(1.) $y(x,t) = 0.01 \sin(\pi x + 2\pi t)$

Wave direction

$$\pi x + 2\pi t = \text{constant}$$

$$x = \text{constant} - 2t$$

$$\frac{dx}{dt} = -2 \text{ m/s}$$

→ (b) RIGHT TO LEFT

(2.) $k = \frac{2\pi}{\lambda} = \pi$

$$\lambda = \frac{1}{2} \text{ meter}$$

→ (d) (d)

(3.) Surface Wave

$$I \propto 1/r \propto (\text{Amplitude})^2$$

$$\text{Amplitude} \propto 1/\sqrt{r}$$

so Amplitude @ 4 m is

$$1\text{cm} \times 1/\sqrt{4\text{m}/1\text{m}}$$

→ (a) $= \frac{1}{2}$ cm

4. Moving detector/observer

$$f' = f\left(1 + \frac{v}{v_s}\right) = 400\left(1 + \frac{30}{300}\right)$$

$$f' = 440\,Hz$$

→ (C)

5. $D_A = D_{0,A}(1 + \alpha_A \Delta T)$

$D_S = D_{0,S}(1 + \alpha_S \Delta T)$

$$D_A - D_S = (D_{0,A} - D_{0,S}) + \Delta T(\alpha_A D_{0A} - \alpha_S D_{0S})$$

$$\simeq -0.002 + \Delta T \underbrace{(23 - 11)}_{12} \cdot 5 \cdot 10^{-6}$$

$$\simeq -0.002 + 60 \underset{100}{\Delta T} \cdot 10^{-6}$$

$$\simeq -0.002 + 6000 \cdot 10^{-6}$$

$$\simeq -0.002 + 0.006 = 0.004 > 0$$

so ball goes through since $D_A > D_S$

→ (b)

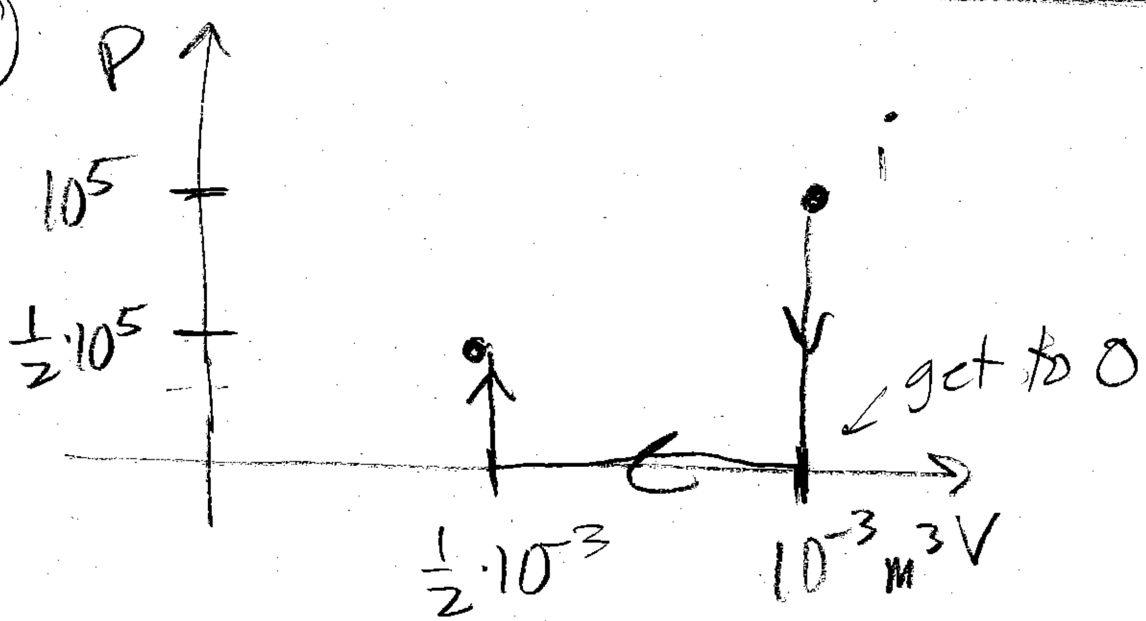
(6.) $\frac{1}{2} M v_{rms}^2 = \frac{3}{2} kT$

so $v_{rms}^2 = \frac{3kT}{M}$

Smaller mass has higher v_{rms}^2

(a)

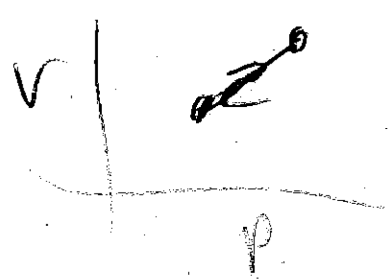
(7.)



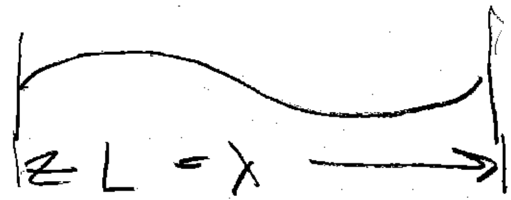
→ (a)

(8.) (b) + (d) True. state variables.

(a) + (c) ... not necessarily true, cycle could have 0 area



9. 2 antinodes:



$$\lambda\nu = v = \sqrt{\frac{F}{\mu}}$$

so $F = \mu\lambda^2\nu^2 = \mu L^2 \nu^2$

$$= 10^{-2}\frac{kg}{m} \cdot (0.25 \cdot 400)^2$$

$$\boxed{F = 100\ N}$$

10. Monatomic : $n_{DOF} = 3$

$$\gamma = 5/3$$

(a) $\underline{1}$: $-12\ Pa \cdot (6-2)\ m^3$

$$\boxed{W_1 = -48\ \text{Joules}}$$

2: $-\frac{1}{2}(12+3)\cdot(6-2)\ J$

$$\boxed{W_2 = -30\ \text{Joules}}$$

3: $W_3 = -3\cdot(6-2)\ J$

$$\boxed{W_3 = -12\ \text{Joules}}$$

(b) $\Delta E_{int} = \frac{n_{DOF}}{2} \cdot nR(T_f - T_i)$

$nRT_F = p_f V_f \quad nRT_i = p_i V_i$

$\Delta E_{int} = \frac{n_{DOF}}{2}(p_f V_f - p_i V_i)$

$= \frac{3}{2}(3 \cdot 6 - 12 \cdot 2)$

$= \frac{3}{2}(18 - 24) = -\frac{3 \cdot 6}{2}$

$\boxed{\Delta E_{int} = -9 \text{ Joules}}$ same for all 3

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

$Q_i = \Delta E_{int} - W_i$

1: $Q_1 = -9 + 48 = -39$ J

2: $Q_2 = -9 + 30 = -21$ J

3: $Q_3 = -9 + 12 = -3$ J

11. (a) $K = \frac{Q_L}{W} = \frac{Q_L}{-Q_H - Q_L}$

reversible

$\frac{Q_L}{T_L} = -\frac{Q_H}{T_H}$

$Q_H = -\frac{T_H}{T_L} Q_L$

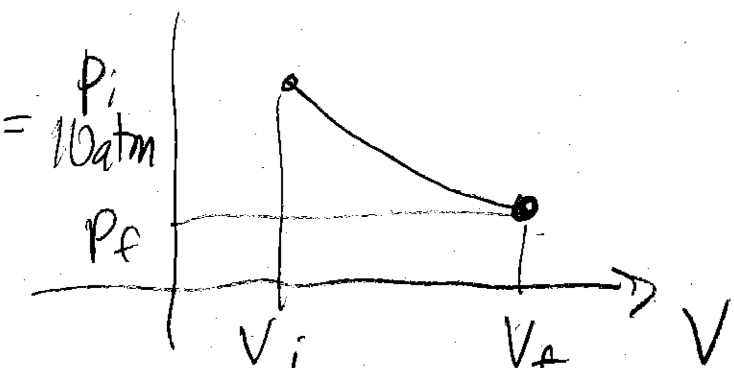
$0 = Q_H + Q_L + W$

so $K = \frac{Q_L}{\frac{T_H}{T_L} Q_L - Q_L} = \frac{T_L}{T_H - T_L}$

$= \frac{278}{25-5} = \frac{278}{20}$

$K = 13.9$

(b) want



$= .001 m^3$

isothermal : $0 = Q + W$

$Q = 1000\,J = -W$

$= nRT_L \ln(V_f/V_i)$

$= P_i V_i \ln(V_f/V_i)$

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$p_i V_i = 10 \cdot 10^5 \cdot 10^{-3} = 1000\ \text{J}$

$1000\text{J} = 1000\ \text{J} \cdot \ln(V_f/V_i)$

$V_f = V_i e^1 = .00272\ m^3$

$P_f V_f = P_i V_i$

$P_f = P_i \cdot \left(\frac{V_i}{V_f}\right) = \frac{P_i}{e}$

$P_f = 3.67\ \text{atm}$

(c) $\Delta S = \frac{Q_L}{T_L} = \frac{1000}{273+5} = 3.60\ \text{J/K}$

(d) $W = \frac{Q_L}{K} = \frac{1000}{13.9} = 71.9\text{J}$