SOLUTION ICE 4

PROBLEM 1

a) $\frac{1}{2} k x^2 = \frac{1}{2} (16\ N/m) \cdot (1m)^2 = \boxed{8J}$

b) ENERGY AND MOMENTUM

ENERGY

$$\frac{1}{2} k x^2 = \frac{1}{2} m V_{1f}^2 + \frac{1}{2} M V_{2f}^2$$

MOMENTUM

$$m V_{1f} = M V_{2f}$$

c) $$8 = \frac{1}{2} \cdot 4 V_{1f}^2 + \frac{1}{2} \cdot 10 V_{2f}^2$$

$$4 V_{1f} = 10 V_{2f}$$

$$\frac{2}{5} V_{1f} = V_{2f}$$

$$8 = 2 V_{1f}^2 + \frac{4}{25} V_{1f}^2$$

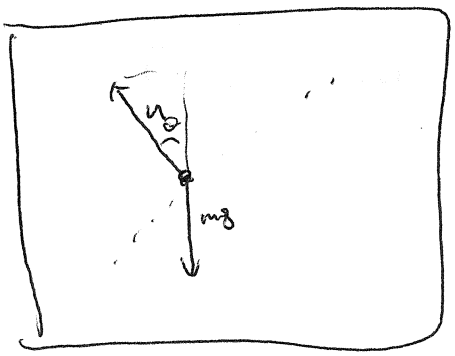
$$8 = \frac{14}{5} V_{1f}^2$$

$$\frac{8 \cdot 5}{14} = V_{1f}^2 \Rightarrow V_{1f} = \sqrt{\frac{40}{14}} = 1.69 m/s$$

$$V_{2f} = -0.676 m/s$$

PROBLEM 2

a)



b)

$$n \sin\theta = \frac{mv^2}{R}$$

$$n \cos\theta = mg$$

OR

$$\tan\theta = \frac{v^2}{Rg}$$

c)

$$\tan 45^\circ = 1 = \frac{v^2}{30 \cdot 9.8\ m/s}$$

$$v = 17.15\ m/s$$

d) =

$$n \cos 45^\circ = mg \qquad m = 10kg$$

$$n \frac{\sqrt{2}}{2} = 98$$

$$\vec{n} = 139\ N$$

PROBLEM 3

a) **INELASTIC**

~~ENERGY~~ MOMENTUM

b) $1\ kg \quad 10\ m/s = (1+9)\ V_{1f}$

$V_{1f} = \boxed{1\ m/s}$

c) $10\ kg\ m/s + 10\ kg\ m/s = (1+10)\ V_{2f}$

$\frac{20}{11}\ m/s = \boxed{1.81\ m/s}$

PROBLEM 4

a) $$\frac{dU}{dx} = -3x^2 + 1 = 0$$

$$x^2 = \frac{1}{3}$$

$$x = \pm \frac{1}{\sqrt{3}} \quad \text{OR} \quad \pm 0.577$$

b) $x = +0.577$ UNSTABLE

$x = -0.577$ STABLE

c) $$-\frac{dU}{dx} = 3x^2 - 1$$ AT 1 $\boxed{F = 2N}$

d) $4J - 2J =$ KINETIC ENERGY $= \underline{\underline{2J}}$ PARTICLE

$$\frac{1}{2} m v^2 = 2J$$

$$\frac{1}{2} 2 \cdot v^2 = 2J$$

$$\boxed{v = 1.41 \text{ m/s}}$$

PROBLEM 5

a) ENERGY AND MOMENTUM

b) $\frac{1}{2} m v^2 = mgh$

$$v = \sqrt{2gh} = \sqrt{2 \cdot 9.8 \cdot 1}$$

$$= 4.43 \text{ m/s}$$

c)

$$4.43 = v_{1i} = v_{1f} + 4 v_{2f}$$

$$v_{1f} = 4.43 - 4 v_{2f}$$

$$\frac{1}{2} m (4.43)^2 = 9.8 \text{ J} = \frac{1}{2} v_{1f}^2 + 2 v_{2f}^2$$

$$9.8 \text{ J} = \frac{1}{2} (4.43 - 4 v_{2f})^2 + 2 v_{2f}^2$$

$$9.8 \text{ J} = \frac{1}{2} (2 \cdot 9.8 - 8 \cdot 4.43 v_{2f} + 16 v_{2f}^2) + 2 v_{2f}^2$$

$$9.8 = 9.8 - 17.7 v_{2f} + 8 v_{2f}^2 + 2 v_{2f}^2$$

$$10 v_{2f}^2 = 17.7 v_{2f}$$

$$v_{2f} = 1.77 \text{ m/s}$$

$$V_{1f} = -2.65 \text{ m/s}$$

$$1.77^2 = 2 g h_M$$

$$h_M = \frac{1.77^2}{2 \cdot 9.8} = \boxed{0.16 \text{ m}}$$

d) $=$ $\quad h_m = \frac{2.65^2}{2 \cdot 9.8} = \boxed{0.358 \text{ m}}$