Show Work:

Noah Palozzi
Kilte Han

9. $\Delta x = 2.2\ m$

$\boxed{x = ?}$

$a = -9.8\ m/s^2$

Law of conservation of energy

$2.2 - 0.27 = 1.93\ m$

Δx w/ $0.011\ m$ x

$\frac{1}{2}\ \Delta y = h$

$\frac{1}{2}kx^2 + \cancel{mgh} = \frac{1}{2}mv^2$

right before falling

$v_x \rightarrow$

since

$$\frac{\frac{1}{2}kx_i^2 = \frac{1}{2}mv_{ix}^2}{\frac{1}{2}kx_f^2 = \frac{1}{2}mv_{fx}^2}$$

v_x stays constant (no a_x at start of fall)

$$\frac{x_i^2}{x_f^2} = \frac{v_{ix}^2}{v_{fx}^2}$$

$$\sqrt{x_f^2} = \sqrt{(x_i^2)\left(\frac{v_{fx}^2}{v_{ix}^2}\right)}$$

$$x_f = \frac{x_i v_{fx}}{v_{ix}}$$

$(\Delta x_i)\ 1.93 = v_{ix}t$

$(\Delta x_f)\ 2.20 = v_{fx}t$

t cancels out when dividing

$$\frac{v_f}{v_i} = \frac{2.20}{1.93}$$

$$\frac{v_f}{v_i} = 1.1399$$

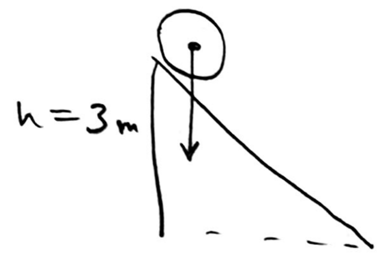
$$x_f = (0.011)(1.1399)$$

$$\boxed{x_f = 1.25\ cm}$$

Noah Palozzi
Kille Han

10. Show Work

Noah Palozzi



a. $mg\sin\theta = \sum F_x$

$\frac{mg\sin\theta}{m} = \frac{ma}{m}$ $R\alpha = a$

$a = g\sin\theta$

$\boxed{a = 5\ m/s^2}$

$mgh = \frac{1}{2}I\omega^2 + \frac{1}{2}mv^2$

$mgh = \frac{1}{2}\left(\frac{1}{2}MR^2\right)\left(\frac{v}{R}\right)^2 + \frac{1}{2}mv^2$

$\frac{mgh}{m} = \frac{\frac{3}{4}mv^2}{m}$

$\sqrt{\frac{4gh}{3}} = v$

$K_{rot} = \frac{1}{5}m\frac{4gh}{3}$

b. $\boxed{K_{rot} = 16\ J}$

11. $PV = nRT$

$(101325)(0.002) = n(8.314)(300)$

$n = 0.08125\ mol$

a. A:

$T = \frac{PV}{nR}$

$T = \frac{4(101325)(0.0005)}{(0.08125)(8.314)}$

$T_A = 300\ K$

B: $T_B = 4T_A$ → factor V changes

$T_B = 1200\ K$

b. C → A (isothermal)

↳ $W = nRT\ln\left(\frac{V_i}{V_f}\right)$

$\boxed{W_{C,A} = 280.93\ J}$

A → B (isobaric)

$W_{A,B} = PV_i - PV_f$

$4(101325)(0.0015)$

$W = -607.95\ J$

B → C (isovolumetric)

$W = 0$

$\boxed{W_{B,C} = 0\ J}$

$\boxed{W_{Total} = -327.02}$

c. $\Delta E_{int} = Q + W$

$\boxed{\Delta E_{C,A} = 0 + 280.93 = 280.93\ J}$

Total: $-327.02\ J$ $Q_i = 607.95 - 607.95$

$\boxed{\Delta E_{B,C} = -607.95 - 0 = -607.95\ J}$

d. $Q_{C,A} = 0$

$Q_{A,B} = 607.95$

$Q_{B,C} = -607.95$

?

$Q_{total} = 0\ J$

e. $e = \frac{W}{Q_H}$ ← ΔE energy released

$\frac{327.02}{327.02}$

$e = 1.0$

12. Show Work: Noah Palozzi

$\rightarrow 0.3c$

a. $\frac{0.3c - 0c}{1 - \frac{u \cdot v}{c^2}}$ $\frac{u - v}{1 - \frac{u \cdot v}{c^2}} = u_x$

$\frac{0.3c - 0c}{1 - \frac{0 \cdot 0.3c^2}{c^2}} = 0.3c$ from ship's and Earth's POV

$\Delta t' = \Delta t \gamma$

$\Delta t = \frac{10.8}{\sqrt{1 - \frac{(0.3c)^2}{c^2}}} \leftarrow \gamma$

$\boxed{\Delta t = 11.32 \text{ light years}}$

b. $\boxed{\Delta t = 11.32 \text{ light years}}$

because earth is stationary so has speed of $-0.3c$ to the probe

(squared it becomes positive)

c. $\xrightarrow{0.3}$

$\xleftarrow{-0.7c}$

$u_x' = \frac{(0.3 + 0.7)c}{1 + \frac{(0.7 \cdot 0.3)c^2}{c^2}} = \frac{1c}{1.21c}$ or $\boxed{0.826c}$

$\Delta t = \frac{10.8}{\sqrt{1}}$