

Time: 2.HR

10 Wad 1 TO 5

Marks: 40

Chapter Details

Science And Technology Part I: Gravitation, Periodic Classification of Elements, Chemical Reactions and Equations, Effects of Electric Current, Heat

Q.1(A) Choose the correct alternative. (5)

i Heating effect of electric current is not observed in_____

- (A) electric oven (B) electric iron.
 (C) electric motor (D) fuse.

ii Which of the following is NOT a chemical change?

- (A) Digestion of food (B) Boiling water
 (C) Boiling of an egg (D) Baking a cake

iii _____ is used for detecting and measuring electric current.

- (A) voltmeter (B) Galvanometer
 (C) Electric motor (D) Electric generator

iv While heating ice and water mixture, it is stirred continuously

- (A) to increase rate of heating. (B) to decrease rate of heating.
 (C) to have uniform heating. (D) to produce ripples in mixture.

v When aluminium metal reacts with dilute hydrochloric acid, _____ gas is liberated.

- (A) oxygen (B) hydrogen
 (C) chlorine (D) hydrogen peroxide

Q.1(B) Answer the following. (5)

i Find the odd one out

Fuse wire, bad conductor, rubber gloves, generator

Others restrict flow of current while generator is used to produce current.

ii Define specific latent heat of fusion.

The amount of heat energy absorbed at constant temperature by unit mass of a solid to convert into liquid phase is called the specific latent heat of fusion.

iii Kinetic energy of a body of mass m on the surface of the earth: $\frac{1}{2}mv_{esc}^2$:: kinetic energy of a body of mass m at infinite distance from earth : _____.

Ans: zero

Explanation:

Kinetic energy of a body of mass m on the surface of the earth is $\frac{1}{2}mv_{esc}^2$ while kinetic energy of a body of mass m at infinite distance from earth is zero.

iv

Column A	Column B	Column C
Mass	kg	Measure of inertia
	N	Zero at the centre
	m/s^2	Depends on height

v **What is meant by the term electropositivity of an element?**

The tendency of an atom of an element to form cation by losing its valence electrons is called electropositivity of that element.

Q.2(A) Give scientific reasons. (Attempt any 2) (4)

i The third period contains only eight elements even though the electron capacity of the third shell is 18.

i. The number of elements in the first three periods depends on the electron capacity of the shells and the law of electron octet.

ii. The electron capacity of third shell is 18. So the third period should actually contain 18 elements. But it contains only 8 elements due to the law of electron octet.

ii If the value of g suddenly becomes twice its value, it will become two times more difficult to pull a heavy object along the floor. Why?

i. In order to pull an object along the floor, it is necessary to do work against the force of friction.

ii. The force of friction is directly proportional to the weight (mg).

iii. If the value of g doubles, the weight of an object doubles, and therefore, the force of friction also doubles.

iv. Thus, it will become two times more difficult to pull a heavy object along the floor.

iii During winter season, we may have observed a white trail at the back of the aeroplane flying high in the clear sky or sometimes it may not get formed.

i. The ratio of actual mass of vapour content in the air for a given volume and temperature to that required to make the air saturated with vapour at that temperature is called the relative humidity.

ii. The white trail is basically the vapour released by aeroplane engine condensing in sky to form cloud.

iii. If the relative humidity of surrounding air is more than, we may get to observe this white trail at the back of the aeroplane flying high in the clear sky.

iv. If the relative humidity of surrounding air is less than, either small sized white trail may get formed or it may not get formed at all.

Q.2(B) Answer the following. (Attempt any 3) (6)

i The mass of a planet is 6 times the mass of earth and its radius is 3 times that of the earth.

Considering acceleration due to gravity on earth to be 9.8 m/s^2 , calculate the value of 'g'

on the other planet.

Ans: Value of acceleration due to gravity on the other planet is **6.53 m/s²**.

Explanation:

Given: Mass of planet (M_P) = $6M_E$, radius of planet (R_P) = $3R_E$, $g_E = 9.8 \text{ m/s}^2$

To find: Acceleration due to gravity on the planet (g_P)

Formula: $g = \frac{GM}{R^2}$

Calculation: From formula,

$$\begin{aligned}\frac{g_P}{g_E} &= \frac{M_P}{R_P^2} \times \frac{R_E^2}{M_E} \\ \therefore g_P &= g_E \times \frac{6M_E}{(3R_E)^2} \times \frac{R_E^2}{M_E} \\ &= 9.8 \times \frac{6}{9} \\ &= \mathbf{6.53 \text{ m/s}^2}\end{aligned}$$

ii **How much heat should be supplied to convert ice of mass 50 g at 0 °C into water at 40 °C?**

Ans: Amount of heat energy that should be supplied is **6000 cal**.

Explanation:

Given : Mass of ice/water (m) = 50 g

Change in temperature (ΔT)

$$= 40 - 0 = 40 \text{ }^\circ\text{C}$$

We know that: Latent heat of melting of ice = $L_{\text{melt}} = 80 \text{ cal/g}$, Specific heat of water $c_w = 1 \text{ cal/g }^\circ\text{C}$

To find: Heat supplied (Q)

Formulae: i Heat required to convert ice at 0 °C into water at 0 °C is

$$Q_1 = mL_{\text{melt}}$$

ii. Heat required to raise temperature of water from 0 °C to 40 °C is

$$Q_2 = m \times c_w \times \Delta T$$

Calculation: From formula (i),

$$Q_1 = 50 \times 80 = 4000 \text{ cal}$$

From formula (ii),

$$Q_2 = 50 \times 1 \times (40 - 0) = 2000 \text{ cal}$$

Total heat energy required

$$Q = Q_1 + Q_2$$

$$= 4000 + 2000 = \mathbf{6000 \text{ cal}}$$

iii(a) **Find the difference between humid air and dry air.**

If relative humidity of air is more than 60%, air is called humid, and if the relative humidity is less than 60%, the air is called dry air.

(b) **When 'm' kg of a substance of specific heat capacity 'c' J/ °C kg cools from temperature 'T' to 'T₀', how much heat energy will be lost by it?**

Heat energy lost by the substance = $mc(T - T_0) \text{ J}$

iv **What is relative humidity? Write the formula for % relative humidity?**

The ratio of actual mass of vapour content in the air for a given volume and temperature to that required to make the air saturated with vapour at that temperature is called the relative humidity.

$$\% \text{ relative humidity} = \frac{\text{actual mass of water vapour content in the air in a given volume}}{\text{mass of vapour needed to make the air saturated in that volume}} \times 100$$

v Which will spend more electrical energy? 500 W T.V. Set in 30 mins, or 600 W heater in 20 mins?

Ans: The energy consumed by T.V. set is **more** than that consumed by heater.

Explanation:

For T.V. set: Power = 500 W,

Time = 30 min = 30 × 60 s

∴ Energy = Power × time

$$E_1 = 500 \times 30 \times 60 = 900 \times 10^3 \text{ J}$$

For Heater: Power = 600 W,

Time = 20 min = 20 × 60 s

∴ Energy (E₂) = 600 × 20 × 60 = 720 × 10³ J

Comparing E₁ and E₂, E₁ > E₂

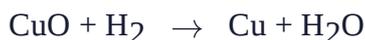
∴ Energy spent by T.V. set (E₁) is greater.

Q.3 Answer the following. (Attempt any 5) (15)

i(a) What is the reaction called when oxidation and reduction take place simultaneously? Explain with one example.

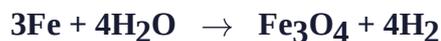
i. The reaction in which oxidation and reduction takes place simultaneously is called a redox reaction.

ii. **Example:**



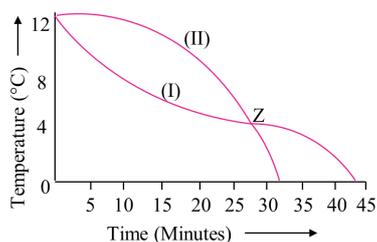
In this reaction, CuO loses oxygen to form Cu. This means that reduction of CuO takes place. H₂ molecule takes up oxygen to form H₂O. This means that oxidation of H₂ takes place. Both the oxidation and reduction reactions always occur simultaneously.

(b) Identify oxidizing agent in the following reaction:



H₂O

ii Time versus temperature graph for two thermometers is plotted as shown below.



i. For which of the thermometers, variation of temperature vs time, is depicted by plot (I)?

ii. What does the point Z in the above graph denote?

iii. In what temperature range, water displays anomalous behaviour?

- i. Thermometer B.
- ii. Point Z denotes temperature at which density of water is maximum.
- iii. 0 °C to 4 °C.

iii A thermally insulated pot has 200 g ice at temperature 0 °C. How much steam of 100 °C has to be mixed to it, so that water of temperature 40 °C will be obtained?

(Given: Latent heat of melting of ice = 80 cal/g, latent heat of vaporisation of water = 540 cal/g, specific heat of water = 1 cal/g °C)

Ans: 41.38 g of steam of 100 °C should be mixed.

Explanation:

Given: Mass of ice/ water (m) = 200 g, Change in temperature of water (ΔT) = 40 °C.

We know that: Latent heat of melting of ice = $L_{\text{melt}} = 80 \text{ cal/g}$

Latent heat of vaporisation of water = $L_{\text{vap}} = 540 \text{ cal/g}$

Specific heat of water $c_w = 1 \text{ cal/g } ^\circ\text{C}$

To find: Mass of steam (M)

Flow of heat: Loss of heat:

$\begin{array}{ccc} \text{steam} & \xrightarrow{Q_1} & \text{water} \\ (100^\circ\text{C}) & & (100^\circ\text{C}) \end{array} \quad \begin{array}{ccc} & \xrightarrow{Q_2} & \text{water} \\ & & (40^\circ\text{C}) \end{array}$

Gain of heat:

$\begin{array}{ccc} \text{ice} & \xrightarrow{Q_3} & \text{water} \\ (0^\circ\text{C}) & & (0^\circ\text{C}) \end{array} \quad \begin{array}{ccc} & \xrightarrow{Q_4} & \text{water} \\ & & (40^\circ\text{C}) \end{array}$

Formulae: i. Heat to be given off in converting steam into water at 100 °C (Q_1) = ML_{vap}

ii. Heat to be given off in cooling water at 100 °C to 40 °C (Q_2) = $M \times c_w \times \Delta T$

iii. Heat required to convert ice at 0 °C into water at 0 °C (Q_3) = $m \times L_{\text{melt}}$

iv. Heat required to raise temperature of water from 0 °C to 40 °C (Q_4) = $m \times c_w \times \Delta T$

Calculation: According to principle of heat exchange,

$$Q_1 + Q_2 = Q_3 + Q_4$$

From formulae (i) to (iv),

$$(M \times 540) + (M \times 1 \times 40) = (200 \times 80) + (200 \times 1 \times 40)$$

$$M(540 + 40) = 16000 + 8000$$

$$\therefore 580 M = 24000$$

$$\therefore M = \frac{24000}{580} = 41.38 \text{ g}$$

iv Two tungsten bulbs of wattage 100 W and 120 W power work on 220 V potential difference. If they are connected in parallel, how much current will flow in the main conductor?

Ans: The total current flowing in the main conductor is 1 A.

Explanation:

Given: Potential difference (V) = 220 V, Power of bulb 1 (P_1) = 100 W, Power of bulb 2 (P_2) = 120 W,

To find: Total current (I)

Formulae: i. $P = VI$ ii. $I = I_1 + I_2$

Calculation: Since both the bulbs are connected in parallel, the potential difference will be same.

From formula (i),

$$I_1 = \frac{P_1}{V} = \frac{100}{220} A,$$

$$I_2 = \frac{P_2}{V} = \frac{120}{220} A$$

From formula (ii),

Total current is given by,

$$I = \frac{100}{220} + \frac{120}{220} = \frac{100 + 120}{220}$$

$$\therefore I = \frac{220}{220}$$

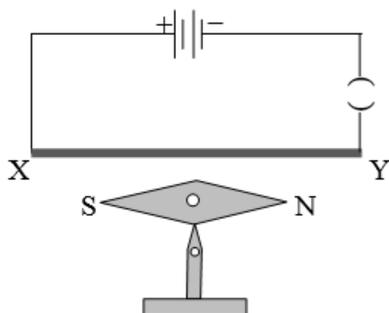
$$\therefore I = 1 A$$

v(a) **State different types of wires used for carrying electric power supply in household circuits.**

Following three types of wires are used for carrying electric power supply:

i. phase wire or live wire ii. neutral wire iii. earth wire

(b) **Which pole of the magnetic needle will move towards wire XY once current starts flowing through the circuit?**

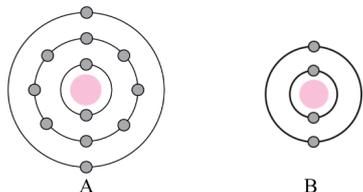


North pole of the magnetic needle will move towards wire XY.

(c) **Working principle of electric generator**

Magnetic effect of electric current

vi **Atoms of two different elements are represented in the following diagram.**



i. **Identify elements A and B.**

ii. **Do these elements belong to the same group? Justify your answer.**

iii. **Which element is more electropositive? Explain with reason.**

i. A is magnesium and B is beryllium.

ii. Yes, they belong to the same group as they have same number of valence electrons.

iii. Element A is more electropositive than element B. This is because electropositivity increases down the group with increase in atomic size.

vii **Complete the following table.**

Element	Atomic No.	Electronic configuration	Type of element

Sodium	11	2,8,1	Metal
Magnesium	12	2,8,2	–
–	13	2,8,3	Metal
Silicon	14	–	Metalloid
Phosphorus	15	2,8,5	–
–	16	–	Nonmetal
Chlorine	17	2,8,7	Nonmetal

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Sodium	11	2,8,1	Metal
Magnesium	12	2,8,2	Metal
Aluminium	13	2,8,3	Metal
Silicon	14	2,8,4	Metalloid
Phosphorus	15	2,8,5	Nonmetal
Sulphur	16	2,8,6	Nonmetal
Chlorine	17	2,8,7	Nonmetal

viii Explain the factors affecting the value of gravitational acceleration of the earth 'g'.

The following factors affect the value of gravitational acceleration of the earth 'g':

i. Shape of the earth:

- The shape of the earth is not perfectly spherical. It is slightly flattened at the poles and bulged at the equator.
- As a result, the radius of the earth at the poles is less than that at the equator.
- Hence, the value of 'g' is the highest at the poles (9.832 m/s^2) and decreases slowly with decreasing latitude. It is the lowest at the equator (9.78 m/s^2).

ii. Height:

- As the height of an object from the surface of the earth increases, the distance between the object and the centre of the earth (r) increases.
- As a result, the value of 'g' decreases with increase in height. However, the decrease is rather small for heights which are small in comparison to the earth's radius.

iii. Depth:

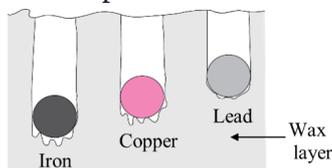
- The value of g is maximum on the surface of the earth.
- As depth of an object increases, the distance between the object and the centre of the earth (r) decreases.
- Along with the distance, the part of the earth which contributes towards the gravitational force felt by the object (M) also decreases.
- As a combined result of change in r and M, the value of g decreases as we go deep inside the earth.
- At the centre of the earth, the value of 'g' becomes zero.

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

Definition: 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 or specific heat capacity of that object.

Experimental verification:

- i. Solid spheres of iron, copper and lead of equal mass are put into a beaker containing boiling water till they reach a temperature of 100 °C.
- ii. The spheres are then taken out together and immediately placed on a thick slab of wax.

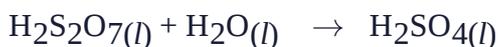


- iii. It is seen that each sphere travels to a different depth in the wax slab. The iron sphere goes the deepest followed by copper and lead spheres.
- iv. The sphere that absorbs more heat from water goes the deepest because it supplies more heat to wax, causing more wax to melt.
- v. This proves that for equal rise in temperature, the three spheres absorbed different amounts of heat. The property that determines the amount of heat absorbed by an object is called as specific heat capacity.

ii(a) Balance the following equation stepwise.



Step I: Write the chemical equation:



Step II: Compare the number of atoms of the various elements present on the two sides of the equation.

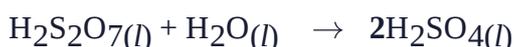
	Reactants (Left side)	Product (Right side)
Element	Number of atoms	Number of atoms
H	4	2
S	2	1
O	8	4

Step III: Choose the reactant or product having maximum number of atoms and equalize its atoms on both the sides. Equalize the number of atoms of remaining elements in the reactants and products.

$\text{H}_2\text{S}_2\text{O}_7$ has maximum number of atoms. First balance 'S' as it requires a smaller factor.

Number of S atoms	In the reactant (in $\text{H}_2\text{S}_2\text{O}_7$)	In the product (in H_2SO_4)
Initially	2	1
To balance	2	1×2

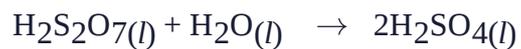
Apply a factor '2' to the product ' H_2SO_4 '.



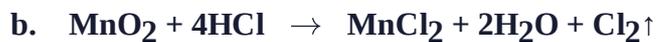
Check whether the equation is balanced.

The number of atoms of the elements in the reactants is same as the number of atoms of those elements in the product.

Step IV: Write down the final balanced equation.



(b) Some more examples of redox reaction are as follows. Identify the reductants and oxidants from them.



a. H_2S is reductant while SO_2 is oxidant.

b. HCl is reductant while MnO_2 is oxidant.