DPP – 3 (SHM)

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Q 1. Periodic time of oscillation T_1 is obtained when a mass is suspended from a spring and if another spring is used with same mass, then periodic time of oscillation is T_2. Now if this mass is suspended from series combination of above springs then calculated the time period.

(a) $T_1 + T_2$ (b) $\frac{T_1 T_2}{T_1+T_2}$

(c) $T_1 T_2$ (d) $\sqrt{T_1^2 + T_2^2}$

Q 2. A spring has a certain mass suspended from it and its period for vertical oscillation is T. The spring is now cut into two equal halves and the same mass is suspended from one of the halves. The period of vertical oscillation is now

(a) $\frac{T}{2}$ (b) $\frac{T}{\sqrt{2}}$

(c) $\sqrt{2}T$ (d) $2T$

Q 3. In a spring block system if length of the spring is reduced by 1%, then time period

(a) increase by 2 % (b) increase by 0.5 %

(c) decrease by 2 % (d) decrease by 0.5 %

Q 4. A spring mass system has time period of 2 second. What should be the spring constant of spring if the mass of the block is 10grams?

(a) 0.1 N/m (b) 100 N/m

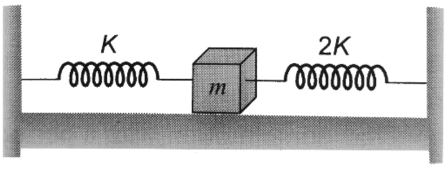
(c) 10^4 N/m (d) 500 N/m

Q 5. Time period of a block with a spring is T_0. Now ,the spring is cut in two parts in the ratio 2:3. Now find the time period of same block with the smaller part of the spring.

(a) $\sqrt{\frac{2}{5}}\, T_0$ (b) $\sqrt{\frac{5}{2}}\, T_0$

(c) $\frac{T_0}{\sqrt{2}}$ (d) $\frac{3T_0}{2}$

Q 6. Two springs of force constants K and 2K are connected to a mass as shown below. The frequency of oscillation of the mass is



(a) $\frac{1}{2\pi}\sqrt{\frac{K}{m}}$ (b) $\frac{1}{2\pi}\sqrt{\frac{2K}{m}}$

(c) $\frac{1}{2\pi}\sqrt{\frac{3K}{m}}$
(d) $\frac{1}{2\pi}\sqrt{\frac{K}{3m}}$

Q 7. Two bodies M and N 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 M to that of N is

(a) $\frac{k_1}{k_2}$
(b) $\sqrt{\frac{k_1}{k_2}}$
(c) $\frac{k_2}{k_1}$
(d) $\sqrt{\frac{k_2}{k_1}}$

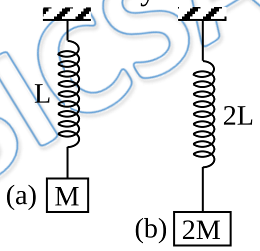
Q 8. When a body of mass 1.0 kg is suspended from a certain light spring hanging vertically, its length increases by 5 cm. By suspending 2.0 kg block to the spring and if the block is pulled through 10 cm and released the maximum velocity in it in m/s is: (g = 10 m/s^2)

(a) 0.5
(b) 1
(c) 2
(d) 4

Q 9. A particle of mass 1 kg is executing s.h.m. on x axis under the action of force F = x^2 - 4x. Angular frequency of s.h.m. is

(a) 1per sec
(b) 2 per sec
(c) 4 per sec
(d) 6 per sec

Q 10. Two springs of the same material same round per unit length and same thickness of wire but of length L and 2L are suspended with masses M and 2M attached at their lower ends. Their time periods when they are allowed to oscillate will be in the ratio

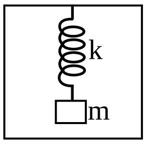


(a) 1 : 2
(b) 2 : 1
(c) 1 : 4
(d) 4 : 1

Q 11. A mass m is suspended from a weightless spring and it has time-period ' T '. The spring is now divided into four equal parts and the same mass is suspended from one of these parts. The now time period will be –

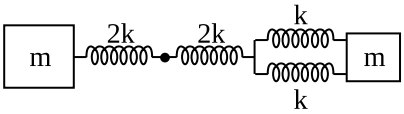
(a) T
(b) T/2
(c) 2T
(d) T/4

Q 12. A spring mass system is hanging from the ceiling of an elevator in equilibrium. The elevator suddenly starts accelerating upwards with acceleration a, the amplitude of the resulting S.H.M. is—



(a) $\frac{mg}{k}$ (b) $\frac{ma}{k}$ (c) $\frac{m(g+a)}{k}$ (d) $\frac{m(g-a)}{k}$

Q 13. Four springs of constant as shown are attached to a pair of masses m each as shown. The time period will be 2p times-

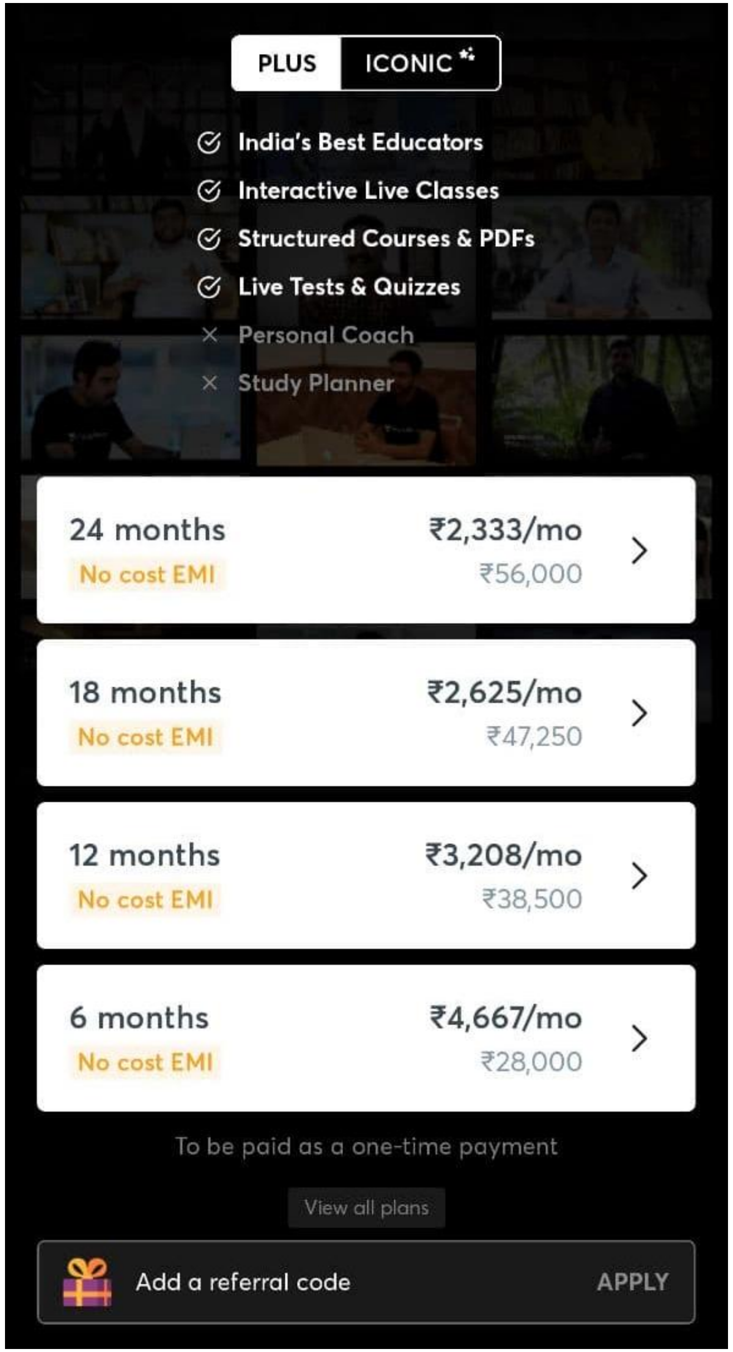


(a) $\sqrt{\frac{m}{k}}$ (b) $\sqrt{\frac{2m}{k}}$

(c) $\sqrt{\frac{4m}{k}}$ (d) $\sqrt{\frac{3m}{4k}}$

Answer Key

Q.1 d	**Q.2 b**	**Q.3 d**	**Q.4 a**	**Q.5 a**
Q.6 c	**Q.7 d**	**Q.8 b**	**Q.9 b**	**Q.10 a**
Q.11 b	**Q.12 b**	**Q.13 d**		



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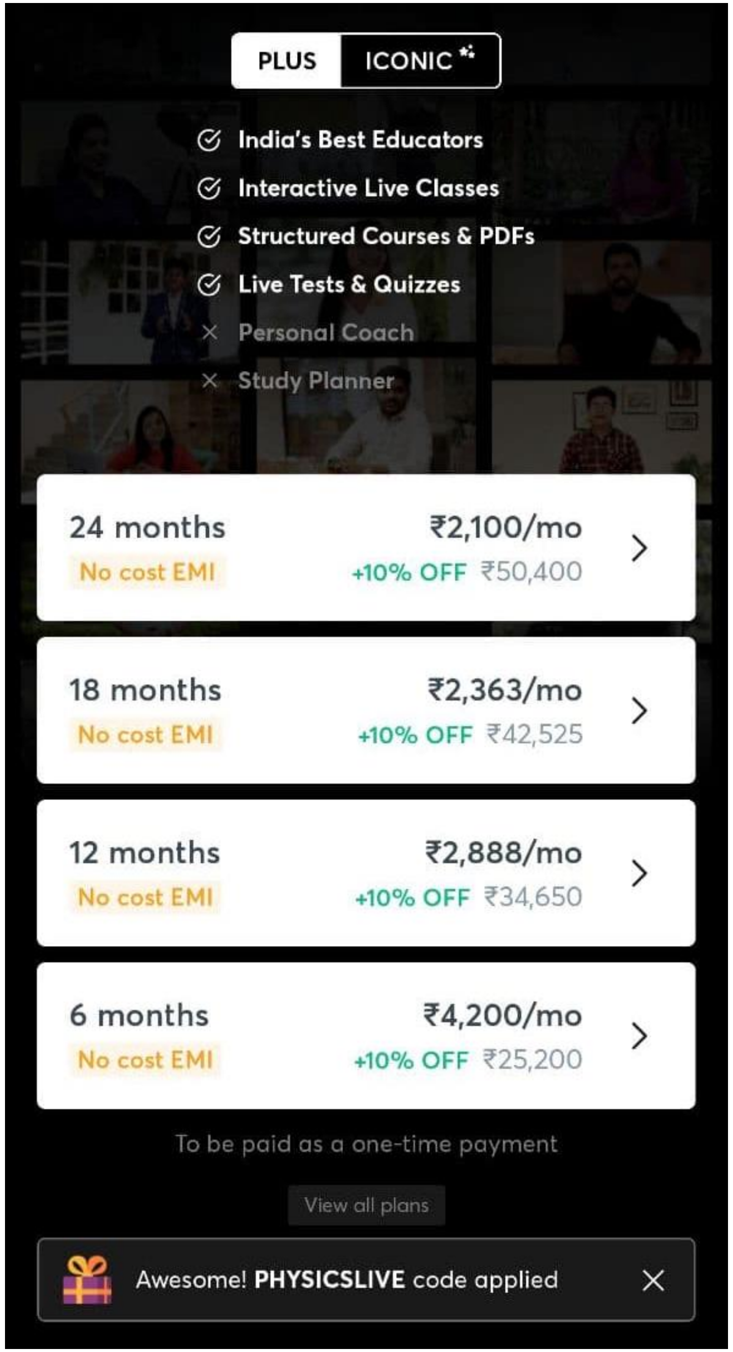

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NEET & JEE Main
Physics DPP- Solution

DPP-3 SHM: Spring block system, time period of systems

By Physicsaholics Team

Q1) Periodic time of oscillation T_1 is obtained when a mass is suspended from a spring and if another spring is used with same mass then periodic time of oscillation is T_2. Now if this mass is suspended from series combination of above springs then calculated the time period.

(a) $T_1 + T_2$

(b) $\frac{T_1 T_2}{T_1+T_2}$

(c) $T_1 T_2$

✓ (d) $\sqrt{T_1^2 + T_2^2}$

$$T_1 = 2\pi\sqrt{\frac{m}{K_1}}$$

$$T_2 = 2\pi\sqrt{\frac{m}{K_2}}$$

for Series Combination

K is effective Constant

$$T = 2\pi\sqrt{\frac{m}{K}}$$

$$\frac{1}{K} = \frac{1}{K_1} + \frac{1}{K_2}$$

$$\frac{m}{K} = \frac{m}{K_1} + \frac{m}{K_2}$$

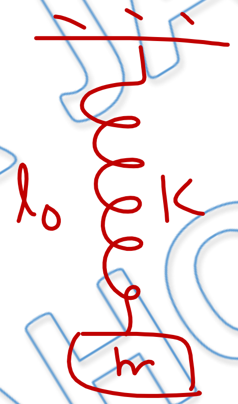
$$\left(\frac{T}{\cancel{2\pi}}\right)^2 = \left(\frac{T_1}{\cancel{2\pi}}\right)^2 + \left(\frac{T_2}{\cancel{2\pi}}\right)^2$$

$$T = \sqrt{T_1^2 + T_2^2}$$

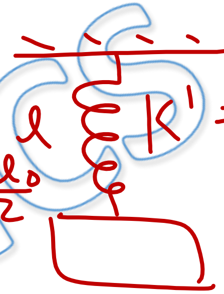
Q2) A spring has a certain mass suspended from it and its period for vertical oscillation is T. The spring is now cut into two equal halves and the same mass is suspended from one of the halves. The period of vertical oscillation is now

(a) $\frac{T}{2}$ (b) $\frac{T}{\sqrt{2}}$

(c) $\sqrt{2}T$ (d) $2T$



$\Rightarrow$ $= \frac{l_0}{2}$



$K' = \frac{K l_0}{l} = \frac{K l_0}{l_0/2}$

$= 2K$

$T = 2\pi\sqrt{\frac{m}{K}}$

$T' = 2\pi\sqrt{\frac{m}{2K}}$

$= \frac{1}{\sqrt{2}} \times T$

Q3) In a spring block system if length of the spring is reduced by 1%, then time period

$$K' = \frac{K l_0}{l}$$

$$\frac{\Delta K'}{K'} = -\frac{\Delta l}{l}$$

(a) increase by 2 % (b) increase by 0.5 %

(c) decrease by 2 % [✓ (d) decrease by 0.5 %]

$$T = 2\pi\sqrt{\frac{m}{K'}} = 2\pi \frac{m^{1/2}}{K'^{1/2}}$$

$$\frac{\Delta T}{T} = -\frac{1}{2}\frac{\Delta K'}{K'} = +\frac{1}{2}\left(\frac{\Delta l}{l}\right)$$

% change in T = $+\frac{1}{2} \times$ % change in l

$= -\frac{1}{2}$ %

Q4) A spring mass system has time period of 2 second. What should be the spring constant of spring if the mass of the block is 10grams ?

[✓ (a) 0.1 N/m]

(b) 100 N/m

(c) 10^4 N/m

(d) 500 N/m

$$T = 2\pi\sqrt{\frac{m}{k}}$$

$$\cancel{2} = \cancel{2}\pi\sqrt{\frac{.01}{k}}$$

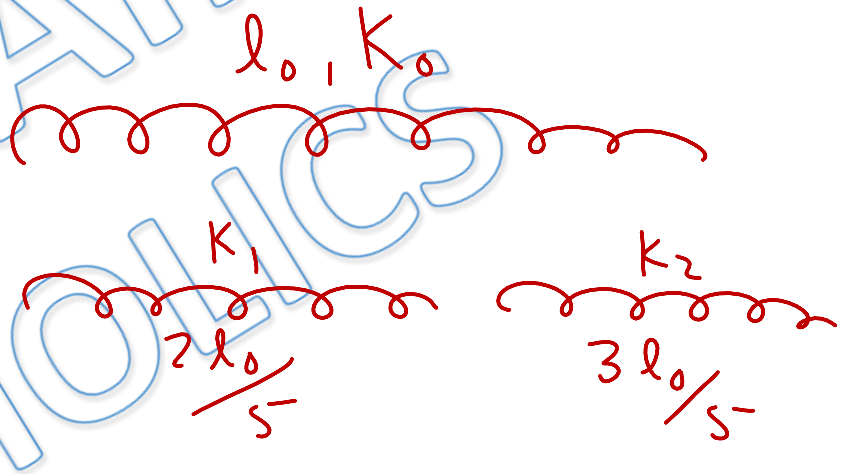
$$1 = \pi^2 \times \frac{.01}{k}$$

$$K = .01\pi^2$$

$$= .1$$

Q5) Time period of a block with a spring is T_0. Now ,the spring is cut in two parts in the ratio 2:3. Now find the time period of same block with the smaller part of the spring.

$$T_0 = 2\pi\sqrt{\frac{m}{K_0}}$$



[✓ (a) $\sqrt{\frac{2}{5}}T_0$]

(b) $\sqrt{\frac{5}{2}}T_0$

(c) $\frac{T_0}{\sqrt{2}}$

(d) $\frac{3T_0}{2}$

$$K_1 = \frac{K_0 l_0}{2l_0/5}$$

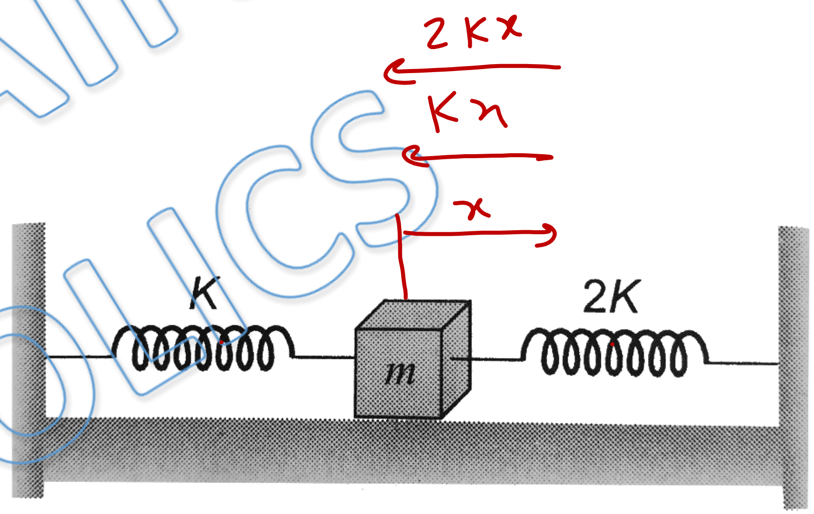
$$K_1 = \frac{5K_0}{2}$$

$$T_{small} = 2\pi\sqrt{\frac{m}{K_1}}$$

$$\frac{T_{small}}{T_0} = \sqrt{\frac{K_0}{K_1}} = \sqrt{2/5}$$

$$\frac{K_0}{K_1} = 2/5$$

Q6) Two springs of force constants K and 2K are connected to a mass as shown below. The frequency of oscillation of the mass is



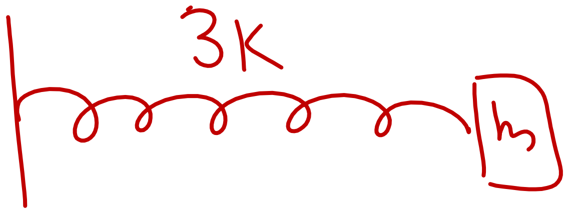
(a) $\frac{1}{2\pi}\sqrt{\frac{K}{m}}$

(b) $\frac{1}{2\pi}\sqrt{\frac{2K}{m}}$

(c) $\frac{1}{2\pi}\sqrt{\frac{3K}{m}}$

(d) $\frac{1}{2\pi}\sqrt{\frac{K}{3m}}$

$\equiv$



$$T = 2\pi\sqrt{\frac{m}{3K}}$$

$$f = \frac{1}{2\pi}\sqrt{\frac{3k}{m}}$$

A_1 $\quad$ A_2

m $\quad$ m

Q7) Two bodies M and N 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 M to that of N is

(a) $\frac{k_1}{k_2}$

(b) $\sqrt{\frac{k_1}{k_2}}$

(c) $\frac{k_2}{k_1}$

[✓ (d) $\sqrt{\frac{k_2}{k_1}}$]

$$V_{max} = A\omega$$

$$A_1\omega_1 = A_2\omega_2$$

$$A_1\sqrt{\frac{K_1}{\cancel{m}}} = A_2\sqrt{\frac{K_2}{\cancel{m}}}$$

$$\frac{A_1}{A_2} = \sqrt{\frac{K_2}{K_1}}$$

Q8) When a body of mass 1.0 kg is suspended from a certain light spring hanging vertically, its length increases by 5 cm. By suspending 2.0 kg block to the spring and if the block is pulled through 10 cm and released the maximum velocity in it in m/s is : (g = 10 m/s^2)

$\frac{mg}{K} = 5\times10^{-2}$

(a) 0.5 [✓ (b) 1]

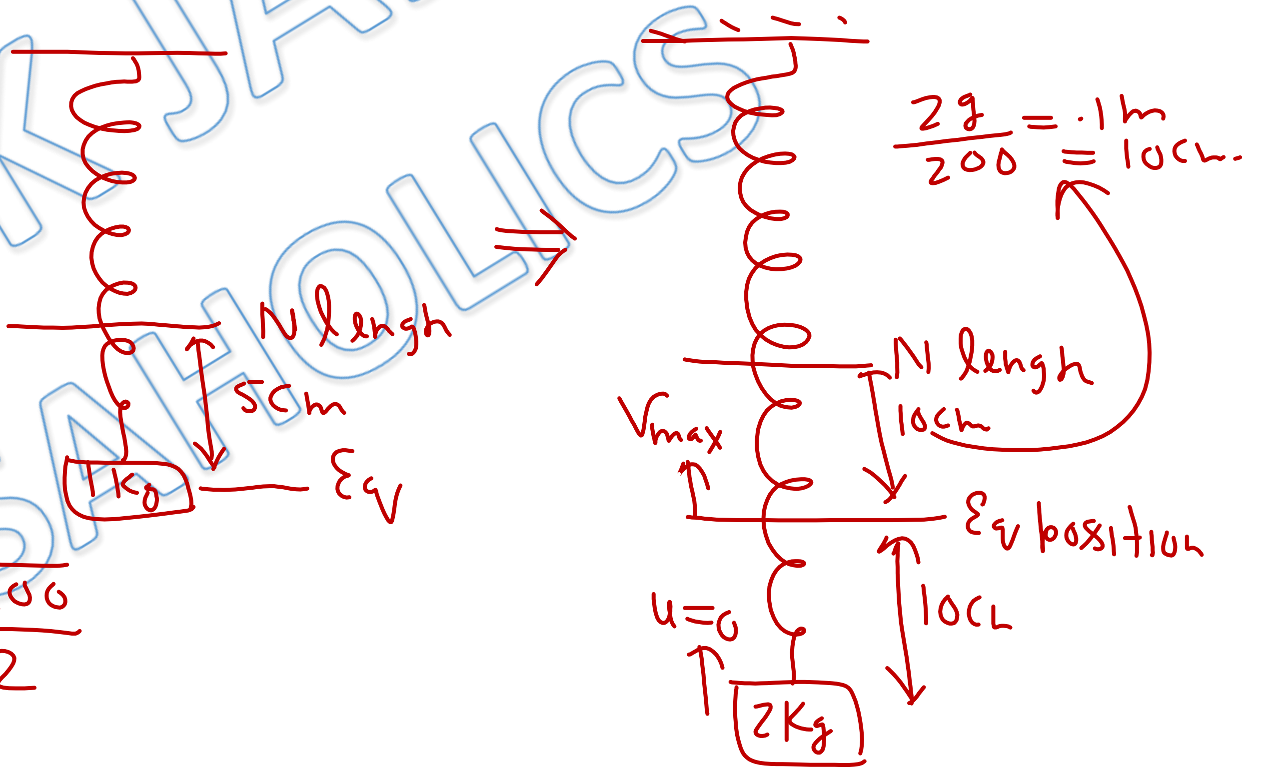
(c) 2 (d) 4

$K = \frac{1\times\cancel{10}^{2}}{\cancel{5}\times10^{-2}}$

$= 200\ N/m$

$V_{max} = A\omega = .1\times\sqrt{\frac{200}{2}}$

$= 1$



$\frac{2g}{200} = .1m$
$= 10cm.$

Q9) A particle of mass 1 kg is executing s.h.m. on x axis under the action of force F = x^2 - 4x . Angular frequency of s.h.m. is

(a) 1per sec

[✓ (b) 2 per sec]

(c) 4 per sec

(d) 6 per sec

$F = x^2 - 4x$, $F = 0 \Rightarrow x = 0, 4$

mean position is $x = 0$

$F = x^2 - 4x$

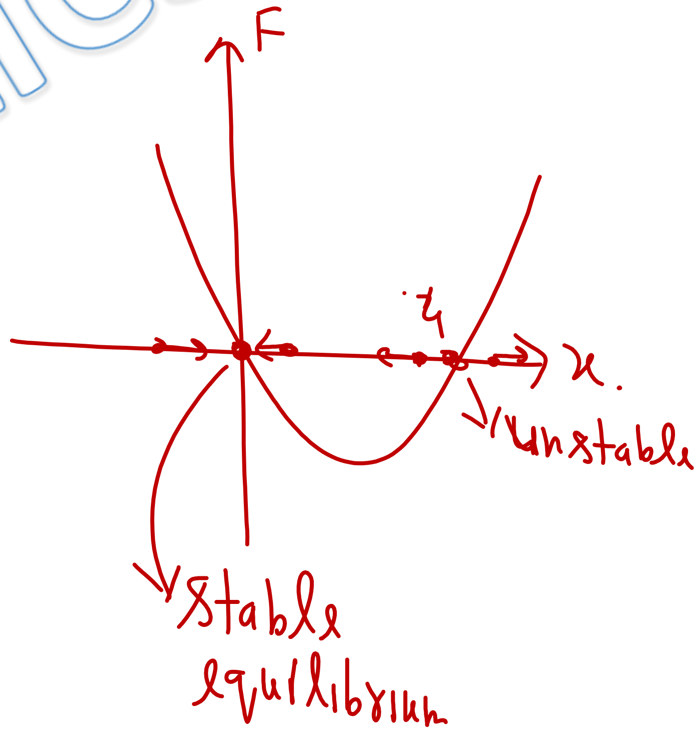
for small amplitude.

$F = -4x$

$a = -4x$

$\omega^2 = 4$

$\underline{\omega = 2}$

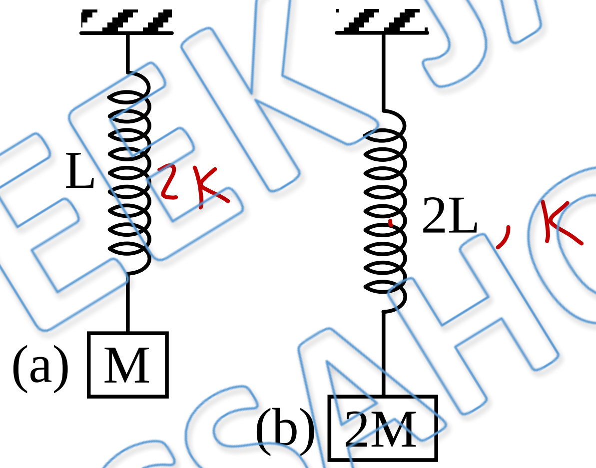


Q10) Two springs of the same material same round per unit length and same thickness of wire but of length L and 2L are suspended with masses M and 2M attached at their lower ends. Their time periods when they are allowed to oscillate will be in the ratio

$$T_1 = 2\pi\sqrt{\frac{M}{2K}}$$

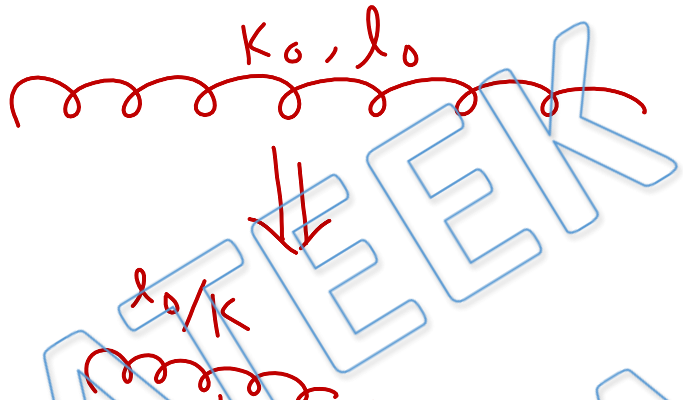
$$T_2 = 2\pi\sqrt{\frac{2M}{K}}$$

$$\frac{T_1}{T_2} = \sqrt{\frac{1}{2\times2}} = 1:2$$



[✓ (a) 1 : 2] (b) 2 : 1 (c) 1 : 4 (d) 4 : 1

Q11) A mass m is suspended from a weightless spring and it has time-period ' T '. The spring is now divided into four equal parts and the same mass is suspended from one of these parts. The now time period will be -



$$T = 2\pi\sqrt{\frac{m}{k_0}}$$

$$k' = \frac{k_0 l_0}{l_0/4} = 4k_0$$

$$T' = 2\pi\sqrt{\frac{m}{4k_0}}$$

(a) T

(b) T/2 ✓

(c) 2T

(d) T/4

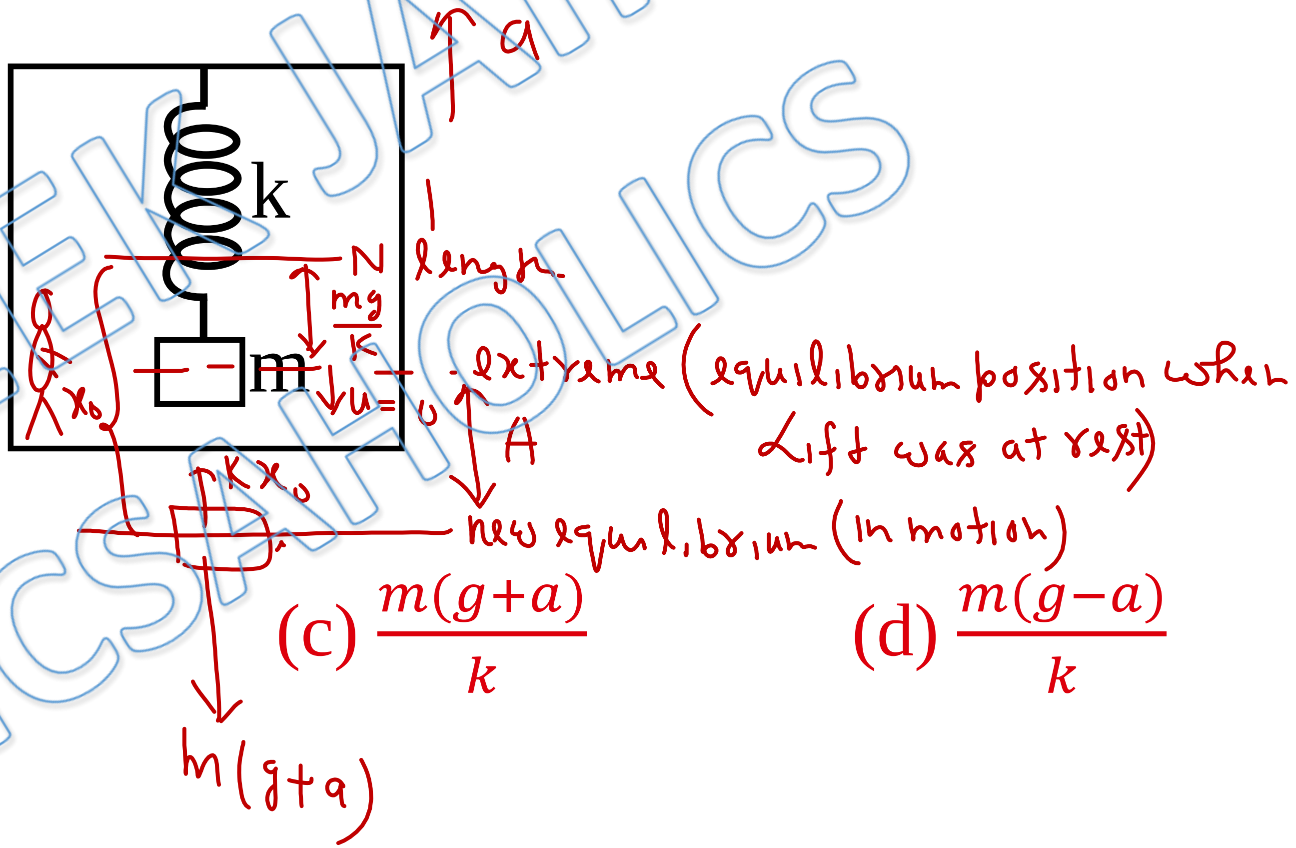
$$\frac{T'}{T} = \sqrt{\frac{1}{4}} = \frac{1}{2}$$

$$T' = T/2$$

Q12) A spring mass system is hanging from the ceiling of an elevator in equilibrium. The elevator suddenly starts accelerating upwards with acceleration a, the amplitude of the resulting S.H.M. is—

$$Kx_0 = m(g+a)$$

$$x_0 = \frac{m(g+a)}{K}$$

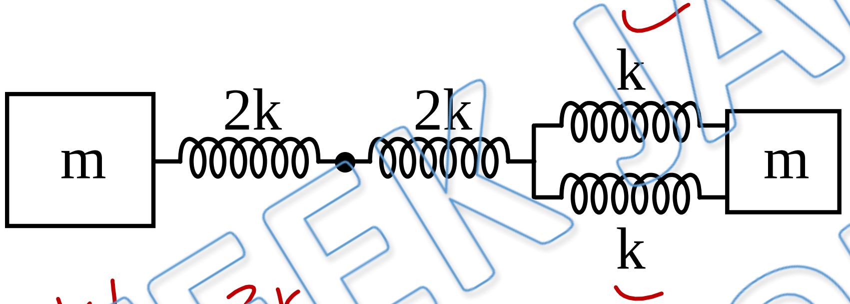


(a) $\frac{mg}{k}$ [✓ (b) $\frac{ma}{k}$] (c) $\frac{m(g+a)}{k}$ (d) $\frac{m(g-a)}{k}$

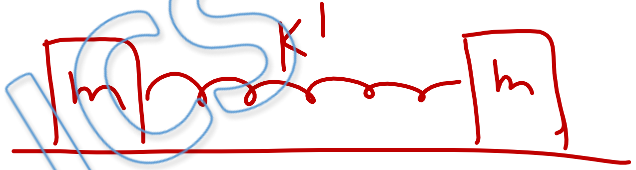
$$A = x_0 - \frac{mg}{K}$$

$$= \frac{ma}{K}$$

Q13) Four springs of constant as shown are attached to a pair of masses m each as shown. The time period will be 2π times-



$K' = \frac{2K}{3}$



$T = 2\pi\sqrt{\frac{\mu}{K'}}$ → reduced mass

$\mu = \frac{m_1 m_2}{m_1 + m_2} = m/2$

(a) $\sqrt{\frac{m}{k}}$

(b) $\sqrt{\frac{2m}{k}}$

$T = 2\pi\sqrt{\frac{3\,m/2}{2K}}$

(c) $\sqrt{\frac{4m}{k}}$

$= 2\pi\sqrt{\frac{3m}{4K}}$

(d) ✓ $\sqrt{\frac{3m}{4k}}$

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