01. HEAT

Questions and Answers

1. What would be the final temperature of a mixture of 50 g of water at 20°C temperature and 50 g of water at 40°C temperature?

A. Mass (m_1) = 50 gm
Temperature (T_1) = 20°C
Mass (m_2) = 50 gm
Temperature(T_2) = 40°C

Final temperature as per Method of mixtures

$(T) = \frac{m_1T_1+m_2T_2}{m_1+m_2} = \frac{50X20+50X40}{50+50} = \frac{1000+2000}{100}$

$= \frac{3000}{100}$ = 30°C

2. Explain why d ogs pant during hot summer days using the concept of evaporation?

A. Dogs pant during hot summer days to Reduce their internal temperature. When dog pants, the water molecules get absorb from its body and evaporated. As a result the interior of dog body gets cooled.

3. Why do we get dew on the surface of a cold soft drink bottle kept in open air?

A. The temperature of the cold soft drink bottle is less than the temperature of atmosphere. The water molecules present in air touches the surface of the bottle and lose their kinetic energy. As a result the temperature of water molecules decrease and condenses on the surface of the bottle. These water droplets are seen as dew.

4. Write the differences between evaporation and boiling.

A. **Evaporation :** The process of escaping of Molecules from the surface of a liquid at any temperature is called evaporation. Evaporation is a cooling process. It is a surface phenomenon.

Boiling : The process in which the liquid phase changes to gaseous phase at a constant temperature and pressure is called boiling. Boiling does not cause cooling. Boiling is a bulk phenomenon.

5. Does the surrounding air become warm or cool when vapour phase of H_2O condenses? Explain.

A. Condensation is a warming process. The process of phase change of vapour to liquid is condensation. When vapour touches a cool object the molecules in vapour lose kinetic energy.

As a result the temperature of water molecules decreases and condenses on the surface of the cool object. This is an exothermic reaction.

So the average kinetic energy of the molecules in vapour increases. Thus the surrounding temperature increase.

6. Answer these.

a) How much energy is transferred when 1gm of water vapour at 100°C condenses to water a 100°C?

b) How much energy is transferred when 1gm of boiling water at 100°C cools to water at 0°C?

c) How much energy is released or absorbed when 1 gm of water at 0°C freezes to ice at 0°C?

d) How much energy is released or absorbed when 1 gm of steam at 100°C turns to ice at 0°C?

A. a) 1gm of water vapour at 100°C condenses to water at 100°C.

The latent heat of vaporization of water is (L) = 540 cal/gm.

Heat transferred (Q_1) = mL
= 1x540 = 540 cal

b) 1gm of boiling water at 100°C cools to water at 0°C.

Heat transferred (Q_2) = m.s.ΔT
= 1x1x100
= 100 cal

c) 1gm of water at 0°C freezes to ice at 0°C.

The latent heat of fusion of ice is (L) = 80 cal/gm.

Heat transferred (Q_3) = mL
= 1x80 = 80 cal

d) 1gm of steam at 100°C turns to ice at 0°C.

Heat transferred (Q) = $Q_1 + Q_2 + Q_3$

= 540+100+80

= 720 cal

7. Explain the procedure of finding specific heat of a solid experimentally.

A. Specific heat of a solid can be measured by using calorimeter. To perform this experiment we need calorimeter, water, hot water, thermometer and solid shots (lead shots).

Procedure:(1) First we have to find the mass of the calorimeter vessel (m_1).

(2) Fill nearly half of the calorimeter with water and find the mass of calorimeter with water (m_2).

(3) Measure the initial temperature with laboratory thermometer (T_1°C). This is the temperature of both water and also calorimeter.

(4) Take a few lead shots and place them in hot water. Heat them nearly 100°C. So measure the temperature of lead shots (T_2°C).

(5) Transfer the lead shots into calorimeter quickly with minimum loss of heat.

(6) Stir the mixture well.

(7) Note the final temperature (T_3°C).

(8) Measure the final mass of calorimeter vessel along with water and lead shots (m_3).

Heat (Q) = m.s.ΔT

According to the method of mixtures :

Heat lost by the solid =Heat gained by calorimeter + Heat gained by water

$(m_3-m_2).S_l.(T_2-T_3) = m_1.S_c.(T_3-T_1) + (m_2-m_1).S_w.(T_3-T_1)$

$$S_l = \frac{[m_1 S_c+(m_2-m_1)S_w][T_3-T_1]}{(m_3-m_2)(T_2-T_3)}$$

This way we can find the specific heat of a solid.

Take S_w = 1 cal/gm -°C

S_c = 0.095 cal/gm -°C

8. Convert 20°C into Kelvin scale.

A. t°C = (t + 273)K

20°C = (20 + 273)K = 293K

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9. Your friend is asked to differentiate between evaporation and boiling. What questions could you ask to make him to know the differences between evaporation and boiling?

A. I would like to ask the following questions:

* Does boiling of a substance takes place at any temperature?
* Does evaporation at any temperature or not?
* Is evaporation a surface phenomenon or bulk phenomenon?
* At which temperature does water boils?
* The water in wet clothes dries due to wind. Is wind provides 100°C ?

10. What happens to the water when wet clothes dry?

A. When wet clothes kept in open place, due to large area exposed to air, the water molecules absorb heat from surroundings and change its state by leaving the clothes dry on wind blows. This process is evaporation.

11. Equal amounts of water are kept in a cup and in a dish. Which will evaporate faster? Why?

A. The rate of evaporation increases with Increasing in surface area. The surface area of water in dish is more than the surface area of water in cup. So Water in dish will evaporate quickly.

12. Suggest an experiment to prove that the rate of evaporation of a liquid depends on its surface area and vapour already present in surrounding area.

A. Experiment to prove that Evaporation depends upon the surface area of the liquid:

Take 5ml of spirit in a small plate And take 5ml of spirit in another big plate (without lid). Keep them some time.

Observation : The spirit in the big dish that disappears quickly, where we find some spirit in the other dish which is small. This means that Evaporation depends upon the surface area of the liquid.

If surface area increases the rate of evaporation also increases.

Experiment to prove that Evaporation depends upon the vapour already present in surrounding area:

Take 5ml of spirit in two small cups. Put one cup in the A.C. room and put another in the normal room. Measure the time taken for disappear the spirit from the cups.

Observation: The spirit in the normal room disappears quickly.This means that the rate of evaporation depends upon the vapour already present in surrounding area. If the vapour in atmosphere increases then the rate of evaporation decreases.

16. How do you appreciate the role of the higher specific heat of water in stabilizing atmospheric temperature during winter and summer seasons?

A. The sun delivers a large amount of energy to the earth daily. The water sources on earth, particularly the oceans, absorb energy for maintaining a relatively constant temperature. They can absorb large amounts of heat at the equator without rise in temperature due to high specific heat of water. Therefore oceans moderate the surrounding temperature near the equator.

Also ocean water transports the heat away from the equator to the polar regions. This transportation helps in moderate the temperature or climates in the areas that are far from the equator. The water in oceans can stabilize the temperatures on earth in winter and summer seasons.

17. Suppose that 1ℓ of water is heated for a certain time to rise its temperature by 2^oC. If 2ℓ of water is heated for the same time, by how much will its temperature rise?

A. Given : $\Delta T_1 = 2^oC$

$m_1 = m$ (let mass of 1ℓ of water)

$\Delta T_2 = ?$

$m_2 = 2m$ (mass of 2ℓ of water)

Heat (Q) = m.s.ΔT

Change in temperature is inversely proportional to the mass

$$\Delta T \propto \frac{1}{m}$$

$$\frac{\Delta T_1}{\Delta T_2} = \frac{m_2}{m_1}$$

$$\frac{2}{\Delta T_2} = \frac{2m}{m}$$

$$\Delta T_2 = 1^oC$$

18. What role does specific heat play in keeping a watermelon cool for a long time after removing it from a fridge on a hot day?

A. If specific heat is high, the rate of rise or fall in temperature is low. So watermelon takes long time to rise in its temperature. Hence Watermelon brought out from a fridge retains its coolness for a long time than other fruits. Because the watermelon consists of more water and water has greater specific heat value.

19. If you are chilly outside the shower stall, why do you feel warm after the bath if you stay in the bathroom?

A. After bath, the number of vapour molecules per unit volume in the bath room is greater than the number of vapour molecules per unit volume outside the bath room. When we try to dry ourselves with towel, the vapour molecules surrounding us condenses on our body. Hence we feel chilly (warm) after bath as condensation is a warming process.

20. Define frost. When do frost form?

A. Frost : Frost is a solid deposition of water vapour from humid air. It is formed when temperature of a solid surface is below the freezing point of water and also below the frost point.

21. What is rain?

A. Rain : Rain is liquid water in the form of droplets that have condensed from atmospheric water vapour.

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