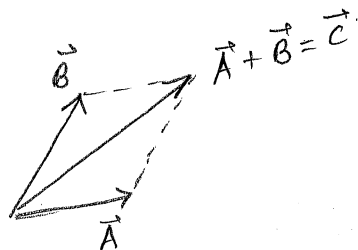


# Solutions

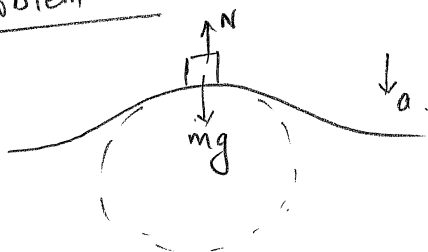
PHYS-205A-002 (Final Exam) Fall 2025

①

## Problem 1



## Problem 2

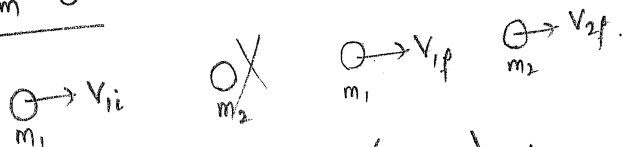


$$ma = mg - N$$

$$N = mg - ma < mg$$

(lighter)

## Problem 3



$$m_1 = m_2$$

$$v_{1f} = \left( \frac{m_1 - m_2}{m_1 + m_2} \right) v_{1i} + \left( \frac{2m_2}{m_1 + m_2} \right) v_{2i} = 0 + 0 = 0$$

$$v_{2f} = \left( \frac{2m_1}{m_1 + m_2} \right) v_{1i} + \left( \frac{m_2 - m_1}{m_1 + m_2} \right) v_{2i} = v_{1i} + 0 = 10. \frac{m}{s}$$

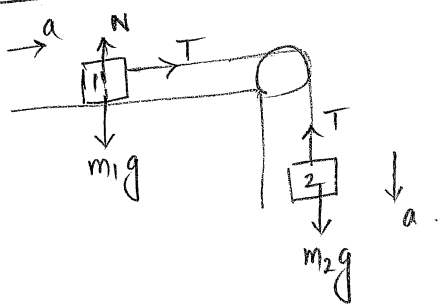
## Problem 4

Approximately:

raw egg — cylindrical shell  $I = MR^2$   
 boiled egg — solid cylinder  $I = \frac{1}{2} MR^2$

Thus, raw egg has larger rotational inertia.

### Problem 5



$$\underline{m_1:}$$

$$m_1 a = T$$

$$\underline{m_2:}$$

$$m_2 a = m_2 g - T$$

$$(m_1 + m_2) a = m_2 g$$

$$a = \left( \frac{m_2}{m_1 + m_2} \right) g = \left( \frac{2.0}{2.0 + 1.0} \right) 9.8 = 6.5 \frac{m}{s^2}$$

### Problem 6

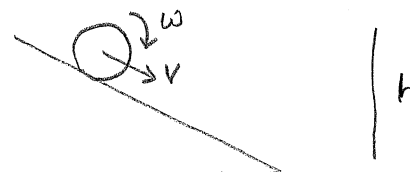
$$\frac{1}{2} m v^2 + \frac{1}{2} I \omega^2 = m g h$$

$$\frac{1}{2} m v^2 + \frac{1}{2} \frac{2}{3} m R^2 \omega^2 = m g h$$

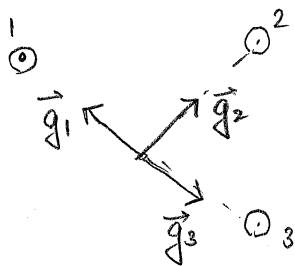
$$\frac{5}{6} m v^2 = m g h$$

$$v = \omega R$$

$$v = \sqrt{\frac{6}{5} g h} = \sqrt{\frac{6}{5} (9.8) (1.00)} = 3.4 \frac{m}{s}$$



### Problem 7



$$\vec{g}_1 + \vec{g}_3 = 0$$

$$\vec{g}_{tot} = \vec{g}_1 + \vec{g}_2 + \vec{g}_3$$

$$= \vec{g}_2$$

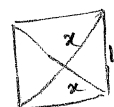
$$= \hat{r}_2 \frac{G m}{x^2}$$

$$= \hat{r}_2 \frac{G m}{(L^2/2)}$$

$$= \hat{r}_2 \frac{G m 2}{L^2}$$

$$x^2 + x^2 = L^2$$

$$x = \frac{L}{\sqrt{2}}$$



$\hat{r}_2$  - unit vector pointing from center of square to corner with mass '2'.