = 1.373$ s

- (v) $n = 2$ gives $t_2 = 2.944$ s
- Q. 8.** (i) $x = A \cos(\omega t + \alpha)$
 $\Rightarrow \frac{dx}{dt} = -\omega A \sin(\omega t + \alpha)$
 $\Rightarrow \frac{d^2x}{dt^2} = -\omega^2 A \cos(\omega t + \alpha) = -\omega^2 x$
 Since the acceleration is proportional to x but in the opposite direction, it will perform SHM.