

Solutions

Midterm Exam 03.

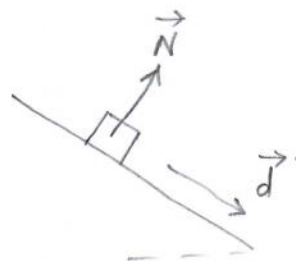
(PHYS-205A-001)

Spring 2023

①

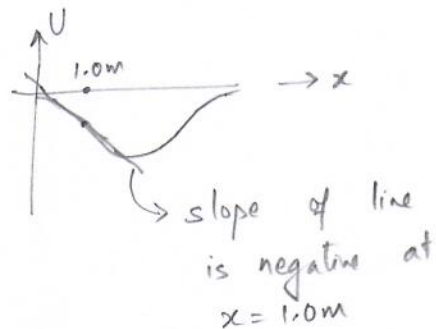
Problem 1

$$W = \vec{N} \cdot \vec{d}$$
$$= Nd \cos 90 = 0.$$



Problem 2

$$F = - \left. \frac{\partial U}{\partial x} \right|_{x=1.0\text{m}}$$
$$= - (\text{slope at } x=1.0\text{m})$$
$$> 0$$



Thus, force is pointing towards positive x .

Problem 3

→ Kinetic energy is conserved in elastic collisions,
but not conserved in inelastic collisions.

Problem 4

at height R , using symmetry.

Problem 5

$$m\vec{a} = m\vec{g} + \vec{N}$$

$$\Delta K + \Delta U_g = W_N$$

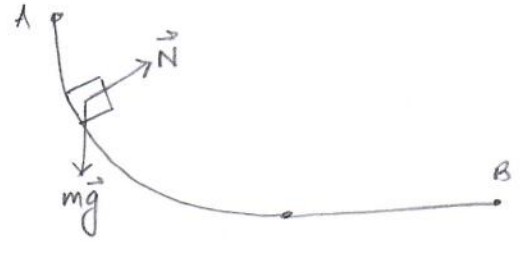
$$W_N = 0 \quad (\text{because } \vec{N} \cdot d\vec{r} = 0)$$

$$\Rightarrow K_A + U_A = K_B + U_B$$

$$\frac{1}{2} m v_A^2 + mgh_A = \frac{1}{2} m v_B^2 + mgh_B \quad \leftarrow = 0$$

$\rightarrow = 0$

$$v_B = \sqrt{2gh_A} = \sqrt{2(9.8)(10.0)} = 14 \frac{m}{s}$$



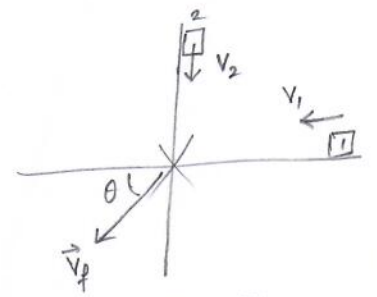
Problem 6

$$m_1 \vec{v}_{1i} + m_2 \vec{v}_{2i} = (m_1 + m_2) \vec{v}_f$$

$$\vec{v}_{1i} + 4 \vec{v}_{2i} = 5 \vec{v}_f$$

$$5 \vec{v}_f = -35 \hat{i} - 4(21) \hat{j}$$

$$\vec{v}_f = -7.0 \hat{i} - 17 \hat{j}$$



$m_2 = 4m_1$

magnitude: $v_f = \sqrt{7.0^2 + 17^2} = 18 \frac{m}{s}$

direction: $\theta = \tan^{-1}(\frac{17}{7.0}) = 68^\circ \text{ S of W}$

Problem 7

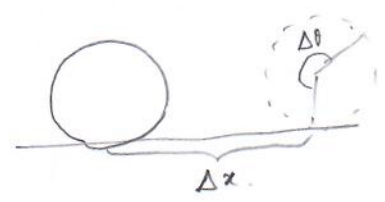
$$\Delta x = \Delta t = 8.00s$$

$$v_i = 0$$
$$v_f = 24.0 \frac{m}{s}$$

$a =$

$$\frac{\Delta x}{\Delta t} = \frac{v_i + v_f}{2}$$

$$\frac{\Delta x}{8.00} = \frac{0 + 24.0}{2} \Rightarrow \Delta x = 96 \text{ m}$$



$$\Delta x = R \Delta \theta$$

$$96 = (0.300) \Delta \theta$$

$$\Delta \theta = 320 \text{ radians}$$