QB365

Important Questions - Oscillation

11th Standard CBSE

Physics Reg.No. :

Time : 01:00:00 Hrs

Total Marks : 50

Section-A

1) Name the quantity which is conserved during the collision 1

2) Two identical springs of force constant κ each are connected in parallel. What will be the equivalent spring constant? 1

3) How will a simple pendulum behave if it is taken to the moon? 1

4) Give the name of three important characteristics of a SHM. 1

5) If the body is given a small displacement from the mean position, a force comes in to play which tends to bring the body back to the mean point, this give rise to vibration. Define phase of a vibrating particle. 1

6) A simple harmonic motion given by $x = 6.0 \quad cos\left(100t + \frac{\pi}{4}\right)$ 1
where x is in cm and t in second. What is the (i) displacement amplitude, (ii) frequency?

7) A simple harmonic motion given by $x = 6.0 \quad cos\left(100t + \frac{\pi}{4}\right)$ 1
where x is in cm and t in second. What is the displacement amplitude

8) The maximum acceleration in a simple harmonic motion is a_m and the maximum velocity is v_o. What is the displacement amplitude of simple harminic motion? 1

9) When a particle oscillates simple harmonically, its potential energy varies periodically. If v is the frequency of oscillation of the particle, then what is the frequency of variation of potential energy? 1

10) Justify the following statement 1
(i) The motion of an artificial satellite around the earth cannot be taken as SHM.
(ii) The time period of a simple pendulum will get doubled if its length is increased four times.

Section-B

11) Justofy the following statements. 2
The time period of a simple pendulumwill get doubled if its length is increased four times.

12) A body of mass 12 kg is suspended by coil spring of natural length 50 cm and force constant $2.0x10^3 Nm^{-1}$. 2
What is the streched length of the spring?If the bosy is pulled down further streching the spring to a length of 5.9 cm and then released,then what is the frequencyof oscillation of the suspended mass?

13) A spring compressed by 0.1 m develops a restoring force 10 N. A body of mass 4 kg placed on it . Deduce the depression of the spring under the weight of the body (take r=10 N/kg) 2

14) A spring compressed by 0.1 m develops a restoring force 10 N. A body of mass 4 kg placed on it . Deducethe period of oscillation, the body is districuted 2

15) A particle excutes SHM of period 8 s. After what time of its passing through the mean position will be energy be half kinetic and half potential? 2

16) Which of the following examples represent periodic motion? **2**

An arrow released from a bow.

17) Which of the following examples represent (nearly) simple harmonic motion and which represent periodic but not simple harmonic motion? **2**

Motion of an oscillating mercury column in a U-tube.

18) A bodyoscillates with SHM according to the equation x(t) $= 5cos\left(2\pi t + \frac{\pi}{4}\right)$, where x is in metres and t is in seconds. **2**

Calculate the following

angular freuency

19) The length of a second pendulum on the surface of earth is 1m. What will be the length of a second pendulum on the moon? **2**

20) Answer the following question **2**

A man with a wristwatch on his hand falls from the top of a tower.Does the watch give correct time during the free fall?

Section-C

21) In a SHM, suppose a particle moves to and fro repeardly about a mean position, under a restoring force Whose magnitude at any instant is directly proportional to the displacement from the mean position and the force is directed always towards the mean position. The SHM of a particle takes place under the condition of stable equilibrium. It is most common among the motion in nature. **5**

(ii) Expalin the relation between phenomenon of SHM and human life.

22) Samar invited his friends for a party at his house. His friends were enjoying the party and jumping on the sofa. They started the competition of high jump on the sofa.Samar's father warned them that the springs of sofa could be broken and they could get hurt and explained them the working of spring. Children promised that they would never jump on the furniture. **5**

(ii) A spring compressed by 0.2 m develops a restoring force of 20 N. A body of mass 4 kg is placed on it. Deduce

(a) the force constant of spring (b)

23) A particle set to be in SHM having two types of energies, potential and kinetic. The potential energy is on account of displacement of the particle from the mean position and kinetic energy is on account of the velocity of the particle. At any instant of time t, these are **5**

$PE = U = \frac{1}{2}m\omega^2x^2 = \frac{1}{2}m\omega^2A^2sin^2\omega t$

$KE = K = \frac{1}{2}m\omega^2(A^2 - x^2) = m\omega^2A^2cos^2\omega t$

and TE=PE+KE=$\frac{1}{2}m\omega^2A^2$ = Constant where, m = mass of the particle

(b) What are the applications of this study in our day to day life?

24) A particle executes SHM with a time period of 2s and amplitude 5 cm. Find acceleration after 1/3 s starting from the mean position. **5**

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Section-A

1) . **1**

2) . **1**

3) . **1**

4) Three important characteristics of an SHM are amplitude, time period (or frequency) and phase **1**

5) **1**

The phase of a vibrating particle at any instant of time is the state of particle as regards to its position and state of motion.

6) (i) -6.0cm **1**

(ii) 16 Hz

7) 16 Hz **1**

8) $\frac{v_0^2}{a_0}$ **1**

9) 2v **1**

10) **1**

(i) The motion of an artificial satellite around the earth is periodic as it repeats after a regular interval of time. But it cannot be taken as SHM because it is not a to and fro motion about any fixed point that is, mean position.

(ii) Time period of simple pendulum,

$$T = 2\pi\sqrt{\frac{l}{g}} \text{ i.e.,} T\alpha\sqrt{l}$$

Clearly, if the length is increased four times, the time period gets doubles.

Section-B

11) Time period of simple pendulum, **2**

$$T = 2\pi\sqrt{\frac{l}{g}} \text{ i.e.,} T\alpha\sqrt{l}$$

Clearly, if the length is increased four times, the time period gets doubles.

12) Given m=12Kg, original length l=50cm **2**

K =2.0x10^3 Nm^{-1}

F =ky

$$y = \frac{F}{k} = \frac{mg}{k} = \frac{12\times9.8}{2\times10^3} = 5.9\times10^{-2}m = 5.9 \quad cm$$

Stretched length of the spring = l + y = 50+55.9 cm

=105.9cm

Frequency of oscillations, $v = \frac{1}{T} = \frac{1}{2\pi}\sqrt{\frac{k}{m}}$

$$= \frac{1}{2\times3.14}\sqrt{\frac{2\times10^3}{12}} = 2.06s^{-1}$$

13) Here F = 10 N,$\triangle l = 0.1m, m = 4kg$ **2**

$$y = \frac{mg}{k} = \frac{4\times10}{100} = 0.4m$$

14) Here F = 10 N,∆l =0.1m,m=4kg **2**

$$T = 2\pi\sqrt{\frac{m}{k}} = 2\times\frac{22}{7}\sqrt{\frac{4}{100}} = 1.26s$$

15) Given PE=KE **2**

i.e $\frac{1}{2}m\omega^2x^2 = \frac{1}{2}m\omega^2(A^2 - x^2)$

$x^2 = A^2 - x^2 \Rightarrow x = \frac{A}{\sqrt{2}}$ cbse-11-phy-aio-c14-546-

$Now \quad x = A \quad sin \quad \omega t = A \quad sin\left(\frac{2\pi}{T}\right)t$

$So, \quad \frac{A}{\sqrt{2}} = A \quad sin 2\pi \frac{t}{8}$

$or \quad sin \frac{\pi t}{4} = \frac{A}{\sqrt{2}} = sin \frac{\pi}{4}$

$or \quad \frac{\pi t}{4} = \frac{\pi}{4} \quad or \quad t = 1s$

16) There is no repetition, hence not periodic. **2**

17) This is a periodic motion and as it follows F=-kx (about mean position, to and fro motion) hence SHM **2**

18) 6.28 s^{-1} **2**

19) A second pendulum means a simple pendulum having time period T = 2s **2**

For a simple pendulum T$= 2\pi\sqrt{\frac{l}{g}}$

where, l=length of the pendulum and g= acceleratin due to gravity On surface of the earth.

$$T_s = 2\pi\sqrt{\frac{l_e}{g_e}}$$

On the surface of the moon,

$$T_n = 2\pi\sqrt{\frac{l_m}{g_m}}$$

Dividing Eq(i) by Eq(ii) we get

$$\frac{T_s}{T_m} = \frac{2\pi}{2\pi}\sqrt{\frac{l_e}{g_e}} \times \sqrt{\frac{l_m}{g_m}}$$

T_s=T_m to maintain the second pendulum time period.

$$1 = \sqrt{\frac{l_e}{g_e} \times \frac{l_m}{g_m}}$$

But the acceleration due to gravity at moon is 1/6 of the acceleration due to gravity at earth i.e.$g_m = \frac{g_e}{6}$

Squaring Eq (iii) and putting this value

$$1 = \frac{l_e}{l_m} \times \frac{g_e/6}{g_e} = \frac{l_e}{l_m} \times \frac{1}{6}$$

$\Rightarrow \quad \frac{l_e}{6l_m} = 1$

$or \quad l_m = \frac{1}{6}l_e = \frac{1}{6} \times 1 = \frac{1}{6}m$

20) **2**

Yes, sice the motion of hands of a wristwatch to indicate time depends on action of the spring and has nothing to do with acceleration due to gravity.

Section-C

21) **5**

(ii) The SHM of the particles takes place under the condition of stable equilibrium. In our daily life, each one of us likes stability. We have to move out for coming out our duties and assignments. Put our tendency alays to return to our central place of stable equilirium. This has the SHM and is rel;ated to our lives.(human lives)

22) (ii) $F = 20 \quad N, \quad \Delta l = 0.2m, \quad m \quad = \quad 4kg$ **5**

$(a) \quad k = \frac{F}{\Delta l} = \frac{20}{0.2} = 100Nm^{-1}$

$(b) \quad y = \frac{mg}{k} = \frac{4 \times 10}{100} = 0.4 \quad m$

23) **5**

(b) This study shows that sum total of PE and KE of a particle in SHM stays constant at all positions and at all times. However, PE and KE both keep on changing with position or time. The same is true in day to day life. We can acquire one form of energy by spending some other form of energy and vice-versa

24) Acceleration, $a = \frac{dv}{dt} = \frac{d(A\omega\cos\omega t)}{dt} = -A\omega^2 \sin\omega t$ **5**

$= \frac{4\pi^2}{T^2}\sin\frac{2\pi}{T}t = -\frac{4\times 9.87\times 5}{4}\sin\frac{\pi}{3}$

$= -9.87\times 5\times\frac{\sqrt{3}}{2} = -42.73cms^{-2}$

$\therefore \quad |a| = 42.73cms^{-2}$.