

MT

2018 ____ 1100

MT - SCIENCE & TECHNOLOGY - I (72) - SEMI PRELIM - II : PAPER - 2

Time : 2 Hours

(Model Answer Paper)

Max. Marks : 40

A.1. (A) Solve the following questions :	
(1) In the dispersion of sunlight through glass prism the violet light deviates the most.	1
(2) Catalyst	1
(3) Long-sightedness : It is corrected by convex lens while others are corrected by concave lens.	1
(4) False - Isotopes are atoms of the same element having same atomic number but different atomic masses.	1
(5) At poles : 9.83 m/s^2 : : At equator : 9.78 m/s^2 .	1
A.1. (B) Choose the correct alternative and rewrite the sentences :	
(1) A chemical reaction involves in Both breaking and formation of bonds .	1
(2) We can see the sun even when it is little below the horizon because of refraction of light .	1
(3) For a convex lens, if the incident ray is parallel to the principal axis, then the refracted ray passes through the principal focus .	1
(4) In p-block of the Modern Periodic table the non-metals are found.	1
(5) The periodic time of a planet is 'T' and the mean distance of the planet from the Sun is 'r', then according to Kepler's third law $T^2 \propto r^3$.	1
A.2. Solve the following questions : (Any 5)	
(1) Sulphur dioxide and hydrogen sulphide react to form sulphur and water. $\begin{array}{ccccccc} \text{SO}_2 & + & 2\text{H}_2\text{S} & \rightarrow & 3\text{S}\downarrow & + & 2\text{H}_2\text{O} \\ \text{Sulphur} & & \text{Hydrogen} & & \text{Sulphur} & & \text{Water} \\ \text{dioxide} & & \text{sulphide} & & & & \end{array}$	2
(2) Given: $r = 1 \text{ m}$ $m_1 = 75 \text{ kg}$ $m_2 = 80 \text{ kg}$ $G = 6.67 \times 10^{-11} \text{ Nm}^2/\text{kg}^2$ To find: Force (F) = ?	2

Formula: $F = \frac{Gm_1m_2}{r^2}$

Solution:

$$F = \frac{6.67 \times 10^{-11} \times 75 \times 80}{1^2}$$

$$F = 6.67 \times 10^{-11} \times (6 \times 10^3)$$

$$= 40.02 \times 10^{-8}$$

$$= 4.002 \times 10^{-7} \text{ N}$$

The gravitational force between Mahendra and Virat is $4.002 \times 10^{-7} \text{ N}$

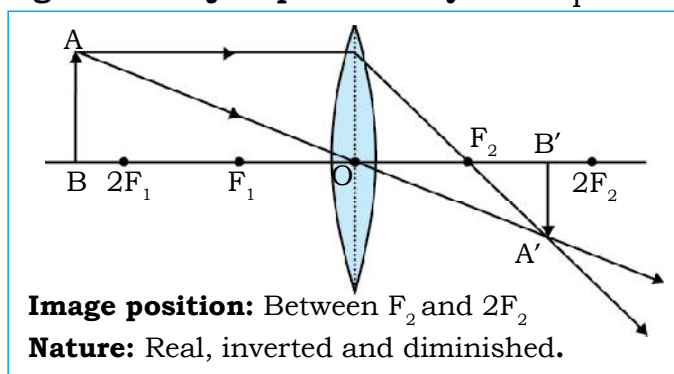
(3) **Inert gases and Normal Elements :**

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Inert gases	Normal Elements
(i) In the atoms of inert gases all the shells are completely filled including outermost shell.	(i) In the atoms of normal elements, all shells are completely filled except for outermost shell.
(ii) They are stable and chemically inert (i.e. chemically non-reactive)	(ii) They are unstable and are chemically reactive.
(iii) They are included in the p-block of the Modern Periodic table.	(iii) They are included in the s-block as well as p-block of Modern Periodic table.
(iv) They are placed in zero group (Group 18) of the Modern Periodic table.	(iv) These elements are placed in groups 1, 2 and 13 to 17 of the Modern Periodic table.

(4) **A ray diagram for object position beyond $2F_1$ for a convex lens.**

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- (5) (i) On heating limestone, it undergoes thermal decomposition to form calcium oxide (quick lime) and carbon dioxide.
- $$\text{CaCO}_{3(s)} \xrightarrow{\Delta} \text{CaO}_{(s)} + \text{CO}_{2\uparrow}$$
- quick lime
- (ii) Calcium oxide dissolved in water forms calcium hydroxide (lime water).
- $$\text{CaO}_{(s)} + \text{H}_2\text{O}_{(l)} \rightarrow \text{Ca(OH)}_{2(aq)}$$
- Calcium hydroxide
- (iii) When carbon dioxide is passed through lime water it turns milky due to formation of white precipitate of calcium carbonate.
- $$\text{Ca(OH)}_{2(aq)} + \text{CO}_{2(g)} \rightarrow \text{CaCO}_{3(s)} + \text{H}_2\text{O}_{(l)}$$
- Calcium carbonate

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(6)

Name of the element	Symbol	Atomic Number	Electronic Configuration		
			K	L	M
Aluminium	Al	13	2	8	3
Silicon	Si	14	2	8	4
Sodium	Na	11	2	8	1
Magnesium	Mg	12	2	8	2
Sulphur	S	16	2	8	6

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All the elements given belong to period 3. Metallic character of an element can be defined as how readily an atom can lose electron. From left to right across a period, metallic character decreases. This is because, electrons are added to the same shell, and hence, these electrons experience greater pull from the Nucleus, thus atomic size decreases, and it becomes difficult to remove an electron from the atom. As in Sodium (2,8,1), only one electron is present in the outermost orbit. So it easily loses this one electron because of weaker Nuclear attraction, so it possesses highest metallic character.

- (7) **Given:** $n_{vac} = 1.36$
 $v_{vac} = 3 \times 10^8 \text{ m/s}$

To find: $v_w = ?$

Formula: $n_{vac} = \frac{v_{vac}}{v_w}$

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Solution: $1.36 = \frac{3 \times 10^8}{v_w}$

$$v_w = \frac{3 \times 10^8}{1.36}$$

$$v_w = 2.21 \times 10^8 \text{ m/s}$$

The velocity of light in water is $2.21 \times 10^8 \text{ m/s}$

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

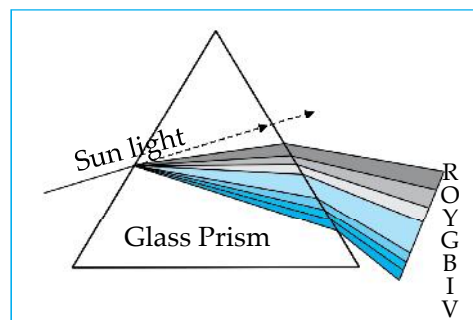
- (1) (a) The angle of incidence is called as Critical angle.
 (b) Mirage **OR** Rainbow formation.
 (c) a) Light should travel from denser medium to rarer medium.
OR
 b) Angle of incidence should be greater than critical angle.

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- (2) (i) The eye defect is myopia.
 (ii) The two possible reasons of myopia :
 (a) Curvature of cornea and eye lens increases, converging power of lens becomes large.
 (b) Eyeball elongates and distance between lens and retina increases.
 (iii) Concave lens of suitable focal length can correct this defect.

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(3) **Dispersion of light :**



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- (i) The process of separation of light into its component colours while passing through a medium is called dispersion of light.
 (ii) Refractive index of a medium is different for different colours.
 (iii) When white light enters a single medium like glass, every colour refracts through different angle.
 (iv) When white light from the sun through air, enters any refracting medium, it emerges as a spectrum of seven colours.
 (v) Sir Issac Newton was the first person to use a glass prism to obtain sun's spectrum.

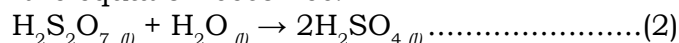
(4)	<p>When oxidation and reduction take place simultaneously in a given reaction it is termed as Redox reaction. During oxidation a reactant combines with oxygen or loses hydrogen and during reduction it gains hydrogen or loses oxygen.</p> <p>Example of Redox reaction:</p> $ \begin{array}{c} \text{oxidation (O}_2 \text{ added)} \\ \downarrow \qquad \qquad \qquad \downarrow \\ 2\text{H}_2\text{S} + \text{SO}_2 \rightarrow 3\text{S} + 2\text{H}_2\text{O} \\ \uparrow \qquad \qquad \qquad \uparrow \\ \text{reduction (O}_2 \text{ lost)} \end{array} $ <p>In the above reaction, SO₂ is reduced and H₂S is oxidised.</p>	3
(5)	<p>(i) Gravitational force is directly proportional to product of masses.</p> <p>(ii) Gravitational force is inversely proportional to square of the distance.</p> <p>(iii) G is universal constant of gravitation. Therefore its value remains the same even on moon i.e. $6.67 \times 10^{-11} \text{ Nm}^2/\text{kg}^2$</p>	3
(6)	<p>Endothermic Reaction :</p> <p>A reaction in which heat is either absorbed from the surrounding or has to be supplied continuously from outside is called as endothermic reaction. e.g. melting of ice, dissolution of potassium nitrate in water. During the process of dissolution of potassium nitrate (KNO₃) in water, heat from the surroundings is absorbed and therefore the temperature of the resulting solution is less. The process in which heat is absorbed from outside is called endothermic process.</p> $ \begin{array}{ccccccc} \text{KNO}_{3(s)} & + & \text{H}_2\text{O}_{(l)} & + & \text{Heat} & \rightarrow & \text{KNO}_{3(aq)} \\ \text{Potassium} & & \text{Water} & & & & \text{Potassium Nitrate} \\ \text{Nitrate} & & & & & & \text{solution} \end{array} $	3
(7)	<p>All elements in a group have the same number of electrons in the outermost shell. Therefore, down the group, valency remains the same. Valency of group 1 elements is 1 and that of group 2 elements is 2. The valency of group 18 elements is zero because they are noble gases with completed outermost shell.</p>	3
A.4.	<p>Solve the following questions : (Any 1)</p>	
(1)	<p>(a) Step 1: Write the equation and then count the number of atoms of each element on the R.H.S. and L.H.S. of the arrow.</p> <p>$\text{H}_2\text{S}_2\text{O}_7 + \text{H}_2\text{O} \rightarrow \text{H}_2\text{SO}_4 \dots\dots\dots(1)$</p>	2

Elements	No. of atoms in reactants (L.H.S.)	No. of atoms in products (R.H.S.)
H	4	2
S	2	1
O	8	4

Step 2: Check whether no. of atoms on both sides is equal. It is seen from the above table number of atoms of all the elements on the two sides are not the same.

Step 3: To balance the number of atom on both sides. We write coefficient 2 for H_2SO_4 .

Now the equation becomes.



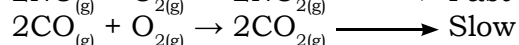
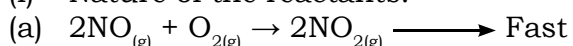
Now see that the number of atoms of each elements are equal on both sides.

Elements	No. of atoms in reactants	No. of atoms in products
H	4	4
S	2	2
O	8	8

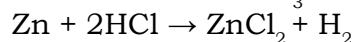
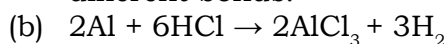
Hence, the equation (2) is a balanced equation.

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

(i) Nature of the reactants:



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.



On reaction of both Al and Zn with dilute hydrochloric acid H_2 gas is liberated and water soluble salts of their 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

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	<p>reaction.</p> <p>(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.</p> <p>(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.</p> <p>(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.</p> <p>(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.</p> <p>(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.</p> <p>(2) Escape velocity : The minimum initial velocity needed by an object projected upwards to overcome Earths gravitational force and not fall back on Earth is called escape velocity.</p> <p>On surface of Earth</p> <p>(A) $\text{K.E.} = \frac{1}{2} m v_{\text{esc}}^2$</p> <p>(B) $\text{P.E.} = - \frac{\text{GMm}}{\text{R}}$</p> <p>(C) $\text{T.E.} = \text{P.E.} + \text{K.E.}$</p> $E_1 = \frac{1}{2} m v_{\text{esc}}^2 - \frac{\text{GMm}}{\text{R}}$ <p>At infinity</p> <p>(A) $\text{K.E.} = 0$</p>	5
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$$(B) \quad \text{P.E.} = - \frac{GMm}{\infty} = 0$$

$$(C) \quad \text{T.E.} = \text{P.E.} + \text{K.E.} \\ = 0 + 0 = 0$$

According to law of conservation of energy.

$$E_1 = E_2$$

$$\frac{1}{2} mv_{\text{esc}}^2 - \frac{GMm}{R} = 0$$

$$\frac{1}{2} mv_{\text{esc}}^2 = \frac{GMm}{R}$$

$$v_{\text{esc}}^2 = \frac{2GM}{R}$$

$$v_{\text{esc}} = \sqrt{\frac{2GM \times R}{R \times R}}$$

$$v_{\text{esc}} = \sqrt{\frac{2GM \times R}{R^2}} \quad \dots \left[g = \frac{GM}{R^2} \right]$$

$$v_{\text{esc}} = \sqrt{2gR}$$

For Earth, $v_{\text{esc}} = 11.2 \text{ km/s}$.

