Section A (MCQ)

Q1/

$1 \text{ mole} = 6.02 \times 10^{23}$ molecules

$\therefore 3 \times 10^{-21}$ mol $= 6.02 \times 10^{23} \times 3 \times 10^{-21}$ molecules

$= 1800$ molecules

Ans: C

Q2/ Consider mass of fertiliser to be 100 g

30 % P_2O_5 = 30 g

$M_r(P_2O_5) = 142$

$\Rightarrow$ 142 g P_2O_5 contain 2×31 g P

30 g $\rightarrow \frac{2 \times 31}{142} \times 30$ g P

$= 13.1$ g P

$\therefore$ 100 g fertiliser = 30 g P_2O_5 = 13.1 g P

% P in fertiliser $= \frac{13.1}{100} \times 100$

$= 13.1$ %

Ans: B

Q3/ Equation: $C_6H_{12} + 9O_2 \rightarrow 6CO_2 + 6H_2O$

$\frac{M_P}{M_Q} = \frac{\text{Mass of } H_2O \text{ produced}}{\text{Mass of } CO_2 \text{ produced}}$

- 1 mol of $C_6H_{12} \rightarrow$ 6 mol of H_2O

$= 6 \times 18$ g $H_2O = 108$ g

- 1 mol $C_6H_{12} \rightarrow$ 6 mol of CO_2

$= 6 \times 44$ g CO_2

$= 264$ g

$\frac{M_P}{M_Q} = \frac{108}{264} = 0.41$

Ans: A

Q4/ $^{262}_{105}Unp$

$p = 105$

$e = 105$

$n = 262 - 105$

$= 157$

Ans: B Isotopes : same number of protons / different nucleon no.

Q5/ Abrupt rise between 5th & 6th ⇒ X has 5 outershell electrons

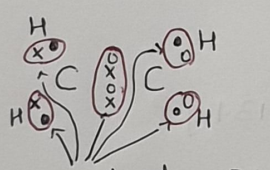
⇒ X is in group V

∴ Valency 3

$X_3 \; Cl_1 \Rightarrow XCl_3$

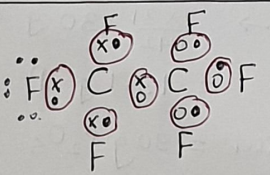
Ans: C

Q6



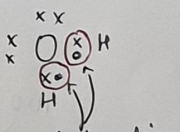
12 bonding e⁻s

A



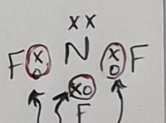
14 bonding e⁻s

B



4 bonding e⁻s

C



6 bonding e⁻s

D

Ans: D

Q7

A D^- : H^- (mass 2)

$p = 1$

$e = 2$

$n = 1$

B H_3O^+ : H_3O^+ (mass 1, 16)

$p = 3(1) + 8 = 11$

$e = 11 - 1 = 10$

$n = 3(1-1) + 1(16-8)$

$= 8$

C OD^- : OD^- (mass 16, 2)

$p = 8 + 1 = 9$

$e = 9 + 1 = 10$

$n = (16-8) + (2-1)$

$= 9$

D OH^- : OH^- (mass 16, 1)

$p = 9$

$e = 9 + 1 = 10$

$n = 8$

Ans: D

Q8 Ans: B

neighbour 1 $3s^2$ ← 2nd e⁻ removed is from 3s/closer to the nucleus

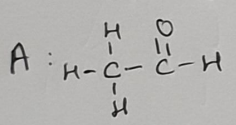
B $3s^2 3p^1$

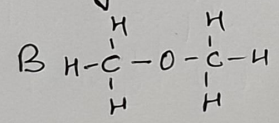
neighbour 2 $3s^2 3p^2$ ← 2nd e⁻ is removed from 3p subshell which is further away from the +ve nucleus.

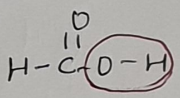
But neighbour 1 has smaller Nuclear Charge & 3s electrons are weakly attracted ∴ less energy.

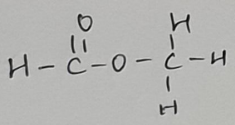
Q9 Ans: C

Hydrogen bonding: Must contain O–H bond

A: 

B 

C 

D 

Q10 Ans: D

$BaO_2 \rightarrow Ba^{2+} + O_2^{2-}$ ← gain of 2 electrons (●) by each oxygen

peroxide ion

Section B

Q1/ (a)(i) Down the group the increasing shielding/screening effect outweighs the increasing nuclear charge
- nucleus weakly attracts the outershell electrons
- outershell electrons get further away from the nucleus

(ii) 3rd electron is removed from an inner shell which is closer to the nucleus and strongly held.

(b) (i) $_{38}Sr$ $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 5s^2$

(ii) Strontium has 4 isotopes

(iii) $A_r = \frac{(0.56 \times 84) + (9.86 \times 86) + (7.00 \times 87) + (82.58 \times 88)}{100}$

$= 87.7$

(c) Boiling points show an increase down the group due to the increasing strength of intermolecular van der Waal's forces with increasing number of electrons.

(d) (i)

Atom	F	I
%	42.8	57.2
A_r	19	126.9
$\frac{\%}{A_r}$	$\frac{42.8}{19}$	$\frac{57.2}{126.9}$
	$= 2.25$	0.45
Divide by smallest	$\frac{2.25}{0.45}$	$\frac{0.45}{0.45} = 1$
	$= 5$	

Empirical formula = IF_5

$n \times IF_5 = 222$

$n \times (126.9 + 5(19)) = 222$

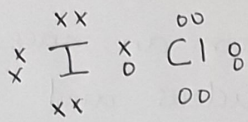
$n \times 222 = 222$

$n = 1$

Molecular formula $= 1 \times IF_5$

$= IF_5$

(iii)



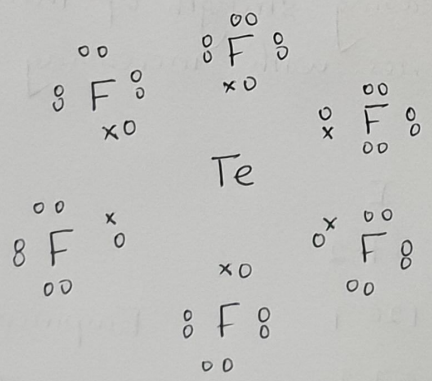
ICl would be polar as chlorine is more electronegative than iodine.

Q2/ (a)

4	0	tetrahedral	CH_4
		pyramidal	NH_3
		Non linear / bent	H_2O

(b)

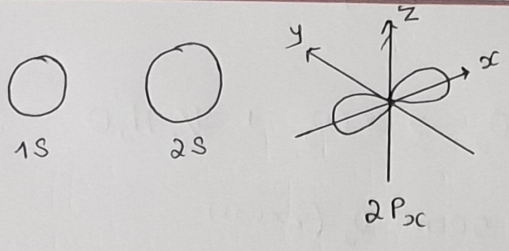
(i)



(ii) Octahedral

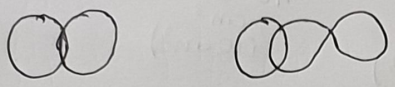
(iii) 90^0

Q3 (a)



(b) (i) Electrostatic forces of attractions between the negatively charged shared pair of electrons and the positively charged protons in the nuclei of the atoms.

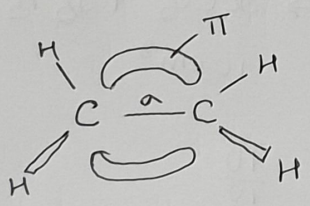
(ii) H_2 HCl



(c) (i) Dipole moment $\delta+$ and $\delta-$ on the atoms forming the bond.

(ii) Chlorine is more electronegative than hydrogen. Chlorine exerts a greater pull of the bonded pair of electrons.

(d)



Q4/

(a) It is the actual number of atoms in a molecule of a substance.

(b) $C_xH_y + (x + y/4)O_2 \rightarrow xCO_2 + y/2\ H_2O$

(c) $10\ cm^3\ A + 50\ cm^3\ O_2$ (excess)

↓ explode

$CO_2 + H_2O + O_2$ (excess)

$40\ cm^3$ gas remained

↓ KOH (Absorbs CO_2)

x's O_2 ($30\ cm^3$)

$40 - 30\ cm^3$ ($10\ cm^3$)

Since H_2O is a liquid at r.t.p, it has no contribution in the volume of gas

(i) Excess O_2

(ii) Carbon dioxide

(iii) $40 - 30\ cm^3 = 10\ cm^3$

(iv) volume of O_2 used up $= 50 - 30$
$= 20\ cm^3$

(d) $C_xH_y + (x + y/4)O_2 \rightarrow xCO_2 + y/2\ H_2O$

	C_xH_y	O_2	CO_2
volume reacted/ produced	$10\ cm^3$	$20\ cm^3$	$10\ cm^3$
volume ratio ($\div 10$)	$10/10 = 1$	$\frac{20}{10} = 2$	$\frac{10}{10} = 1$

$x = 1$

$x + y/4 = 2$

$y/4 = 2 - x$

$y = 4(2 - x)$

$= 4(2 - 1)$

$= 4$

M.F = CH_4