Fill in the blanks and rewrite the sentences:

a. The amount of water vapour in air is determined in terms of its.....

Answer:

The amount of water vapour in air is determined in terms of its absolute humidity.

b. If objects of equal masses are given equal heat, their final temperature will be different. This is due to difference in their.....

Answer:

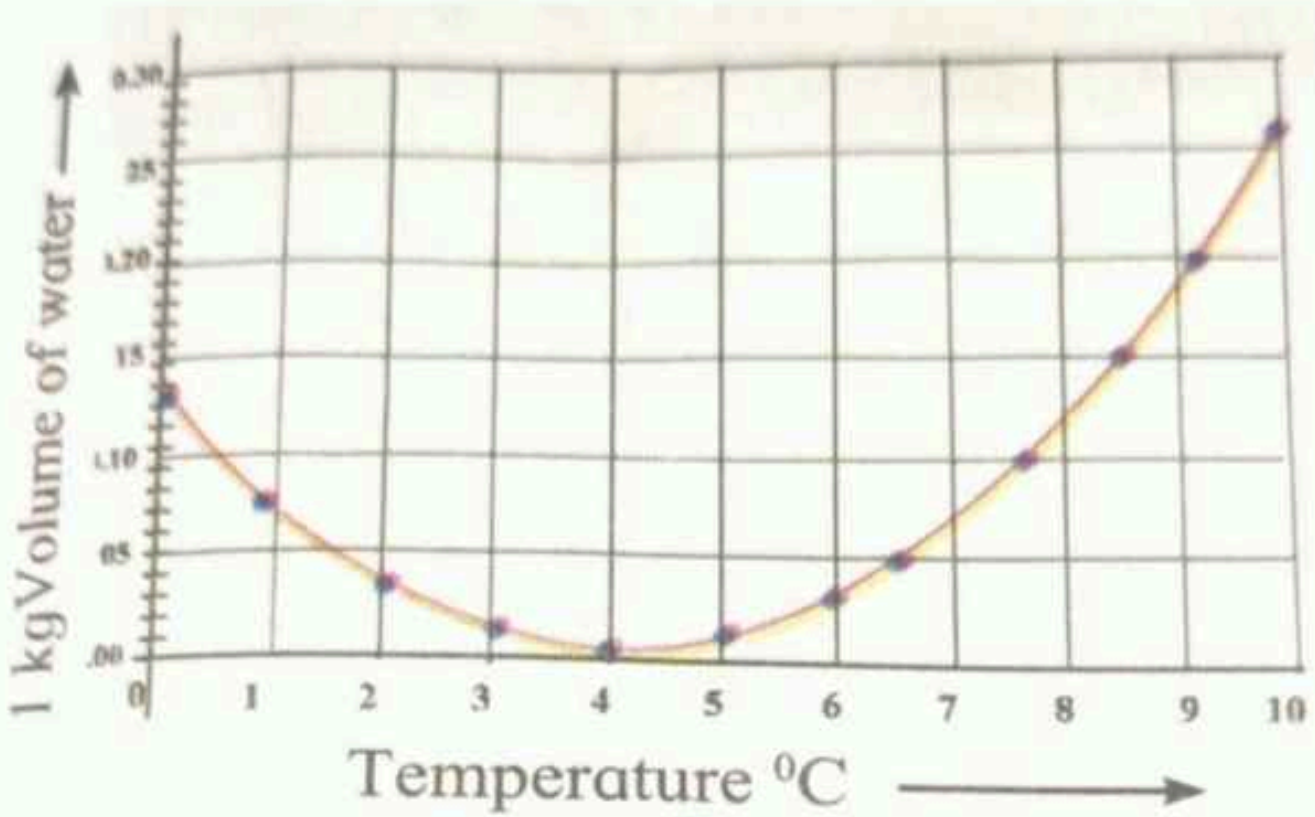
If objects of equal masses are given equal heat, their final temperature will be different. This is due to difference in their specific heat capacities.

c. When a liquid is getting converted into solid, the latent heat is..... (Practical Activity Sheet – 1 and 2)

Answer:

When a liquid is getting converted into solid, the latent heat is released.

2. Observe the following graph. Considering the change in volume of water at its temperature is raised from 0 °C, discuss the difference in the behaviour of water and other substances. What is this behaviour of water called ?



If the temperature of water is raised from 0°C to 10°C, its volume goas on decreasing in the range 0°C to 4°C. It is minimum at 4°C. The volume of water goes on increasing in the range 4°C to 10°C.

In general, when a substance is heated, its volume goes on increasing with temperature. Thus, in the range 0°C to 4°C, behaviour of water is different from other substances. It is called anomalous behaviour of water.

3. What is meant by specific heat capacity ? How will you prove experimentally that different substances have different specific heat capacities ?

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The amount of heat energy required to raise the temperature of a unit mass of an object by 1°C is called the specific heat capacity of that object.

Experiment

Material

A tray with thick layer of wax, solid spheres of iron, lead and copper of equal mass, burner or spirit lamp, large beaker.

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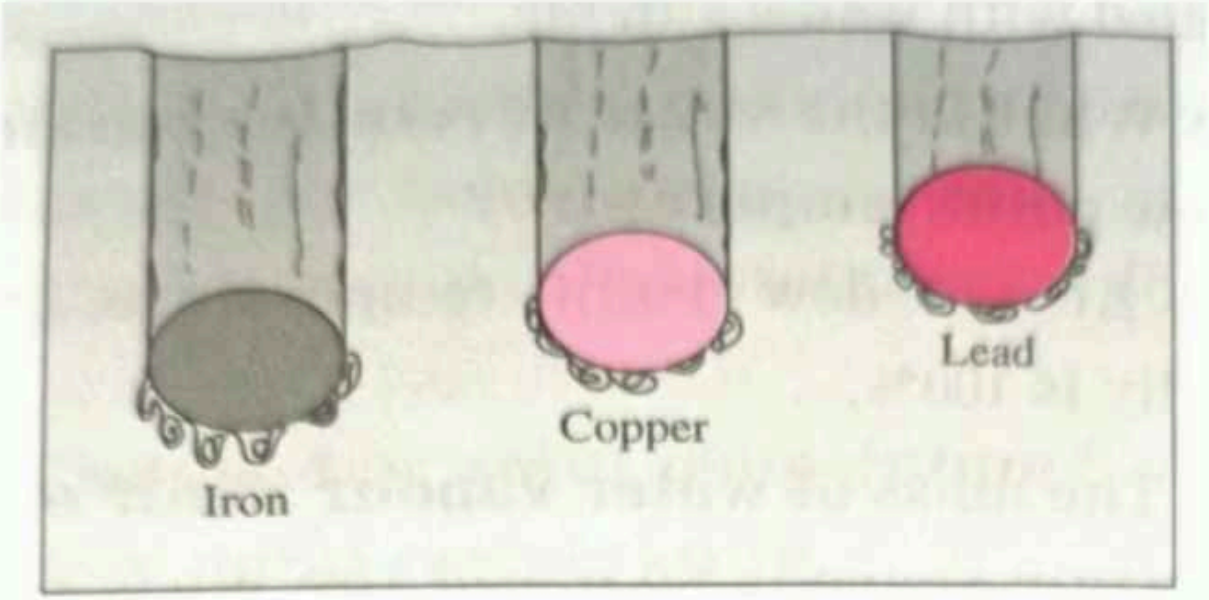
Wax layer



Procedure

(1) Take three spheres of iron, Copper and lead of equal mass.

(2) Put all the three spheres in boiling water in the beaker for some time.

(3) Take the three spheres out of the water. All the spheres will be at temperature 100°C. Put them immediately on the thick slab of wax.

(4) Note, the depth that each of the sphere goes into the wax.

The sphere which absorbs more heat from the water will give more heat to wax. More wax will thus melt and the sphere will go deeper in the wax.

It can be observed that the iron sphere goes deepest into the wax. Lead sphear goes the least and copper sphere goes to intermediate depth. This shows that for equal rise in temperature, the three spheres have obsorbed different amounts of heat.

4. While deciding the unit for heat, which temperatures interval is chosen ? why ?

While deciding the unit for heat, the temperature interval chosen is 14.5°C to 15.5°C.

If we heat 1 kg of water by 1°C in different temperature range than 14.5°C to 15.5°C, the amount of heat required will be slightly different. It is, therefore, essential to define a specific temperature range while defining the unit of heat. The calorie and joule are related by the following relation.

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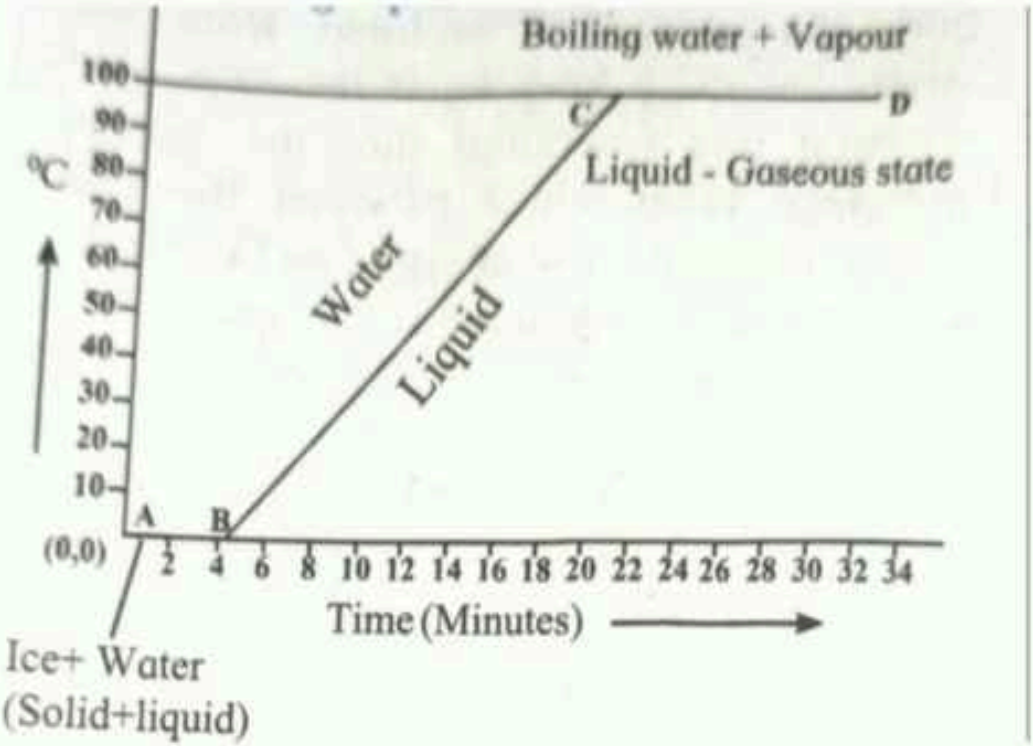
1 cal = 4.18 joules.

5. Explain the following temperature vs time graph.



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The graph shows what happens when a mixture of ice and water is heated continuously. The temperature of the mixture remains constant (0°C)till all the ice melts as shown by the line AB.

On further heating, the temperature rises steadily from 0°C to 100 °C as shown by the line BC. At 100°C water starts converting into steam.

Further heating does not change the temperature and the conversion water → stream continues as shown by the line CD.

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6. Explain the following.

a. What is the role of anomalous behaviour of water in preserving aquatic life in regions of cold climate ?

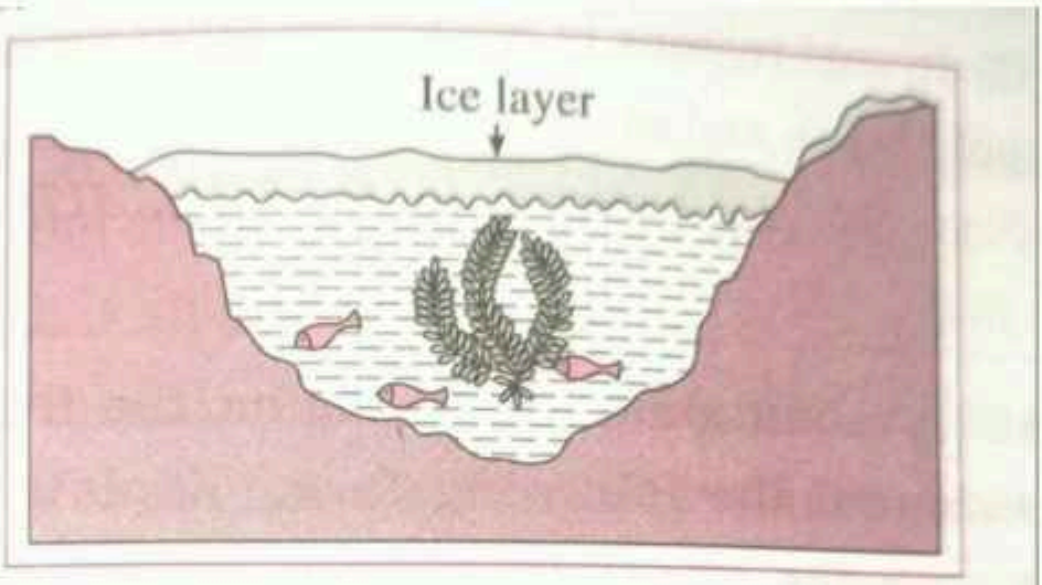

Fig. 5.8 : Aquatic animals in cold regions

In cold regions, during winter, the temperature of the atmosphere for well below 0°C. As the temperature decreases, the water at surfaces of lakes and Ponds starts contracting.

Hence, its density increases and it sinks to the bottom. This process continues till the temperature of all the water in a lake falls to 4°C.

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As the water at the surface cools further, i.e. its temperature falls below 4°C. It starts expanding instead of contracting. Therefore, its density decreases and it remains at the surface.

The temperature of the water at the surface continues to fall to 0°C. Finally, the water at the surface is converted into ice, but the water below the layer of ice is at 4°C.

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Ice is a bad conductor of heat. Hence, the layer of the ice at the surface does not allow transfer of heat from the water to the atmosphere. As the water below the layer of ice remains at 4°C, fish and other aquatic animals and plants can survive in it.

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b. How can you relate the formation of water droplets on the outer surface of a bottle taken out of a refrigerator with formation of dew ?

At a given temperature, there is a limit on how much water vapour the given volume of air can hold. The lower the temperature, the lower is the capacity of air to hold water vapour.

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The temperature of a battle kept in a refrigerator is lower than room temperature. Hence, when the bottle is taken out of the refrigerator, the temperature of the air surrounding the bottle is lowered. Therefore, the capacity of the air to hold water vapour becomes less. Hence, the excess Water vapour condenses to form water droplets on the outer surface of the bottle.

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c. In cold regions in winter, the rocks crack due to anomolous expansion of water.

sometimes water enters into crevices of the rocks. When the temperature of the atmosphere falls below 4°C, water expands. Even when water freezes to form ice, there is increase in its volume. As there is no room for expansion, it exerts a tremendous pressure on the rocks which crack and break up into small pieces.

7. Answer the following :

a. What is meant by latent heat ? How will the state of matter transform if latent heat is given off ?

Latent heat is the heat absorbed or given out by a substance during a change of state at constant temperature.

In transformations from liquid to solid, gas to liquid and gas to solid, latent heat is given out by the substance.

b. Which principle is used to measure the specific heat capacity of a substance ?

The principle of heat exchange is used to measure the specific heat capacity of a substance.

This principle is as follows :

If a system of two objects is isolated from the environment by keeping it inside a heat resistant box, then no energy can leave the box or enter the box. In this situation, heat energy lost by the hot object = heat energy gained by the cold object.

c. Explain the role of latent heat in the change of state of a substances ?

When a solid is heated, initially, its temperature increases. Here, the heat absorbed by the body is used in increasing the kinetic energy of the particles of the body as well as for doing work against the forces of attraction between them. As the heating it continued, at a certain temperature solid is converted into liquid. In this case, the temperature remains constant and the heat absorbed is used for the weakening the bonds and conversion into liquid phase. This heat is called the latent heat of fusion.

When a liquid is converted into the gaseous phase, at the boiling point, the heat absorbed is used for breaking the bonds between the atoms or molecules. This heat is called the latent heat of vaporazation.

Some solids, under certain conditions, are directly transformed into the gaseous Phase. Here the heat is absorbed but the temperature remains constant. The absorbed heat is used for breaking the bonds between atoms or molecules. This heat is called the latent heat of sublimation.

In general, latent heat is the heat absorbed or given out by a substance during a change of state at constant temperature.

In transformations from liquid to solid, gas to liquid and gas to solid, latent heat is given out by the body.

d. On what basis and how will you determine whether air is saturated with vapour or not ?

Whether air is saturated with water vapour or not is determined on the basis of the extent of water vapour present in the air. If the relative humidity is 100%, air is saturated with water vapour. In that case, we can see formation of water vapour. In that case, we can see formation of water droplets on the leaves of plants/grass.

8. Read the following paragraph and answer the questions :

If heat is exchanged between a hot and cold object, the temperature of the cold object goes on increasing due to gain of energy and the temperature of the hot object goes on decreasing due to loss of energy.

The change in temperature continues till the temperatures of both the objects attain the same value. In this process, the cold object gains heat energy and the hot object loses heat energy. If the system of both the objects is isolated from the environment by keeping it Inside a heat resistant box (meaning that the energy exchange takes place between the two objects only), then no energy can flow from inside the box or come into the box.

i. Heat is transferred from where to where ?

Heat is transferred from a hot object to cold object.

ii. Which principle do we learn about from this process ?

Heat is transferred from an object at higher temperature to an object at lower temperature.

iii. How will you state the principle briefly ?

If a system of two objects is isolated from the surroundings, heat energy lost by the hot object = heat energy gained by the cold object.

iv. Which property of the substance is measured using this principle ?

This principle is used to measure the specific heat capacity of a substance.

a. Equal heat is given to two objects A and B of mass 1g. Temperature of A increases by 3°C and B by 5°C. Which object has more specific heat ? And by what factor ?

a. Specific heat capacity of a body is given as

$$s = \frac{\Delta Q}{m\Delta T}$$

Let Q cal of heat is given to both A and B.

For body A,

$$s_1 = \frac{Q}{1\times 3} = \frac{Q}{3} \text{ cal g}^{-1}\,^{\circ}\text{C}^{-1}$$

For body B,

$$s_2 = \frac{Q}{1\times 5} = \frac{Q}{5} \text{ cal g}^{-1}\,^{\circ}\text{C}^{-1}$$

Now,

$$\frac{s_1}{s_2} = \frac{\frac{Q}{3}}{\frac{Q}{5}} = \frac{5}{3}$$

$$\Rightarrow s_1 = \frac{5}{3}s_2$$

Thus, specific heat capacity of body A is more than body B and by a factor of $\boxed{\frac{5}{3}}$.

b. Liquid ammonia is used in ice factory for making Ice from water. If water at 20 °C is to be converted into 2 kg ice at 0 °C, how many grams of ammonia are to be evaporated ?

b. Amount of heat energy released in cooling 2 kg water from 20°C to 0°C =

$$2 \times 1000 \times 1 \times 20 = 40000 \ \text{cal}$$

Amount of heat energy released in converting 2 kg water at 0°C to ice =

$$2 \times 1000 \times 80 = 160000 \ \text{cal}$$

Thus, total energy required in converting water at 20°C to ice = 200000 cal

Grams of ammonia to be evaporated = $\frac{200000}{341} =$ 586.5 g

c. A thermally insulted pot has 150 g ice at temperature 0°C. How much steam of 100 °C has to be mixed to it, so that water of temperature 50 °C will be obtained ?

c. Amount of heat required in converting 150 g ice to 0°C to water at 0°C = $150 \times 80 = 12000 \text{ cal}$

Amount of heat energy required in heating 150 g water at 0°C to 150 g water at 50°C =

$150 \times 1 \times 50 = 7500 \text{ cal}$

Total heat energy required to convert 150 g ice at 0°C to water at 50°C = 19500 cal

Let *m* g be the amount of steam be mixed with water to bring the final temperature of system at 50°C.

The amount of heat released in converting *m* g of steam at 100°C to water at 100°C =

$m \times 540 = 540m$

The amount of heat released in converting *m* g of water at 100°C to water at 50°C =

$m \times \times 1 \times 50 = 50m$

Total heat energy released to convert *m* g steam at 100°C to water at 50°C = 590*m* cal

Using the principle of calorimetry, we have

590*m* = 19500

$$m = \frac{19500}{590} = 33 \text{ g}$$

d. A calorimeter has mass 100 g and specific heat 0.1 kcal/kg.°C. It contains 250 gm of liquid at 30°C having specific heat of 0.4 kcal/kg.°C. If we drop a piece of ice of mass 10 g at 0°C, What will be the temperature of the mixture ?

d. Let the final temperature of the mixture be T.

Amount of heat required in converting 10 g ice to 0°C to water at 0°C = $10 \times 80 = 800 \text{ cal}$

Total amount of heat required in converting 10 g water to 0°C to water at T°C = $10 \times 1 \times T = 10T$

Total heat energy required to convert 10 g ice at 0°C to water at T°C = $800 + 10T$

Amount of heat released to raise the temperature of calorimeter at 30°C to T°C =

$$100 \times 0.1 \times (30 - T) = 10(30 - T)$$

Amount of heat released to raise the temperature of 250g of eater at 30°C to T°C =

$$250 \times 0.4 \times (30 - T) = 100(30 - T)$$

Total amount of heat released in the process =

$$110(30 - T)$$

Using the principle of calorimetry, we have

$110(30 - T) = 800 + 10T$

$$\Rightarrow T = 20.83 \text{ °C}$$