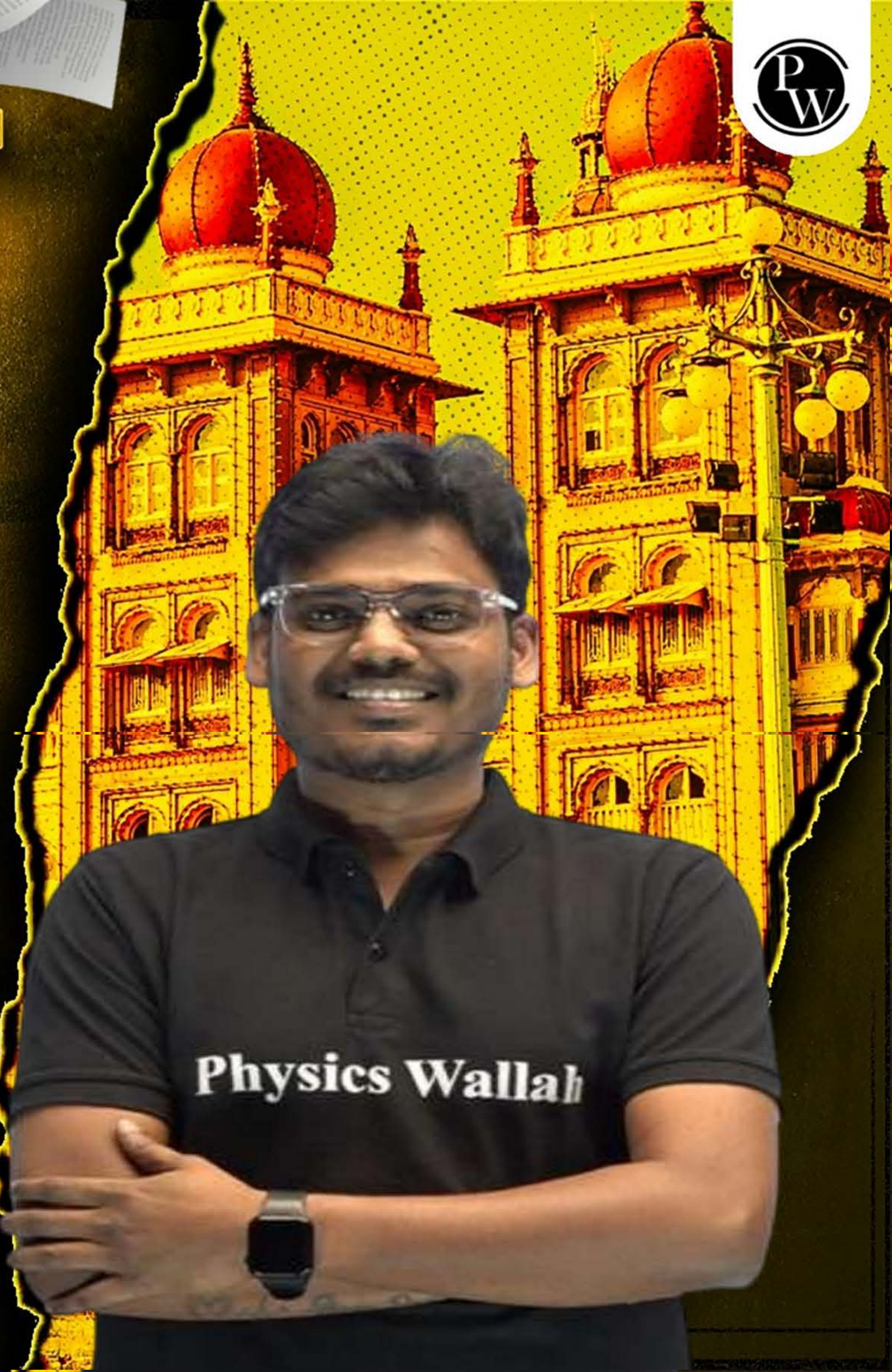
ULTIMATE KCET

CRASH COURSE 2026

Physics	Lecture: 01

Mechanical properties of fluids & Thermal properties of matter

By: AK Sir



Recap *of previous lecture*

1. GRAVITATION
2. QUESTIONS ON GRAVITATION
3. MECHANICAL PROPERTIES OF SOLIDS
4. QUESTION MPOS

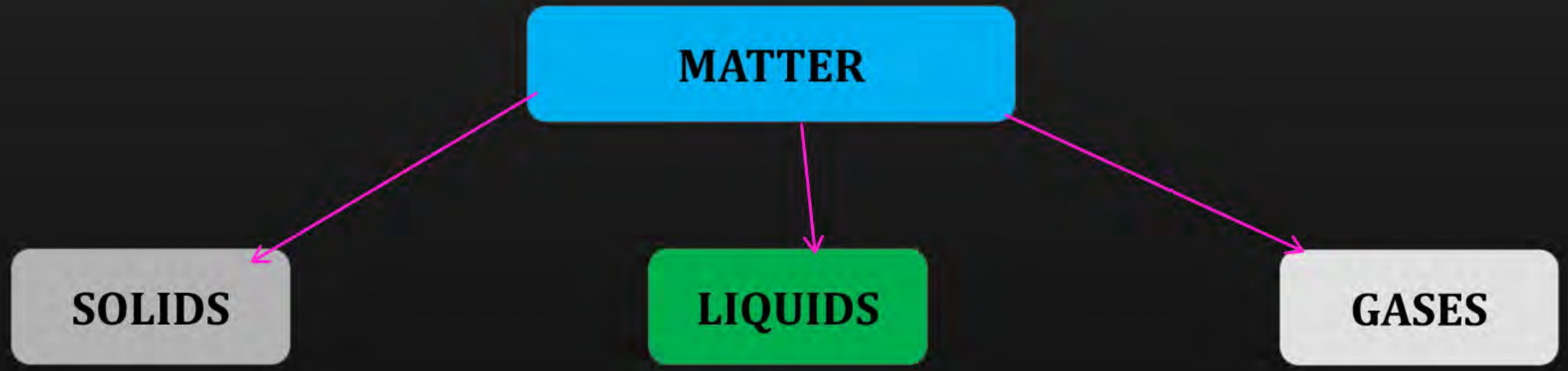
Topics

to be covered

1. MECHANICAL PROPERTIES OF FLUIDS
2. QUESTIONS ON MPOF
3. THERMAL PROPERTIES OF MATTER
4. QUESTION TPOM

Mechanical Properties of Fluids

MATTER



FLUIDS

$0\,0\,0\,0\,0\,1$ ✓

$1\,1\,1\,1\,1\,1$ ✗

$1\,0\,0\,0\,1$

Density : $D = \frac{m}{V} \rightarrow kg/m^3$

Relative density : $R.D = \frac{\text{Density of substance}}{\text{Density of water at } 4^\circ C}$

Pressure : $\boxed{P = \frac{F}{A}}$ $\boxed{F = PA}$ $P = 1.013 \times 10^5\ Pa$

↳ N/m^2

↳ Pa

FLUIDS

$P + K.E + P.E = \text{const}$

$\frac{P}{Vol} + \frac{1}{2}\left(\frac{m}{Vol}\right)V^2 + \left(\frac{m}{Vol}\right)gh = \text{const.}$

Bernoulli's theorem :

$$\boxed{P_E + \frac{1}{2}\rho V^2 + \rho g h = \text{const}}$$

Equation of continuity :

$AV = \text{constant},$

$$\boxed{A_1 V_1 = A_2 V_2}$$

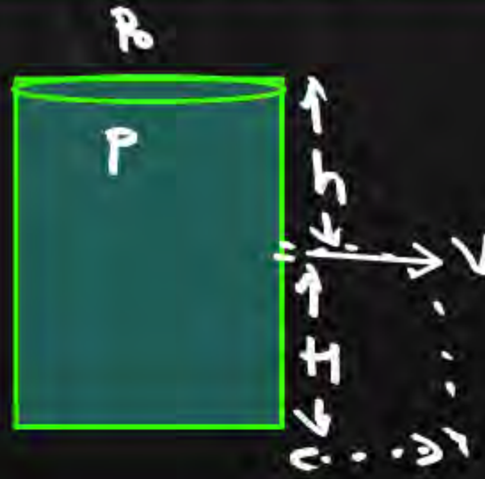
$A = \pi r^2$

$$\boxed{\frac{V_1}{V_2} = \frac{A_2}{A_1} = \left(\frac{r_2}{r_1}\right)^2 = \left(\frac{d_2}{d_1}\right)^2}$$

Velocity of efflux :

$V = \sqrt{2gh + \frac{2(P - P_0)}{\rho}}$ → closed tank

$V = \sqrt{2gh}$ → open tank.



$V = \sqrt{2gh}\,,\quad t = \sqrt{\frac{2H}{g}}$

$R = V \times t$

FLUIDS

According to Newton, Viscous force (F) of a liquid between two layers is given by

$$\boxed{F = -\eta A \frac{dv}{dx}}$$

Stokes Law :

$$\boxed{F = -6\pi\eta r v}$$

FLUIDS

Terminal velocity :

$$v = \frac{(\rho - \sigma) 2 g r^2}{9\eta}$$

Uplift Force

$$F = PA$$

$$F = A(P_2 - P_1)$$

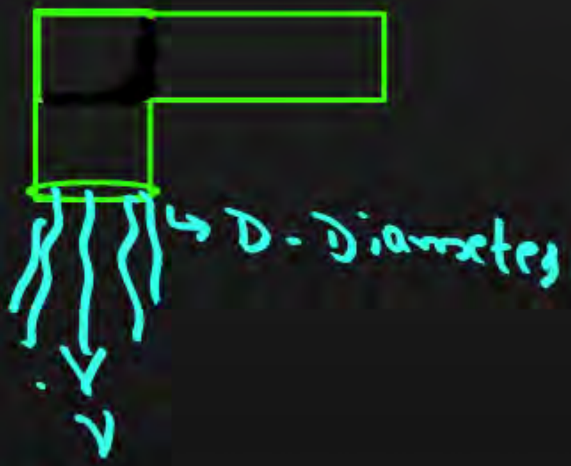
$$F = \frac{1}{2}\rho(v_2^2 - v_1^2) A$$

↓

wind speed

Reynold Number :

$$N_R = \frac{\rho V D}{\eta}$$



$N_R < 1000 \rightarrow$ streamline

$N_R > 2000 \rightarrow$ Turbulent flow

FLUIDS

$\boxed{\text{Surface tension :}}$ $\boxed{S = \frac{F}{L}}$

$$\frac{[M^1 L^1 T^{-2}]}{[L^1]} = [M^1 L^0 T^{-2}]$$

Work done in forming a $\boxed{\text{liquid drop}}$: $W = 4\pi R^2 S$

Work done in forming a $\boxed{\text{soap bubble}}$: $W = 8\pi R^2 S$

Work done in increasing the radius of a liquid drop and soap bubble :

$W = 4\pi S (R_2^2 - R_1^2)$ ↳ liquid drop

$W = 8\pi S (R_2^2 - R_1^2)$ ↳ soap bubble

FLUIDS

Excess of pressure inside a liquid drop : $P = \frac{2S}{R}$

Excess of pressure inside a soap bubble : $P = \frac{4S}{R}$

The rise or fall in capillary tube : $h = \frac{2S\cos\theta}{\rho g r}$

QUESTION

Two water pipes P and Q having diameter 2×10^{-2} m and 4×10^{-2} m respectively are joined in series with the main supply line of water. The velocity of water flowing in pipe P is

$$\frac{v_1}{v_2} = \left(\frac{d_2}{d_1}\right)^2$$

(A) $\boxed{\text{4 times that of Q}}$

(B) 2 times that of Q

(C) 1/2 times that of Q

(D) 1/4 times that of Q

$$\frac{v_P}{v_Q} = \left(\frac{d_Q}{d_P}\right)^2 = \left(\frac{4\times10^{-2}}{2\times10^{-2}}\right)^2 = 2^2 = 4$$

$$\boxed{v_P = 4v_Q}$$

QUESTION

Water is flowing through a non-uniform radius tube. If ratio of the radius of entry and exit end of the pipe is 3: 2 then the ratio of velocities of entring and exit liquid is

$r_1 : r_2$

A) $\boxed{4 : 9}$

$$\frac{v_1}{v_2} = \left(\frac{r_2}{r_1}\right)^2 = \left(\frac{2}{3}\right)^2 = \frac{4}{9}$$

B) 9 :4

$$\boxed{\frac{v_1}{v_2} = \frac{4}{9}}$$

C) 8 : 27

D) 1 : 1

QUESTION

The velocity of water flowering in a non-uniform tube is 20 cm/s at a point where the tube radius is 0.2 cm. The velocity at another point, where the radius is 0.1 cm is

A) $\boxed{80 \text{ cm/s}}$

B) 40 cm/s

C) 20 cm/s

D) 5 cm/s

$$\frac{v_1}{v_2} = \left(\frac{r_2}{r_1}\right)^2$$

$$\frac{20}{v_2} = \left(\frac{0.1}{0.2}\right)^2$$

$$\frac{v_2}{20} = \left(\frac{0.2}{0.1}\right)^2 = 4$$

$$v_2 = 4 \times 20$$

$$\boxed{v_2 = 80 \text{ cm/s}}$$

QUESTION

V_2

A wind with speed 40 m/s blows parallel to the roof of a house. The area of the roof is 250 m^2. Assuming that the pressure inside the house is atmospheric pressure, the force exerted by the wind on the roof and the direction of the force will be: (ρ_{air} = 1.2kg / (m^3))

A) 4.8×10^5 N, upwards

B) $\boxed{2.4 \times 10^5 \text{ N, Upwards}}$

C) 2.4×10^5 N, Downwards

D) 4.8×10^5 N, Downwards

$$F = \frac{1}{2} \rho (v_2^2 - v_1^2) A$$

$$F = \frac{1}{2} \times 1.2 \times [(40)^2 - 0] \times 250$$

$$F = 240000$$

$$\boxed{F = 2.4 \times 10^5 \text{ N}}$$

QUESTION

The total area of wings on a an aero planes is 10 m^2 The speed of air above and below the wings is 140 m/s and 110 m/s. The force on the airplane by air is ?
(ρ_{air} = 1.28 kg/m^3)

$$F = \frac{1}{2}\rho(v_2^2 - v_1^2)A$$

$$F = \frac{1}{2} \times 1.28 \times [(140)^2 - (110)^2] \times 10$$

$$F = 6.4 \times (19600 - 12100)$$

$$\boxed{F = 48000 N}$$

(A) 48750 N

(B) $\boxed{48000 \text{ N}}$

(C) 95000 N

(D) 50000 N

QUESTION

The excess of pressure inside a $\boxed{\text{soap bubble}}$ than that of the outer pressure is:

A $2T/r$

B $\boxed{4T/r}$

C $T/2r$

D T/r

QUESTION

If radius of two soap bubbles are R_1 and R_2 respectively combined in vacuum in isothermal conditions to form a single soap bubble then radius of combined soap bubble is

↳ $PV = nRT = \text{constant}$

(A) $\dfrac{R_1 R_2}{R_1 + R_2}$

(B) $\boxed{\sqrt{R_1^2 + R_2^2}}$

(C) $\dfrac{R_1 + R_2}{2}$

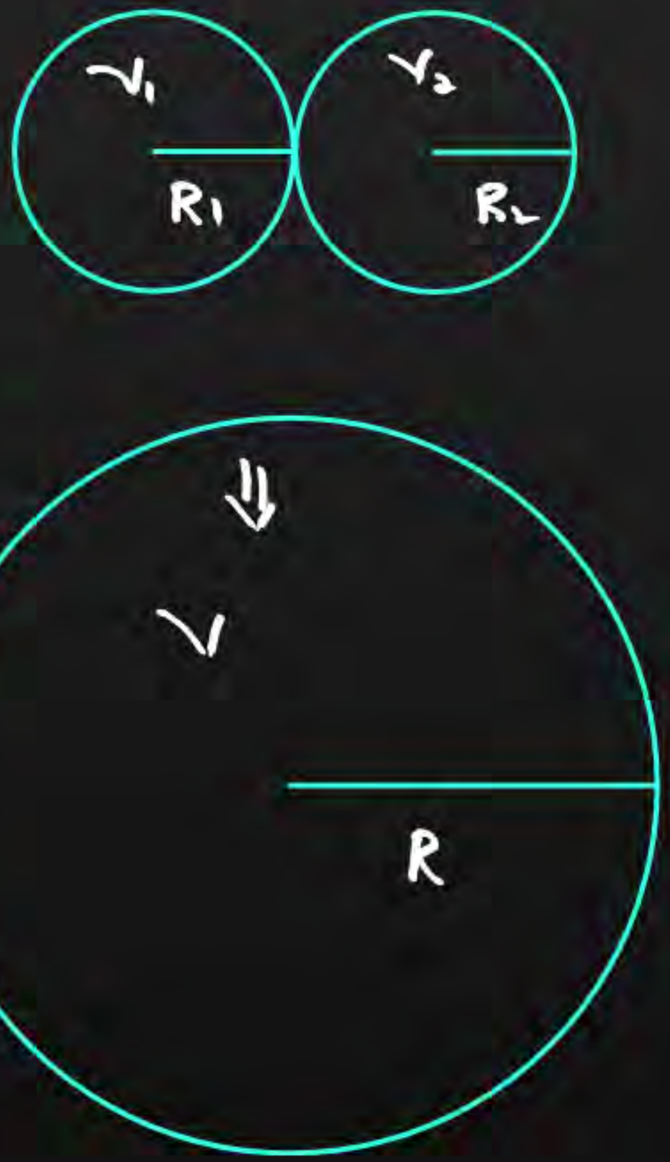
(D) $\dfrac{R_1 R_2}{R_1 - R_2}$

$$PV = P_1V_1 + P_2V_2$$

$$\cancel{\frac{4S}{R}} \cdot \cancel{\frac{4}{3}\pi} R^{\cancel{3}\,2} = \cancel{\frac{4S}{R_1}} \times \cancel{\frac{4}{3}\pi} R_1^{\cancel{3}} + \cancel{\frac{4S}{R_2}} \times \cancel{\frac{4}{3}\pi} R_2^{\cancel{3}}$$

$$R^2 = R_1^2 + R_2^2$$

$$\boxed{R = \sqrt{R_1^2 + R_2^2}}$$



QUESTION

A soap bubble in vacuum has a radius of 3 cm and another soap bubble in vacuum has a radius of 4 cm. If the two bubbles coalesce under isothermal condition, then the radius of the new bubble is:

(A) 2.3 cm

(B) 4.5 cm

(C) $\boxed{5 \text{ cm}}$

(D) 1 cm

$$R = \sqrt{R_1^2 + R_2^2}$$

$$R = \sqrt{3^2 + 4^2}$$

$$R = \sqrt{9+16} = \sqrt{25}$$

$$\boxed{R = 5\,\text{cm}}$$

QUESTION

The spherical shape of rain-drop is due to

A. Density of the liquid

B. $\boxed{\text{Surface tension}}$

C. Atmospheric pressure

D. Gravity

QUESTION

In a capillary tube, water rises by 1.2 mm. The height of water that will rise in another capillary tube having, half of the radius of the first is

(A) 1.2 mm

(B) $\boxed{2.4 \text{ mm}}$

(C) 0.6 mm

(D) 0.4 mm

$$\frac{h_2}{h_1} = \frac{r_1}{r_2}$$

$$\frac{h_2}{1.2} = \frac{r}{\frac{r}{2}} = 2$$

$$h_2 = 2 \times 1.2$$

$$\boxed{h_2 = 2.4 \text{ mm}}$$

$$h = \frac{2S\cos\theta}{\rho g r}$$

$$\boxed{h \propto \frac{1}{r}}$$

QUESTION

Water rises to a height h in a capillary at the surface of earth. On the surface of the moon the height of water column in the same capillary will be:

A) $\boxed{6\ h}$

B) 1/6 h

C) h

D) Zero

$$\frac{h_m}{h_E} = \frac{g_E}{g_m} = \frac{g}{\frac{g}{6}}, \quad g_m = \frac{1}{6} g_E$$

$$h = \frac{2S\cos\theta}{\rho g r}$$

$$h \propto \frac{1}{g}$$

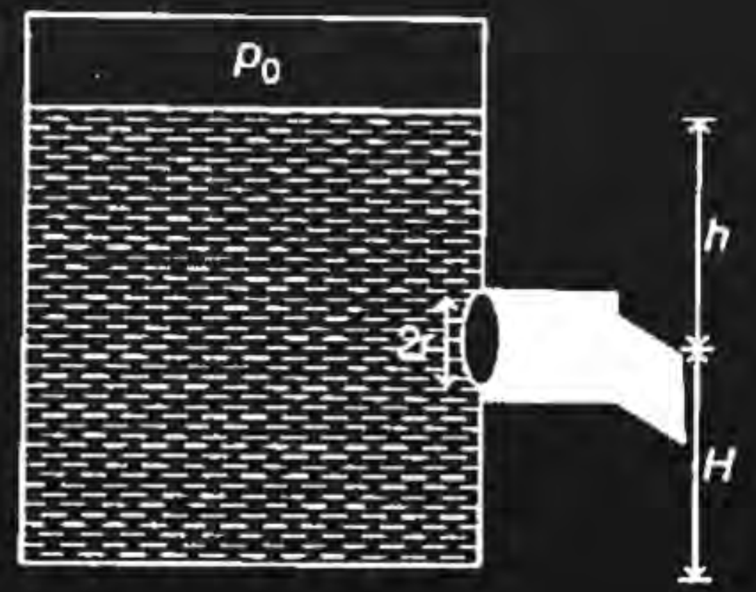
$$\frac{h_m}{h} = 6$$

$$\boxed{h_m = 6h}$$

QUESTION

A closed water tank has cross-sectional area A. It has a small hole at a depth of h from the free surface of water. The radius of the hole is r so that $r << \sqrt{\frac{A}{\pi}}$. is the pressure inside the tank above water level and p_a is the atmospheric pressure, the rate of flow of the water coming out of the hole is (ρ is density of water)

↳ $AV = \text{const}$



(A) $\pi r^2 \sqrt{2gh}$ $= \pi r^2 v$

(B) $\pi r^2 \sqrt{2gh + \frac{2(\rho_o - \rho_a)}{\rho}}$

(C) $\pi r^2 \sqrt{2gH}$

(D) $\pi r^2 \sqrt{gh + \frac{2(\rho_o - \rho_a)}{\rho}}$

QUESTION

Two capillary tubes P and Q are dipped vertically in water. The height of water level in capillary tube P is 2/3 of the height in capillary tube Q. The ratio of their diameter is

(A) 2:3

(B) $\boxed{3:2}$

(C) 3:4

(D) 4:3

$h \propto \frac{1}{r} \propto \frac{1}{d}$

$\frac{h_P}{h_Q} = \frac{d_Q}{d_P}$

$\frac{2}{3}\frac{\cancel{h_Q}}{\cancel{h_Q}} = \frac{d_Q}{d_P}$

$\boxed{\frac{d_P}{d_Q} = \frac{3}{2}}$

QUESTION

When a soap bubble is charged?

A. Its radius increases

B. Its radius decreases

C. The radius remains the same

D. Its radius may increase or decrease

QUESTION

A cylindrical container containing water has a small hole at height of $H = 8$ cm from the bottom and at a depth of 2 cm from the top surface of the liquid. The maximum horizontal distance travelled by the water before it hits the ground x is

(A) $\boxed{8 \text{ cm}}$

(B) $4\sqrt{2}$ cm

(C) 4 cm

(D) 6 cm

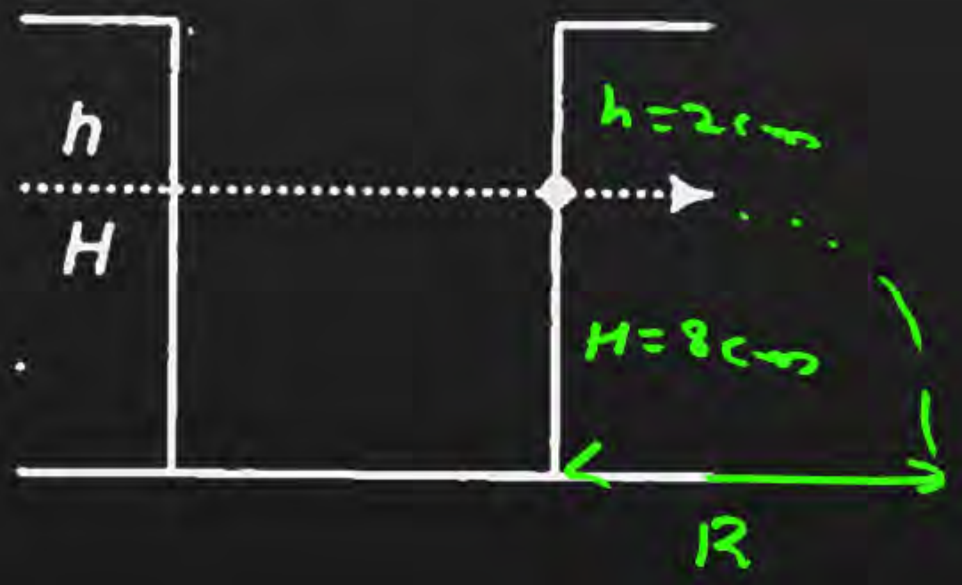
$$R = vt$$

$$R = \sqrt{2gh} \times \sqrt{\frac{2H}{g}}$$

$$R = \sqrt{2 \times 10 \times 2} \times \sqrt{\frac{2 \times 8}{10}}$$

$$R = \sqrt{\frac{2 \times \cancel{10} \times 2}{\cancel{10}} \times 2 \times 8} = \sqrt{64}$$

$$\boxed{R = 8 \text{ cm}}$$



QUESTION

The pressure at the bottom of a liquid tank is not proportional to the

$P = \rho g h$

A acceleration due to gravity ✓

B density of the liquid ✓

C height of the liquid ✓

D $\boxed{\text{area of the liquid surface}}$

QUESTION

Hydraulic lift' works on the basis of

A Stoke's law

B Bernoulli's law

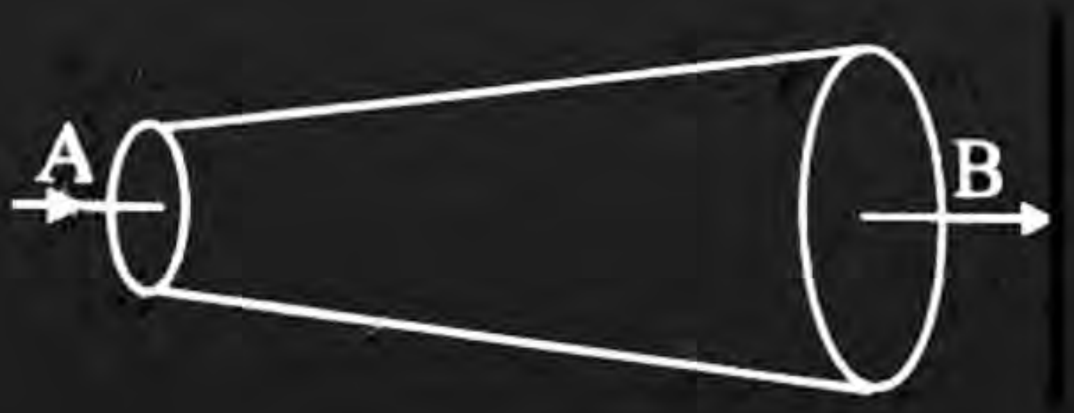
C Pascal's law

D Toricelli's law

QUESTION

H.W

An ideal fluid flows through a pipe of circular cross-section with diameters 5 cm and 10 cm as shown in the figure. The ratio of velocities of fluid at A and B is



A) 4 : 1

B) 1 : 4

C) 2 : 1

D) 1 : 2

QUESTION

A flow of liquid is streamline, if the Reynold's number is

A. Less than 1000

B. Greater than 1000

C. Between 2000 to 3000

D. Between 4000 to 5000

QUESTION

Two capillary tubes of different diameters are dipped in water. The rise of water is

$h \propto \frac{1}{r} \propto \frac{1}{d}$

(A) The same in both tubes ✗

(B) Greater in the tube of larger diameter ✗

(C) $\boxed{\text{Greater in the tube of smaller diameter}}$ ✓

(D) Independent of the diameter of the tube ✗

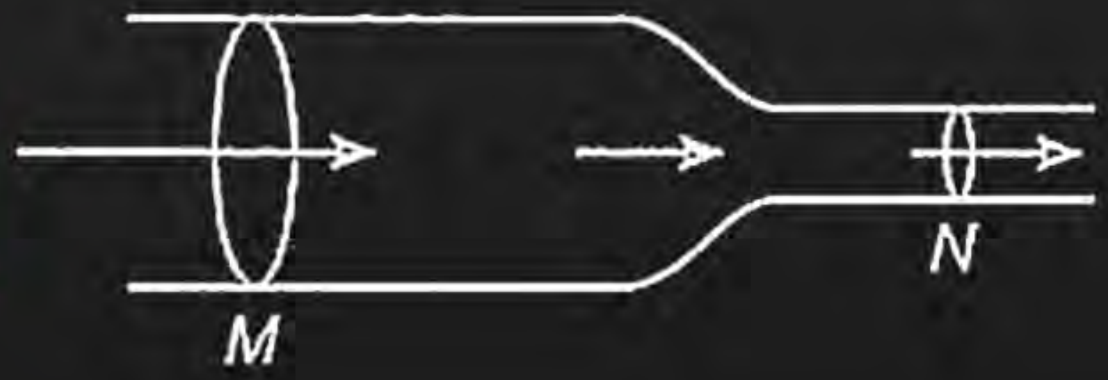
QUESTION

Horizontal tube of non-uniform corss-section has radii of 0.1 m and 0.05 m respectively at M and N. For a streamline flow of liquid the rate of liquid flow is

(A) Changing continuously with time

(B) greater at M than at N

$\boxed{AV = \text{constant}}$



(C) greater at N than at M

(D) same at M and N

QUESTION

Water rises in plant fibres due to

A. capillarity

B. viscosity

C. fluid pressure

D. osmosis

THERMAL PROPERTIES OF MATTER

Thermal properties of matter

Relationship between different temperature scales:

$$\boxed{\frac{C}{100} = \frac{K-273}{100} = \frac{F-32}{180}}$$

$$\frac{X - LFP}{UFP - LFP} = \text{constant}$$

Coefficient of linear expansion of a solid, $\Delta L = L\alpha\Delta T$, $\boxed{\alpha = \frac{\Delta L}{\Delta T} \times \frac{1}{L}}$

Coefficient of area expansion of a solid, $\Delta A = A\beta\Delta T$ $\boxed{\beta = \frac{\Delta A}{\Delta T} \times \frac{1}{A}}$

Coefficient of volume expansion of a solid, $\Delta V = V\gamma\Delta T$ $\boxed{\gamma = \frac{\Delta V}{\Delta T} \times \frac{1}{V}}$

Thermal properties of matter

Relation between α, β and γ:

$\alpha : \beta : \gamma$

$1 : 2 : 3$

$\Rightarrow \boxed{\begin{array}{l} \alpha : \beta : \gamma = 1 : 2 : 3 \\ \alpha = \frac{\beta}{2} = \frac{\gamma}{3} \end{array}}$ *

The specific heat of a substance is given by

$\Delta Q \propto m \Delta T$

$\Delta Q = C m \Delta T$

$\boxed{C = \frac{\Delta Q}{m \Delta T}}$

m- mass

The molar specific heat of a substance is given by

$\boxed{C = \frac{\Delta Q}{n \Delta T}}$ n- No. of mole

Thermal capacity $C' = \frac{\Delta Q}{\Delta T} = Cm \Rightarrow \boxed{C' = Cm}$

Thermal properties of matter

The latent heat of a substance $\boxed{\Delta Q = mL}$

Principle of calorimetry:

$$\Delta Q_{Lost} = \Delta Q_{gain}$$

$$m_1 c_1 \Delta T_1 = m_2 c_2 \Delta T_2$$

$$\boxed{m_1 c_1 (T - T_1) = m_2 c_2 (T_2 - T)}$$

When the ends of a bar are maintained at temperatures T1 and T2, the rate of flow of heat H is given by

$$\boxed{H = \frac{dQ}{dt} = \frac{KA\,\Delta T}{L}}$$

Thermal properties of matter

Thermal resistance of the bar

$$R = \rho \frac{l}{A}$$

$$R = \frac{1}{\sigma} \frac{l}{A}$$

$$\boxed{R = \frac{l}{KA}}$$

Stefan–Boltzmann law

$$E \propto T^4$$

$$\boxed{E = \sigma T^4}$$

If the body is not a perfectly black body, then

$$\boxed{E = e\sigma T^4}$$

Thermal properties of matter

T_s - Surrounding temp.

The energy radiated per second by a body of area A:

$$\boxed{P = \frac{E}{At} = \frac{\sigma T^4}{A}}$$

Newton's law of cooling: $\frac{T_i - T_f}{t} = K\left(\frac{T_i + T_f}{2} - T_s\right)$

Wien's displacement law : $\lambda \propto \frac{1}{T} \Rightarrow \boxed{\lambda = \frac{b}{T}}$

Thermal stress : $\boxed{F = Y \alpha A \Delta T}$

QUESTION

If a thermometer reads freezing point of water as 20°C and boiling point as 150°C, how much thermometer read when the actual temperature is 60°C ?

(A) $\boxed{98°\ C}$

(B) 110° C

(C) 40° C

(D) 60° C

$$X^\circ = {}^\circ C$$

$$\frac{X - LFP}{UFP - LFP} = \frac{C}{100}$$

$$\frac{X - 20}{150 - 20} = \frac{6\cancel{0}}{10\cancel{0}}$$

$$\frac{X - 20}{13\cancel{0}} = \frac{6}{1\cancel{0}} \Rightarrow X - 20 = 78$$

$$\boxed{X = 98^\circ C}$$

$$\frac{13 \times 6}{78}$$

QUESTION

If temperature of an object is 104°F, then its temperature in centigrade is

A) 100° C

B) 60° C

C) $\boxed{40° C}$

D) 20° C

$$\frac{C}{100} = \frac{F-32}{180}$$

$$\frac{C}{5} = \frac{F-32}{9}$$

$$C = \frac{5}{9}(104-32)$$

$$\boxed{C = 40°C}$$

QUESTION

At what temperature does the temperature in Celsius and Fahrenheit equalise

A $\boxed{-40°}$

B 40°

C 36.6°

D 38°

$$°C = °F$$

$$\frac{x}{10\cancel{0}} = \frac{x-32}{18\cancel{0}}$$

$$\frac{x}{5} = \frac{x-32}{9}$$

$$9x = 5(x-32)$$

$$9x = 5x - 160$$

$$4x = -160$$

$$\boxed{x = -40°C}$$

QUESTION

The graph AB shown in figure is a plot of temperature of a body in degree Celsius and degree Fahrenheit. Then

(A) slope of line AB is 9/5

(B) slope of line AB is 5/9

(C) slope of line AB is 1/9

(D) slope of line AB is 3/9

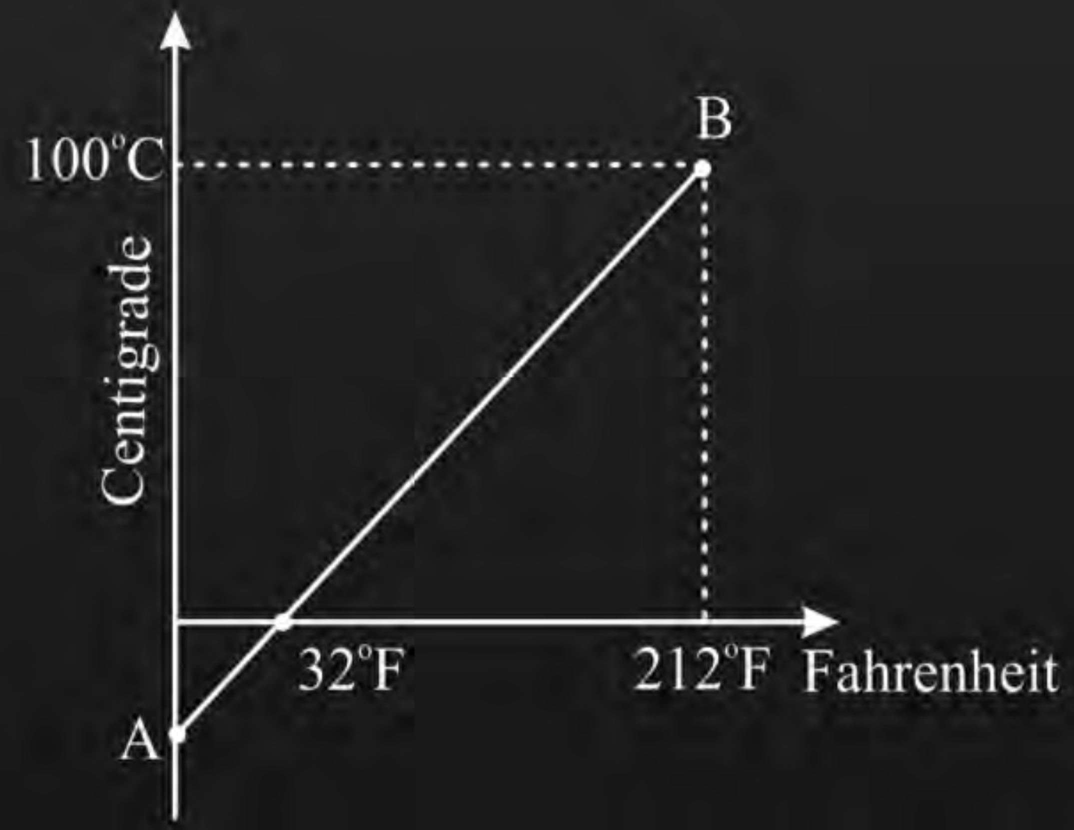
$\frac{C}{5} = \frac{F-32}{9}$

$C = \frac{5(F-32)}{9}$

$C = \frac{5}{9}F - \frac{160}{9}$

$y = mx + c$

$\boxed{m = \frac{5}{9}}$



QUESTION

An iron bar of length 10 m is heated from 0°C to 100°C. If the coefficient of linear thermal expansion of iron is $10 \times 10^{-6}/°C$, the increase in the length of bar is

(A) 0.5 cm

(B) $\boxed{1.0 \text{ cm}}$

(C) 1.5 cm

(D) 2.0 cm

$\Delta L = L \alpha \Delta T$

$\Delta L = 10 \times 10 \times 10^{-6} \times 100$

$\Delta L = 10^{4} \times 10^{-6}$

$\boxed{\begin{array}{l} \Delta L = 10^{-2} \text{ m} \\ \Delta L = 1 \text{ cm} \end{array}}$

QUESTION

cooling

A bar of iron is 10 cm at 20°C. At 19°C it will be (α of iron = $11 \times 10^{-6}/°C$)

(A) 11×10^{-6} cm longer ✗

(B) 11×10^{-6} cm shorter

(C) $\boxed{11 \times 10^{-5} \text{ cm shorter}}$

(D) 11×10^{-5} cm longer ✗

$\Delta L = L \alpha \Delta T$

$= 10 \times 11 \times 10^{-6} \times 1$

$\boxed{\Delta L = 11 \times 10^{-5} \text{ cm}}$

QUESTION

The coefficient of superficial expansion of a solid is $2 \times 10^{-5}/°C$. It's coefficient of linear expansion is

$\alpha = ?$

$\beta = 2 \times 10^{-5}/°C$

$\alpha = \frac{\beta}{2} = \frac{2 \times 10^{-5}}{2}$

$\boxed{\alpha = 1 \times 10^{-5}/°C}$

A $4 \times 10^{-5}/°C$

B $3 \times 10^{-5}/°C$

C $2 \times 10^{-5}/°C$

D $\boxed{1 \times 10^{-5}/°C}$

QUESTION

Ratio among linear expansion coefficient (α), areal expansion coefficient (β) and volume expansion coefficient (γ) is

A $\boxed{1 : 2 : 3}$

B $3 : 2 : 1$

C $4 : 3 : 2$

D None of these

QUESTION

$l = 1m$

A meter rod of silver at 0°C is heated to 100° C. It's length is increased by 0.19 cm. Coefficient of cubical expansion of the silver rod is

(A) $\boxed{5.7 \times 10^{-5} /°C}$

(B) $0.63 \times 10^{-5} /°C$

(C) $1.9 \times 10^{-5} /°C$

(D) $16.1 \times 10^{-5} /°C$

$\alpha = \frac{\Delta L}{\Delta T} \times \frac{1}{L}$

$\alpha = \frac{0.19 \times 10^{-2}}{100}$

$\alpha = 0.19 \times 10^{-4}$

$\boxed{\alpha = 1.9 \times 10^{-5} /°C}$

$\gamma = ?$

$\gamma = 3\alpha$

$\alpha = \frac{\gamma}{3}$

$\gamma = 3 \times 1.9 \times 10^{-5}$

$\boxed{\gamma = 5.7 \times 10^{-5} /°C}$

QUESTION

The volume of a metal sphere increases by 0.15% when its temperature is raised by 24°C. The coefficient of linear expansion of metal is :

(A) $2.5 \times 10^{-5}/°C$

(B) $\boxed{2.0 \times 10^{-5}/°C}$

(C) $-1.5 \times 10^{-5}/°C$

(D) $1.2 \times 10^{-5}/°C$

$\gamma = \frac{\Delta V}{\Delta T} \times \frac{1}{V}$

$\gamma = \frac{\Delta V}{V} \times \frac{1}{\Delta T}$

$\gamma = \frac{0.15}{100} \times \frac{1}{24}$

$\gamma = 0.00625 \times 10^{-2}$

$\boxed{\gamma = 6.25 \times 10^{-5} /°C}$

$\alpha = \frac{\gamma}{3}$

$\alpha = \frac{6.25 \times 10^{-5}}{3}$

$\boxed{\alpha = 2.08 \times 10^{-5} /°C}$

QUESTION

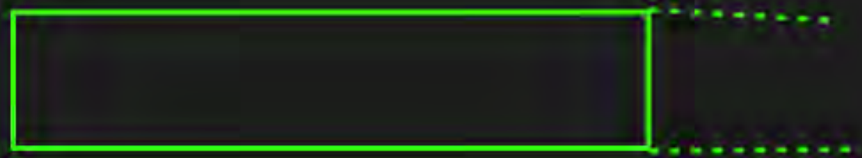
A uniform copper rod of length 50 cm and diameter 3.0 mm is kept on a frictionless horizontal surface at 20°C. The coefficient of linear expansion of copper is $2.0\times10^{-5}\ K^{-1}$ and Young's modulus is $1.2\times10^{11}\ N/m^2$. The copper rod is heated to 100°C, then the tension developed in the copper rod is

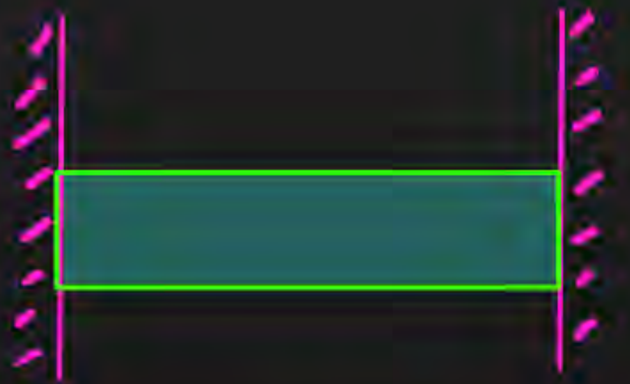
(A) 12×10^3 N

(B) 36×10^3 N

(C) 18×10^3 N

(D) Zero





$F = Y\alpha A\Delta T$

QUESTION

H.:

A rod of length 2m rests freely on smooth horizontal floor. If the rod is heated from 0°C to 20°C. Find the longitudinal strain developed?
($\alpha = 5 \times 10^{-5}/°C$)

$\varepsilon = \frac{\Delta L}{L}$

$Y = \frac{\sigma}{\varepsilon}$

$\varepsilon = \frac{\sigma}{Y}$

- **A** 10^{-3}
- **B** 2×10^{-3}
- **C** Zero
- **D** None

QUESTION

A body of mass 5 Kg falls from a height of 30 metre. Its all mechanical energy is changed heat, Then heat produced will be

A. $\boxed{350 \text{ cal}}$

B. 150 cal

C. 60 cal

D. 6 cal

$1 \text{cal} = 4.186 \text{ J}$

$1 \text{J} = \dfrac{1 \text{cal}}{4.186}$

$P.E = mgh$

$H.E = 5 \times 10 \times 30$

$\boxed{= 1500 \text{ J}}$

$H.E = 1500 \times \dfrac{1 \text{cal}}{4186}$

$\boxed{H.E = 358.33 \text{ cal}}$

CALORIMETRY

Specific Heat:

	C.G.S	**S.I.**
S_{ice}	$\simeq 0.5$ cal/gm	$\simeq 2100$ J/kg
S_{water}	$\simeq 1$ cal/gm	$\simeq 4200$ J/kg
S_{steam}	$\simeq 0.5$ cal/gm	$\simeq 2100$ J/kg

Latent heat:

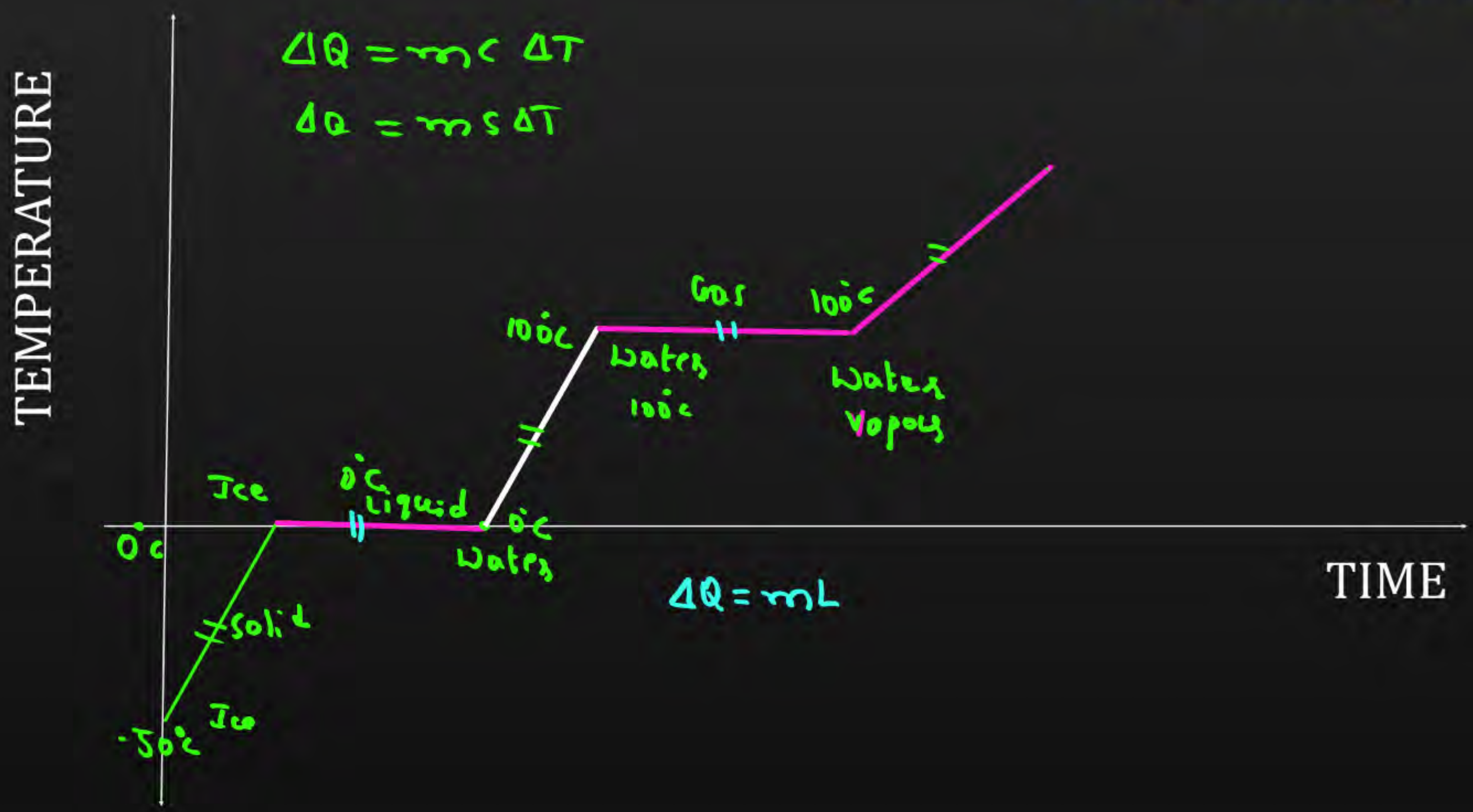
Heat Required to change the phase of substance. During phase change temperature remains constant

$$\text{Solid} \xrightarrow{L_f} \text{Liquid} \qquad L_f = 80 \text{ cal/gm (ice – water)}$$

$$\text{Liquid} \xrightarrow{L_v} \text{Gas} \qquad L_v = 540 \text{ cal/gm [water - steam]}$$

PHASE DIAGRAM FOR WATER

Sample of 50 gm ice at $-50^0 C$



QUESTION

Find the amount of heat required to change 10g of water at 100°C to steam at 100°C

$$\Delta Q = mL_v$$

$$= 10 \times 540$$

$$\boxed{\Delta Q = 5400 \text{ cal}}$$

QUESTION

100 gm water at 20°C is mixed with 200 gm water at 80°C. Find the final temperature of mixture.

$$\Delta Q_{lost} = \Delta Q_{gain}$$

$$m_1 c_1 (T_1 - T) = m_2 c_2 (T - T_2)$$

$$200 \times \cancel{c} \times (80 - T) = 100 \times \cancel{c} \times (T - 20)$$

$$160 - 2T = T - 20$$

$$3T = 180$$

$$\boxed{T = 60^\circ C}$$

QUESTION

10 g Ice at 0°C is mixed with 10 g water at 60°C water at 60°C. Find the final temperature of mixture. [H.W]

QUESTION

80 gm of water at 30°C are poured on a large block of ice at 0°C. The mass of ice that melts is

$$\Delta Q_{lost} = \Delta Q_{gain}$$

$$m_1 C_1 (T_1 - T) = m_2 L_f$$

$$\cancel{80} \times 1 \times (30 - 0) = m \times \cancel{80}$$

$$30 = m$$

$$\boxed{m = 30g}$$

(A) $\boxed{30 \text{ gm}}$

(B) 80 gm

(C) 1600 gm

(D) 150 gm

MODE OF HEAT TRANSFER

Heat can be transferred from one place to another place in three ways.

HEAT TRANSFER

- **CONDUCTION**
- **CONVECTION**
- **RADIATION**

Wein's Displacement Law

The wavelength corresponding to maximum emission of radiation decrease with increasing temperature $\left(\lambda_m \propto \frac{1}{T}\right)$. This is known as Wein's displacement law.

$$\lambda_m T = b$$

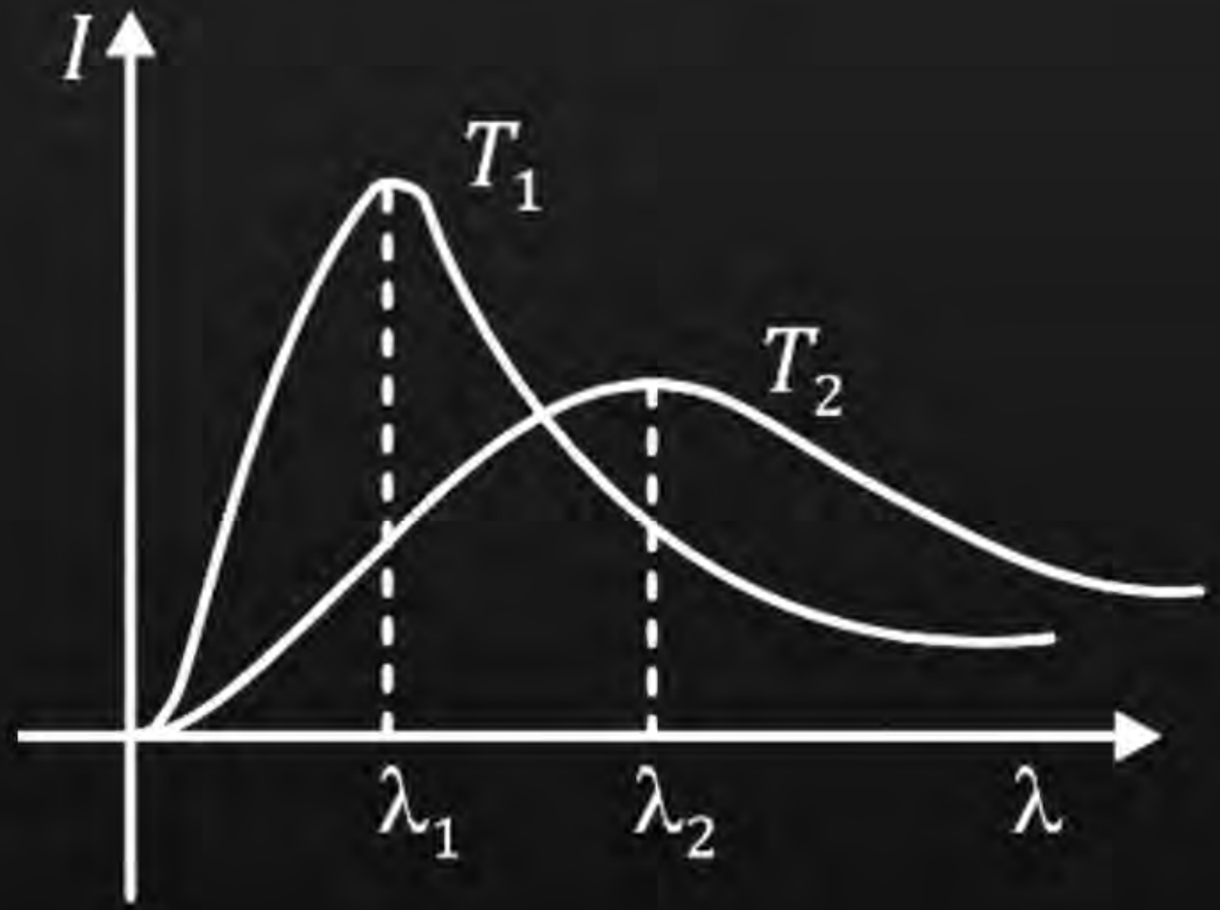
Where b is Wein's constant = 2.89×10^{-3} mK.

Dimensions of *b*: $M^0L^1T^0\theta^1$

$$\boxed{\begin{array}{l} T_1 > T_2 \\ \lambda_1 < \lambda_2 \end{array}}$$

$$\lambda_m T = b$$

$$\lambda \propto \frac{1}{T}$$



QUESTION

In the figure, the distribution of spectral energy of the radiation emitted by a black body at a given temperature is shown. The possible temperature of the black body is :-
(b = 3×10^{-3} mk)

(A) 1500 K

(B) $\boxed{2000\ K}$

(C) 2500 K

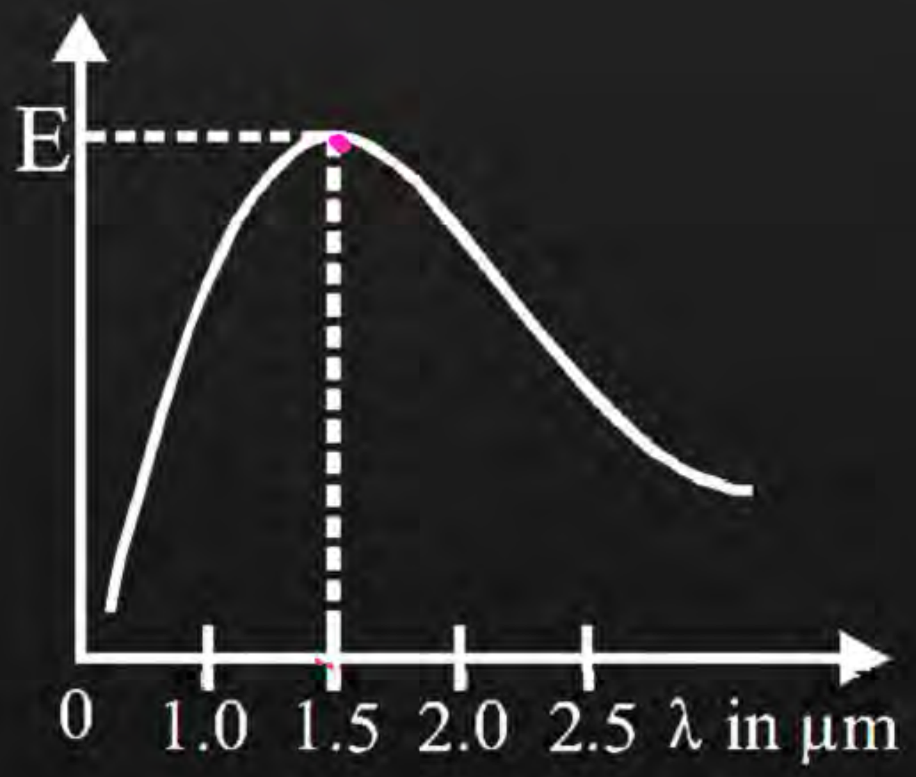
(D) 3000 K

$\lambda = \frac{b}{T}$

$T = \frac{b}{\lambda} = \frac{3 \times 10^{-3}}{1.5 \times 10^{-6}}$

$T = 2 \times 10^{3}$

$\boxed{T = 2000\ K}$



QUESTION

A black body emits radiation of maximum intensity at 5000 Å When its temperature is 1227°C. If its temperature is increased by 1000°C then the maximum intensity of emitted radiation will be at

A. 2754.8 Å

B. $\boxed{3000\ \text{Å}}$

C. 3500 Å

D. 4000 Å

$\lambda \propto \frac{1}{T}$

$\frac{\lambda_2}{\lambda_1} = \frac{T_1}{T_2}$

$\frac{\lambda_2}{5000} = \frac{1227+273}{2227+273} = \frac{1500}{2500} = \frac{15}{25} = \frac{3}{5}$

$\boxed{\lambda_2 = 3000\ A^\circ}$

QUESTION

A piece of iron is heated in a flame. It first becomes dull red then becomes reddish yellow and finally turns to white hot. The correct explation for the above observation is possible by using:

A. Newton's law of cooling

B. Stefan's Law

C. Wein's displacement Law

D. Kirchoffs Law

QUESTION

Two stars A and B od Surface areas S_a and S_b & temperature T_a and T_b glow red and blue respectively. Choose the correct option is [H.W]

A $T_a > T_b$

B $T_a < T_b$

C $T_a S_a = T_b S_b$

D $T_a S_b = T_b S_a$

Thank

You