PHYSICS:

31 The maximum acceleration of a particle in SHM is made two times keeping the maximum speed to be constant. It is possible when

1) amplitude of oscillation is doubled while frequency remains constant

2) amplitude is doubled while frequency is halved

3) frequency is doubled while amplitude is halved

4) frequency is doubled while amplitude remains constant

32 The time taken by a particle performing SHM to pass from point A to B where its velocities are same is 2 seconds. After another 2 seconds it returns to B. The time period of oscillation is (in seconds)

1) 2 2) 8

3) 6 4) 4

33 A particle executes SHM with time period T and amplitude A. The maximum possible average velocity in time $\frac{T}{4}$ is

1) $\frac{2A}{T}$ 2) $\frac{4A}{T}$ 3) $\frac{8A}{T}$ 4) $\frac{4\sqrt{2}A}{T}$

34 Two particles are in SHM in a straight line about same equilibrium position. Amplitude A and time period T of both the particles are equal. At time t=0, one particle is at displacement $y_1 = +A$ and the other at $y_2 = -A/2$, and they are approaching towards each other. After what time they cross each other?

1) T/3 2) T/4

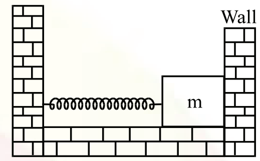
3) 5T/6 4) T/6

35 Two particles P and Q describe simple harmonic motions of same period, same amplitude, along the same line about the same equilibrium position O. When P and Q are on opposite sides of O at the same distance from O they have the same speed of 1.2 m/s in the same direction, when their displacements are the same they have the same speed of 1.6 m/s in opposite directions. The maximum velocity in m/s of either particle is

1) 2.8 2) 2.5

3) 2.4 4) 2

36 In the figure, the block of mass m, attached to the spring of stiffness k is in contact with the completely elastic wall, and the compression in the spring is 'e'. The spring is compressed further by 'e' by displacing the block towards left and is then released. If the collision between the block and the wall is completely elastic then the time period of oscillations of the block will be:



1) $\frac{2\pi}{3}\sqrt{\frac{m}{k}}$ 2) 2π

3) $\frac{\pi}{3}\sqrt{\frac{m}{k}}$ 4) $\frac{\pi}{6}\sqrt{\frac{m}{k}}$

37 A particle of mass m is executing oscillations about the origin on the x-axis. Its potential energy is

$V(x) = k|x|^3$ where k is a positive constant. If the amplitude of oscillations is a, then its time period T is

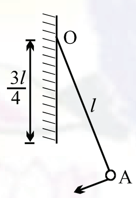
1) proportional to $1/\sqrt{a}$

2) independent of a

3) proportional to $\sqrt{a}$

4) proportional to $a^{3/2}$

38 A small bob attached to a light inextensible thread of length l has a periodic time T when allowed to vibrate as a simple pendulum. The thread is now suspended from a fixed end O of a vertical rigid rod of length $\frac{3l}{4}$ (as in figure). If now the pendulum performs periodic oscillations in this arrangement, the periodic time will be



1) $\frac{3T}{4}$ 2) $\frac{T}{2}$

3) T 4) 2 T

39. A circular disc has a tiny hole in it, at a distance z from its center. Its mass is M and radius R (R>z). A horizontal shaft is passed through the hole and held fixed so that the disc can freely swing in the vertical plane. For small disturbance, the disc performs SHM whose time period is minimum for z =

1) $\frac{3T}{4}$ 2) R/3

3) $R/\sqrt{2}$ 4) $R/\sqrt{3}$

40. A particle is subjected to two mutually perpendicular simple harmonic motions such that its x and y coordinates are given by $x = 2\sin\omega t;\ y = 2\sin\left(\omega t + \frac{\pi}{4}\right)$

The path of the particle will be

1) an ellipse 2) a straight line

3) a parabola 4) a circle

41. Two simple harmonic motions $y_1 = A\sin\omega t$ and $y_2 = A\cos\omega t$ are superimposed on a particle of mass m. The total mechanical energy of the particle is

1) $\frac{1}{2}m\omega^2A^2$ 2) $m\omega^2A^2$

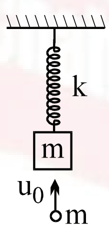
3) $\frac{1}{4}m\omega^2A^2$ 4) zero

42. Vertical displacement of a plank with a body of mass ‘m’ on it is varying according to law $y = \sin\omega t + \sqrt{3}\ \cos\theta\omega t$. The minimum value of ω for which the mass just off the plank and the moment it occurs first after t = 0 are given by; (y is positive vertically upwards)

1) $\sqrt{\frac{g}{2}}, \frac{\sqrt{2}}{6}, \frac{\pi}{\sqrt{g}}$ 2) $\frac{g}{\sqrt{2}}, \frac{2}{3}, \sqrt{\frac{\pi}{g}}$

3) $\sqrt{\frac{g}{2}}, \frac{\pi}{3}, \sqrt{\frac{2}{g}}$ 4) $\sqrt{2g}, \sqrt{\frac{2\pi}{3g}}$

43. A block of mass m is hanging from a massless spring of spring constant K. It is in equilibrium under the influence of gravitational force. Another particle of same mass m moving upwards with velocity v_0 hits the block and sticks to it. For the subsequent motion choose the correct statement.



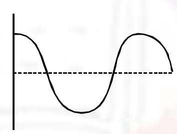
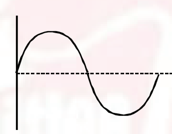
1) speed of combined mass must be maximum at natural length of the spring

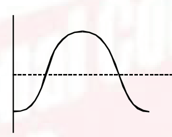
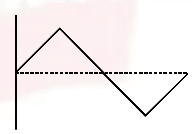
2) speed of combined mass must be maximum at the new equilibrium position

3) speed of combined mass must be maximum at the instant particle hits the block

4) speed of combined mass must be maximum at a point lying between old equilibrium position and natural length

44. Now suppose you are oscillating with amplitude A = 0.05 m and the railroad car is moving to the right with constant velocity. Treating your equilibrium position at station as origin, select your path, as seen by someone standing still at the railroad station.

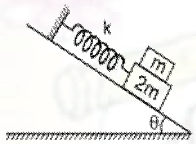
1)  2) 

3)  4) 

45. The potential energy of a particle of mass 1 kg in motion along the x-axis is given by $U=(10-10\cos 6x)J$. The period of small oscillations is $(\pi^2\approx 10)$

1) $\frac{1}{3}s$ 2) $\frac{3}{2}s$ 3) $\frac{2}{3}s$ 4) $\frac{1}{4}s$

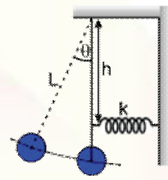
46. The coefficient of friction between block of mass m and 2m is $\mu=2\tan\theta$. There is no friction between block of mass 2m and inclined plane. The maximum amplitude of two block system for which there is no relative motion between both the blocks.



1) $g\sin\theta\sqrt{\frac{k}{m}}$ 2) $\frac{mg\sin\theta}{k}$

3) $\frac{3mg\sin\theta}{k}$ 4) None of these

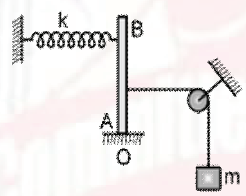
47. A pendulum of length L and bob of mass M has a spring of force constant k connected horizontally to it at a distance h below its point of suspension. The rod is in equilibrium in vertical position. The rod of length L used for vertical suspension is rigid and massless. The frequency of vibration of the system for small values of θ is



1) $\frac{1}{2\pi L}\sqrt{gL+\frac{kh}{m}}$ 2) $\frac{1}{2\pi L}\sqrt{\frac{mgL+k}{m}}$

3) $2\pi\sqrt{\frac{mL^2}{mgL+kh}}$ 4) $\frac{1}{2\pi L}\sqrt{gL+\left(\frac{kh^2}{m}\right)}$

48. A massless rigidly fixed at O A string carrying a mass m at one end is attached to point A on the rod so that OA = a. At another point B=(OB=b) of the rod a horizontal spring of force constant k is attached as shown. Find the period of small vertical oscillations of mass m around its equilibrium position.



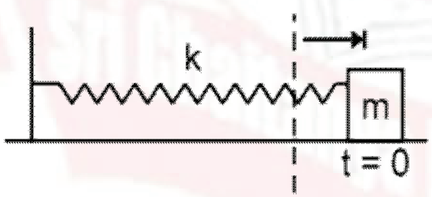
1) $\frac{2\pi a}{b}\sqrt{\frac{m}{k}}$ 2) $\frac{\pi a}{b}\sqrt{\frac{m}{k}}$

3) $\frac{b}{2\pi a}\sqrt{\frac{m}{k}}$ 4) none of these

49. A block weighing 10 N is attached to the lower end of a vertical spring (k =200 N/m), the other end of which is attached to a ceiling. The block oscillates vertically and has a kinetic energy of 2.0 J as it passes through the point at which the spring is unstretched. Maximum kinetic energy of the block as it oscillates is $\left(g = m/s^2\right)$

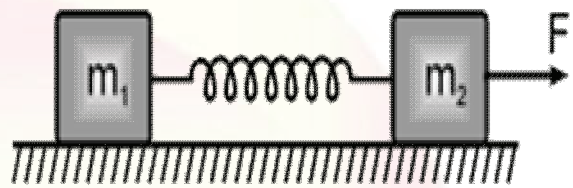
1) 2.0 J 2) 2.25 J
3) 2.5 J 4) 2.64 J

50. In a horizontal spring-mass system, mass m is released after being displaced towards right by some distance at t = 0 on a frictionless surface. The phase angle of the motion in radian when it is first time passing through the equilibrium position is equal to



1) $\pi/2$ 2) π
3) $3\pi/2$ 4) 0

51. Two blocks connected by a spring rest on a smooth horizontal plane as shown in the Figure. A constant force F starts acting on the block m_2 as shown in the Figure.



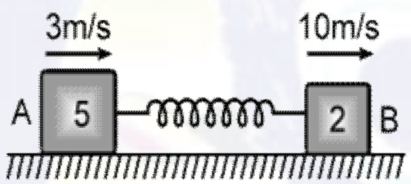
1) Length of the spring increases continuously if $m_1 > m_2$

2) Blocks start performing SHM about centre of mass of the system, which moves rectilinearly with constant acceleration

3) Blocks start performing oscillations about centre of mass of the system with increasing amplitude

4) Acceleration of m_2 is maximum at initial moment of time only.

52. Two blocks A (5kg) and B (2kg) attached to the ends of a spring constant 1120 N/m are placed on a smooth horizontal plane with the spring undeformed. Simultaneously velocities of 3m/s and 10 m/s along the line of the spring in the same direction are imparted to A and B then the INCORRECT option is



1) when the extension of the spring is maximum the velocities of A and B are zero

2) the maximum extension of the spring is 25 cm

3) the first maximum compression occurs $3\pi/56$ seconds after start

4) maximum extension and maximum compression occur alternately

53. A body when suspended from a spring vibrates with an energy of 8.0 J when the amplitude is 0.04m. If the mass of the body is reduced to half and the system is again set into vibration with the same amplitude, the energy of the system now is

1) 4 J 2) 8 J

3) 12 J 4) 16J

54. Two identical springs are fixed at one end and masses M and 4 M are suspended at their other ends. They are both stretched down from their mean position and let go simultaneously. If they are in the same phase after every 4 seconds the springs constant k is

1) $\pi \frac{N}{m}$

2) $\pi^2 \frac{N}{m}$

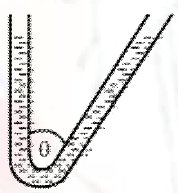
3) $2\pi \frac{N}{m}$

4) given data is insufficient

55. A body executes simple harmonic motion under the action of a force F_1 with a time period $\frac{4}{5}s$. If both the forces F_1 *and* F_2 act simultaneously in the same direction on the body. Its time period in seconds is

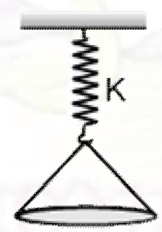
1) $\frac{12}{25}$
2) $\frac{24}{25}$
3) $\frac{35}{24}$
4) $\frac{15}{12}$

56. The period of oscillation of mercury of mass m and density ρ poured into a bent tube of cross sectional area S whose right arm forms an angle θ with the vertical is



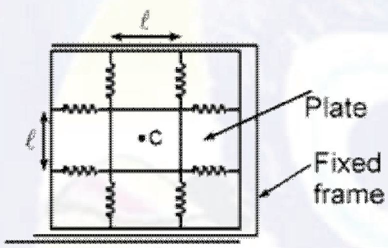
1) $2\pi\sqrt{\frac{m}{\rho S(1+\sin\theta)g}}$
2) $2\pi\sqrt{\frac{m}{\rho S\sin\theta g}}$
3) $2\pi\sqrt{\frac{m}{\rho S(1+\cos\theta)g}}$
4) $2\pi\sqrt{\frac{m}{\rho S\cos\theta g}}$

57. A solid ball of mass m is made to fall from a height H on a pan suspended through a spring of spring constant K. If the ball does not rebound and the pan is massless, then amplitude of oscillation is



1) $\frac{mg}{k}$
2) $\frac{mg}{k}\left(1+\frac{2HK}{mg}\right)^{1/2}$
3) $\frac{mg}{K}+\left(\frac{2HK}{mg}\right)^{1/2}$
4) $\frac{mg}{K}\left[1+\left(1+\frac{2HK}{mg}\right)^{1/2}\right]$

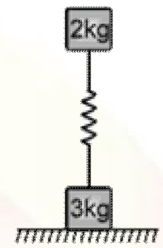
58. A square plate of mass m is held by eight springs, each of constant k in vertical plane. Knowing that each spring can act in either tension or compression, determine the frequency of the resulting vibration if the plate is rotated through a small angle about Center C and released.



1) $\frac{1}{2\pi}\sqrt{\frac{k}{m}}$ 2) $\frac{1}{2\pi}\sqrt{\frac{4k}{m}}$

3) $\frac{1}{2\pi}\sqrt{\frac{12k}{m}}$ 4) None of these

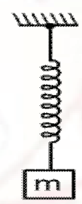
59. The ends of spring are attached to blocks of mass 3 kg and 2 kg. the 3 kg block rests on a horizontal surface and the 2 kg block which is vertically above it is in equilibrium producing a compression of t cm of the spring. The 2 kg mass must be compressed further by at least ____ so that when it is released, the 3 kg block may be lifted off the ground.



1) 1 cm 2) 2 cm

3) 2.5 cm 4) 1.5 cm

60. A block of mass 'm' is suspended from a spring and executes vertical SHM of time period T as shown in figure. The amplitude of the SHM is A and spring is never in compressed state during the oscillation. The minimum force exerted by spring on the block is



1) $mg-\frac{4\pi^2}{T^2}mA$ 2) $mg+\frac{4\pi^2}{T^2}mA$

3) $mg-\frac{\pi^2}{T^2}mA$ 4) $mg+\frac{\pi^2}{T^2}mA$

Sec: Jr.Super60 **Date: 29-10-16**

Time: 07:30AM to10:30AM **WTM-25** **Max. Marks: 360**

KEY SHEET

MATHEMATICS:

1	1	**2**	3	**3**	4	**4**	4	**5**	2	**6**	1
7	3	**8**	2	**9**	2	**10**	2	**11**	4	**12**	3
13	2	**14**	3	**15**	4	**16**	3	**17**	2	**18**	3
19	2	**20**	2	**21**	2	**22**	2	**23**	4	**24**	4
25	1	**26**	4	**27**	2	**28**	1	**29**	1	**30**	3

PHYSICS:

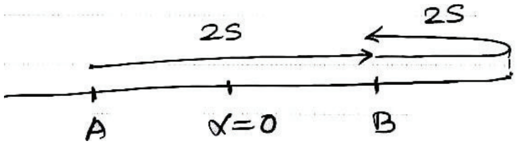
31	3	**32**	2	**33**	4	**34**	4	**35**	4	**36**	1
37	1	**38**	1	**39**	3	**40**	1	**41**	2	**42**	1
43	2	**44**	1	**45**	1	**46**	3	**47**	4	**48**	1
49	2	**50**	2	**51**	2	**52**	1	**53**	2	**54**	4
55	1	**56**	3	**57**	2	**58**	2	**59**	3	**60**	1

CHEMISTRY:

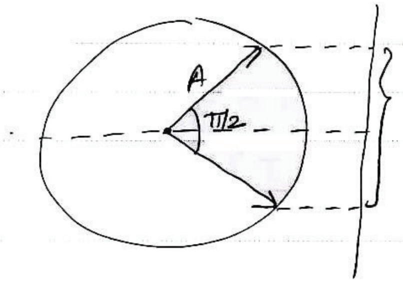
61	2	**62**	4	**63**	2	**64**	3	**65**	2	**66**	2
67	3	**68**	3	**69**	4	**70**	4	**71**	3	**72**	2
73	1	**74**	2	**75**	3	**76**	3	**77**	4	**78**	3
79	2	**80**	4	**81**	2	**82**	4	**83**	3	**84**	4
85	4	**86**	4	**87**	4	**88**	4	**89**	1	**90**	1

PHYSICS

31. Use $a_{max} = w^2 A$ and $v_{max} = wA$

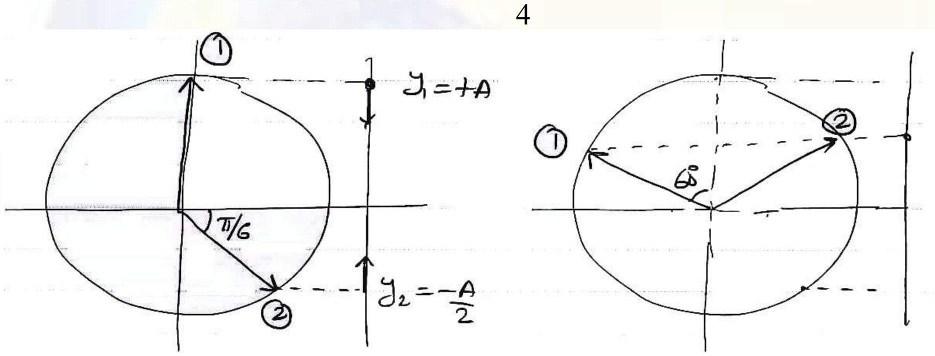


32. ANS : 8s



33. $A\sqrt{2}$ is max displacement in $\frac{T}{4}$

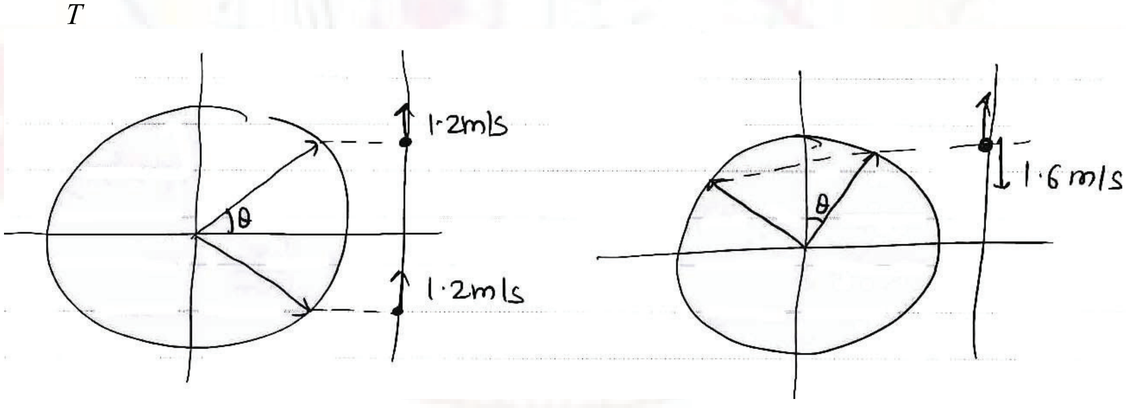
$$\left(V_{av}\right)_{max} = \frac{A\sqrt{2}}{\frac{T}{4}}$$



34.

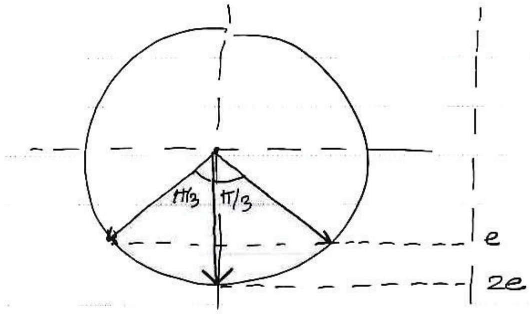
Phasor rotates by $60°$ when the particles are at same position

$$t = \frac{\pi/3}{\frac{2\pi}{T}} = \frac{T}{6}$$



35.

$1.2 = w\sqrt{A^2 - \left(A\sin\theta\right)^2}$ $1.6 = w\sqrt{A^2 - \left(A\cos\theta\right)^2}$

36.


$$T = \frac{\frac{2\pi}{3}}{w} = \frac{2\pi}{3w}$$

37. $KA^3 = \frac{1}{2}mw^2A^2 \Rightarrow w\alpha\sqrt{A} \Rightarrow T\alpha\frac{1}{\sqrt{A}}$

38. $T = 2\left(\frac{2\pi\sqrt{\frac{2}{g}}}{4} + \frac{2\pi\sqrt{\frac{4_a}{8}}}{4}\right) = 2\left(\frac{T}{4} + \frac{T}{8}\right)$

39. For min time period d = k (radius of gyraton)

40. Concept

41. $A_r = \sqrt{2}A$ total energy = $\frac{1}{2}mw^2\left(Ar\right)^2$

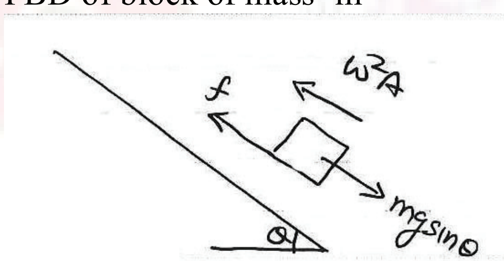
42. $y = \sin wt + \sqrt{3}\cos wt$ For mass to loose contact
$y = 2\sin\left(wt + \pi/3\right)$ $w^2A = g$
at the extreme position

43. Conceptual speed in SHM is max at equilibrium

44. Conceptual

45. $F = -\frac{dv}{dx} = -60\sin 6x \approx -360x$
$T = 2\pi\sqrt{\frac{m}{k}}$ k = 360

46. FBD of block of mass 'm'

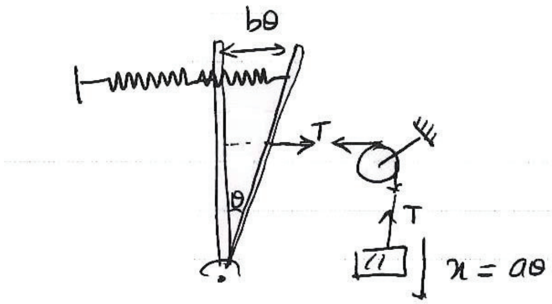


$$\mu mg\cos\theta - mg\sin\theta = m\left(w^2A\right)$$

Put $w = \sqrt{\frac{k}{3m}}$

47. For small angular disp $'\theta'$
$mgL\theta + kh^2\theta = mL^2\alpha$

48.



$Ta = kb^2\theta$ (rod is massless)

$mA = \frac{kb^2}{a^2}\theta \quad (x = a\theta)$

$mA = \frac{kb^2}{a^2}x$

$A = \frac{k}{m}\frac{b^2}{a^2}x$

49. $\frac{1}{2}mw^2\left(A^2 - x^2\right) = 2J \quad x = \frac{mg}{k}$

50. Conceptual

51. Conceptual

52. In center of mass frame $\frac{1}{2}kx^2 = \frac{1}{2}uv_{rel}^2$

Max extention $x = \frac{1}{4}m$

Max compression occurs after $\frac{3T}{4}$ time after start

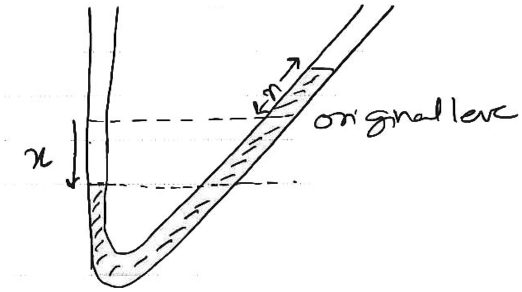
$T = 2\pi\sqrt{\frac{\mu}{k}}$

53. $E = \frac{1}{2}mw^2A^2 = \frac{1}{2}KA^2$

54. $w_1 = \sqrt{\frac{K}{M}}, \quad w_2 = \sqrt{\frac{K}{4M}} = \frac{w_1}{2}$

$4 = \frac{2\pi}{w_{rel}} = \frac{2\pi}{\frac{w_1}{2}} \Rightarrow w_1 = \pi$

55. $F = mw^2x, \; w = \frac{2\pi}{T}$

56. 

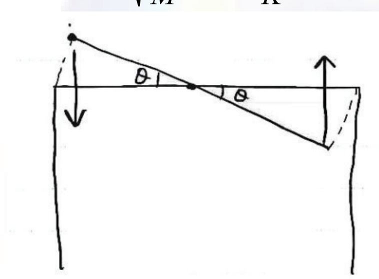
Total restoring force

$$= P\left(x+\frac{x}{\cos\theta}\right)Ag\cos\theta$$

57. Final velocity after collision $v=\sqrt{2gH}$

$v = w\sqrt{A^2-x^2}$

Use $w=\sqrt{\frac{K}{M}}$ $\quad x=\frac{mg}{K}$

58. 

Net torque on one side

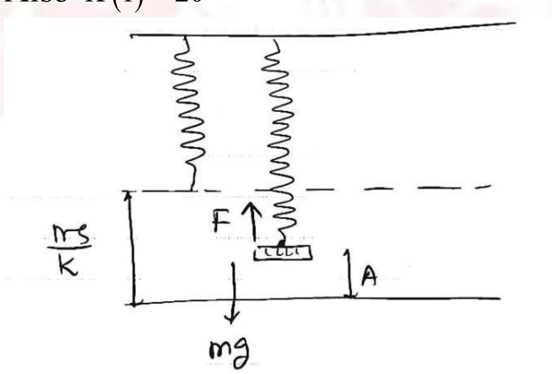
$$=2v\left(\frac{v}{2}\right)^2\theta$$

Total torque = 4 x Torque on one side

59. Suppose spring is elongated by x_0

$kx_0 = 30$ $\qquad x_0 = 1.5$

Also $K(1)=20$

60. 

$mg - F = mw^2 A$ $\qquad w=\frac{2\pi}{T}$

Final key

S.NO	SUB	Q.NO	GIVEN KEY	FINALIZED KEY	EXPLANATION
3	PHY	42	1	Delete	Two commas, create a confusion, if we have to neglect comma its not clear weather to reglect left comma or right comma.
4	PHY	44	1	Delete	Initial instant of observation is not given.also marking on the graph are not mentioned. many possibileiteis 1 or 2or 3or 4 may occure. please delete the question.
5	PHY	50	2	Delete	Phase angle can anything between $0 \& 2\pi$ and unless equation such as $x = A\sin(\omega t+\delta)\, or\, x = A\cos(\omega t+\delta)$ is given and δ is asked, question can have any answered
6	PHY	54	4	Delete	Answer is wrong out to be $\pi^2\mu$ which is not any one of the option (but data is sufficient to calculate K)
7	PHY	55	1	Delete	NO OPTIONS F_2 NOT MENTIONED
8	PHY	58	2	3	KEY MISTAKE ANSWER IS $\frac{1}{2\pi}\sqrt{\frac{12k}{m}}$
9	PHY	59	3	Delete	Compression t cm is wrong. t should be a numerical value