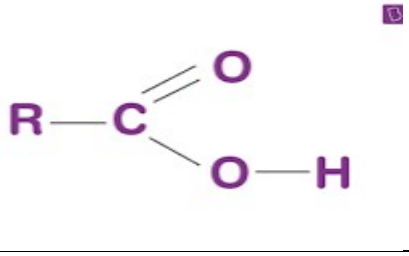
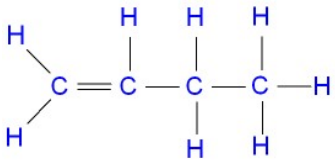
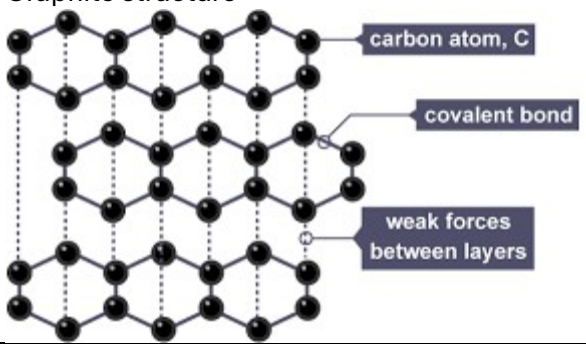
4E Chem 2024 Prelim Paper 1 Ans

1	2	3	4	5	6	7	8	9	10
A	C	A	B	C	A	D	B	C	B
11	12	13	14	15	16	17	18	19	20
C	B	B	B	A	C	B	A	D	C
21	22	23	24	25	26	27	28	29	30
B	B	B	C	D	C	A	B	B	C
31	32	33	34	35	36	37	38	39	40
A	D	B	D	A	B	D	A	D	B

Qn	Explanation
1	A. Carbon dioxide produced when calcium carbonate reacts with dilute hydrochloric acid. Carbon dioxide subsequently reduced when heated with charcoal (carbon) to form carbon monoxide. Excess carbon dioxide which is an acidic oxide will be removed when bubbled through sodium hydroxide. Carbon monoxide is a neutral oxide and will not react with sodium hydroxide.
2	C 1. Fractional distillation to separate two miscible liquids 2. Separation funnel to separate two immiscible liquids 3. Simple distillation to obtain solvent from a solution
3	A. Mr Helium:4 ; carbon dioxide: 44; carbon monoxide: 28; nitrogen: 28; hydrogen; 2 Mr of gas 1 must be lower than gas 2 so that rate of diffusion of gas 1 is faster than gas 2 into the porous pot, and therefore exert a greater pressure.
4	B. Argon: monoatomic Chlorine, Cl_2: diatomic Nitrogen, N_2: diatomic Mixture of 1 monoatomic particle and 2 different diatomic particles.
5	C. Double bond present in -COOH and O=O 
6	A. $2Al^{3+} + 3O^{2-} \rightarrow Al_2O_3$ $2Al \rightarrow 2Al^{3+} + 6e$

7	D Electrical conductivity of metals and ionic compound are as follows Aqueous/molten ionic compound → mobile ions Metals and graphite → mobile electrons
8	B. 
9	C Electronic configuration P: 2.4 Q: 2.8.2 R. 2.8.3 S:2.6 Ionic: R_2S_3 Covalent: PS_2
10	B ^{243}X differ from ^{239}X by having 4 more neutrons and therefore higher density.
11	C Graphite structure 
12	B From the graph, 100 cm^3 (0.1dm^3) of 0.600 mol/dm^3 reacts with 50 cm^3 of potassium iodide. 1 mole of potassium iodide reacts with 1 mole of silver nitrate (mole ratio from eqn) (m1v1)/(m2v2) = n1/n2 conc = (0.1 x 0.6)/0.05 = 1.2 mol/dm^3

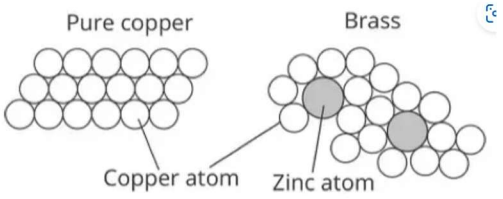
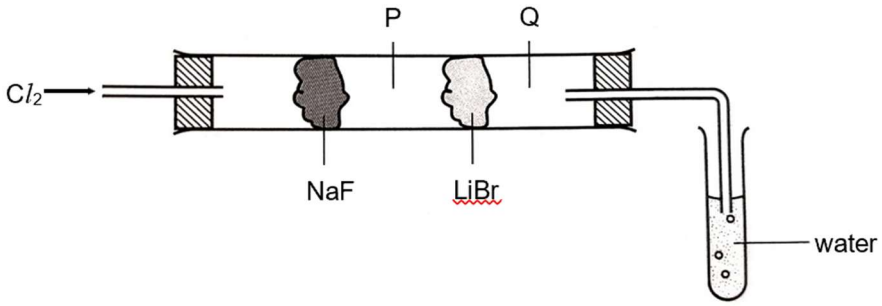
1 3	B Mass of MO = 1.12g Molar ratio 1 MO : 1 CO_2 Mol of CO_2 = mol of MO = 0.48 dm^3/24 Mr of MO = mass/mol = 1.12/ (0.48/24) **Ar** of M = Mr of MO – Ar of O = Mr of MO – 16 = [1.12/ (0.48/24)] - 16
14	B **A** 0.5 mol of $\mathbf{C_6}H_{12}$ [0.5 x **6** = 3] **B** 1.5 mol of $\mathbf{C_4}H_8$ [1.5 x **4** = 6] **C** 3.0 mol of $\mathbf{C_3}H_7OH$ [3 x **3** =9] **D** 6.0 mol of $\mathbf{C_2}H_6$ [6 x **2**=12] No of mol in 144 dm^3 of carbon dioxide = 144/24 = 6 mole Hint: use the **number of moles of the substance and multiply by the number of carbon atoms in the molecule.** e.g 1.5 mol of C_4H_8 = 1.5 x 4 = 6 mol
15	A Purity of 36% = 36 g of calcium bromide present Formula = $CaBr_2$ Mr of $CaBr_2$ = 200 Mr of $2Br^-$ = 160 Mass of Br = 160/200 x 36 = 28.8g
16	C Molar ratio C_4H_6 : O_2 : CO_2 2 : 11 : 8 100 : 550 400 100 cm^3 of butyne reacts with 550 cm^3 of oxygen to produce 400 cm^3 of CO_2. Excess O_2 = 660 - 550 = 110 110 $cm^3$of oxygen in excess and left behind. Total volume of gas = 110 + 400 = 500 cm^3

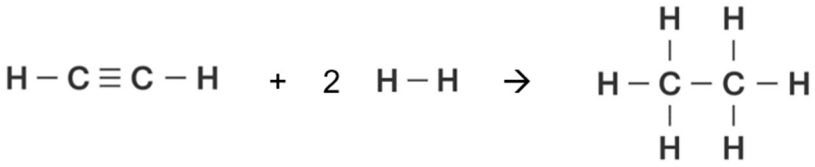
<table>
<tr><td>17</td><td>B
aqueous sodium chloride and aqueous silver nitrate (Precipitation reaction)
➔ Sodium nitrate and silver chloride
$NaCl + AgNO_3 \rightarrow AgCl + NaNO_3$(2 salts)</td></tr>
<tr><td>18</td><td>A
Use of alkali will result in reaction with ammonium salts in the fertilizers which results production of ammonia gas and loss of nitrogen to environment.
Alkali + ammonium salt → salt + water + ammonia gas</td></tr>
<tr><td>19</td><td>D
Solution X is more acidic than solution Y therefore has a higher concentration of hydrogen ions.</td></tr>
<tr><td>20</td><td>C
<table>
<tr><th>step</th><th>test</th><th>observations</th></tr>
<tr><td>1</td><td>Dissolve 5 g of P in 10 ml of water.</td><td>Green solution formed. (Hint of iron (II) ions)</td></tr>
<tr><td></td><td>Add 2 cm^3 of the solution into two test tube.</td><td></td></tr>
<tr><td>2</td><td>To the first test tube, add aqueous ammonia dropwise.

Allow the mixture to stand for 5 minutes.</td><td>Green precipitate formed in green solution. (QA: Iron(II) ions present)

Green precipitate turns into reddish-brown precipitate. (Iron (II) ions oxidised to iron(III) ions)</td></tr>
<tr><td>3</td><td>To the second test tube, add an equal volume of nitric acid and followed by aqueous barium nitrate.</td><td>White precipitate formed in the green solution. (QA: sulfate ions is present)</td></tr>
</table></td></tr>
<tr><td>21</td><td>B
Oxidation state of underlined element
HNO_3 : +5
CaSO_4 : +6
FeO : -2
NaHCO_3 :+4</td></tr>
<tr><td>22</td><td>B
acidified aqueous potassium manganate(VII): test for reducing agent (RA) – purple to colourless
potassium iodide: test for oxidising agent (OA) – colourless to brown
Q: Both RA and OA
R: OA
S: RA
T: no RA, no OA

Both Q and S contains RA</td></tr>
</table>

23	B **RA** **OA** $Ba(s) + 2H^+(aq) \rightarrow Ba^{2+}(aq) + H_2(g)$ 0 +1 +2 0 Ba acts as a reducing agent: reduces H from +1 in H+ to 0 in H_2. Ba is oxidised.
24	C 1 A X atom(2.6) ~~loses~~ **gains** 2 electrons to form **X^{2-} ion**. X 2 **X** burns with hydrogen to form a neutral oxide(**H_2O**).√ 3 X is a strong oxidising agent.√ 4 X is found in ~~Group 2~~ of the Periodic Table X (**group 16**) X X^{2-} → electronic configuration of 2.8 (oxide ion) An atom of X → 2.6 ➔ Gained 2 electrons to form the ion ➔ Proton no: 8 → oxygen. Burns with hydrogen to produce water which is a neutral oxide ➔ Oxygen gains electron easily to form oxide ions → strong oxidising agent (gains electron from the other atom) ➔ Group 16
+2 5	D 
26	C  Halogen displacement→ more reactive halogen displaces less reactive halogen Reactivity: F_2 (pale-yellow)>Cl_2 (yellow-green)>Br_2(red-brown) P: Chlorine **unable** to displace F_2 from NaF, chlorine remains (yellow-green) Q: Chlorine **displaces** bromine from LiBr to form bromine gas. (red-brown) Water: bromine gas dissolves in water (reddish brown solution)

27	A $Fe + CuSO_4 \rightarrow FeSO_4 + Cu$ Displacement of metal. Iron is more reactive than copper metal. Iron will displace copper from copper(II) sulfate solution to form reddish-brown solids (copper metal) on the surface of the container. Solution will turn from blue to pale green.
28	B Key concepts Displacement of metal → More reactive metal displaces less reactive metal from its solution Carbonate very reactive metals do not undergo thermal decomposition (typical of Group 1 metal carbonate) • The metals form cations Q^{2+}, R^{2+}, S^{+} and T^{2+}. • When a piece of solid Q is placed in a solution of T^{2+} ions, **a layer of solid T** is formed on the piece of solid Q. [**Q > T**] • **No reaction** when a piece of solid Q is placed in a solution containing R^{2+} ions. [**Q < R**] • Only the carbonate of S does not undergo thermal decomposition. [**S is group 1 carbonate and does not decoompose on heating**] • T reacts with hydrochloric acid to produce hydrogen gas. [**T is above H]** S> R> Q> T
29	B **A** combustion of fuels {**exothermic**} **B** Melting (**endothermic-**energy taken in) **C** reaction of acid with metals (**exothermic)** **D** reaction of alkali metals with water(**exothermic**) Positive enthalpy change which products has higher energy level than reactant → endothermic process
30	C  Enthalpy change = Energy taken in for bond-breaking in reactants – energy given out during bond-forming 2C- H C≡C 2 H-H 6C-H C-C Enthalpy change = + (2 x413 + 839 + 2 x432) – (6x413 + 347) = 2529 – 2825 = -296 kJ/mol

31 A

No of mole of ammonia formed = no of mole of nitrogen

A 1.0 mol $(NH_4)_3PO_4$ [1 x **3**]

B 1.0 mol $(NH_4)_2SO_4$ [1 x 2]

C 2.0 mol NH_4Cl [2 x 1]

D 2.0 mol NH_4NO_3 [2 x1]

A → 3 mole of ammonia
B → 2 mole of ammonia
C → 2 mole of ammonia
D → 2 mole of ammonia

32 D

The reaction is reversible

$N_2 + 3H_2 \rightleftharpoons 2NH_3$

33 B

Cobalt(II) nitrate solution, ions Co^{2+}, NO^{3-}, H^+ , OH^-

Cobalt ions preferentially discharged at platinum foil cathode, $Co^{2+}(aq) + 2e \rightarrow Co(s)$ (gain electrons / reduced)

Hydroxide ions preferentially discharged at graphite rod anode,

$4OH^-(aq) \rightarrow \mathbf{O_2}(g) + 2H_2O(l) + 4e$ (lose electrons/ oxidised)

Graphite rod reacts with oxygen to produce CO_2

34 D

Hydrogenation results in increased in mp and bp.

Unsaturated organic molecules have one or more C=C bonds.

R and T are isomers→ same chemical formula, different structural formula.

S has longest chain of carbon and therefore highest mp/bp.

35 A

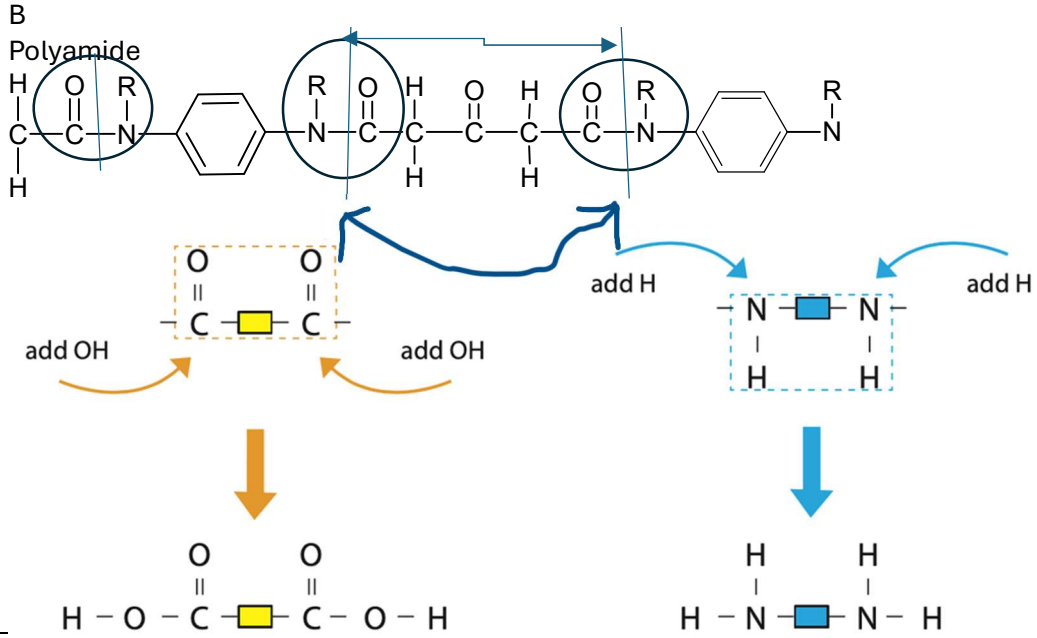
test	results
aqueous bromine	Negative (no C=C)
acidified potassium manganate(VII) solution	Negative (No -OH)
sodium carbonate solution	Negative(no -COOH)

aqueous bromine → test for unsaturated organic compounds

acidified potassium manganate(VII) solution → oxidise alcohol to carboxylic acid

sodium carbonate solution → reacts with carboxylic acid to form carbon dioxide

Therefore X is unsaturated (no C=C), not an alcohol (no -OH) and not a carboxylic acid (no -COOH)

36	B Polyamide 
37	D Halogens reacts with alkanes in a substitution reaction. 1 mol of **propane** reacts with 2 mol of chlorine gas in a reaction
38	A The monomers used to form nylon are dicarboxylic acid and diamine The monomers used to form terylene are dicarboxylic acid and diol
39	D Unburnt hydrocarbons are oxidised to form carbon dioxide Nitrogen monoxide is reduced to form nitrogen gas
40	B Carbon dioxide produced when acidic flue gases (SO_2) reacts with calcium carbonate. $SO_2 + CaCO_3 \rightarrow CaSO_3 + CO_2$

	type of reaction	formula of organic product
A	addition	$C_3H_4Cl_4$ [C_3H_4 has triple bond added with $2Cl_2$]
B	addition	**$C_3H_6Cl_2$** [C_3H_6 added with terylene]
C	substitution	$C_3H_2Cl_6$ [C_3H_8 substituted with $3Cl_2$]
D	**substitution**	$C_3H_6Cl_2$ [C_3H_8 substituted with $2Cl_2$]