

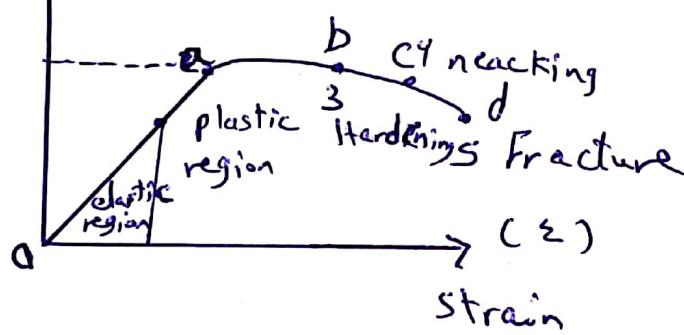
### أ) سؤال الأول

a)  $\therefore \rho = \frac{m}{V} = \frac{23.49}{2.10 \text{ cm}^3} \times \frac{(1000)}{(10^3)^3} = 1.14 \times 10^4 \text{ kg/m}^3$  (SI)

$$\rho = \frac{m}{V} = 695 \text{ (British units) lb/ft}^3$$


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b) Stress ( $\sigma$ )



The stress-strain diagram divided into two region

① elastic region

② plastic region

① stress and strain are proportional is called elastic deformation, a plot of stress-strain in linear relationship.

The slope of this linear corresponds to the modulus of elasticity  $E$ . (Hooke's law).

- \* stress at point (b) is called elastic limit or yield limit.
  - \* from (b to c) when we increase the stress the strain continues to increase.
  - \* At point (c) if we remove some loads the material does not come back to original length.  
maximum stress called "Necking Point".
  - \* Maximum stress called "Elastic deformation".
  - \* From (b to d) material show plastic deformation.
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C- Isothermic process

$$\begin{aligned} \delta T &= 0 \\ \therefore \delta Q &= \delta u + P \cdot \delta V \\ \therefore \delta Q &= \delta W = P \delta V \\ &= nRT \ln \frac{P_1}{P_2} \end{aligned}$$

b- isomeric process  $\delta V = 0$

$$\begin{aligned} \therefore \delta Q &= \delta u \\ \therefore Q &= nC_V (T_2 - T_1) \end{aligned}$$

c- isobaric process :  $\delta P = 0$        $\therefore \delta Q = \delta u$   
 $= nC_p (T_2 - T_1)$

(2)

d- adiabatic process :

$$Q = 0$$
$$\therefore dU = -dW = PdV$$

الجاهز لسؤال المقابل

Q<sub>2</sub>

a)

$$\therefore \Delta L = \alpha L_0 \Delta T$$

$$= 11 \times 10^{-6} \times 30 \times (40 - 10)$$

$$= 0.0099 \text{ m} = 9.9 \times 10^{-3} \text{ m}$$

$$\therefore E = \frac{\text{stress}}{\text{strain}}$$

$$\therefore \text{stress} = E \cdot \text{strain}$$

$$= 20 \times 10^{10} \times \frac{0.0099}{30} = 66 \times 10^6 \text{ N/m}^2$$

b)

$$\therefore F = GMm \frac{1}{r^2}$$

$$\therefore G = \frac{F r^2}{m \cdot M} = \frac{m^3}{kg \cdot s^2}$$

$$c) \quad \therefore P = \epsilon \sigma A (T_2^4 - T_1^4)$$

$$\therefore T_2 = 315 + 273 = 588 \text{ K}$$

$$T_1 = 22 + 273 = 295 \text{ K}$$

$$\therefore A = 2\pi rL = 2\pi(r_1 + r_2)L$$

$$A = 2\pi [15 \times 10^{-3} + 24 \times 10^{-3}] \times 3 = 0.735 \text{ m}^2$$

$$\therefore P = 0.94 \times 5.67 \times 10^{-8} \times 0.735 [588^4 - 295^4]$$

$$= 4386 \text{ W} \approx 4.386 \times 10^3 \text{ W}$$

الإجابة

$$a) \quad ii) \quad \therefore \beta_1 = 10 \log \frac{I}{I_0} = 10 \log \left( \frac{2 \times 10^{-7}}{1 \times 10^{-12}} \right) = 53 \text{ dB}$$

ii) when both machines are operating, the intensity is

doubled to  $4 \times 10^{-7} \text{ W/m}^2$ , the sound level is

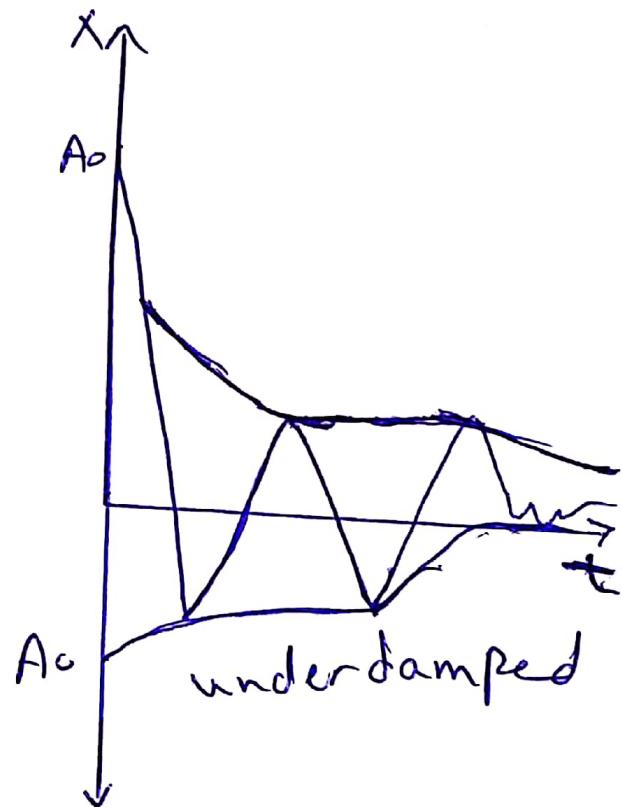
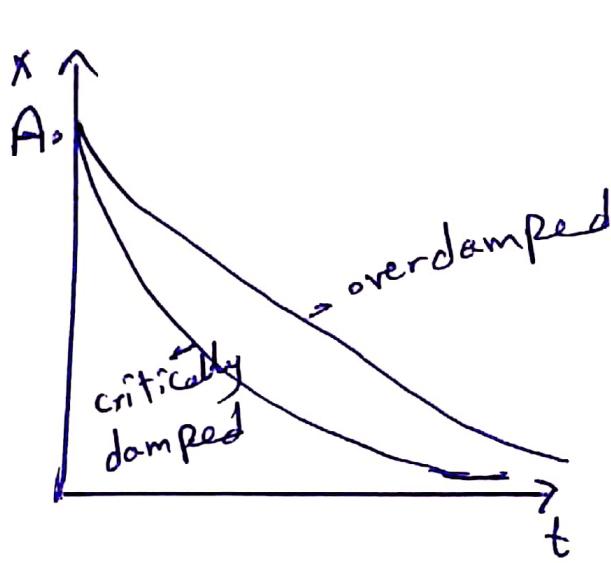
$$\beta_2 = 10 \log \frac{I}{I_0} = 10 \log \left( \frac{4 \times 10^{-7}}{(2 \times 10^{-12})} \right) = 56 \text{ dB}$$

These result, the intensity is doubled, the sound level increased by only 3 dB

b)  
1) over damped ( $\eta > 1$ ): The system returns to equilibrium without oscillating.

2) critically damped ( $\eta = 1$ ): The system returns to equilibrium as quickly as possible without oscillating.

3) underdamped ( $\eta < 1$ ): The system oscillates with the amplitude gradually decreasing to zero.



c) i)  $U = \frac{1}{2} k X^2$   
 $= \frac{1}{2} \times 200 [0.05 \sin(\frac{2\pi}{3} + \frac{\pi}{2})]^2$   
 $= \frac{1}{16} J$

[5]

$$K = \frac{1}{2} mv^2 = \frac{1}{2} \times 2 \left[ 0.5 \cos \left( \frac{2\pi}{3} + \frac{\pi}{2} \right) m/s \right]^2 \\ = \frac{3}{16} J$$

$$E = K + U = \frac{1}{16} + \frac{3}{16} = \frac{1}{4} J$$

$$ii) \therefore \frac{1}{2} mv^2 + \frac{1}{2} k \left(\frac{A}{2}\right)^2 = \frac{1}{2} k A^2$$

$$\therefore v^2 = \frac{3 k A^2}{4 m} = \frac{3 \times 20 \times (0.05)^2}{4 \times 2} = 0.188 \text{ m}^2/\text{s}^2$$

$$\therefore v = 0.43 \text{ m/s}$$

Questions

a) Blackbody: an object that absorbs all energy incident on it and the emissivity  $\varepsilon = 1$

\* stefan's law: The rate at which an object radiates energy is proportional to fourth power of its temperature :  $P = \sigma A \varepsilon T^4$

\* latent heat of fusion: The amount of thermal energy required to change the phase of material from solid to liquid.

a) Types of expansion:

- 1) linear expansion:  $\Delta L = \alpha L_0 \Delta T$
- 2) surface expansion  $\Delta A = \gamma A_0 \Delta T$
- 3) volume expansion  $\Delta V = \beta V_0 \Delta T$

From Bernoulli's equation



$$\therefore P_1 + \rho gh_1 + \frac{1}{2} \rho v_1^2 = P_2 + \frac{1}{2} \rho v_2^2 + \rho gh_2$$

$$\therefore P_1 = P_2 = P_a \quad \rightarrow v_2 = 0 \\ h_2 = 0$$

$$\therefore \frac{1}{2} \rho v^2 = \rho g h$$

$$\therefore v = \sqrt{2gh}$$

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$$c) A = 1 \text{ cm}^2 \rightarrow h = 4 \text{ m}$$

$$R = A \cdot v = A \sqrt{2gh}$$

$$= 10^{-4} \sqrt{2 \times 9.8 \times 4} = 8.185 \times 10^{-4} \text{ m}^3/\text{s}$$

FD

Q5. (1) digits

a) Inverse square law: The intensity of waves radiating isotropically from a point source is inversely proportional to the square of the distance of source

$$\frac{I_1}{I_2} = \left( \frac{R_2}{R_1} \right)^2$$

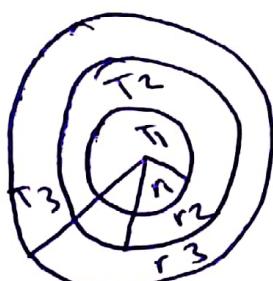
\* Elastic modulus:

The ratio between the stress and strain

$E = \frac{\text{Stress}}{\text{strain}}$ , There are three elastic modulus Young, Bulk, Shear.

\* Rate of flow: The volume of the fluid passes cross section area per unit time  $R = \frac{Avt}{t} = Av$

b)



$$\therefore P_1 = \frac{2\pi L k_1 (T_1 - T_2)}{\ln \frac{r_2}{r_1}}$$

$$P_2 = \frac{2\pi L k_2 (T_2 - T_3)}{\ln \frac{r_3}{r_2}}$$

$$\therefore T_1 - T_3 = \frac{1}{2\pi L} P \left[ \frac{m r_2/r_1}{K_1} + \frac{m r_3/r_2}{K_2} \right]$$

$$\therefore P = \frac{2\pi L (T_1 - T_3)}{\left[ \frac{m r_2/r_1}{K_1} + \frac{m r_3/r_2}{K_2} \right]} \quad //$$

c)  $\Delta P = P_2 - P_1 = 2(X)_o^7 - 1(X)_o^5 = 19.9 X_o^6 \text{ N/m}^2$

$$V = \frac{4}{3}\pi r^3 = \frac{4}{3}\pi (0.2)^3 = 0.0335 \text{ m}^3$$

$$\therefore \beta = -\frac{\Delta P}{\Delta V} / V$$

$$10.1 X_o^{10} = \frac{(2X)_o^7 - (X)_o^5}{0.0335}$$

$$= 6.6 \times 10^{-6} \text{ m}^3$$