JEE

Prayas JEE (2025)

Physics

Oscillations

DPP: 5

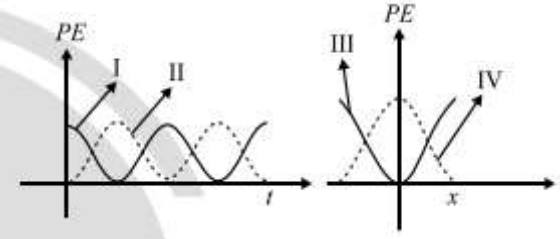
Q1 A body is executing Simple Harmonic Motion. At a displacement x its potential energy is E_1 and at a displacement y its potential energy is E_2. The potential energy E at displacement $x+y$ is

(A) $E=\sqrt{E_1}+\sqrt{E_2}$
(B) $\sqrt{E}=\sqrt{E_1}+\sqrt{E_2}$
(C) $E=E_1+E_2$
(D) None of these

Q2 A particle of mass m is executing oscillations about the origin on the x-axis. Its potential energy is $U(x)=k[x]^3$, where k is a positive constant. If the amplitude of oscillation is a, then its time period T is

(A) Proportional to $\frac{1}{\sqrt{a}}$
(B) Independent of a
(C) Proportional to $\sqrt{a}$
(D) Proportional to $a^{3/2}$

Q3 For a particle executing S.H.M. the displacement x is given by $A\cos\omega t$. Identify the graph which represents the variation of potential energy (P.E.) as a function of time t and displacement x.



(A) I, III
(B) II, IV
(C) II, III
(D) I, IV

Q4 A particle executes linear simple harmonic motion with an amplitude of $3\ \text{cm}$. When the particle is at $2\ \text{cm}$ from the mean position, the magnitude of its velocity is equal to that of its acceleration. Then its time period in seconds is

(A) $\frac{\sqrt{5}}{2\pi}$
(B) $\frac{4\pi}{\sqrt{5}}$
(C) $\frac{2\pi}{\sqrt{3}}$
(D) $\frac{\sqrt{5}}{\pi}$

Q5 A body of mass m is attached to the lower end of a spring whose upper end is fixed. The spring has negligible mass. When the mass m is slightly pulled down and released, it oscillates with a time period of $3\ \text{s}$. When the mass m is increased by $1\ \text{kg}$, the time period of oscillations becomes $5\ \text{s}$. The value of m in kg is

(A) $3/4$
(B) $4/3$
(C) $16/9$
(D) $9/16$

Q6 A particle of mass m oscillates along x-axis according to equation $x=a\sin\omega t$. The nature of the graph between momentum and displacement of the particle is

(A) Circle
(B) Hyperbola
(C) Ellipse
(D) Straight line passing through origin

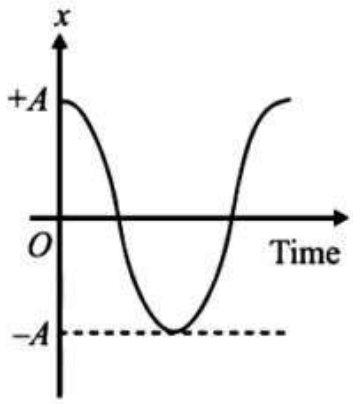
Q7 The period of oscillation of a mass M suspended from a spring of negligible mass is T. If along with it another mass M is also suspended, the period of oscillation will now be

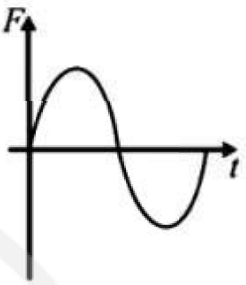
(A) T
(B) $\frac{T}{\sqrt{2}}$
(C) $2T$
(D) $\sqrt{2}T$

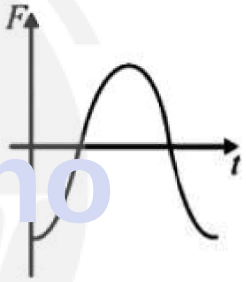
Q8 Two bodies P and Q of equal masses are suspended from two separate massless springs of force constants k_1 and k_2 respectively. If the two bodies oscillate vertically such that their maximum velocities are equal. The ratio of the amplitude of P to that of Q is
(A) $\sqrt{\frac{k_1}{k_2}}$
(B) $\frac{k_1}{k_2}$
(C) $\sqrt{\frac{k_2}{k_1}}$
(D) $\frac{k_2}{k_1}$

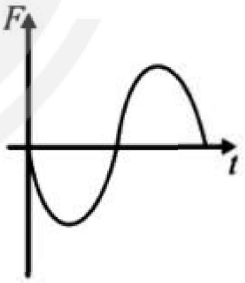
Q9 A disc of radius R is pivoted at its rim. The period for small oscillations about an axis perpendicular to the plane of disc is
(A) $2\pi\sqrt{\frac{R}{g}}$
(B) $2\pi\sqrt{\frac{2R}{g}}$
(C) $2\pi\sqrt{\frac{2R}{3g}}$
(D) $2\pi\sqrt{\frac{3R}{2g}}$

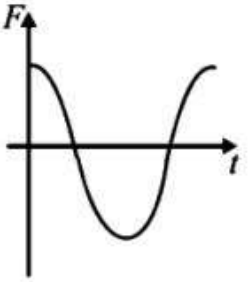
Q10 The displacement-time $x-t$ graph of a particle executing simple harmonic motion is shown in figure. The correct variation of net force F acting on the particle as a function of time is



(A) 

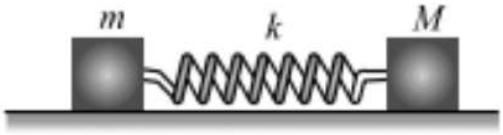
(B) 

(C) 

(D) 

Q11

The spring as shown in figure is kept in a stretched position with extension x when the system is released. Assuming the horizontal surface to be frictionless, the frequency of oscillation is



(A) $\frac{1}{2\pi}\sqrt{\frac{k(M+m)}{Mm}}$

(B) $\frac{1}{2\pi}\sqrt{\left[\frac{mM}{k(M+m)}\right]}$

(C) $\frac{1}{2\pi}\sqrt{\left[\frac{kM}{(m+M)}\right]}$

(D) $\frac{1}{2\pi}\sqrt{\left[\frac{km}{(M+m)}\right]}$

Q12 A uniform stick of length l is mounted so as to rotate about a horizontal axis perpendicular to the stick and at distance d from the centre of mass. The time period of small oscillations has a minimum value when d/l is

(A) $\frac{1}{\sqrt{2}}$

(B) $\frac{1}{\sqrt{12}}$

(C) $\frac{1}{\sqrt{3}}$

(D) $\frac{1}{\sqrt{6}}$

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Answer Key

Q1	(B)	Q7	(D)
Q2	(A)	Q8	(C)
Q3	(A)	Q9	(D)
Q4	(B)	Q10	(B)
Q5	(D)	Q11	(A)
Q6	(C)	Q12	(B)

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