Q1.

A particle moves in one dimension such that its position x(t) as a function of time t is given by $x(t) = 2.0 + 27\,t - t^3$, where t is in seconds and x(t) is in meters. At what position does the particle change its direction of motion?

A) 56 m
B) 54 m
C) 27 m
D) 81 m
E) 100 m

Ans:

$$\frac{dx}{dt} = 0 = 27t - 3t^2$$

$$\Rightarrow t = 3.0\ \text{s}$$

$$x(t) = 2.0 + 27\,t - t^3 \Rightarrow x(3) = (2 + 27 \times 3 - 27)\text{m}$$

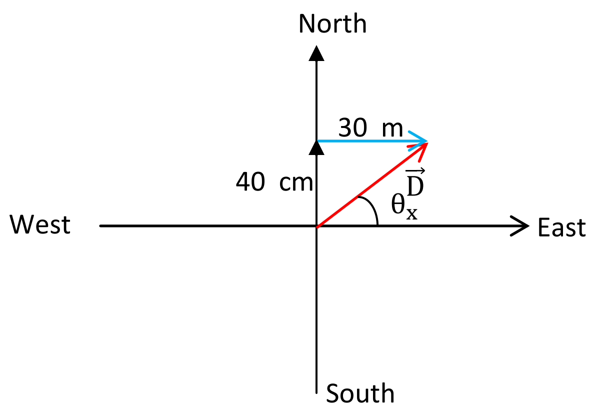
$$x(3) = (2 + 81 - 27)\text{m} = 56.0\ \text{m}$$

Q2.

What is your total displacement when you follow directions that tell you to walk 40.0 m north then 30.0 m east?

A) 50.0 m, 53.1^{o} North of East
B) 50.0 m, 53.1^{o} East of North
C) 50.0 m, 45.0^{o} East of North
D) 45.0 m, 45.0^{o} East of North
E) 45.0 m, 30.1^{o} North of East

Ans:



$$\vec{D} = \left(30\,\hat{i} + 40\,\hat{j}\right)\text{m}$$

$$|\vec{D}| = 50.0\ \text{m}$$

$$Q_x = \cos^{-1}\left(\frac{30}{50}\right) = 53.1°$$

Q3.

A projectile is fired from the ground with an initial velocity $v_o = (30.00\,\hat{i} + 19.62\,\hat{j})$ m/s. Find the horizontal distance the projectile travels before hitting the ground.

A) 120.0 m
B) 60.00 m
C) 78.48 m
D) 156. 9 m
E) 400.3 m

Ans:

$v_{0x} = 30.0\ \text{m/s};\quad v_{0y} = 19.62\ \text{m/s}$

Time to reach ground:

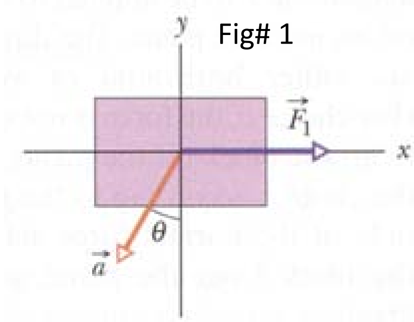
$\Delta y = 0 = 19.62\ t - \frac{1}{2} g t^2 \Rightarrow t = \frac{2 \times 19.6}{9.8} = 4.0\ \text{s}$

$\Delta x = v_{0x}\, x t = (30.0 \times 4.0) = 120.0\ \text{m}$

Q4.

There are two forces on the 3.00 kg box in the overhead view of Figure 1, but only one is shown. For F_1 = 20.0 N, a = 12.0 m/s^2, and θ = 30.0^o, find the second force in unit vector notation.

A) $(-38.0N)\,\hat{i} + (-31.2N)\,\hat{j}$
B) $(-51.2N)\,\hat{i} - (+18.0N)\,\hat{j}$
C) $(-38.0N)\,\hat{i} + (+31.2N)\,\hat{j}$
D) $(+38.0N)\,\hat{i} + (+31.2N)\,\hat{j}$
E) $(-31.2N)\,\hat{i} + (-38.0N)\,\hat{j}$



Ans:

$\vec{F}_1 + \vec{F}_2 = m\vec{a}$

$20.0\,\hat{i} + \vec{F}_2 = 3.0\left[-12.0\,\text{Sin}\theta\,\hat{i} - 12.0\,\cos\theta\,\hat{j}\right]$

$= -36.0\left[0.5\,\hat{i} + 0.866\,\hat{j}\right]\text{N}$

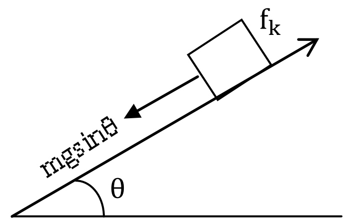
$= \left(-18.0\,\hat{i} - 31.2\,\hat{j}\right)\text{N}$

$\therefore \vec{F}_2 = \left(-20.0\,\hat{i} - 18.0\,\hat{i} - 31.2\,\hat{j}\right)\text{N}$

$\vec{F}_2 = (-38.0\ \text{N})\,\hat{i} + (-31.2\ \text{N})\,\hat{j}$

Q5.

A block slides with a constant acceleration down a rough plane inclined at an angle of 40.0^{o} with the horizontal. If the block starts from rest and slides a distance of 39.2 m down the plane in 4.00 s, calculate the coefficient of kinetic friction between the block and the plane.



A) 0.186
B) 0.215
C) 0.125
D) 0.110
E) 0.098

Ans:

$$mg\sin\theta - \mu_k mg\cos\theta = ma$$

$$a = g\sin 40^{0} - \mu_k g\cos 40° = 9.8 \times 0.643 - \mu_k \times 9.8 \times 0.766$$

$$\therefore a = 6.299 - 7.51\mu_k$$

$$\Delta x = v_0 t + \frac{1}{2} at^2$$

$$39.2 = 0 + \frac{1}{2}(6.299 - 7.51\,\mu_k) \times 16^{8}$$

$$39.2 = 50.39 - 60.08\mu_k \;\; \Rightarrow \mu_k = 0.186$$

Q6.

A 100-kg parachute falls at a constant speed of 1.00 m/s. At what rate is energy being lost?

A) 980 W
B) 19.8 W
C) 89.0 W
D) 49.0 W
E) 490 W

Ans:

$$P = mgv$$
$$= 100 \times 9.8 \times 1.0 = 980\text{ W}$$

Q7.

The work done by a conservative force acting on a body

A) does not change the total energy.
B) does not change the potential energy.
C) does not change the kinetic energy.
D) is always equal to zero.
E) is always equal to the sum of the changes in potential and kinetic energies.

Ans:

A

Q8.

The velocity of a given body is increased to such an extent that the kinetic energy of the body is increased by a factor of 16. The momentum of the body is increased by a factor of:

A) 4.0
B) 16
C) 8.0
D) 2.0
E) 1.0

Ans:

$$k_i = \frac{1}{2} m{v_1}^2 = \frac{{P_1}^2}{2m}$$

$$k_f = \frac{1}{2} m{v_2}^2 = \frac{{P_2}^2}{2m}$$

$$\Rightarrow \frac{k_f}{k_i} = \left(\frac{P_2}{P_1}\right)^2$$

$$4 = \left(\frac{P_2}{P_1}\right)$$

$$P_2 = 4.0\ P_1$$

Q9.

A 32.0-kg thin loop has a radius of 2.00 m and is rotating at 280 rev/min about its central axis. What is the average power required to bring it to a stop in 20.0 s?

A) 2.75×10^3 W
B) 1.32×10^3 W
C) 3.15×10^3 W
D) 1.32×10^2 W
E) 9.38×10^1 W

Ans:

$$\omega_i = \left(280\ \frac{\text{rev}}{\text{min}}\right)\left(2\pi\ \frac{\text{rad}}{\text{rev}}\right)\left(\frac{\text{min}}{60\ \text{s}}\right) = 29.3\ \text{rad/s}$$

$$I = MR^2 = 32.0 \times (2.0)^2 = 128\ \text{kg.m}^2$$

$$P = \frac{W}{\Delta t} = \frac{\Delta k}{\Delta t} = \frac{\left|\frac{1}{2}\ I\ ({\omega_f}^2 - {\omega_i}^2)\right|}{20.5} = \frac{\frac{1}{2} \times 128 \times (29.3)^2}{20}\ J/S$$

$$P = 2.75\ \times\ 10^3\ W$$

Q10.

A uniform solid sphere rolls down an incline. What must be the incline angle if the linear acceleration of the center of the sphere is to have a magnitude of 1.96 m/s^2?

A) 16.3°
B) 45.0°
C) 30.0°
D) 60.0°
E) 25.4°

Ans:

$$a = \frac{-g \sin\theta}{I + \frac{I}{MR^2}} = \frac{-g\sin\theta}{1 + \frac{2}{5}\frac{MR^2}{MR^2}} = \frac{-g\sin\theta}{\frac{7}{5}}$$

$$\therefore a = \frac{-5}{7}\ g\sin\theta \Rightarrow\ -1.96 = -\frac{5}{7} \times 9.8 \times \sin\theta$$

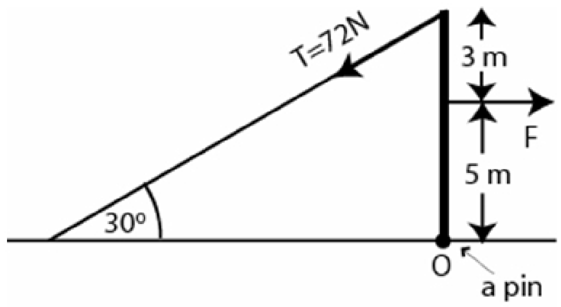
$$\sin\theta = 0.280$$

$$\theta = 16.26° = 16.3°$$

Q11.

A uniform beam is held in a vertical position by a pin at its lower end and a cable at its upper end (see Figure 2). The tension in the cable is 72.0 N. Find the horizontal force F acting on this beam.

Fig# 2



A) 99.8 N
B) 120 N
C) 65.0 N
D) 135 N
E) 50.3 N

Ans:

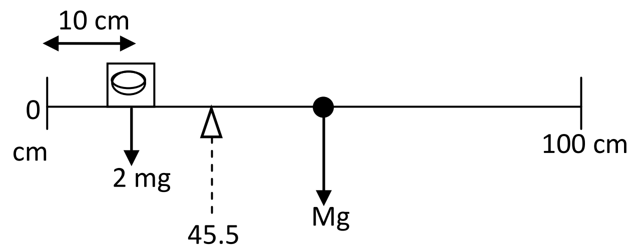
$$\sum \tau_0 = 0$$

$$5\text{ F} = 72\ \cos 30° \times 8$$

$$\text{F} = \frac{72\ \cos 30° \times 8}{5} = 99.76\text{ N} = 99.8\text{ N}$$

Q12.

A meter stick balances horizontally on a knife-edge at the 50.0 cm mark. With two 5.00 g coins stacked over the 10.0 cm mark, the stick is found to balance at the 45.5 cm mark. What is the mass of the meter stick?



A) 78.9×10^{-3} kg
B) 78.9 kg
C) 98.7×10^{-3} kg
D) 50.0×10^{-3} kg
E) 25.0×10^{-3} kg

Ans:

$$\sum \tau_0 = 0$$

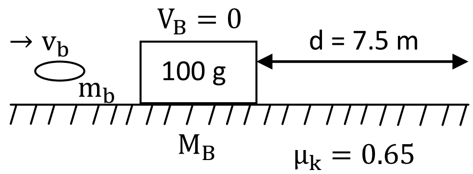
$$2\text{ m}\not{g}\,(45.5 - 0.10) = \text{M}\not{g}\,(50 - 45.5)$$

$$2 \times 5.0 \times 10^{-3}\ (35.5) = \text{M}\ (4.5) \Rightarrow \text{M} = \frac{10 \times 10^{-3} \times (35.5)}{4.5} = 78.9 \times 10^{-3}\text{ kg}$$

Q13.

A 12-gram bullet is fired into a 1.0 × 10^2-gram wooden block initially at rest on a horizontal surface. After impact, the bullet is imbedded inside the wooden block which slides 7.5 m before coming to rest. If the coefficient of friction between the block and the surface is 0.65, what was the speed of the bullet immediately before impact?

A) 91.2 m/s
B) 49.0 m/s
C) 25.0 m/s
D) 100 m/s
E) 190 m/s



Ans:

$$m_b v_b = (m_b + M_B)v \rightarrow (1)$$

$$\Delta k + \Delta u_g = W_{nc} \rightarrow (2)$$

$$0 - \frac{1}{2}(m_b + M_B)v^2 = -\mu_k(m_b + M_B)gd \Rightarrow v = \sqrt{2\mu_k gd} = 9.77\ m/s$$

From equation (1): $12 \times 10^{-3} v_b = 112 \times 10^{-3} \times 9.77 \Rightarrow v_b = 91.2\ m/s$

Q14.

A certain wire stretches 1.00 cm when a force F is applied to it. The same force is applied to a second wire of the same material with equal length but with twice the diameter. The second wire stretches:

A) 0.25 cm
B) 4.0 cm
C) 2.5 cm
D) 0.50 cm
E) 2.0 cm

Ans:

$$\frac{F_1}{A_1} = E\frac{\Delta L_1}{L_1}, \quad \frac{F_2}{A_2} = E\frac{\Delta L_2}{L_2} \Rightarrow \left(\frac{F_2}{F_1}\right)\left(\frac{A_1}{A_2}\right) = \left(\frac{\Delta L_2}{\Delta L_1}\right)\left(\frac{L_1}{\frac{L}{2}}\right)$$

$$\therefore \Delta L_2 = \left(\frac{A_1}{A_2}\right)\Delta L_1 = \frac{1}{4}\Delta L_1 = 0.25\ cm$$

Q15.

A cube of volume 1.0 m^3 is made of material with a bulk modulus of 2.0×10^9 N/m^2. When it is subjected to a pressure of 2.0×10^5 Pa, the magnitude of the change in its volume is:

A) 1.0×10^{-4} m^3
B) 0.25×10^{-4} m^3
C) 1.4×10^{-4} m^3
D) 3.5×10^{-2} m^3
E) 2.4×10^{-3} m^3

Ans:

$$\Delta P = -B\frac{\Delta V}{V}$$

$$\Delta V = -\frac{\Delta P \times V}{B} = \frac{2 \times 10^5 \times 1.0}{2.0 \times 10^9} = -1.0 \times 10^{-4} m^3$$

$$|\Delta V| = 1.0 \times 10^{-4} m^3$$

Q16.

Let the acceleration due to gravity on the surface of Earth be g_E. The acceleration due to gravity (g_p) on the surface of a planet whose mass is equal to that of Earth but whose radius is only 0.100 R_E is given by (R_E is Earth's radius)

A) $g_p = 100\ g_E$
B) $g_p = 10.0\ g_E$
C) $g_p = 50.0\ g_E$
D) $g_p = 25.0\ g_E$
E) $g_p = 1.00\ g_E$

Ans:

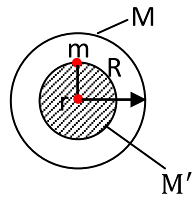
$$g_e = \frac{GM_e}{R^2}, \quad g_p = \frac{GM_p}{{R_p}^2} \Rightarrow \frac{g_p}{g_e} = \left(\frac{R_e}{R_p}\right)^2 = \left(\frac{R_e}{0.1R_e}\right)^2$$

$$g_p = 100\ g_e$$

Q17.

A solid uniform sphere has a mass of 1.00×10^4 kg and a radius of 1.00 m. What is the magnitude of the gravitational force due to the sphere on a particle of mass m = 1.00 kg located at a distance of 0.500 m from the center of the sphere

A) 3.34×10^{-7} N
B) 1.17×10^{-5} N
C) 6.68×10^{-3} N
D) 1.50×10^{-5} N
E) 1.67×10^{-8} N



Ans:

$$F = \frac{GmM'}{r^2}$$

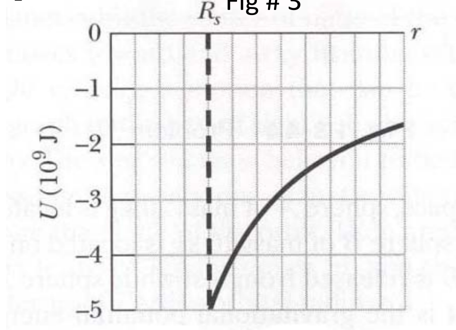
$$M' = \frac{M}{\left(\frac{4}{3}\pi R^3\right)} \times \left(\frac{4}{3}\pi r^3\right) = \frac{Mr^3}{R^3}$$

$$F = \frac{GmMr}{R^3} = \frac{6.67 \times 10^{-11} \times 1.0 \times 1 \times 10^4 \times 0.5}{(1.0)^3} = 3.34 \times 10^{-7}\ \text{N}$$

Q18.

Figure 3 gives the potential energy function U(r) of a projectile, plotted outward from the surface of a planet of radius R_s. What kinetic energy is required of a projectile launched at the surface if the projectile is to "escape" the planet?

Fig # 3



A) $+5.0 \times 10^9$ J
B) -5.0×10^9 J
C) $+4.0 \times 10^9$ J
D) -4.0×10^9 J
E) -9.0×10^8 J

Ans:

$$\Delta K + \Delta U = 0 \quad \Rightarrow \quad \Delta K = -\Delta U$$

$$k_f - k_i = -(U_f - U_i)$$

$$k_i = (0 - U_i)$$

$$k_i = -U_i$$

$$k = 5 \times 10^9\ \text{J}$$

Q19.

A satellite travels in a circular orbit around a certain planet. The orbit has a radius of 10×10^6 m and a period of 8.0 hours. What is the mass of the planet?

A) 7.1×10^{23} kg
B) 9.1×10^{20} kg
C) 9.8×10^{17} kg
D) 4.9×10^{26} kg
E) 8.5×10^{29} kg

Ans:

$$T^2 = \frac{4\pi^2}{GM} r^3$$

$$M = \frac{4\pi^2}{GT^2} r^3 = \frac{(4)\left(\frac{22}{7}\right)^2 \times 10^{21}}{6.67 \times 10^{-11} \times (8 \times 3600)^2} = 7.1 \times 10^{23} \text{ kg}$$

Q20.

A 250-kg spaceship is in a circular orbit of radius 3.00 R_E about the earth. How much energy is required to transfer the spaceship to a circular orbit of radius 4.00 R_E? (R_E is the radius of the earth)?

A) 6.52×10^8 J
B) 3.52×10^{11} J
C) 5.32×10^{14} J
D) 4.37×10^5 J
E) 8.97×10^1 J

Ans:

$$E_i = -\frac{G_m M_E}{2(3.00R_E)} \;;\; E_f = -\frac{G_m M_E}{2(4.00R_E)}$$

$$\Delta E = -\frac{G_m M_E}{2R_E}\left(\frac{1}{4} - \frac{1}{3}\right) = +\frac{G_m M_E}{2R_E} \times \frac{1}{12}$$

$$\Delta E = \frac{G_m M_E}{24R_E} = \frac{6.67 \times 10^{-11} \times 250 \times 5.98 \times 10^{24}}{24 \times 6.37 \times 10^6} \text{ J}$$

$$\Rightarrow \Delta E = 6.52 \times 10^8 \text{ J}$$

Q21.

Find the pressure increase in the fluid in a syringe when a nurse applies a force of 31.4 N to the syringe's circular piston, which has a radius of 1.00 cm.

A) 1.00×10^5 Pa
B) 1.50×10^4 Pa
C) 2.00×10^3 Pa
D) 3.00×10^6 Pa
E) 5.00×10^3 Pa

Ans:

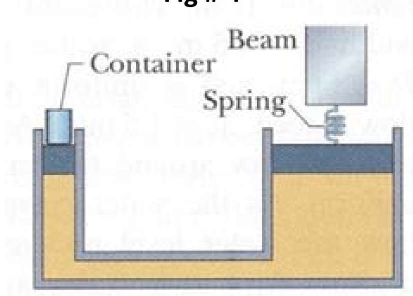
$$P = \frac{F}{A} = \frac{31.4\ \text{N}}{\pi(10^{-2})^2} = 9.99 \times 10^4\ \text{N/m}^2$$

Q22.

In Figure 4, a spring of spring constant 5.00×10^4 N/m is between a rigid beam and the output piston of a hydraulic lever. An empty container with negligible mass sits on the input piston. The input piston has area A, and the output piston has area 20 A. Initially the spring is at its rest length. How many kilograms of sand must be (slowly) poured into the container to compress the spring by 4.00 cm?

A) 10.2 kg
B) 100 kg
C) 9.80 kg
D) 980 kg
E) 250 kg

Fig # 4



Ans:

$$\frac{F_1}{A_1} = \frac{F_2}{A_2} = \frac{kx}{A_2}$$

$$F_1 = kx\left(\frac{A_1}{A_2}\right)$$

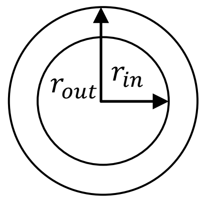
$$F_1 = 5 \times 10^4 \times 4 \times 10^{-2} \times \left(\frac{A}{20A}\right)$$

$$m = \frac{F_1}{g} = \frac{5 \times 10^4 \times 4 \times 10^{-2}}{20 \times 9.8} = \frac{10^2}{9.8}\ \text{kg} = 10.2\ \text{kg}$$

Q23.

A hollow spherical iron shell floats almost completely submerged in water. The outer diameter is 50.0 cm, and the density of iron is 7.87 g/cm^3. Find the inner diameter.

A) 47.8 cm
B) 12.5 cm
C) 15.5 cm
D) 7.87 cm
E) 25.0 cm



Ans:

$\rho_f V_{submerged} \cancel{g} = \rho_0 V_0 \cancel{g}$

$1.0 \times \cancel{\frac{4}{3}} \cancel{\pi} (50)^3 = 7.87 \times \cancel{\frac{4}{3}} \cancel{\pi} (50^3 - {r_{in}}^3)$

$(50)^3 = 7.87(50^3 - {r_{in}}^3) \Rightarrow {r_{in}}^3 = (50)^3 - \frac{(50)^3}{7.87} \Rightarrow r_{in} = 47.8 \text{ cm}$

Q24.

Two streams merge to form a river. One stream has a width of 8.0 m, depth of 4.0 m, and current speed of 2.0 m/s. The other stream is 7.0 m wide and 3.0 m deep, and flows at 4.0 m/s. If the river has a width of 10.0 m and a speed of 4.0 m/s, what is its depth?

A) 3.7 m
B) 4.0 m
C) 3.0 m
D) 8.0 m
E) 7.0 m

Ans:

$A_1 v_1 + A_2 v_2 = A_3 v_3$

$32 \times 2 + 21 \times 4 = 10 \text{ d} \times 4$

$64 + 84 = 40 \text{ d}$

$\text{d} = 3.7 \text{ m}$

Q25.

A liquid of density 1.00×10^3 kg/m^3 flows through a horizontal pipe that has a cross-sectional area of 2.00×10^{-2} m^2 in region A and a cross-sectional area of 10.0×10^{-2} m^2 in region B. The pressure difference between the two regions is 10.0×10^3 Pa. What is the mass flow rate between regions A and B?

A) 91.3 kg/s
B) 87.3 kg/s
C) 857 kg/s
D) 576 kg/s
E) 100 kg/s

Ans:

$$A_1 v_1 = A_2 v_2$$

$$2 \times 10^{-2} v_1 = 10 \times 10^{-2} v_2 \Rightarrow v_1 = 5v_2$$

$$P_1 + \frac{1}{2}\rho v_1^2 + \rho g y_1 = P_2 + \frac{1}{2}\rho v_2^2 + \rho g y_2 \quad (\rho g y_1 \to 0,\ \rho g y_2 \to 0)$$

$$P_2 - P_1 = \frac{1}{2}\rho(v_1^2 - v_2^2) = \frac{1}{2} \times 10^3 (25v_2^2 - v_2^2)$$

$$\therefore 10 \times 10^3 = \frac{1}{2} \times 10^3 \times 24 v_2^2$$

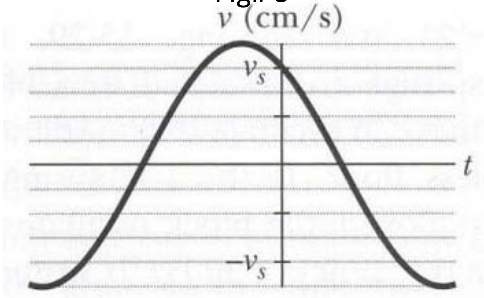
$$v_2^2 = \frac{10}{12} \Rightarrow v_2 = \sqrt{\frac{10}{12}} = 0.9313 \text{ m/s}$$

$$\therefore \text{Mass flow rate: } = A_2 v_2 \rho = 91.3 \text{ kg/s}$$

Q26.

What is the phase constant for the harmonic oscillator with the velocity function v(t) given in Figure 5 if the position function x(t) has the form $x(t) = x_m \cos(\omega t + \phi)$? The vertical axis scale is set by v_s= 4.00 cm/s.

Fig# 5



A) -53.1^o
B) $+53.1^o$
C) -5.24^o
D) $+5.24^o$
E) -40.0^o

Ans:

From Fig. $v_s = 4, v = \frac{5}{4} v_s$

$$v = \frac{4}{4} \times 5 = 5\ \text{cm/s}$$

$$x = x_m \cos(\omega t + \phi)$$

$$\frac{dx}{dt} = -x_m \omega \sin(\omega t + \phi)$$

$$v_s = -v\sin(\omega t + \phi)$$

$$4 = -5\sin(\phi); t = 0$$

$$\sin(\phi) = -\frac{4}{5} \Rightarrow \phi = \sin^{-1}(-4/5) = -53.1°$$

Q27.

If the phase angle for a block-spring system in SHM is $\pi/6$ rad and the block's position is given by $x(t) = x_m \sin(\omega t + \phi)$, what is the ratio of the kinetic energy to the potential energy at time t = 0?

A) 3
B) 1/3
C) 9
D) 1/9
E) 5

Ans:

$$x(t) = x_m \sin(\omega t + \phi)\ ; \quad v = \omega x_m \cos(\omega t + \phi)$$

$$U = \frac{1}{2}kx^2 = \frac{1}{2}k{x_m}^2 \sin^2(\phi)$$

$$k = \frac{1}{2}mv^2 = \frac{1}{2}m\omega^2 {x_m}^2\cos(\phi) = \frac{1}{2}k\,{x_m}^2\cos^2(\phi)$$

$$\therefore \frac{k}{U} = \frac{\cos\phi}{\sin\phi} = \left[\frac{\cos\left(\frac{\pi}{6}\right)}{\sin\left(\frac{\pi}{6}\right)}\right]^2$$

$$\therefore \frac{k}{U} = 3$$

Q28.

Find the mechanical energy of a block-spring system having a spring constant of 2.0 N/cm and an oscillation amplitude of 3.0 cm.

A) 9.0×10^{-2} J
B) 7.8×10^{-1} J
C) 12×10^{-3} J
D) $13 \times 10^{+2}$ J
E) 5.0×10^{-3} J

Ans:

$$E = \frac{1}{2}k{x_m}^2 = \frac{1}{2}\left(2.0\ \frac{N}{cm}\right)\left(\frac{10^2\ cm}{1\ m}\right) \times (3 \times 10^{-2} m)^2$$

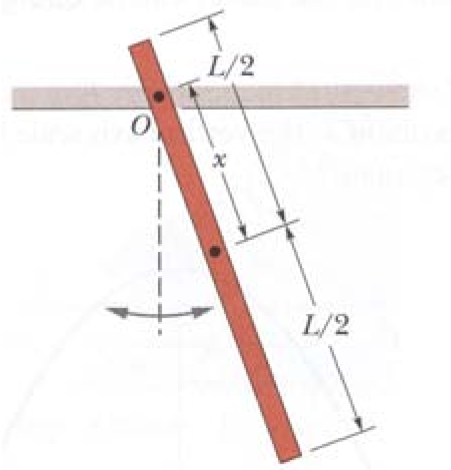
$$= 10^2 \times 9 \times 10^{-4} = 9 \times 10^{-2}\ J$$

$$E = 9 \times 10^{-2}\ J$$

Q29.

In Figure 6, a stick of length L = 1.73 m oscillates as a physical pendulum. What value of x between the stick's center of mass and its pivot point O gives the least period?

Fig# 6



A) 0.50 m
B) 0.87 m
C) 1.73 m
D) 0.58 m
E) 0.43 m

Ans:

$$T = 2\pi\sqrt{\frac{I}{mgd}}\ ; d = x$$

$$I = \frac{1}{12}mL^2 + mx^2$$

$$T = 2\pi\left[\frac{\frac{1}{12}mL^2 + mx^2}{mgx}\right]^{\frac{1}{2}}$$

$$T^2 = 4\pi^2\left(\frac{\frac{1}{12}mL^2 + mx^2}{mgx}\right)$$

$$T^2 = \frac{4\pi^2}{g}\left(\frac{1}{12}L^2x^{-1} + x\right)$$

$$2T\frac{dt}{dx} = \frac{4\pi^2}{g}\left(-\frac{1}{12}L^2x^{-1} + 1\right) = 0$$

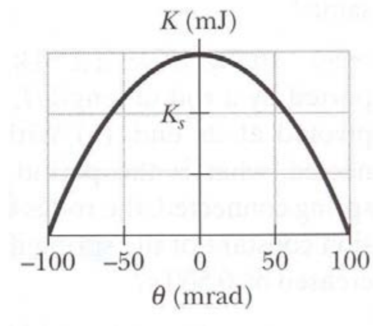
$$\frac{L^2}{12x^2} = 1 \Rightarrow x^2 = \frac{L^2}{12} = \frac{(1.73)^2}{12}$$

$$\text{or } x^2 = 0.249 \Rightarrow x = 0.499 \text{ m}$$

Q30.

Figure 7 shows the kinetic energy K of a simple pendulum versus its angle θ from the vertical. The vertical axis scale is set by K_s = 20.0 mJ. The pendulum bob has mass 0.30 kg. What is the length of the pendulum?

Fig# 7



A) 2.04 m
B) 1.25 m
C) 2.25 m
D) 0.500 m
E) 3.05 m

Ans:

$\theta = 100 \times 10^{-3}\text{rad} = 5.73°$

$k_{max} = U_{max} = mgL(1 - \cos\theta)$

$\therefore 30 \times 10^{-3} = (0.30)(9.8)(L)(1 - \text{Cos } 573°)$

$30 \times 10^{-3} = (0.30)(9.8)(L)(1 - 0.995)$

$$L = \frac{30 \times 10^{-3}}{(0.30)(9.8)(0.00499)}$$

$L = 2044 \times 10^{-3}\text{ m} = 2.04\text{ m}$