	INDIAN SCHOOL AL WADI AL KABIR	
Class: XI	**Department: SCIENCE 2023-24 (PHYSICS)**	**Date: 20/01/2024**
Worksheet No:10	**Topic: THERMAL PROPERTIES OF MATTER**	**Note: A4 FILE FORMAT**
NAME OF THE STUDENT-	**CLASS & SECTION**	**ROLL NO.**

Multiple choice questions:

1. The density of a substance at 0°Cis 10 g/cc and at 100°C its density is 9.7 g/cc. The coefficient of linear expansion of the substance is

(a) 10^{-4}°C^{-1} (b) 10^{-2} °C^{-1} (c) 10^{-3} °C^{-1} (d) 10^{-5} °C^{-1}

2. A copper wire of length L increases in length by 0.3% on heating from 20°C to 40°C. Then percentage change in area of a copper plate of dimensions 3L x 2L on heating from 20°C to 40°C is

(a) 0.15% (6) 0.3% (c) 0.4% (d) 0.6%

3. The ratio of densities of iron at 10°C and 30°C is (α of iron = 10 x 10^{-6} °C^{-l})

(a) 1.003 (6) 1.0003 (c) 1.006 (d) 1.0006

4. pendulum clock shows correct time at certain temperature. At a higher temperature the clock

(a) loses time (b) gains time
(c) neither gains nor loses time (d) firstly gains and then loses

5. Certain amount of heat is given to 100g of copper to increase its temperature by 21°C. If the same amount of heat is given to 50 g of water, then the rise in its temperature is (specific heat capacity of copper = 400 J kg^{-l} K^{-l} and that for water = 4200 J kg^{-l} K^{-l})

(a) 4 °C (b) 5.25 °C (c) 8 °C (d) 10.5 °C

6. Specific heat of a substance at the melting point becomes

(a) low (b) high (c) remains unchanged (d) infinite

7. Person weighing 60 kg takes in 2000 kcal diet in a day. If this energy was to be used in heating the person without any losses, his rise in temperature would be nearly (Given sp. heat of human body is 0.83 cal g^{-l} °C^{-l})

(a) 30°C (b) 40°C (c) 35°C (d) 45°C

ANSWERS OF MCQs; -1. (a),2. (d), 3. (d), 4. (a), 5. (a), 6. (d), 7. (b),

CASE STUDY BASED QUESTIONS: -

1. Bernoulli's theorem, in fluid dynamics, relation among the pressure, velocity and elevation in a moving fluid (liquid or gas), the compressibility and viscosity of which are negligible and the flow of which is steady, or laminar. Bernoulli's principle is applicable on those non-viscous liquids which have laminar or stream lined flow. It means that a liquid in which its particles exert no force on each other i.e. the speed of all particles of the liquid is same.

Answer the following questions (any four)

(i) Bernoulli's principle is based on the conservation of

(a) momentum (b) energy and momentum both (c) mass (d) energy

(ii) Water is following through a horizontal pipe in a streamline flow, at the narrowest part of the pipe

(a) both pressure and velocity remain constant.

(b) velocity is maximum and pressure is minimum.

(c) both the pressure and velocity are maximum.
(d) both the pressure and velocity are minimum.
(iii) In houses for away from municipal water tanks often find it difficult to get water on the top floor. This happens because
(a) water wets the pipe. (b) the pipes are not of uniform diameter.
(c) the viscosity of water is high. (d) of loss of pressure during the flow of water.
(iv) In which of the following types of flows is the Bernoulli's theorem strictly applicable
(a) streamline and rotational (b) turbulent and rotational
(c) turbulent and irrotational (d) streamline and irrotational
Or
Viscosity of gases
(a) decreases with increases in temperature (b) independent of temperature
(c) increases with increase in temperature (d) may increase or decrease depend on nature of gas

2. Surface tension is the tendency of fluid surfaces to shrink into the minimum surface area possible. Intermolecular forces such as Van der Waals Force draw the liquid particles together. The ratio of the surface force F to the length L along which the force acts.
T = F/L Where, F is the force per unit length
L is the length in which force act,
T is the surface tension of the liquid
Answer the following questions (do any four)
(i) If T is the surface tension of the soap solution, the amount of work done in blowing a soap bubble from diameter D to a diameter 2D is
(a) $2\pi D^2T$ (b) $4\pi D^2T$ (c) $6\pi D^2T$ (d) πD^2T
(ii) If the surface a liquid is plane, then the angle of contact of the liquid with the walls of the container is
(a) acute angle (b) obtuse angle (c) 90° (d) 0°
(iii) When a soap bubble is charged
(a) it contracts (b) it expands
(c) it does not undergo any change in size (d) none of these
(iv) If common salt is dissolved in water, then the surface tension of saltwater is
(a) increased (b) decreased (c) not changed (d) first increased then decrease
Or
A drop of oil is placed on the surface of the water. Which of the following statements is correct?
(a) it will remain on it as a sphere
(b) it will spread as a thin layer
(c) it will partly be as spherical droplets and partly as thin films
(d) it will float at the distorted drop on the water surface

ASSERTION - REASON BASED QUESTIONS

Direction: - In the following questions, a statement of assertion is followed by a statement of reason. Mark the correct choice as:
(a) If both assertion and reason are true and reason is the correct explanation of assertion.
(b) If both assertion and reason are true but reason is not correct explanation of assertion.
(c) If assertion is true, but reason is false.
(d) If both assertion and reason are false.
8. Assertion: The bridges declared unsafe after long use.
Reason: Elastic strength of bridges losses with time.
(a)A (b) B (c) C (d)D

2. Assertion: Stress is the internal force per unit area of a body.
Reason: Rubber is more elastic than steel.

(a)A (b) B (c) C (d)D

3. Assertion: A rigid body can be elastic.
Reason: If force is applied on rigid body, it's dimension may change.

(a)A (b) B (c) C (d)D

5. Assertion: The shape and size of rigid body remain unaffected under the effect of external forces.
Reason: The distance between two particles remains constant in rigid body.

(a)A (b) B (c) C (d)D

6. Assertion: A lead is more elastic than rubber.
Reason: If same load is applied on the lead and rubber wire of same cross-sectional area, the strain of lead is very much less than that of rubber.

(a)A (b) B (c) C (d)D

Short answer type questions-

1. Can water be boiled without heating?

Ans: - Yes. At low pressure. Below the room temperature, when the pressure is made low, the water starts boiling without supplying any heat.

2. Why water is preferred to any other liquid in the hot water bottles?
Ans: - Water is preferred to any other liquid in the hot water bottles because the specific heat of water is high. It does not cool fast.
3. The ice at 0°C is converted into steam at 100°C. State the isothermal changes in the process.
Ans: - Isothermal changes are (i) conversion of ice at 0°C into water at 0°C (ii) conversion of water at 100°C into steam at 100°C.

4. What is relegation?
Ans. It is a phenomenon of refreezing the water into ice (on the surface of ice formed due to increase in pressure) on removing the increased pressure.
5. What is sublimation?
Ans. On heating a substance, the change from solid state to vapour state without passing through the liquid state is called sublimation.
6. What is specific heat of a gas in an isothermal process?
Ans- Infinite, because $\Delta T = 0$, $c = Q/m\Delta T$.
7. What is the basic condition for Newton's law of cooling to be obeyed?
Ans. Newton's law of cooling will be obeyed if the temperature difference between body and surroundings is small, i.e., not more than 40°C.

NUMERICAL TYPE QUESTIONS: -

1. A brass disc has a hole of diameter 2.5 cm at 27°C. Find the change in the diameter of the hole of the disc when heated to 327°C. Given coefficient of linear expansion of brass is 1.9 x 10^{-5} °C^{-1}

Solution. Here, $D_{27} = 2{\cdot}5$ cm ;

$\Delta T = 327 - 27 = 300$°C

$\alpha = 1{\cdot}9 \times 10^{-5}$ °C^{-1} ; $D_{327} - D_{27} = ?$

$D_{327} = D_{27}[1 + \alpha\,\Delta T] = D_{27} + D_{27}\,\alpha\,\Delta T$

Change in diameter $= D_{327} - D_{27} = D_{27}\,\alpha\,\Delta T$

$= 2{\cdot}5 \times (1{\cdot}9 \times 10^{-5}) \times 300$

$=$ **0·014 cm.**

2. How much should the temperature of a brass rod be increased so as to increase its length by 1%? Given α for brass is 0.00002 °C^{-1}

Solution. Here, $\Delta T = ?$; $\frac{\Delta L}{L} = \frac{1}{100}$

$\alpha = 0{\cdot}00002$ °C^{-1}

As, $\Delta L = \alpha\, L\, \Delta T$

$$\therefore \quad \Delta T = \frac{\Delta L}{L\alpha} = \frac{1}{100 \times 0{\cdot}00002}$$

$$= \frac{10^5}{2 \times 10^2} = \mathbf{500°\,C}$$

3. Railway lines are laid with gaps to allow for expansion. If the gap between steel rails 60 m long be 3.60 cm at 10°C, then at what temperature will the lines just touch? Co-efficient of linear expansion of rail = 11 x 10^{-6} °C^{-1}

Here, $l = 60$ m ; $\Delta l = 3{\cdot}60$ cm $= 3{\cdot}6 \times 10^{-2}$ m ;

$\theta_1 = 10$°C, $\theta_2 = ?$; $\alpha = 11 \times 10^{-6}$ °C^{-1}

$$\alpha = \frac{\Delta l}{l(\theta_2 - \theta_1)} \text{ or } \theta_2 - \theta_1 = \frac{\Delta l}{l\,\alpha}$$

$$\text{or } \theta_2 = \theta_1 + \frac{\Delta l}{l\,\alpha} = 10 + \frac{3{\cdot}60 \times 10^{-2}}{60 \times 11 \times 10^{-6}}$$

$= 10 + 54{\cdot}54 =$ **64·54°C**

4. A blacksmith fixes iron ring on the rim of the wooden wheel of a bullock cart. The diameter of the rim and the ring are 5.243 m and 5.231 m respectively at 27°C. To what temperature should the ring be heated so as to fit the rim of the wheel? Coefficient of linear expansion of iron is 1.20 x 10^{-5} K^{-1}.

Solution. Here, $L_{T_1} = 5{\cdot}231$ m ;

$L_{T_2} = 5{\cdot}243$ m ; $T_1 = 27$°C, $T_2 = ?$

$$\text{As, } \alpha = \frac{L_{T_2} - L_{T_1}}{L_{T_1}(T_2 - T_1)} \quad \therefore \; T_2 - T_1 = \frac{L_{T_2} - L_{T_1}}{L_{T_1} \times \alpha}$$

$$\text{or } T_2 = \frac{L_{T_2} - L_{T_1}}{L_{T_1} \times \alpha} + T_1$$

$$= \frac{5{\cdot}243 - 5{\cdot}231}{5{\cdot}231 \times 1{\cdot}2 \times 10^{-5}} + 27$$

$= 191{\cdot}1 + 27 = 218{\cdot}1 \approx$ **218°C**

5. The water of mass 75 g at 100°C is added to ice of mass 20g at-15°C. What is the resulting temperature. (Latent heat of ice = 80 cal/g and specific heat of ice = 0.5 cal g^{-l} $°C^{-l}$)

Solution. Let the resulting temperature be T_0°C

Sp. heat of water, s_1 = 1 cal/g/°C

Heat lost by water = $m_1 s_1 \Delta T_1$

$= 75 \times 1 \times (100 - T_0)$ cal.

Heat gained by ice

(*i*) from – 15°C to 0°C = $m_2 s_2 \Delta T_2$

$= 20 \times 0{\cdot}5 \times (0 + 15) = 150$ cal

(*ii*) in converting into water at 0°C = $m_2 L$

$= 20 \times 80 = 1600$ cal

(*iii*) in raising the temperature of water formed from 0°C to T_0°C.

$= m_2 s_1 (T_0 - 0) = 20 \times 1 \times T_0 = 20\, T_0$ cal

According to principle of calorimetry,

heat lost = heat gained

$75\,(100 - T_0) = 150 + 1600 + 20\,T_0$

or $7500 - 75\,T_0 = 1750 + 20\,T_0$

or $95\,T_0 = 5750$ or $T_0 = \frac{5750}{95} = $ **60·5° C**

6. When 0.15 kg of ice at 0°C is mixed with 0.30 kg of water at 50°Cin a container, the resulting temperature is 6.7°C. Calculate the heat of fusion of ice. (water 4186 J kg^{-l} K^{-1})

Solution. Heat lost by water

$= m_w s_w (T_1 - T_2) = 0{\cdot}30 \times 4186 \times (50 - 6{\cdot}7)$

$= 54376{\cdot}14$ J

Heat taken by ice $= m_i L + m_i s_w (T_2 - T_0)$

$= 0{\cdot}15 \times L + 0{\cdot}15 \times 4186 \times (6{\cdot}7 - 0)$

$= 0{\cdot}15\, L + 4206{\cdot}93$ J

Heat lost = heat gained

$\therefore\quad 54376{\cdot}14 = 0{\cdot}15\, L + 4206{\cdot}93$

or $\quad$ **$L = 3{\cdot}34 \times 10^5$ J kg^{-1}**

7. How many grams of ice at -14°C are needed to cool 200 gram of water form 25°C to 10°C? Take specific heat of ice = 00.5 cal g^{-l} $°C^{-l}$ and Latent heat of ice = 80 cal g^{-1}.

Solution. Here, m_{ice} = ? m_w = 200 g ;

$s_{ice} = 0{\cdot}5$ cal $g^{-1}\,°C^{-1}$, $L_{ice} = 80$ cal g^{-1}

Heat lost by water in cooling from 25°C to 10°C is

$Q_1 = m_w \times s_w \times \Delta T_1 = 200 \times 1 \times (25 - 10)$

$= 3000$ cal.

Heat gained by ice at – 14°C to change into water at 10°C is

$Q_2 = m_{ice}\, s_{ice}\, \Delta T_2 + m_{ice} L_{ice} + m_{ice} \times s_w \times \Delta T_3$

$= m \times 0{\cdot}5 \times [0 - (-14)] + m \times 80 + m \times 1 \times (10 - 0)$

= 97 m cal

As heat lost = heat gained, so $Q_1 = Q_2$

or $\quad 3000 = 97$ m or $m = \frac{3000}{97} = $ **31 g**

8. How much meters can a 50 kg man climbs by using the energy from a slice of a bread which produces 420 kJ heat? Assuming that the human body efficiency working is 30%. Use g = 10 m/s^2.

Sol: - Let h be the height climbed by man. Increase in PE of man = mgh = 50 x 10 x h J

Heat produced; H = 420 kJ = 420 x 1000 J = 4.2 x 10^5 J

efficiency of man = 30%,

So heat energy utilized = $\frac{30}{100}$ x 4.2 x 10^5 = 12.6 x 10^4 J

Now, increase in PE = heat energy utilized

50 x 10 x h = 12.6 x 10^4

h = $\frac{126000}{50 \times 10}$ = 252m.

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