DPP – 5 (SHM)

Video Solution on Website:- https://physicsaholics.com/home/courseDetails/89

Video Solution on YouTube:- https://youtu.be/AeVBWqGL9EM

Written Solution on Website:- https://physicsaholics.com/note/notesDetalis/29

Q 1. In a damped oscillation with damping constant b. The time taken for amplitude of oscillation to drop to half of its initial value?

(a) $\frac{b}{m}\ln 2$ (b) $\frac{b}{2m}\ln 2$
(c) $\frac{m}{b}\ln 2$ (d) $\frac{2m}{b}\ln 2$

Q 2. A damped harmonic oscillator has a frequency of 5 oscillations per second. The amplitude drops to half its value for every 10 oscillations. The time it will take to drop to $\frac{1}{1000}$ of the original amplitude is close to :-

(a) 100 s (b) 20 s
(c) 10 s (d) 50 s

Q 3. The amplitude of damped oscillation decreases to .9 times to its original magnitude in 5 sec. In another 10 sec it will decrease to α times its original value, where α is

(a) 0.81 (b) 0.729
(c) 0.6 (d) 0.7

Q 4. A block of mass 2 kg is connected to a spring of stiffness 8N/m. System is allowed to oscillate under a damping force F = 0.23 V where V is velocity. Time required to decrease amplitude to half its initial value is

(a) 0.693 sec (b) 12 sec
(c) 0.8 sec (d) 14.3 sec

Q 5. Resonance is special case of

(a) Damped oscillation (b) Forced oscillation
(c) Natural oscillation (d) Both (a) & (c)

Q 6. In forced oscillation if we increase frequency from very small value keeping amplitude of driving force constant, amplitude of motion of particle

(a)Increases (b)Decreases
(c)First increases then decreases (d)First decreases then increases

Q 7. In case of damped oscillation frequency of oscillation is

(a) Greater than natural frequency
(b) Less than natural frequency
(c) Equal to natural frequency
(d) Both (a) & (c)

Q 8. Frequency of forced oscillation is equal to
(a) Frequency of driving force
(b) Natural frequency
(c) Difference in natural frequency and frequency of driving force
(d) Mean of natural frequency and frequency of driving force

Q 9. What is the effect of increasing damping in resonance?
(a) decrease slightly the value of resonance frequency.
(b) reduce the maximum amplitude of an oscillator.
(c) The shape of the curve of resonance becomes broad.
(d) All of these

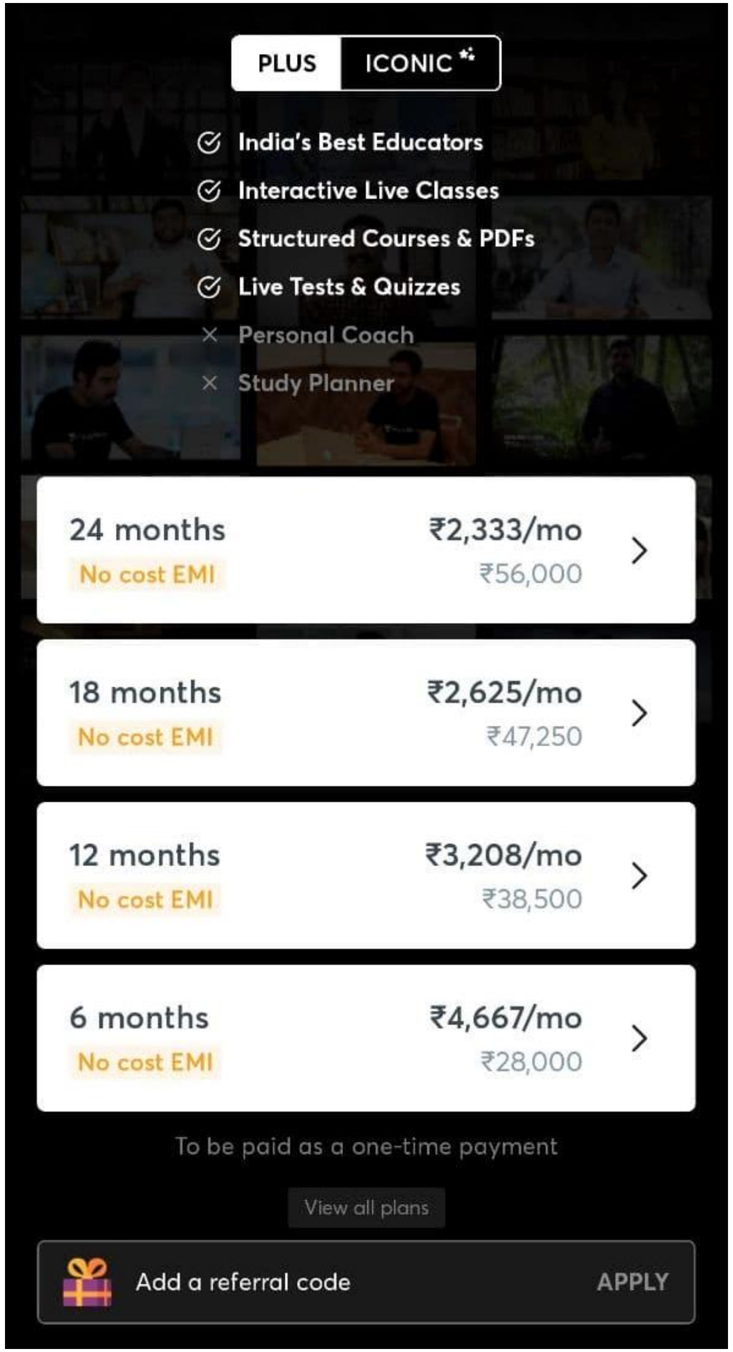
Q 10. Which of the following equation represents damped oscillation
(a) $\frac{d^2x}{dt^2} + \frac{dx}{dt} + \frac{kx}{m} = 0$ (b) $\frac{d^2x}{dt^2} = -kx$
(c) $\frac{d^2x}{dt^2} - kx + \frac{dx}{dt} = 0$ (d) $\frac{d^2x}{dt^2} = -kx + f_0 \text{Sin}\omega_0 t$

Q 11. For sharper amplitude vs angular frequency of driving force graph, damping constant should be
(a) High
(b) Low
(c) Does not depend on damping constant
(d) None of these

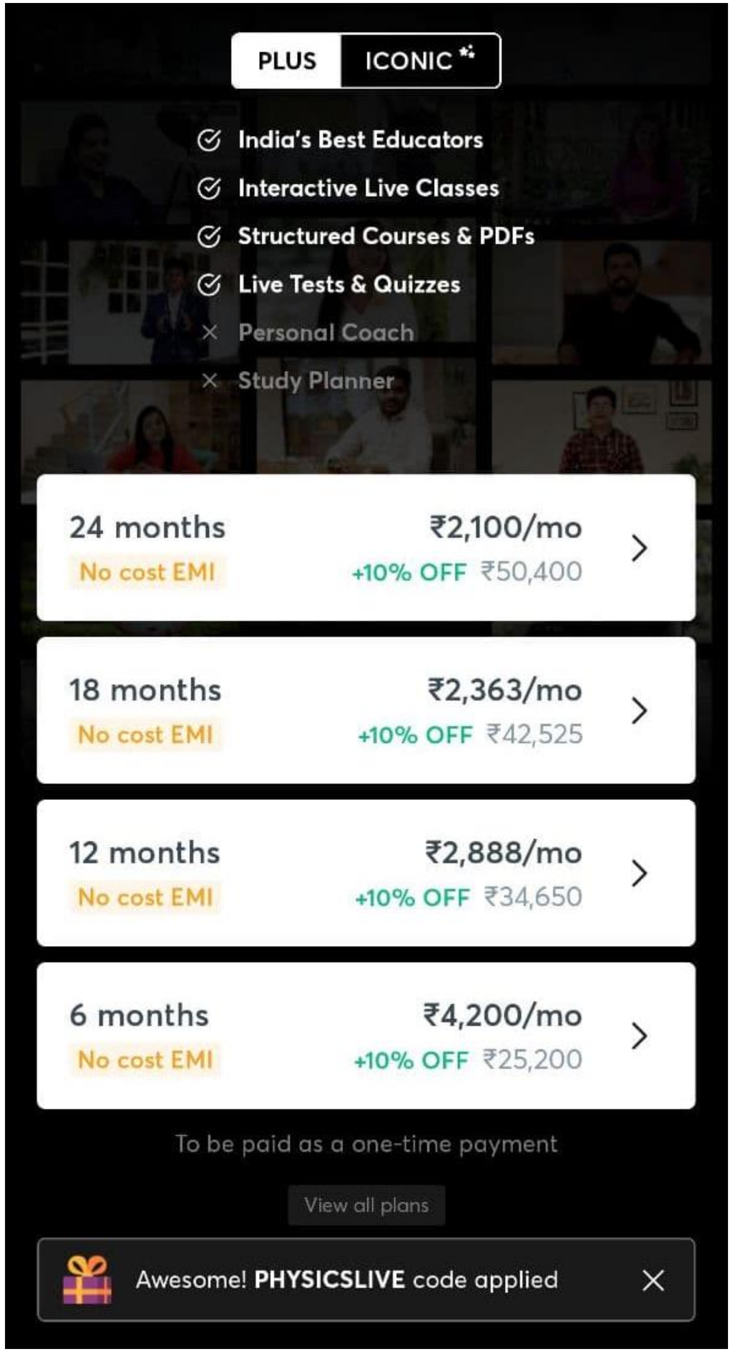
Q 12. The forced harmonic have equal displacement amplitude at frequencies 400/sec and 600/sec, then resonance frequency is (damping constant is very small)
(a) 500/sec (b) 510/sec
(c) 490/sec (d) 520/sec

Answer Key

Q.1 d	**Q.2 b**	**Q.3 b**	**Q.4 b**	**Q.5 b**
Q.6 c	**Q.7 b**	**Q.8 a**	**Q.9 d**	**Q.10 a**
Q.11 b	**Q.12 b**			



PHYSICSLIVE



Use code PHYSICSLIVE to get 10% OFF on Unacademy PLUS.

Physics DPP- Solution

DPP- 5 S.H.M. : Forced And Damping Oscillation, Resonance

By Physicsaholics Team

Q1) In a damped oscillation with damping constant b. The time taken for amplitude of oscillation to drop to half of its initial value?

(a) $\frac{b}{m}\ln 2$

(b) $\frac{b}{2m}\ln 2$

(c) $\frac{m}{b}\ln 2$

(d) $\frac{2m}{b}\ln 2$

$A = A_0 e^{-bt/2m}$

$\frac{A_0}{2} = A_0 e^{-bt/2m}$

$\ln 2 = \frac{bt}{2m}$

$t_{1/2} = \frac{2m}{b}\ln 2$

Q2) A damped harmonic oscillator has a frequency of 5 oscillations per second. The amplitude drops to half its value for every 10 oscillations. The time it will take to drop to $\frac{1}{1000}$ of the original amplitude is close to :-

(a) 100 s

(b) 20 s

(c) 10 s

(d) 50 s

$f = 5$

$t_{1/2} = 10$ oscillation $= 2$ Sec

$A = A_0 \left(\frac{1}{2}\right)^n$ → n is no of half life $n = t/t_{1/2}$

$\frac{A_0}{1000} = A_0 \left(\frac{1}{2}\right)^{t/2}$

$\log 1000 = \frac{t}{2} \log 2$

$t = \frac{3}{.301} \times 2 \simeq 20$ Sec

Q3) The amplitude of damped oscillation decreases to .9 times to its original magnitude in 5 sec. In another 10 sec it will decrease to α times its original value, where α is

$t_{.9} = 5$ Sec

$A = A_0(.9)^n$ → where n is no of .9 life

$A = A_0(.9)^{\frac{15}{5}}$

$= A_0(.9)^3$

$= .729 A_0$

(a) 0.81

(b) 0.729 ✓

(c) 0.6

(d) 0.7

Q4) A block of mass 2 kg is connected to a spring of stiffness 8N/m. System is allowed to oscillate under a damping force F = 0.23 V where V is velocity. Time required to decrease amplitude to half its initial value is

$b = .23$

$A = A_0 e^{-bt/2m}$

$\frac{A}{A_0} = \frac{1}{2} = e^{-bt/2m}$

$\ln 2 = \frac{bt}{2m}$

$t = \frac{2m}{b} \ln 2 = \frac{2 \times 2}{.23} \times .69$

$= 12$ sec

(a) 0.693 sec

(b) 12 sec

(c) 0.8 sec

(d) 14.3 sec

Q5) Resonance is special case of

(a) Damped oscillation

(b) Forced oscillation

(c) Natural oscillation

(d) Both (a) & (c)

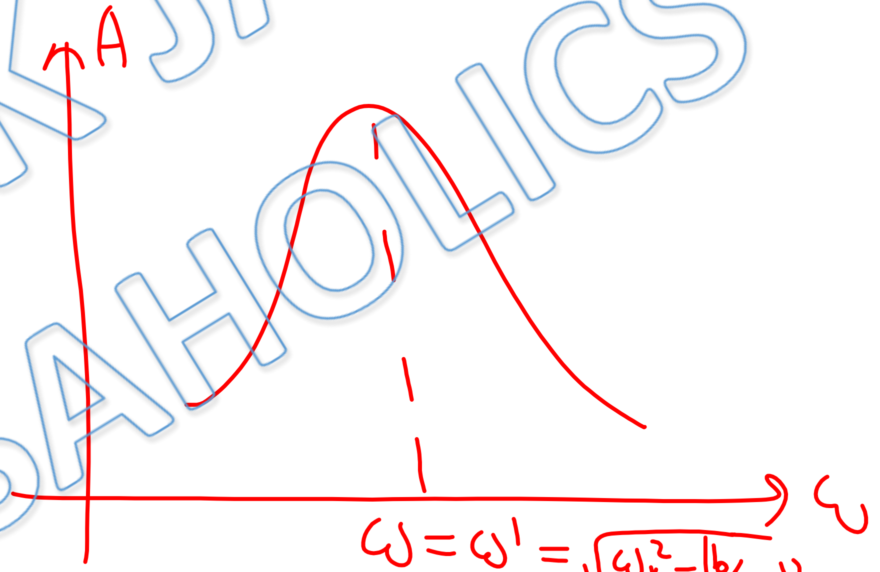
Q6) In forced oscillation if we increase frequency from very small value keeping amplitude of driving force constant , amplitude of motion of particle

(a) Increases

(b) Decreases

(c) First increases then decreases

(d) First decreases then increases



$\omega = \omega' = \sqrt{\omega_0^2 - (b/2m)^2}$

If b is small

$\omega' \simeq \omega_0$

Q7) In case of damped oscillation frequency of oscillation is

$\omega' = \sqrt{\omega_0^2 - \left(\frac{b}{2m}\right)^2}$

ω_0 → natural frequency

(a) Greater than natural frequency

(b) Less than natural frequency ✓

(c) Equal to natural frequency

(d) Both (a) & (c)

Q8) Frequency of forced oscillation is equal to

$F_0 \sin \omega t$

same

$x = A \sin(\omega t + \phi)$

(a) Frequency of driving force

(b) Natural frequency

(c) Difference in natural frequency and frequency of driving force

(d) Mean of natural frequency and frequency of driving force

Q9) What is the effect of increasing damping in resonance?

resonance frequency $\omega' = \sqrt{\omega_0^2 - (b/2m)^2}$

(a) decrease slightly the value of resonance frequency.

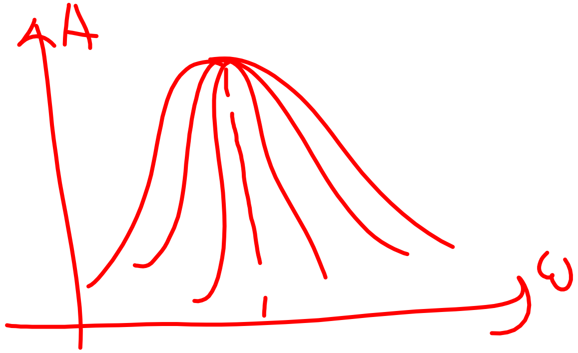
(b) reduce the maximum amplitude of an oscillator.

$Q = \frac{1}{R}\sqrt{\frac{L}{C}}$

(c) The shape of the curve of resonance becomes broad.

(d) All of these

$$A = \frac{F_0/m}{\sqrt{(\omega^2 - \omega_0^2)^2 + \left(\frac{b\omega}{m}\right)^2}}$$



Q10) Which of the following equation represents damped oscillation

$-kx - bv = ma$ (F_{net})

$m\frac{d^2x}{dt^2} + b\frac{dx}{dt} + kx = 0$

$\frac{d^2x}{dt^2} + \frac{b}{m}\frac{dx}{dt} + \frac{kx}{m} = 0$

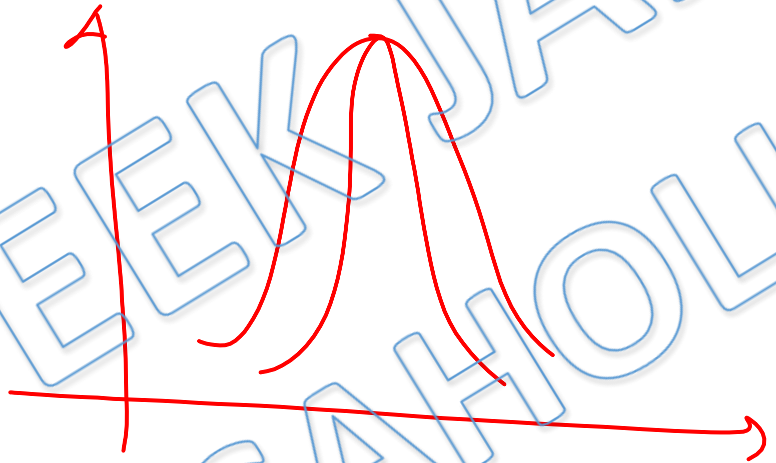
(a) $\frac{d^2x}{dt^2} + \frac{dx}{dt} + \frac{kx}{m} = 0$ ✓

(b) $\frac{d^2x}{dt^2} = -kx$

(c) $\frac{d^2x}{dt^2} - kx + \frac{dx}{dt} = 0$

(d) $\frac{d^2x}{dt^2} = -kx + f_0 \sin\omega_0 t$

Q11) For sharper amplitude vs angular frequency of driving force graph, damping constant should be



Sharpness $= \frac{1}{R}\sqrt{\frac{L}{C}}$

(a) High

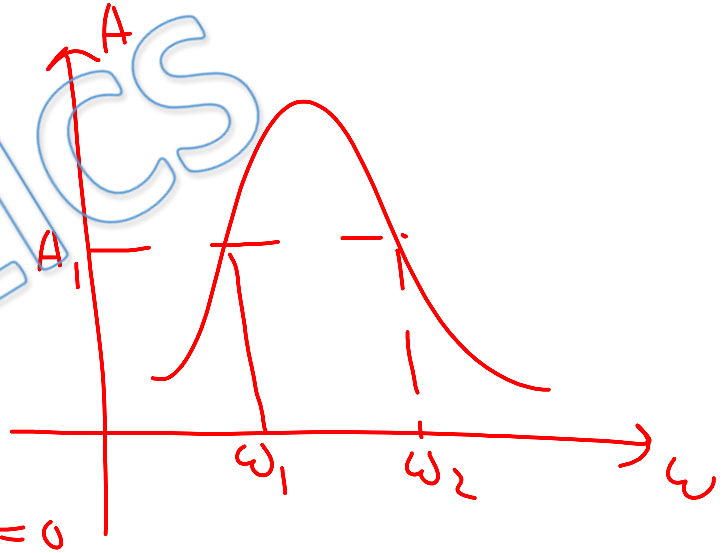
(b) Low

(c) Does not depend on damping constant

(d) None of these

Q12) The forced harmonic (motion) have equal displacement amplitude at frequencies 400/sec and 600/sec, then resonance frequency is (damping constant is very small)

$$A = \frac{F_0/m}{\sqrt{(\omega^2-\omega_0^2)^2+\left(\frac{b\omega}{m}\right)^2}}$$



$$(\omega^2-\omega_0^2)^2+\left(\frac{b\omega}{m}\right)^2 = C$$

$$\omega^4+\omega_0^4-2\omega^2\omega_0^2+\frac{b^2\omega^2}{m^2}-C=0$$

$$\omega^4-\omega^2\left(2\omega_0^2-\frac{b^2}{m^2}\right)+(\omega_0^4-C)=0$$

$$\omega_1^2+\omega_2^2 = 2\omega_0^2-b^2/m^2 \simeq 2\omega_0^2$$

$$\omega_0=\sqrt{\frac{\omega_1^2+\omega_2^2}{2}} = \sqrt{\frac{(400)^2+(600)^2}{2}} \simeq 510/\text{sec}$$

(a) 500/sec

(b) 510/sec ✓

(c) 490/sec

(d) 520/sec

For Video Solution of this DPP, Click on below link

Video Solution on Website:- https://physicsaholics.com/home/courseDetails/89

Video Solution on YouTube:- https://youtu.be/AeVBWqGL9EM

Written Solution on Website:- https://physicsaholics.com/note/notesDetalis/29

Chalo Niklo