PHY 107

Problem 1

- Impulse is a force acting on a particle for a short period of time.

a)$J = \Delta p = m(v-u) = 1.2(10-(-25)) = 42\ kg.m/s$
b) $F_{avg} = J/(\Delta t) = 2100\ kg.m/s^2$

Problem 2

Conservation of linear momentum. Total linear momentum for a system of particles stays constant. The system is assumed to be closed and isolated.

$$m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$$
$$\frac{15}{1000}(-2.5) + \frac{15}{1000}(0) = \frac{15}{1000}(v_1) + \frac{15}{1000}(-2.5)$$
$$v_1 = 0\ ms^{-1}$$

Problem 3

Elastic collision: Total kinetic energy of the system of particles stays constant.
Inelastic collision: Total kinetic energy of the system of particles is NOT conserved.

a,b) COLM: $m_1v_{1i} + m_2v_{2i} = m_1v_{1f} + m_2v_{2f}$
$1.2m_1 = 0.66m_1 + m_2v_{2f}$
$m_2v_{2f} = 0.1836$

COKE: $\frac{1}{2}m_1v_{1i}^2 + \frac{1}{2}m_2v_{2i}^2 = \frac{1}{2}m_1v_{1f}^2 + \frac{1}{2}m_2v_{2f}^2$
$\frac{1}{2}m_1(1.2)^2 = \frac{1}{2}m_1(0.66)^2 + \frac{1}{2}m_2v_{2f}^2$
$m_2v_{2f}^2 = 0.341$

$0.1836v_{2f} = 0.341 \rightarrow v_{2f} = 1.86\ m/s$
$m_2 = 0.0985\ kg = \ 98.6\ g$

c) $(m_1v_{1i} + m_2v_{2i})/(m_1 + m_2) = 0.930\ m/s$

Problem 4

$$a(t) = -\omega^2x(t)$$

where,
a = acceleration

ω =angular frequency
x = displacement
t = time.

a)$x = \ (6.0m)\ cos[(3\pi\ rad/s)(2\ s)\ +\ \pi/3\ rad]$
b)$v = \frac{dx}{dt} = -6(3\pi)\ sin[(3\pi\ rad/s)(2\ s)\ +\ \pi/3\ rad]$
c)$a = \frac{dv}{dt} = -6(3\pi)(3\pi)\ cos[(3\pi\ rad/s)(2\ s)\ +\ \pi/3\ rad]$
d)$phase = (3\pi\ rad/s)(2\ s)\ +\ \pi/3\ rad$
e) $f = \ \frac{\omega}{2\pi} = \frac{3\pi}{2\pi}$
f) $T = \ \frac{1}{f}$

Problem 5

$$T = 2\pi\sqrt{\frac{L}{g}}$$

$$T^2 = 4\pi^2\frac{L}{g}$$

$$g = 4\pi^2\frac{L}{T^2}$$

$$g = 9.83\ ms^{-2}$$