You chose a lot of problems!

week 8 - Phys A - Giancoli Ch 8 Q 26, 27, #16

Ch 14 #1, 4, 5, 10, 13, 29, 31, 36

26. Name the type of equilibrium for each position of the balls in Fig. 8–26.

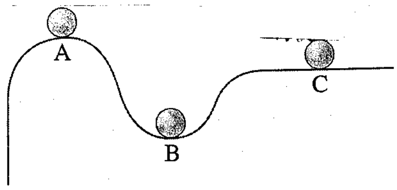


FIGURE 8–26 Question 26.

* 27. Figure 8–27 shows a potential energy curve, $U(x)$. (*a*) At which point does the force have greatest magnitude? (*b*) For each labeled point, state whether the force acts to the left or to the right, or is zero. (*c*) Where is there equilibrium and of what type is it?

$F = -\frac{\partial U}{\partial x} = -$ slope of U.

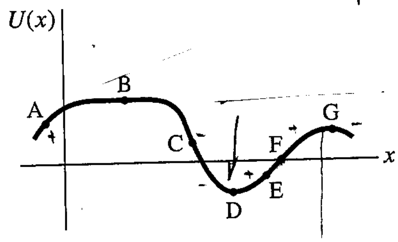


FIGURE 8–27 Question 27.

#16

h:

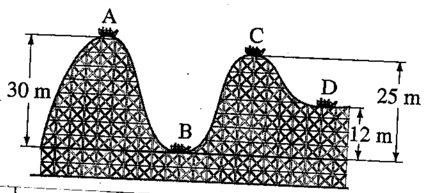


FIGURE 8–29 Problems 16 and 30.

Roller coaster is released from A at rest. Find speeds at B, C, D, assuming no friction.

$U_A = E_{tot} = mgh = K_B + U_B = K_C + U_C = K_D + U_D = \frac{1}{2}mv^2 + mgh_0$

$gh = \frac{1}{2}v^2 + gh_0 \rightarrow v^2 =$

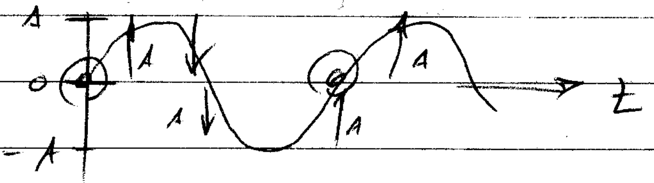
$V_B =$

$V_C =$

$V_D =$

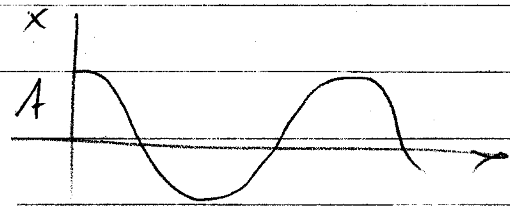
Calc/

1. (I) If a particle undergoes SHM with amplitude 0.15 m, $= A$ what is the total distance it travels in one period?



distance $= 4A = 0.60\,m$ displacement $= 0$

4. (I) (a) What is the equation describing the motion of a mass on the end of a spring which is stretched 8.8 cm from equilibrium and then released from rest, and whose period is 0.75 s? (b) What will be its displacement after 1.8 s? $= A$



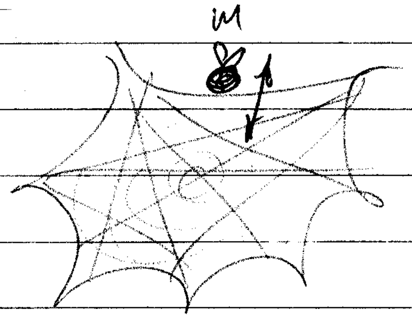
$T = 3/4\,s$

$\omega = \frac{2\pi}{T} =$

(a) $x(t) = A\cos\omega t =$

(b) $x(1.8s) =$

5. (II) A small fly of mass 0.60 g $= M$ is caught in a spider's web. The web vibrates predominantly with a frequency of 10 Hz. $= f$ (a) What is the value of the effective spring constant k for the web? (b) At what frequency would you expect the web to vibrate if an insect of mass 0.40 g were trapped?



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

$f_b =$

10. (II) A mass m at the end of a spring vibrates with a frequency of 0.88 Hz; when an additional 1.25 kg mass is added to m, the frequency is 0.48 Hz. What is the value of m?

ω_1 m_2 ω_2

$\omega_1^2 = \frac{k}{m}$ $\omega_2^2 = \frac{k}{m + m_2}$

Eliminate K to solve for m: $k = k$

13. (II) The position of a SHO as a function of time is given by $x = 3.8\cos(7\pi t/4 + \pi/6)$ where t is in seconds and x in meters. Find (*a*) the period and frequency, (*b*) the position and velocity at $t = 0$, and (*c*) the velocity and acceleration at $t = 2.0$ s.

$x = A\cos(\omega t + \phi)$ $\phi = \frac{\pi}{6}$

$A = 3.8\,m$, $\omega = \frac{7\pi}{4}\frac{rad}{s} = 2\pi f \rightarrow f =$

a Period $T = \frac{1}{f} =$

b $x(t=0) = 3.8\cos(0 + \frac{\pi}{6}) =$

$V = \frac{dx}{dt} = A\frac{d}{dt}\cos(\omega t + \phi) =$

$V(t=0) =$

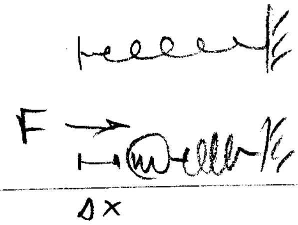
c $V(t=2s) =$

$a = \frac{dV}{dt} = \frac{d^2}{dt^2}A\cos(\omega t + \phi) =$

$a(t=2s) =$

F

Δx **29.** (II) It takes a force of 95.0 N to compress the spring of a popgun 0.185 m to "load" a 0.200-kg ball. With what speed will the ball leave the gun? m



$F = k\Delta x$

$k =$

$U_{compressed} = K_{released}$; $\frac{1}{2}k\Delta x^2 = \frac{1}{2}mv^2$

$v^2 =$

$v =$

31. (II) If one vibration has 10 times the energy of a second one of equal frequency, but the first's spring constant k is twice as large as the second's, how do their amplitudes compare?

$U_1 = 10U_2$, $k_1 = 2k_2$

$U = \frac{1}{2}kx^2$. Find $\frac{x_1}{x_2}$

36. (II) At $t = 0$, a 650-g (m) mass at rest on the end of a horizontal spring ($k = 184$ N/m) is struck by a hammer which gives it an initial speed of 2.26 m/s ($V_0 =$). Determine (*a*) the period and frequency of the motion, (*b*) the amplitude, (*c*) the maximum acceleration, (*d*) the position as a function of time, (*e*) the total energy, and (*f*) the kinetic energy when $x = 0.40A$ where A is the amplitude.

$K_0 = E_{tot} = U_{max}$

$\frac{1}{2}mV_0^2 = \frac{1}{2}kA^2$

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

$f = \frac{\omega}{2\pi} =$ $T = \frac{1}{f} =$

(b) $A =$

(c, d) $x = A\cos\omega t =$

$V = \frac{dx}{dt} =$

$a = \frac{dV}{dt} =$

$a_{max} =$

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36 (e) $E_{tot} = K_0 = \frac{1}{2} m V_0^2 =$

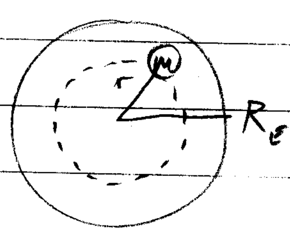
(f) $K(t) = \frac{1}{2} m V(t)^2 =$

when $x = 0.4A$, find t or v:

Then $K =$

88. Imagine that a 10-cm-diameter circular hole were drilled all the way through the center of the Earth (Fig. 14–46). At one end of the hole, you drop an apple into the hole. Show that, if you assume that the Earth has a constant density, the subsequent motion of the apple is simple harmonic. How long will the apple take to return? Assume that we can ignore all frictional effects.

From the Shell Theorem, we know only the mass $M(r)$ inside r attracts the falling mass at r.



If density $\rho = \frac{\text{mass}}{\text{volume}}$ = constant, then

$$\frac{M(r)}{\frac{4}{3}\pi r^3} = \frac{M_E}{\frac{4}{3}\pi R_E^3} \rightarrow M(r) = M_E \left(\frac{r}{R_E}\right)^3$$

Force on falling mass (m) is

$$F = -\frac{G M(r) m}{r^2} = ma = m\frac{d^2 r}{dt^2} = -\frac{Gm}{r^2} M_E \left(\frac{r}{R_E}\right)^3 = -\frac{G m M_E r}{R_E^3}$$

→ Since $\frac{d^2 r}{dt^2} \propto r$, $r = A\cos\omega t$ and $\frac{d^2 r}{dt^2} = -\omega^2 r =$