MT

2018 ___ ___ 1100

MT - SCIENCE & TECHNOLOGY - I (72) - SEMI PRELIM - II : PAPER - 4

Time : 2 Hours **(Model Answer Paper)** **Max. Marks : 40**

A.1. (A) Solve the following questions :

(1) The focal length of a **convex lens** lens is positive. **1**

(2) Biogas **1**

(3) Colour-blindness : It is a deficiency disease while others are defects. **1**

(4) False - La stands for Lanthanum. **1**

(5) If the value of 'G' is doubled, then the gravitational force (F) also will get doubled. **1**

A.1. (B) Choose the correct alternative and rewrite the sentences :

(1) Iron oxide **1**

(2) The angle of incidence should be **0°**. **1**

(3) The weight of body gradually decreases from **poles to equator**. **1**

(4) Na **1**

(5) To obtain an image of the same size as the object with the help of a convex lens, the object should be placed **at $2F_1$**. **1**

A.2. Solve the following questions : (Any 5)

(1) Copper reacts with dilute nitric acid to form copper nitrate, water and nitric oxide gas. **2**

$$3Cu_{(s)} + 8HNO_{3(aq)} \longrightarrow 3Cu(NO_3)_{2(aq)} + 2NO_{(g)} + 4H_2O_{(l)}$$

Copper — dil. Nitric acid — Copper nitrate — Nitric oxide — Water

(2) (a) The light undergoes refraction 2 times. **2**

(b) Angle of incidence (i) is equal to angle of emergence(e).

(3) **Groups and Periods of Modern Periodic Table** **2**

Groups	Periods
(i) Vertical columns of elements in the Modern Periodic table are called Groups.	(i) Horizontal rows of elements in the Modern Periodic table are called periods.
(ii) There are 18 groups in the Modern Periodic table.	(ii) There are 7 periods in the Modern Periodic table.
(iii) The group number indicates the valence electrons in the outermost shell.	(iii) The period number indicates the number of shells in the atoms of an element.
(iv) The elements in the same group have similar chemical properties.	(iv) The elements in a period exhibit gradual change in properties from left to right.

(4) **Given:** Distance from star = R
Time of Revolution = T
New distance = 2R

To find: New time T_N = ?

Formula: $\frac{T^2}{R^3} = k$

Solution: Case (i)

$$\frac{T^2}{R^3} = k \text{ .....(i)}$$

Case (ii)

$$\frac{T_N^2}{(2R)^3} = k \quad \text{OR} \quad \frac{T_N^2}{8R^3} = k \text{.....(ii)}$$

From (i) and (ii)

$$\frac{T_N^2}{8\cancel{R^3}} = \frac{T^2}{\cancel{R^3}}$$

$$T_N^2 = 8T^2$$

$$T_N = \sqrt{8T^2}$$

$$T_N = \sqrt{8}\,T$$

2

(5) (i) When HCl is added to Shahabad stone effervescence of CO_2 is formed. **2**
(ii) The CO_2 effervescence is formed slowly with the pieces of Shahabad tiles while at the faster speed with the powder.
(iii) This is because the rate of a reaction depends upon the size of the particles of the reactants taking part in the reaction.
(iv) Smaller the size of the reactant particles, higher is the rate of the reaction.
(v) Hence, it takes time for pieces of Shahabad tile to disappear in HCl, but its powder disappears rapidly.

(6) **2**

Name of the element	Symbol	Atomic Number	Electronic Configuration			
			K	L	M	N
Potassium	K	19	2	8	8	1
Sodium	Na	11	2	8	1	
Beryllium	Be	4	2	2		

Atomic radius is the distance between centre of the atom and its outermost shell.
From the electronic configuration of the above elements, it is seen that atom of Be has 2 shells, atom of sodium has 3 shells and atom of K has 4 shells, the outermost shells go aways from the nucleus extending the radius respectively. Therefore Be atom has smallest atomic radius.

(7) (i) A magnifying glass works on the principle of simple microscope. **2**
(ii) When an object is placed within the focal length of a convex lens we get a virtual, erect and magnified image on the same side of the lens.
(iii) This principle is used by the watch repairer to see the small parts more clearly. Hence, watchmakers use a magnifying glass while repairing wristwatches.

A.3. Solve the following questions : (Any 5)

(1) (i) Gravitational force is directly proportional to product of masses. **3**
(ii) Gravitational force is inversely proportional to square of the distance.
(iii) G is universal constant of gravitation. Therefore its value remains the same even on moon i.e. 6.67×10^{-11} Nm^2/kg^2

(2) (a) **Optical centre (O) :** **3**
The imaginary point on the lens through which the light ray passes undeviated is called optical centre.

(b) (i) The minimum distance at which an object is placed from the normal eye so that it can be seen clearly without giving any strain on the eye is called the distance of the distinct vision.
(ii) This distance is 25 cm for a normal human eye.
(iii) If the object is placed at a distance less than 25 cm, ciliary muscles are unable to adjust the lens, there is a strain on the eye and it cannot be seen clearly.
(iv) Hence an object should be placed at 25 cm or more to have a clear and sharp image of it on the retina.

(3) (a) Mirage **1**
(b) Refraction of light or Total internal Reflection. **1**
(c) Formation of Rainbow. **1**

(4) The process in which taste and smell of food gets spoiled is called rancidity. It happens due to oxidation. **3**
Prevention from rancidity.
(i) Antioxidants are added to fattyacids to prevent oxidation. E.g. Chips are packed in presence of nitrogen gas which prevents spoilage by oxidation.
(ii) Food should be kept in airtight container in refrigerator.

(5) **3**

Given: Mass (m) = 3 kg

Displacement (s) = 125 m

$g = 10\ m/s^2$

Initial velocity (u) = 0 m/s

To find: Time (t) = ?

Final velocity (v) = ?

Height ($h_{t/2}$) = ?

Formulae: $s = ut + \frac{1}{2} gt^2, v = u + gt$

Solution: Case (i)

$s = ut + \frac{1}{2} gt^2$

$125 = 0 \times t + \frac{1}{\cancel{2}_1} \times \cancel{10}^{5} \times t^2$

$125 = 5t^2$

$\frac{\cancel{125}^{25}}{\cancel{5}_1} = t^2$

$t^2 = 25$

$t = 5$ s

Case (ii)

$v = u + gt$

$= 0 + 10 \times 5$

$v = 50$ m/s

Case (iii)

$$\text{time} = \frac{t}{2} = \frac{5}{2} \text{ s}$$

$$s = ut + \frac{1}{2} gt^2$$

$$= 0 + \frac{1}{\cancel{2}_{1}} \times \cancel{10}^{5} \frac{25}{4}$$

$$= \frac{125}{4} = 31.25 \text{ m}$$

But $h = 125 - s$

$= 125 - 31.25$

$= 93.75$ m

(i) Time taken by the ball to reach the ground is 5s.
(ii) Velocity of ball on reaching ground is 50 m/s.
(iii) Height of ball at half time is 93.75 m.

(6) **Oxidation Reaction :** **3**

The chemical reaction in which a reactant combines with oxygen or loses hydrogen to form the product is called oxidation reaction.

For example :

(1) $2Mg_{(s)} + O_{2(g)} \rightarrow 2MgO_{(s)}$

Magnesium Oxygen Magnesium oxide

(2) $2Cu_{(s)} + O_{2(g)} \rightarrow 2CuO_{(s)}$

Copper Oxygen Copper oxide

(3) $MgH_2 \rightarrow Mg + H_2$

Magnesium hydride Magnesium Hydrogen

(7) Atomic masses of some elements were revised so as to give them proper place in the periodic table in accordance with their properties. For example, the previously determined atomic mass of beryllium, 14.09, was changed to the correct value 9.4, and beryllium was placed before boron. **3**

Mendeleev kept vacant places in the periodic table for elements not discovered till then. Three of these unknown elements were given the names eka-boron, eka-aluminium and eka-silicon from the known neighbours and their atomic masses were indicated as 44, 68 and 72, respectively. Not only this but their properties were also predicted. Later on these elements were discovered and named as scandium (Sc), gallium (Ga) and germanium (Ge) respectively. The properties of these elements matched well with those predicted by Mendeleev.

There was no place reserved for noble gases in Mendeleev's original periodic table. However, when noble gases such as helium, neon and argon were discovered towards the end of nineteenth century, Mendeleev created the 'zero' group without disturbing the original periodic table in which the noble gases were fitted very well.

A.4. Solve the following questions : (Any 1)

(1) (a) $\mathbf{Ag_{(s)} + HCl_{(aq)} \rightarrow AgCl \downarrow + H_2 \uparrow}$ **2**

Step 1: Write the chemical equation and count the numbers of atoms on both sides.

$Ag + HCl \rightarrow AgCl + H_2$ .....(1)

Elements	No. of atoms in reactants	No. of atoms in products
Ag	1	1
H	1	2
Cl	1	1

Step 2: From the above table, we see the number of atoms of hydrogen on reactant side is not balanced. So, to balance hydrogen atom, we write coefficient 2 for HCl.

$Ag + 2HCl \rightarrow AgCl + H_2$ .....(2)

Again count the number of atoms of elements on both sides.

Elements	No. of atoms in reactants	No. of atoms in products
Ag	1	1
H	2	2
Cl	2	1

Step 3: Now to balance chlorine, we write coefficient 2 for AgCl

$Ag + 2HCl \rightarrow 2AgCl + H_2$ .....(3)

Again count the number of atoms of elements on both sides.

Elements	No. of atoms in reactants	No. of atoms in products
Ag	1	2
H	2	2
Cl	2	2

Step 4: Atoms of element, hydrogen and chlorine are now balanced. Number of atoms of Ag on product side is 2, and on reactant side is 1 to balance number of atoms of Ag on reactant side, we write coefficient 2 for Ag.

$\therefore 2Ag + 2HCl \rightarrow 2AgCl + H_2$ .....(4)

Now equation (4) is a balanced equation.

(b) The rate of reaction depends upon the following factors. **3**

(i) Nature of the reactants:

(a) $2NO_{(g)} + O_{2(g)} \rightarrow 2NO_{2(g)} \longrightarrow$ Fast

$2CO_{(g)} + O_{2(g)} \rightarrow 2CO_{2(g)} \longrightarrow$ Slow

These reactions appear to be similar but the first is fast while second is slow. This is due to the difference in the amounts of energies which are required for breaking up of different bonds and different amounts of energies are released in the formation of different bonds.

(b) $2Al + 6HCl \rightarrow 2AlCl_3 + 3H_2$

$Zn + 2HCl \rightarrow ZnCl_2 + H_2$

On reaction of both Al and Zn with dilute hydrochloric acid H_2 gas is liberated and water soluble salts of there metals are formed. However the reaction of aluminium metal takes place faster as compared to zinc metal. The nature of metal is responsible for this difference. Al is more reactive than Zn. Therefore the rate of reaction of Al with hydrochloric acid is higher than that of zinc. Nature of reactivity of reactants influences the rate of a chemical reaction.

(ii) Concentration of the reactants:

Greater the concentration of the reactants, faster is the reactions

conversely, as the concentrations of the reactants decreases the rate of reaction also decreases Dilute HCl reacts slowly with $CaCO_3$ and thereby $CaCO_3$ disappears slowly and CO_2 also liberate slowly, On the other hand the reaction with concentrated HCl takes place rapidly and $CaCO_3$ disappears fast. Concentrated acid reacts faster than dilute acid, which means that rate of reaction is proportional to the concentration of reactants.

(iii) Temperature:
The rate of reaction increases with increases of temperature. In most of the cases, the rate of reaction becomes nearly double for 10k rise of temperature. In some cases, reactions do not take place at room temperature but take place at higher temperature.

(iv) Presence of catalyst:
A catalyst generally increases the speed of a reaction without itself being consumed in the reaction. In case of reverse reactions, a catalyst helps to attain the equilibrium quickly without disturbing the state of equilibrium.

(v) Size of the particles of reactants:
For a reaction involving a solid reactant or catalyst, the smaller is the particle size, greater is the surface area, and the faster is the reaction.

(vi) Presence of light:
Some reactions do not take place in the dark but can take place in the presence of light like photosynthesis or photochemical reactions.

(2) **Kepler's laws:** **5**

(i) Kepler's first law : The orbit of a planet is an ellipse with the Sun at one of the foci.

(ii) Kepler's second law : The line joining the planet and the Sun sweeps equal areas in equal intervals of time.

(iii) Kepler's third law : The square of its period of revolution around the Sun is directly proportional to the cube of the mean distance of a planet from the Sun.

Newton's Universal Law of Gravitation states that : Every object in the universe attracts every other object with a force, which is directly proportional to the product of their masses and inversely proportional to the square of the distance between their centres.

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