Solutions

PHYS-203A-002 (Final Exam) Fall 2021

Problem 1

$$9.8 \frac{m}{s^2} = 9.8 \frac{m}{s^2} \left(\frac{3600\ s}{1\ hour}\right)^2$$

$$= 9.8\ (3600)^2 \frac{meter}{hour^2} = 1.3 \times 10^8 \frac{meter}{hour^2}$$

Problem 2

$50.0 \frac{m}{s}$. There is no acceleration in horizontal direction.

Problem 3

No, circular motion requires acceleration.

Problem 4

Solid cylinder, because it has a smaller moment of inertia I.

Problem 5

$\Delta y = 15\ m$ $\quad V_i = \text{missing}$ $\quad a = -9.8 \frac{m}{s^2}$

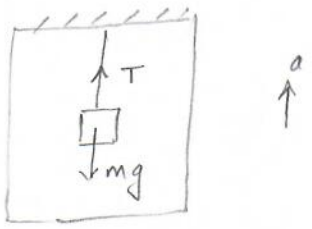
$\Delta t = ?$ $\quad V_f = 0$

$$\Delta y = V_f \Delta t - \frac{1}{2} a \Delta t^2$$

$$15 = 0 - \frac{1}{2}(-9.8)\ \Delta t^2$$

$$\Delta t = 1.8 \text{ seconds.}$$

Problem 6



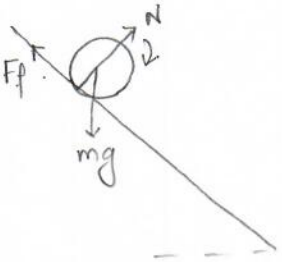
$$ma = T - mg$$

$$T = ma + mg$$

$$= (5.0)(2.0) + (5.0)(9.8)$$

$$= 59 \text{ Newtons}$$

Problem 7



Linear work and rotational work done by force of friction cancel.

$$\frac{1}{2}MV_i^2 + \frac{1}{2}I\omega_i^2 + Mgh_i = \frac{1}{2}MV_f^2 + \frac{1}{2}I\omega_f^2 + Mgh_f$$

($\frac{1}{2}MV_i^2 = 0$, $\frac{1}{2}I\omega_i^2 = 0$, $Mgh_f = 0$)

$$Mgh_i = \frac{1}{2}MV_f^2 + \frac{1}{2}I\omega_f^2$$

$$\frac{1}{2}I\omega_f^2 = \frac{1}{2}\left(\frac{2}{5}MR^2\right)\omega_f^2 = \frac{1}{5}MV_f^2$$

$$= \frac{1}{2}MV_f^2 + \frac{1}{5}MV_f^2$$

$$Mgh_i = \frac{7}{10}MV_f^2$$

$$V_f = \sqrt{\frac{10}{7}gh_i}$$

$$= \sqrt{\frac{10}{7}(9.8)(1.20)}$$

$$= 4.1 \frac{m}{s}$$

Problem 8

$$U = -\frac{GM_1M_2}{r}$$

$$= -\frac{(6.7\times10^{-11})(6\times10^{24})(8\times10^{27})}{(6\times10^{11})}$$

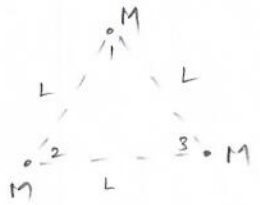
$$= -6\times10^{30}\ \text{J}$$

You will need 6×10^{30} J of energy.

$56\times10^{-11-11+24+27}$

56×10^{29}

Problem 9



$$U = U_{12} + U_{13} + U_{23}$$

$$= -\frac{GM^2}{L} - \frac{GM^2}{L} - \frac{GM^2}{L}$$

$$= -3\frac{GM^2}{L}$$