

Solutions - Final Exam - PHYS 121 - 0401

④ $COP = 4.0$

$$COP = \frac{Q_c}{W} ; W + Q_c = Q_H$$

$$W = Q_H - Q_c$$

$$COP = \frac{Q_c}{Q_H - Q_c}$$

$$\frac{Q_H}{T_H} = \frac{Q_c}{T_c}$$

$$4.0 = \frac{Q_H - W}{W} = \frac{Q_H}{W} - 1$$

$$5.0 = \frac{Q_H}{W}$$

$$Q_H = W \cdot 5.0 = (12 \text{ J}) (5.0) = 60 \text{ J}$$

a) $Q_H = 60 \text{ J}$

b) $COP = \frac{Q_c}{Q_H - Q_c} = \frac{Q_c}{\frac{T_H}{T_c} Q_c - Q_c} = \frac{T_c}{T_H - T_c}$

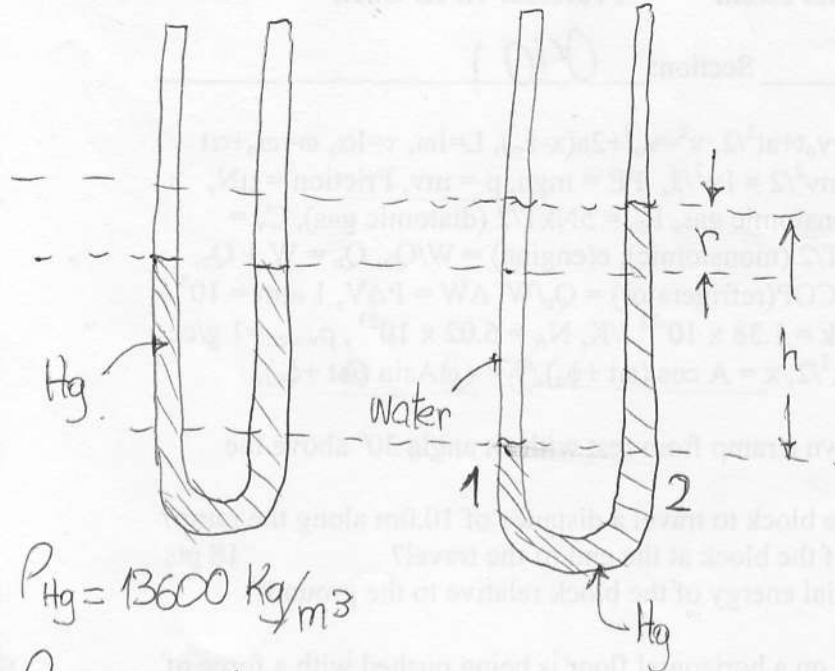
if $COP = 4.0 = \frac{T_c}{T_H - T_c} \Rightarrow 4.0 (300 \text{ K} - T_c) = T_c$
 $1200 \text{ K} = 5.0 T_c$

$T_c = 240 \text{ K}$
$T_c = -33^\circ \text{C}$

5

Initially

After



$$P_1 = P_2$$

$$P_{atm} + \rho_w g d = P_{atm} + \rho_{Hg} g h$$

$$\rho_w g d = \rho_{Hg} g h$$

$$h = \left(\frac{\rho_w}{\rho_{Hg}} \right) d$$

$$h = 2r$$

$$r = \left(\frac{\rho_w}{\rho_{Hg}} \right) \frac{d}{2}$$

$$\rho_{Hg} = 13600 \text{ kg/m}^3$$

$$\rho_w = 1000 \text{ kg/m}^3$$

$$d = 0.10 \text{ m (10 cm)}$$

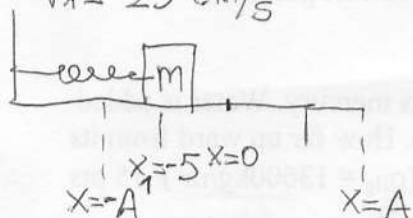
$$r = 0.37 \text{ cm}$$

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$$m = 0.120 \text{ kg}$$

$$K = 3.0 \text{ N/m}$$

$$v_1 = 25 \text{ cm/s}$$



$$a) \omega = \sqrt{\frac{K}{m}} = \sqrt{\frac{3.0 \text{ N/m}}{0.120 \text{ kg}}} = \sqrt{\frac{3.0 \text{ kg/s}^2}{0.120 \text{ kg}}}$$

$$\omega = 5.0 \text{ rad/s}$$

$$\omega = 2\pi f \Rightarrow f = 0.80 \text{ Hz}$$

$$b) E_T = \frac{1}{2} m v^2 + \frac{1}{2} K x^2$$

$$= \frac{1}{2} m v_1^2 + \frac{1}{2} K x_1^2 = 7.5 \times 10^{-3} \text{ J} = 7.5 \text{ mJ} = E_T$$

$$c) E_T = \frac{1}{2} K A^2 \Rightarrow A = \sqrt{\frac{2 E_T}{K}} \Rightarrow A = 0.071 \text{ m} \Rightarrow A = 7.1 \text{ cm}$$

$$d) E_T = \frac{1}{2} m V_2^2 + \frac{1}{2} k x_2^2 \quad ; \quad x_2 = 3.00 \text{ cm} \Rightarrow 0.03 \text{ m}$$

$$\sqrt{\frac{2E_T - kx_2^2}{m}} = V_2 = 0.32 \text{ m/s}$$

$$V_2 = 32 \text{ cm/s}$$