MARKING SCHEME CHEM. P1.

1. (a) - Soil colloids: Are very small organic and inorganic particles present in the soil responsible for potential fertility of the soil and determine the physical and chemical properties of the soil. (1)

- Soil colloids can be formed as (i) When soil formed during weathering process some minerals and organic matter broken down into extremely small particles. (1)
  (ii) Due to chemical changes which reduce these particles until they can not be seen with our naked eye.

(b) Significance of C.E.C

i) It is a measure of soil fertility
ii) It a measure of nutrients retention capacity. (2)
iii) Help to protect ground water from cation contamination.
iv) Used in the expression of the cation value.

(c) Solution:

$molarity = \frac{Conc}{Mr}$

$Conc = 1 \times 0.1 = 0.1$

$Conc = \frac{n}{V}$ 001/2

$n = 0.1 \times 4 \times 10^{-3}$

$n_{H^+} = 0.004$ moles (001/2)

Remaining HCl will react with NaOH hence HCl was in excess

$molarity = \frac{Conc}{Mr}$ 001/2

$Conc = 0.1 \times 40 = 4 g/dm^3$

$Conc = \frac{n}{V}$ (001/2)

$n = 4 \times 24 \times 10^{-3} = 0.0024$ moles (001/2)

Then mole used $= 0.004 - 0.0024 = 0.0016$ moles was the moles of H^+ attached to the colloids (1)

Then, from

$1\ eq = 1$ mole of H^+ ---(*) (001/2)

0.0016 eq. was in 250g of the soil
x 100g (1)

$= 0.8$ meq/100g

From, $P.B.S = \frac{\sum EB}{CEC} \times 100\%$

$= \frac{0.8\ meq/100g}{25\ meq/100g} \times 100\%$ (1)

$P.B.S = 3.2\%$

2. (a) (i) Sodium (Na) = $1s^2 2s^2 2p^6 3s^1$

(ii) Iron (Fe) = $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^6$ 01/2 @

(iii) Barium (Ba) = $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^{10} 5p^6 6s^2$

(iv). Bromine (Br) = $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^5$.

(b) i) Refer to the region of space around an atomic nucleus where there is high probability of finding an electron. 01

ii) - S-orbitals :- Are spherical in shape and have no angular nodes.
• They are labelled as 1s, 2s, 3s etc where ~~by~~ the front number show the principal quantum number (n) and (s) show the type of orbital, where (n) indicate the energy level of the orbital. 01/2

- P-orbitals :- Are dumbbell-shaped and have two lobes with nodes at the nucleus. They are labelled as 2P, 3P, 4P etc. 01/2

P-orbital occurs in different orientations as (P_x, P_y, P_z) along the X, Y and Z axes respectively.

(c) Orbits in Bohr's Atomic model (Theory) are fixed, circular paths with specific radii and energies, While ~~Orb~~ 02

orbitals :- Are three-dimensional regions of space with varying probabilities of finding an electron.
- orbitals based on the probabilistic nature of $\bar{e}$ and describe their behavior according to the principles of quantum numbers. 02

3. (a) Given Radiation energy = 4.8 eV.
plank's constant (h) —
mass of an electron —
~~From~~ De-Brogile wavelength (λ) = ?
from $\lambda = \frac{h}{\sqrt{2meV}}$ substitute.

$\lambda =$ 03

(b) Heisenberg Uncertainty Principle challenges the notion of Bohr's Theory of the atom that $\bar{e}$ move in well-defined orbits with precise positions and velocities. 03 1/2
According to Bohr's theory, $\bar{e}$ occupy specific energy levels and move in circular orbits around the nucleus. However the Uncertainty Principle state that it is impossible simultaneously to exact determine the position and momentum of the particles ~~of~~ like $\bar{e}$. the more precisely we try to measure one of these properties the less precisely we can know the other. This uncertainty in determining both position

3. and momentum of $\bar{e}$ contradicts the idea of orbits as proposed by Bohr's theory,

© The Heisberg Uncertainty Principle and the wave nature of particles are not practical ways of examining the behaviors of macroscopic objects b/se the effects of quantum mechanics become negligible on macroscopic scale, macroscopic scale have large mass and high energy compared to subatomic particles, the wavelength of macroscopic object is small, making any wave-like behavior undetectable. Therefore uncertainties introduced by the uncertainty principle become insignificant at macroscopic scales, as the uncertainties become extremely small compared to size of object. 03/6

4. (a) i) Boyles law state ii) Graham's law of diffusion state (3) iii) Avogadro's law

(b) From, Ideal gas law eqn, $PV = nRT$

P- Pressure in atm, V- volume in litre, n- number of mole (mol) and T- Temperature in kelvin (k).

Then, $P = 1atm$, $V = 22.4L$ (Avogadros number) (4)

$n = 1mole$. $R = Constant$ $T = 273K$ (0c)

then $R = \frac{PV}{nT} = \frac{1atm \times 22.4L}{1mol \times 273K} = 0.08205 \, atm \, L \, mol^{-1} K^{-1}$

(c) (1) # The gas is composed of large number of molecules moving in random direction, separated by distances that are large compared to their size (2)

\# Molecules undergo perfect elastic collisions (no energy loss) with each other.

(ii) When the temperature is very high and the pressure is very low. (1)

5. (a) The yellow liquid is PCl_3. It is hydrolysed in air to form HCl which fumes since it absorbs water vapor from the atmosphere. (3)

(b) i) The outer most $\bar{e}$ in mg and Al are delocalized and free to move hence allow the flow of electric current. (2)

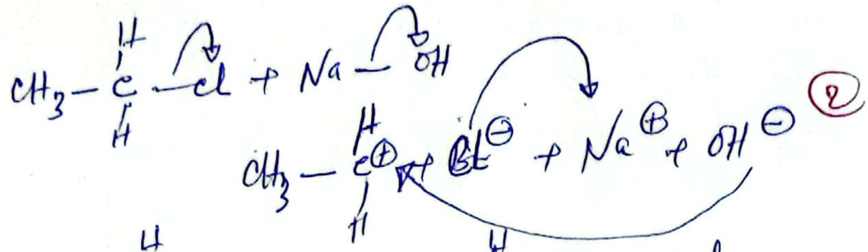
ii) Aluminum form protective coat and prevents further corrosion. (1)

(c) i) Potassium — Sodium — Lithium. (1)

ii) Lithium has small atomic radius compared to others. The outermost $\bar{e}$ are attracted very strongly by the nucleus charges. A lot of energy is required to pull out the outer most $\bar{e}$. Since atomic radius decrease from K to Li (02)

6. (a) (i) Ability to forming multiple bonds among carbon to carbon atoms.
(ii) Undergo catenation tendency. ½ (a)
(iii) It show isomerism.
(iv) Having variation in oxidation state.

(b) Rexn mechanism for $CH_3CH_2Cl + NaOH \rightarrow CH_3CH_2OH + NaCl$.



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$\therefore$ $CH_3CH_2Cl + NaOH \rightarrow CH_3CH_2\text{—}OH + NaCl$.

(c) (i) HCOOH is more acidic than CH_3COOH b/se CH_3 group is CH_3COOH (2) denote electrons density and distable the conjugate base that lower the acidic of CH_3COOH.
(ii) CH_2FCOOH is more acidic than $CH_2ClCOOH$ b/se OH bond in CH_2FCOOH is very weak than in $CH_2ClCOOH$ due to strong negative inductive effects due to presence of F which is more electronegative than Cl atom. (2)
(iii) CH_2FCOOH is more acidic than CH_3COOH b/se it's conjugated base is stabilized by negative inductive effects caused by F atom. (2)

7. (a) Hess's law states the overall changes in energy of a process can be calculated by breaking it down into parts then adding energy changes of each phase. (3) But Born-Haber cycle it is employed to find the electronic affinity, crystal energy and lattice energy.
(b) The stability can not be solely explained by enthalpies of ionic (2) b/se of the solid stru molecular formation. Those molecules are more stable due to their lattice energy.
(c) Born-Haber cycle used to calculate lattice energy for only elements with low ionization energy b/se elements with high IE cannot be recovered the resulting lattice energy. (3)

(d) Example of Born-Haber Cycle:-
i) A solid magnesium atom sublimes to a gaseous atom by absorbing heat energy (H subli). (1)
ii) magnesium atoms in gaseous form emit two ē with matching ionization in two stages. (1)

8. (a) i) molality: Is the number of moles of solute dissolved in 1000g of the solvent.

ii) mole fraction: Is the fraction obtained by dividing the number of moles of that constituents by the total number of moles of all constituents present in the solution.

iii) Normality: Is the number of grames equivalent of the solute dissolved in per litre of the given soln. 1@

iv) molarity: The number of moles of solute dissolved in per litre of the solution.

v) strength: - Is the amount of solute in gram present in 1 litre of the soln. denoted as g/dm^3.

vi) mass fraction: Is the mass of the given components per unit mass of the solution.

(b) To be Ideal solution: - should be no change in enthalpy when two components mixed.
- should no be volume change. 1@
- should obey Raoult's law.

(c) (a) Examples of osmotic processes are: -
i) Absorption of water from the soil through the roots of plants.
ii) water transport through plants body. ½@
iii) stretching of leaves is due to osmosis.
iv) Opening and closing of flowers is due to osmosis.

(d) Ideal soln: Is the soln in which the intermolecular interaction btn their components are the same as that of the liquid itself. 4
While, Non-ideal soln: - Is the one in which solute & solvent molecules interact with one another with different forces of interaction btn molecules of the pure components..

9. (a) When rexn having reached equal means that the forward rexn rate equal to backward rexn rate, with regard to con and moles or amount in reactant and product there is no change due to forward rexn rate being equal to the backward rexn rate. 5

(b) It is not correct to say the rexn has "stopped" when it has as reached equilibrium b/se no necessary static process where it can be assumed that the rexn rates cancel each other out to equal zero or be stopped but rather a dynamics process in which reactants are converted to products at the same rate products are converted to reactants. eg. Soda has co_2 dissolved in the liquid and the cap that usually exchanged with each other. 5

Consider the simple rexn equation.

$$CO_{2(g)} + 2H_2O_{(l)} \rightleftharpoons H_2CO_3\ (aq).$$

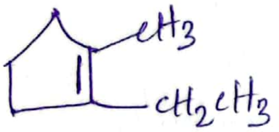
5

(c) Chemical equilibrium is described as dynamic process b/ce there is a movement in which the forward and reverse rexn occur at the same rate to reach a point where the amount/constituents of the reactants and products are unchanging with time. chemical rexn in saturated in saturated soln of NaCl as on the the macroscopic level, Na^+ and Cl^- ions continues leave the surface of an NaCl crystal to enter the soln, while at the same time Na^+ and Cl^- ions in the soln precipitate on the surface of the crystal.

10 (a) ~~i~~ i)

i)  $\xrightarrow[Zn/H_2O]{O_3}$ $H-\overset{O}{\overset{\|}{C}}-CH_2CH_2CH_2CH_2-\overset{O}{\overset{\|}{C}}-H$ 2

ii) $H_2C=\underset{CH_3}{\underset{|}{C}}-CH=CH_2 \xrightarrow[Zn/H_2O]{O_3} O=\underset{CH_3}{\underset{|}{C}}-\underset{H}{\underset{|}{C}}=O + 2\ \overset{O}{\overset{\|}{C}}(H)-H.$ 2

iii)  $\xrightarrow[Zn/H_2O]{O_3}$ $CH_3-\overset{O}{\overset{\|}{C}}-CH_2CH_2CH_2-\overset{O}{\overset{\|}{C}}-CH_2CH_3.$ 2

(b) (i) The structure formula of the organic hydrocarbon is

$$CH_3-\overset{CH_3}{\overset{|}{CH}}\cdot CH_2CH=CH_2.$$ 1

- All possible rexn taking places are :-

- $CH_3\overset{CH_3}{\overset{|}{CH}}-CH_2CH=CH_2 \xrightarrow[CCl_4]{Br} CH_3-\overset{CH_3}{\overset{|}{CH}}-CH_2-\overset{Br}{\overset{|}{CH}}-\overset{Br}{\overset{|}{CH_2}}$ 2

- $CH_3-\overset{CH_3}{\overset{|}{CH}}-CH_2CH=CH_2 \xrightarrow{H_2SO_4} CH_3-\overset{CH_3}{\overset{|}{CH}}-CH_2-\underset{OSO_3H}{\underset{|}{CH}}-CH_3.$ 2

- $CH_3-\overset{CH_3}{\overset{|}{CH}}-CH_2CH=CH_2 \xrightarrow[Ni]{H_2} CH_3-\overset{CH_3}{\overset{|}{CH}}-CH_2CH-CH_3.$ 2

- $CH_3-\overset{CH_3}{\overset{|}{CH}}-CH_2CH=CH_2 \xrightarrow[Zn/H_2O]{O_3} CH_2-\overset{CH_3}{\overset{|}{CH}}-CH_2-\overset{O}{\overset{\|}{C}}(H) + \overset{O}{\overset{\|}{C}}(H)-H$ 2