Heat

Improve your learning

Q. 1. What would be the final temperature of a mixture of 50g of water at 20°C temperature and 50g of water at 40°C temperature? (AS1)

Answer : Let the final temperature of the mixture of 50g of water at 20°C temperature and 50g of water at 40°C be T.

For the first solution i.e mixture of 50g of water at 20°C temperature: -

Let the mass of water be m_1 = 50g

Let the temperature of water be = T_1 = 20°C

Similarly, For the second solution i.e mixture of 50g of water at 40°C temperature: -

Let the mass of water be m_2 = 50g

Let the temperature of water be = T_2 = 40°C

Let the specific heat capacity of water be S.

The amount of heat gained by the cooler water sample is: -

$Q_1 = m_1S(T - T_1)$

The amount of heat lost by the hotter water sample is: -

$Q_2 = m_2S(T_2 - T)$

According to the principle of method of mixtures we know that: -

The amount of heat lost by the hotter sample = The amount of heat gained by the cooler water sample

$\therefore Q_1 = Q_2$

$\Rightarrow m_1 s(T - T_1) = m_2 S(T_2 - T)$

$$\Rightarrow T = \frac{(m_1 T_1 + m_2 T_2)}{(m_1 + m_2)}$$

$$\Rightarrow T = \frac{50 \times 20 + 50 \times 40}{50 \times 50}$$

$\Rightarrow T = 30°C$

Hence, the final temperature of a mixture of 50g of water at 20°C temperature and 50g of water at 40°C temperature would be 30°C.

Q. 2. Explain why dogs pant during hot summer days using the concept of evaporation? (AS 1)

Answer : Dogs have tongues with large surface area. The water molecules which are present on the surface of the tongue of a dog gets evaporated while panting. This evaporation cools the area. Hence, dogs pant during hot summer days as panting promotes cooling effect and relieves them from the heat.

Q. 3. Why do we get dew on the surface of a cold soft drink bottle kept in open air? (AS1)

Answer : When a cold soft drink bottle kept in open air the surrounding air is at a higher temperature then that of the surface of the bottle hence the vapor molecules in the air during their motion collide with the surface of the cold drink bottle which is cool. In this process they lose a huge amount of energy and get converted into droplets. It is these droplets that we see as dew on the surface of a cold soft drink bottle kept in open air.

Q. 4. Write the differences between evaporation and boiling? (AS1)

Answer :

Evaporation	Boiling
It is the process in which the molecules leave the surface of a liquid at any temperature.	It is a process in which a liquid phase changes into its vapor phase at constant temperature at a given pressure.
It takes place over an entire range of temperature.	It takes place at specific temperature.
It is fast process.	It is a slow process.
Occurs throughout the liquid.	Takes place only from the exposed surface of the liquid.
Bubbles are formed.	No bubbles are formed.

Q. 5. Does the surrounding air become warmer or cool when vapor phase of H_2O Condenses? Explain.

Answer : When the vapor phase of H_2O Condenses it transfers its energy to the surface upon which it condenses hence their kinetic energy is reduced and the difference in the kinetic energy is transferred to the vessel upon which they condense. Now as the kinetic energy of the vapor reduces it leads to a reduction in their temperature along with that of the surroundings. Hence, the surrounding air becomes cooler when vapor phase of H_2O condenses.

Q. 6 A. Answer these. (ASI)

How much energy is transferred when I gm of boiling water at 100^{o}c condense to water at 100C?

Answer : when 1 g of boiling water at 100^{o}C condense to water at 100^{o}C there is no change in temperature and the energy transferred is given by the latent heat of vaporization of water which is equal to 2260 Joule.

Q. 6 B. Answer these. (ASI)

How much energy is transferred when I gm of boiling water at 100^{o}C cools to water at 0^{o}C?

Answer : Given: -

Mass, m = 1g

Initial temperature = 100^{o}C

Final temperature = 0^{o}C

Change in temperature, ΔT = 100 ^{o}C

The specific heat capacity of water is, S = 1cal/g°C

We know that $Q = mS\Delta T$

Hence, energy transferred when 1g of boiling water at 100^{o}C cools to water at 0^{o}C: -

$\Rightarrow Q = mS\Delta T$

$\Rightarrow Q = 1 \times 1 \times 100$

⇒ Q = 100cal

Q. 6 C. Answer these. (ASI)

How much energy is released or absorbed when 1gm of water at 100^{o}c freezer to ice at 0^{o}C?

Answer : Energy transferred when 1g of boiling water at 100^{o}C cools to water at 0^{o}C is as found in the above question is - 100cal

Now, latent heat change on changing the state from water to ice = 80cal/g

Hence, energy released when 1gm of water at 100^{o}c freezes to ice at 0^{o}C = 100 + 80 = 180cal

Q. 6 D. Answer these. (ASI)

How much energy is released or absorbed when 1gm of steam at 100^{o}c turns to ice at 0^{o}C?

Answer : Latent heat of vaporization = 540cal/g

Energy transferred when 1g of boiling water at 100^{o}C cools to water at 0^{o}C is - 100cal

Latent heat change on changing the state from water to ice = 80cal/g

Hence, energy released when 1gm of steam at 100^{o}C turns to ice at 0^{o}C = 540 + 100 + 80 = 720cal.

Q. 7. Explain the procedure of finding specific heat of solid experimentally. (AS1)

Answer : The procedure of finding specific heat of solid experimentally is as follows : -

a. Take a calorimeter along with a stirrer.

b. Measure them in a weighing scale and let their mass be m_1.

c. Fill one third of the volume of calorimeter with water and let it's weight be $m_2$with temperature T_1.

d. Take a few lead shots and place them in hot water and heat them up to a temperature 100^{0}C. Let this temperature be T_2.

e. Transfer the hot lead shots quickly into the calorimeter.

f. Then measure the temperature of water and lead shots as T_3.

g. The mass of calorimeter along with content is measured as m_3.

Now we have: -

Mass of the water = $m_2 - m_1$

Mass of the lead shots = $m_3 - m_2$

Specific heat of calorimeter = S_c

Specific heat of water = S_w

Specific Heat of lead shots = s_l

Initial temperature of water = T_1

Temperature of Lead shots = T_2

Final temperature of the system = T_3

h. We know from the method of mixtures that: -

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

$$\Rightarrow (m_3 - m_2) S_1 (T_2 - T_3) = m_1 S_C (T_3 - T_1) + (m_2 - m_1) S_W (T_3 - T_1)$$

$$\Rightarrow S_1 = \frac{m_1 S_C (T_3 - T_1) + (m_2 - m_1) S_W (T_3 - T_1)}{(m_3 - m_2)(T_2 - T_3)}$$

From the above formula we can find the specific heat of solid experimentally.

Q. 8. Covert 20ºC into Kelvin scale. (AS1)

Answer : We know that : -

Temperature in Kelvin = Temperature in Degree Celsius + 273

Hence, 20ºC = 20 + 273 = 293K.

Q. 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? (AS2)

Answer : The questions that I ask my friend to make him know the differences between evaporation and boiling would be : -

a. Which phenomena take place at all temperatures?

b. Is evaporation a cooling process or warming process?

c. Which a surface phenomena?

Q. 10. What happens to the water when wet clothes dry'? (AS3)

Answer : When wet clothes dry the liquid present on the surface of the clothes keeps escaping from the surface till the entire liquid disappears into the air by the process of evaporation. This process is aided when we have a windy day with dry atmosphere as it helps to carry the molecules away from the cloth more rapidly.

Q. 11. Equal amounts of water are kept in a cap and in a dish. Which will evaporate faster? Why? (AS3)

Answer : We know that the rate of evaporation of a liquid depends on its surface area exposed, temperature and amount of vapour already present in the air.

Now when the temperature and amount of vapour already present in the air is constant then the rate solely depends upon the surface area exposed. The larger the surface area would be the more will be the number of water molecules escaping into the air and faster would be the rate of evaporation. Now between cap and dish, the dish has larger surface area and hence the water kept in the dish will evaporate faster.

Q. 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 air. (AS3)

Answer : An experiment to prove that the rate of evaporation of a liquid depends on its surface area is as follows: -

Take 10 ml of volatile liquid in a test-tube and another 10 ml of volatile liquid in the large dish. Observe the change in the volume of the liquid in both the cases. It would be found out that the liquid in the large dish had vanished much earlier than that in the test-tube which clearly implies that the rate of evaporation of a liquid depends on its surface area as the large dish has more surface area than the test-tube.

An experiment to prove that the rate of evaporation of a liquid depends on the vapour already present in surrounding air : -

Take a few drops of spirit in two Petri dishes separately. Keep one of the dishes containing spirit under a ceiling fan and switch on the fan. Keep another dish with its lid closed. Observe the quantity of spirit in both dishes after 7 minutes. It would be seen that the spirit which was in the petri dish had evaporated faster than the spirit which was in the other. This was because the ceiling fan was dispersing the vapour making the surrounding less humid while the closed lid leads to a more humid condition. Hence we could conclude that the rate of evaporation of a liquid depends on the vapour already present in surrounding air.

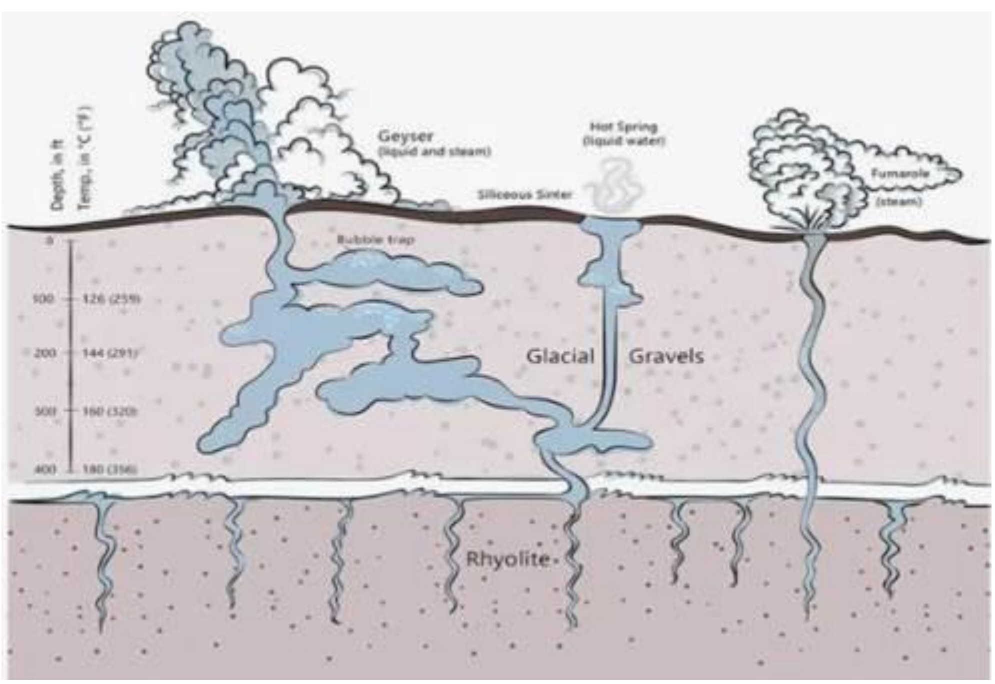
Q. 13. Place a Pyrex& ass llama with its mouth-down in a sauce pan full of water, in such a way Out the stern tube of the funnel is above the water or pointing upward into the air. Rest the edge of the bottom portion of the funnel on a nail or on a coin so that water can get under it. Place the pan on a stove and heat it till it begins to boil. Where do the bubbles form first? Why'? Can you ex plain how a natural geyser works using this experience. (AS4)

Answer : We know the fact that the boiling point of water increases with increase in pressure. In this case, the bubbles start from the bottom of the sauce pan were we had put the nail or coin.

Similarly, in the geyser, boiling begins near the bottom and the bubbles that are raising above push the water out starting the process of eruption. This method could be treated as the laboratory demonstration of how a natural geyser functions.

Q. 14. Collect information about working of natural geyser and prepare a report. (AS4)

Answer : Working of a natural geyser.



Geysers are generally associated with volcanic areas. As the water boils, the resulting pressure forces a superheated column of steam and water to the surface through the geyser's internal plumbing. The heat needed for geyser formation comes from magma that needs to be close to the surface of the earth.

Geyser activity, like all hot spring activity, is caused by surface water gradually seeping down through the ground until it meets rock heated by magma. The geothermally heated water then rises back toward the surface by convection through porous and fractured rocks. Geysers differ from non-eruptive hot springs in their subterranean structure; many consist of a small vent at the surface connected to one or more narrow tubes that lead to underground reservoirs of water and pressure tight rock.

As the geyser fills, the water at the top of the column cools off, but because of the narrowness of the channel, convective cooling of the water in the reservoir is impossible. The cooler water above presses down on the hotter water beneath, not unlike the lid of a pressure cooker, allowing the water in the reservoir to become superheated, i.e. to remain liquid at temperatures well above the standard-pressure boiling point.

Ultimately, the temperatures near the bottom of the geyser rise to a point where boiling begins; steam bubbles rise to the top of the column. As they burst through the geyser's vent, some water overflows or splashes out, reducing the weight of the column and thus the pressure on the water underneath. With this release of pressure, the superheated water flashes into steam, boiling violently throughout the column. The resulting froth of expanding steam and hot water then sprays out of the geyser vent.

Q. 15. Assume that heat is being supplied continuously to 2kg of ice at -5ºC. You know that ice melts at 0ºC and boils at 100ºC Continue the heating till it starts boiling. Note the Immature every minute. Draw a graph between temperature and time using the values you get. What do you understand from the graph. Write the conclusion. (AS3)

Answer : Experimental question can’t be explained theoretically need to perform the experiment to obtain the solution.

Q. 16. How do you appreciate the role of the higher specific heat of water in stabilizing atmospheric temperature dying winter and summer seasons? (AS6)

Answer : Earth receives huge amount of heat energy from the Sun every day. With this heat, the Earth must have been heated beyond the level that it can withstand, but this is not actually happening because of the water bodies such as oceans, seas, lakes and rivers. They act as the store houses of heat energy from the Sun.

During the winter and summer, the water acts as balancing factor for controlling the temperature with its high specific heat.

During summer the water near the equator heats up faster and more than that near the poles as near the equator the amount of heat energy received is comparatively larger and hence circulation of water from the equator to the poles helps in maintaining the temperature of both the regions. Almost a similar phenomenon occurs during winter.

Q. 17. Suppose that 1l of water is heated for a certain time to rise and its temperature by 2°C. If 2l of water is heated for the same time, by how much will its temperature rise? (AS7)

Answer : We know that: -

$Q = mS\Delta T$

$\Rightarrow \Delta T = \frac{Q}{mS}$

$\Rightarrow \Delta T$ is inversely proportional to the heat supplied.

$\Rightarrow$If the mass is greater than we get a change in temperature for the same amount of heat supplied.

Given the change in temperature when 1l(m_1) of water is heated for a certain time = $\Delta T_1 = 2^oC$

Let the change in temperature when 2l(m_2) of water is heated for a certain time be ΔT_2

Heat supplies and specific heat is constant for both the cases.

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

$\Rightarrow \frac{2}{\Delta T_2} = \frac{2}{1}$

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

$\Rightarrow \Delta T_2 = 1\ ^oC$

Hence, if 2l of water is heated for the same time then 1 ^{o}f temperature rise will take place.

Q. 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'? (AS7)

Answer : The specific heat of watermelon is more than that of the surrounding air. Hence even after coming out of the refrigerator, it maintains it's coldness for a long time as due to high specific heat the rate of heat loss to the surroundings is low.

Q. 19. If you are chilly outside the shower stall, why do you feel warm alter the bath if you stay in the bathroom? (AS7)

Answer : We feel warm after we finish our bath under the shower. The reason for this could be that in the bathroom, the number of vapor molecules per unit volume is relatively greater than the number of vapour molecules per unit volume outside the bathroom. Hence, when we try to dry ourselves with a towel, the vapour molecules surrounding us condense on our skin. This condensation is what which makes us feel warm.