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PHYSICS

BOOKS - JEEVITH PUBLICATIONS PHYSICS (KANNADA ENGLISH)

OSCILLATIONS

One Mark Questions And Answers

1. What is meantby the periodic motion of particle?

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2. Give an example for a periodic motion.


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3. Give an example for a non - periodic motion.


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4. What is the meant by an oscillatory motion.


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5. Is circular motion of a particle on oscillatory motion?

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6. Give an example for an oscillatory motion of a particle.

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7. What is a SHM?

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8. What is meant by a damped oscillation?

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9. Define the term period of oscillation.

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10. Mention the 'SI unit of period of oscillation.

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11. Define frequency and period of oscillation.

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12. Express the SI unit of frequency.

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13. Give the simplest periodic mathematical function of time.

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14. Express time period 'T' interval of angular frequency 'ω'.

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15. If $f_1(t) = A\sin\omega t$ and $f_2(t) = B\cos\omega t$, then say whether $f(t) = A\sin\omega t + B\cos\omega t$ is also periodic.

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16. Say whether $y = e^{-\omega t}$ is periodic or not.

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17. Say whether $y = \log(\omega t)$ is periodic or not.

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18. Represent $y = A \sin \omega t$ graphically.

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19. The equation to the x - projection of the radius vector of the rotating paticle is given by

$x(t) = A\cos\left(\left(\frac{2\pi}{4}\right)t + \frac{\pi}{4}\right)$. Find the period of the wave function.

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20. If the displacement of a particle is given by $y(t) = A\sin(\omega t + \phi)$, then find the maximum velocity of the particle.

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21. If the displacement of a particle is represented by $y(t) = A\sin(\omega t + \phi)$, then give the

expression for the maximum accleration of the particle.

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22. What is the acceleration of a particle at the mean position?

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23. Give the expression for the angular frequency in terms of force constant and mass of the particle executing SHM.

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24. Give the expression for the potential energy of a particle executing SHM.

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25. Drawn a graph of a(t) defined by $a(y) = -\omega^2 t \cos(\omega t - \phi)$ where $\phi = 0$

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26. A spring of spring constant 'k' is supported from one end and tied by a mass 'm' at the other end. Write the formula to find the period of oscillation of the mass body. (Ignore the mass of the spring).

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27. What is meant by a free oscillation?

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28. What is the meant by a forced oscillation?

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29. What is meant by resonance?

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30. Give the expression for angular frequency of a damped oscillator.

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31. State the condition for resonance.

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32. What will be the amplitude of simple harmonic motion at resonance in the absence of damping force?

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33. When a system is induced to oscillation, say whether the system oscillation to its natural

frequency force?

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34. Under what condition will the motion of the simple pendulum be simple harmoic ?

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35. How does the period of oscillation of a particle depend on its phase constant?

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36. How does the period of oscillation of a particle depend of its phase constant?

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37. How does the period of oscillationof a particle depend on its amplitude?

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38. Mention any two arbitrary initial conditions in order to determine the linear simple harmonic

motion.

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39. If 'T' is the period of osillation and 'A' is the amplitude of oscillation then what will be the displacement of the particle corresponding to the time $\frac{T}{4}$?

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40. If the initial phase of the particle is $\frac{\pi}{4}$, amplitude 0.2m, period of oscillation 0.01s, then

write the expression for the instantaneous displacement of the particle.

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Two Marks Questions With Answers

1. If $f_1(t) = A \sin \omega t$ and $f_2(t) = B \cos \omega t$ represent two functions, then express, then express the combined amplitude.

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2. Give the expression for the torque acting on a simple pendulum about the support.

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3. Give the exression for the angular accleration of the simple pendulum and give the meanings of the symbols used.

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4. Give the expression for the period of oscillation of a simple pendulum along with the meanings of the symbols used.

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5. Give the expression for the damping force acting on an oscillating system (simple pendulum) due to the pressure of surroundng medium along the the meanings of the symbols used.

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6. Give the expression for total force acting on a mass suspended by a spring (of spring constant k) along with the meaning of the symbols used.

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7. Give the differential equation for a damped motion of an oscillating system (mass attached to a spring) along with the meanings of the symbols used.

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8. Give the expression for mechanical energy of a damped oscillator along with the condition for a small damping?

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9. Give the expression for differential equation of a forced oscillating system along with meanings of the symbols used.

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10. Calculate the period of oscillation of a block of mass 0.5 kg attached to a spring (spring constant $100 N m^{-1}$) at one end.

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11. Give the expression for acceleration and period of oscillation of two equal masses supported by a common spring and excited by applying equal force on the sides of the two masses.

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12. If $y = \sin \omega t - \cos \omega t$ then S.T. the function represents a SHM.

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Three Marks Questions With Answers

1. Arrive at the expression for kinetic energy of particle executing SHM.

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2. Represent KE and PE of a particle executing SHM graphically.

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Five Marks Questions With Answers

1. Arrive an expression for time period of simple pendulum.

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2. Give the expression for the amplitude of a damped oscillation of a particle. Hence discuss the amplitude for driving frequency (a) far from natural frequency and (b) close to natural frequecny.

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3. Given displacement of a particle executing SHM $y(t) = A\cos(\omega t + \phi)$. Plot instantaneous displacement, velocity and acceleration of particle with respect to time.

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4. Arrive at the expression for time period of oscillation of a mass attached to a vertical spring.

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Numericals With Solutions

1. Calculate total energy of a particle of mass $2.0 \times 10^{-3} kg$ oscillating simple harmonically with angular frequency $0.45 \, \mathrm{rad \, s^{-1}}$ and amplitude $1.0 \times 10^{-3} m$.

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2. If a mass of $2.0kg$ is attached to one end of a spring and the spring has a spring constant $1500Nm^{-1}$, then calculate the maximum velocity and acceleration of the mass body for an amplitude $0.05m$.

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3. Calculate the period of a simple pendulum of length 0.98 m at a place where acceleration due to

gravity is $9.8ms^{-2}$.

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4. For a damped oscillation of a particle, show that time taken for the amplitude to drop to half of its initial value $= \frac{2m\ln(2)}{b}$, where b is a damping constant.

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5. Give the expression for frequency of oscillation of a mass body as shown in the fig.

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6. Calculate the time taken for particele energy to drop to half its initial value in the case of a damped oscillator.

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7. The displacement equation of a particle executing S.H.M is given by $y = 0.01 \sin \pi(t + 0.005)m$. Calculate the

maximum velocity and displacement at the time of start of the motion.

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8. The acceleration of a particle executing SHM is $0.10ms^{-2}$ at a distance of $8 \times 10^{-2}m$ from the mean position. Calculate its time period.

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9. In a simple pendulum, the displacement of the bob is half of the amplitude. Calculate fraction of

PE and KE of the pendulum.

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10. Calculate the time period of a body executing SHM whose displacement is 0.04 m and 0.05 m and the corresponding velocities are 0.1m/s and $0.08ms^{-1}$.

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11. If T_1 and T_2 are the time of oscillations for two springs of constants k_1 and k_2 connected to

the mass m individually then calculate the time period of oscillations when both the spring are connected to the same mass and subjected to oscillations.

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12. Two spring of spring constants $10Nm^{-1}$ and $20Nm^{-1}$ are connected in series. One end of the combination is supported rigidly and the other to a body of mass 2 kg. Neglecting the masses of the springs, calculate the frequency of oscillation of the system.

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13. A small pole of density 0.75 g/cc and height 5 cm is placed in water such that the pole oscillates along ite length vertically. If the density of water is 1.012 g/cc, then calculate the period of oscillation of the pole $\left(g = 10ms^{-2}\right)$.

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14. Calculate the period of oscillation of a body falling freely inside the tunnel created along the diameter of the earth. Given average density of

the material of the Earth $5500 kgm^{-3}$ and universal gravitational constant $6.67 \times 10^{-11} Nm^2 kg^{-2}$.

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15. Show that $y = \sin^2 \omega t$ does not represent simple harmonic but periodic. What is the period of the given function.

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16. A harmonic osillator is represented by $y = 0.5\cos(1500\pi t + 0.8)$ where 'y' and 't' are in 'm' and 's' respectively. Calculate (i) amplitude, (ii) frequency, (iii) angular frequency, (iv) period (v) intial phase or epoch of the particle

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17. A harmonic osillator is represented by $y = 0.5\cos(1500\pi t + 0.8)$ where 'y' and 't' are in 'm' and 's' respectively. Calculate (ii) frequency

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18. A harmonic osillator is represented by $y = 0.5\cos(1500\pi t + 0.8)$ where 'y' and 't' are in 'm' and 's' respectively. Calculate (iii) angular frequency

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19. A harmonic osillator is represented by $y = 0.5\cos(1500\pi t + 0.8)$ where 'y' and 't' are in 'm' and 's' respectively. Calculate (iv) period

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20. A harmonic osillator is represented by $y = 0.5\cos(1500\pi t + 0.8)$ where 'y' and 't' are in 'm' and 's' respectively. Calculate intial phase or epoch of the particle

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21. Two simple harmonic motions are represented by

$v_1 = 10\pi\cos\left(100\pi t + \frac{\pi}{3}\right)$ and $v_2 = -0.1\pi\sin\pi t$,

where v_1 and v_2 represent velocities of particles.

Calculate the initial phase of velocity of particle (1) w.r.t. the velocity of particle (2).

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22. A body executes S.H.M under influence of a force with a time period of 1.0s. It has a time period of 1.5s under theaction of a force of different magntitude. What will be the period of oscillation of the body when these two force are impressed simultaneously in the same direction upon the same body?

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23. A spring balance has a scale that reads from 0 to 50 kg. The length of the scale is 20 cm. A body suspended from this balance, when displaced and released, oscillates with a period of 0.6 s. What is the weight of the body?

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24. A spring having a spring constant $1200Mn^{-1}$ is mounted on a horizontal table. A mass of 3 kg is attached to the free end of the spring. The mass is then pulled sideways to a distance of 0.02 m and

released. Determine (i) frequency of oscillations (ii) maximum acceleration of the mass and (iii) the maximum speed of the mass.

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25. Plot the corresponding SHM of particle. Indicate the intial $(t = 0)$ position of the particle, the radius of the circle and angular speed of the rotating particle. Consider sense of rotation to be anticlockwise and x in cm and t is in s.

(a) $= -2\sin\left(3t + \frac{\pi}{3}\right)$

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26. Plot the corresponding SHM of particle. Indicate the intial $(t = 0)$ position of the particle, the radius of the circle and angular speed of the rotating particle. Consider sense of rotation to be anticlockwise and x in cm and t is in s.

(b) $x = \cos\left(\frac{\pi}{6} - t\right)$

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27. Plot the corresponding SHM of particle. Indicate the intial $(t = 0)$ position of the particle, the radius of the circle and angular speed of the

rotating particle. Consider sense of rotation to be anticlockwise and x in cm and t is in s.

(c) $x = 3\sin\left(2\pi t + \frac{\pi}{4}\right)$

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28. Plot the corresponding SHM of particle. Indicate the intial $(t = 0)$ position of the particle, the radius of the circle and angular speed of the rotating particle. Consider sense of rotation to be anticlockwise and x in cm and t is in s.

(d) $x = 2\cos \pi t$

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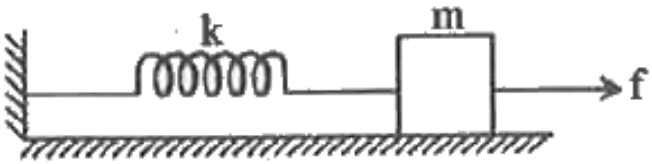
29. Calculate the maximum extension of the spring in the following two cases. Also calculate period of oscillation in each case.

(a)



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30. The acceleration due to gravity on the surface of the Moon is $1.7ms^{-2}$. What is the time period of a simple pendulum on the surface of the Moon,

if its time period on the surface of Earth is 3.5 s? (g on the surface of the Earth is $9.8ms^{-2}$).

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31. A simple pendulum of length 'l' and having a bob of mass M is suspended in a car. The car is moving on a circular track of radius R with a uniform speed v. If the pendulum makes small oscillation in a radial direction about its equilibrium position, then what will be its time period?

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32. A cylindrical piece of cork of density ρ, base area A and height h, floats in a liquid of density ρ_1. The cork is depressed slightly and then released. Show that the cork oscillates up and down simple harmonically, with a period $T = 2\pi\sqrt{\frac{h\rho}{\rho_1 g}}$, where $'\rho'$ is the density of the cork.

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33. An air champer of volume 'V' has a neck area of cross - section A into which a ball of mass m just

fits and can move up and down without any friction. Show that when the ball is pressed down a little and released, it executes SHM. Obtain an expression for the time period of oscillation assuming pressure volume variations of air to to be isothermal.

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34. A circular disc of mass 10 kg is suspended by a wire attached to its centre. The wire is twisted by rotating the disc and released. The period of torsional oscillations is found to be 1.5s. The

radius of the disc is 0.15m. Determine the torsional spring constant of the wire. (Note : Torsional spring constant $'\alpha'$ is defined by the relation $J = -\alpha\theta$ where J is the restoring couple is torque).

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35. A body describes SHM with an amplitude of 0.05 m and a period of 0.2 s. Find the acceleration and velocity of the body when the displacement is (a) 5cm (b) 3 cm (c) zero cm.

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36. A mass attached to a spring is free to oscillate, with an angular velocity ω in a horizontal plane without friction or damping. It is pulled to a distance x_0 and pushed towards the centre with a velocity v_0 at tmet $t = 0$. Determine the amplitude of the resulting oscillations in terms of the parameter ω, x_0, v_0 (Hint : Start with the equation $x = a\cos(\omega t + \theta)$ and note that the initial velocity is negative.)

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37. You are riding in an automobile of mass 3000 kg. Assuming that you are examining the oscillation characteristics of its suspension system. The suspension sags 0.15 m when the entire automobile is placed on it. Also, the amplitude of oscillation decreases by $50\,\%$ during one complete oscillation. Estimate the value of (a) the spring constant k and (b) damping constant'b' for the spring and shock absorber system of one wheel, assuming that each wheel supports 750 kg $\left(g = 10ms^{-2}\right)$.

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38. Show that for a particle in linear system, the average K.E. over a period of oscillation equals the average potential energy ever the same period.

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39. The period of oscillation of a simple pendulum is 1.45 s. If the density of the material of the bob is $7.8 \times 10^3 \ \text{kgm}^{-3}$ and that of water is $1.0 \times 10^3 \ \text{kgm}^{-3}$, then calculate the period of oscillation of the simple pendulum in water.

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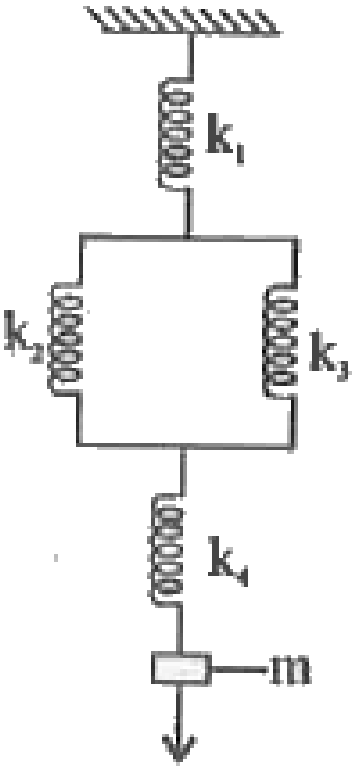
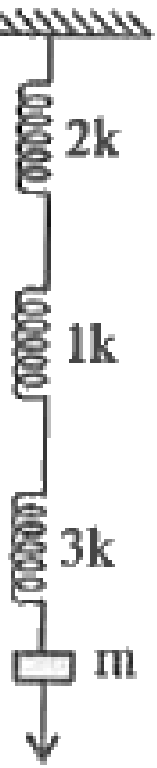
40. Calculate the effective spring constant in each case and hence write the expression for period of oscillation. Ignore the masses of the spring.



(b)



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41. Show that in simple harmoni motion, the acceleration is directly proportional to its displacement at the given instant.

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