**2024 Prelim Chem Paper 2**

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| 1(a) | $SO_2$ or $NO_2$<br>**Poly(ethene) is a <u>macromolecule</u>** whereby the boiling point will be higher than those with simple covalent structure.<br>**$SO_2$ or $NO_2$ has <u>simple covalent structure</u>**<br>with <u>molecular mass greater than 32</u> so their boiling point will be higher than oxygen due to the **<u>stronger intermolecular forces of attraction</u>**. | 1<br>1<br><br><br><br>1 |
| (b) | $NH_3$ | 1 |
| (c) | ZnO | 1 |
| (d) | CO /$SO_2$ | 1 |
| (e) | $NH_3$ | 1 |
| (f) | $K_2O$ | 1 |
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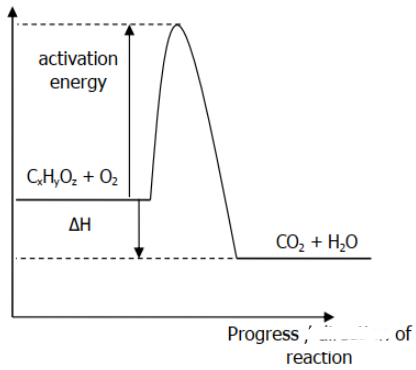
| 2(a) | $H^+$<br>any suitable indicator eg moist blue litmus turns red<br>OR<br>Add magnesium , lighted splint extinguished with a pop sound.<br>OR<br>Add carbonate, white precipitate formed in limewater. | 1<br>1 |
| (b) | Potassium hydroxide/potassium carbonate and phosphoric acid<br>Titration | 1<br>1 |
| (c) | Add acidified aqueous silver nitrate<br>White ppt observed<br><br>Aqueous lead(II) nitrate max 1m | 1<br>1 |
| (d) | Mole of Na+ = (156/1000)/23 = 0.00678 mol OR Mole of Na+ = (48/1000)/23 = 0.00209 mol<br>AND<br>Mole of Cl- = (127/1000)/35.5 = 0.00358 mol OR Mole of Cl- = (39/1000)/35.5 = 0.00110 mol<br><br>For every mole of NaCl, no of mole of Na+ = No of mol of Cl-. Since there are more mole of Na+ than Cl-, there are other compounds of sodium. | <br><br><br>1<br><br>1 |
| (e) | Energy<br>  <br><br>Shape of graph [1]<br>Label axes with units and include correct reactant and product [1]<br>Enthalpy change and activation energy [1]<br>Level diagram 2m max<br>Endo 1m max | 3 |

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| (f) | (i)yeast, $37^0$C, darkness, no air | 0.5 ea |
| | (ii) $C_2H_5OH + 3O_2 \rightarrow 2CO_2 + 3H_2O$ and<br>$C_6H_{12}O_6 \rightarrow 2C_2H_5OH + 2CO_2$<br><br>$6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$<br><br>not balance -1m | 1<br><br>1 |
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| 3(a) | Stage IV | 1 |
| (b) | No, a catalyst provides an alternative pathway with <u>lower activation energy</u> but the <u>enthalpy change remains unchanged as the energy of reactant and product remain the same.</u> | 1<br><br>1 |
| (c) | Stage I: S is oxidised as its oxidation state increases from 0 to +4 in $SO_2$ and $O_2$ is reduced as its oxidation state decreases from 0 to -2 in $SO_2$<br>OR<br>Stage II: $SO_2$ is oxidised as the oxidation state of S increases from +4 in $SO_2$ to +6 in $SO_3$ and $O_2$ is reduced as its oxidation state decreases from 0 in $O_2$ to -2 in $SO_3$ | 1<br>1 |
| (d) | Stage II is a <u>reversible reaction</u>.<br>*Some of the sulfur trioxide decompose to sulfur dioxide *at the same time/immediately | 1 |
| (e) | $2S+ 3O_2 + 2H_2O \rightarrow 2H_2SO_4$<br>Not balanced : 0m | 1 |
| (f) | (i) $NO_2$<br>Nitrogen and oxygen in air react in the high temperature at the combustion engine<br>OR lightning<br><br>NO/oxides of nitrogen [0] | 1<br><br>1 |
| | (ii) $Zn + 2H^+ \rightarrow Zn^{2+} + H_2$<br>OR<br>$CaCO_3 + 2H^+ \rightarrow Ca^{2+} + CO_2 + H_2O$ | 1 |
| | (iii) $CaCO_3$ | 1 |
| | (iv) It causes respiratory problems | 1 |
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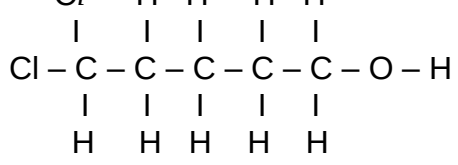
| 4(a) |  <br>*OH must be at the first C<br>Change the position of Cl | 1 |
| (b) | <u>Steam</u><br>High temperature, high pressure, phosphoric (V) acid as catalyst<br><u>Chlorine</u> under UV light | <br>1<br>1 |

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| (c) | Aqueous bromine: pent-1-ene decolourises the reddish-brown bromine spontaneously whereas 1,2-dichloropentanol has no visible change.<br><br>OR warm with acidified potassium manganate(VII) – 1,2-dichloropentanol will decolourise the purple $KMnO_4$ but pent-1-ene shows no visible change<br><br>Reagent – 1 mark<br>Observation – 1 mark ea | 3 |
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| 5(a) | Statement 1: AgCl /$PbCl_2$ are insoluble in water.<br>Statement 3: Chlorine is a stronger oxidising agent than bromine cos it can gain electrons more readily than bromine. | 1,1<br>1,1 |
| (b) | (i) $2Fe + 3Cl_2 \rightarrow 2FeCl_3$<br>not balanced [0m] | 1 |
| | (ii) $Cl_2$ gain electrons to become chloride ion | 1 |
| | (iii) addition of aqueous sodium hydroxide/aqueous ammonia , a green ppt is form<br><br>Wrong reagent 0m | 1 |
| | (iv) addition of acidified potassium manganate (VII)<br>Iron (II) chloride will decolourise the $KMnO_4$ but not iron(III) chloride. | 1<br>1 |

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| 6(a) | (i) | In Fig 6.1, there are two ions/pacticles/peaks which have different m/z values of 6 and 7[1]<br>This shows that these two ions have different number of neutrons.[1]<br><br>2 relative abundance 0m | 2 |
| | (ii) | Ar of Lithium = $\frac{3.75}{100}$x6 + $\frac{96.25}{100}$x 7 = 6.96 | 1 |
| (b) | There are3 possible combinations as follows:<br>2 atoms of chlorine -35 [1]<br>1 atoms of chlorine –Cl-35 and Cl-37[1]<br>2 atoms of chlorine -37 [1] | | 3 |
| (c) | (i) | Methane has a relative molecular mass of 16<br>The largest m/z value is 16 [1] | 1 |
| | (ii) | $CH^+$ | 1 |
| | (iii) | $CH_3Cl^+$ [1]<br>m/z value is 52[1] | 2 |
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| 7(a) | No visible change.[1]<br>Hydroethanoic does not dissociate/ionize in methylbenzene to form H+[1] | | 2 |
| (b) | the stronger the acid as the higher tendency for acid to produce $H^+$ ions and the lower the pH value. [1]<br>Hence with more mobile ions, conductivity will increase.[1] | | 2 |
| (c) | Hydroxypentanoic produces less effervescence per unit time during the reaction / rate of effervescence is slower. [1]<br>Less $H^+$ per unit volume / lower concentration of $H^+$ [1]<br>Frequency of collision between reactant particles is lower | | 3 |

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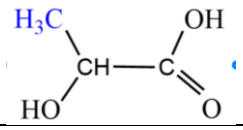
| | Frequency of effective collision is lower [1]<br>Speed of reaction is lower | | |
| (d) | (i) |  | 1 |
| | (ii) | Economical<br>It can be more expensive than disposal in landfills or incineration as it involves transporting the waste to the processing plant; sorting and cleaning of the waste; carrying out physical or chemical processes. | 1 |
| | (iii) | cracking | 1 |
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| 8(a) | (i) | $Zn \rightarrow Zn^{2+} + 2e$ | 1 |
| | (ii) | $Cu^{2+} + 2e \rightarrow Cu$ | 1 |
| (b) | (i) | Electrode Y is the cathode./negative electrode[1]Silver ions will be selectively discharged/reduces to form silver.[1] | 2 |
| | (ii) | Agee with James.<br>The same metals are used as electrodes. The voltage will be the same 0.42V[1].<br>The voltage will be negative as the direction of electron flow is different.[1]<br>Disagee with Megan.<br>Magnesium is more reactive than zinc.[1]<br>The further apart the reactivity of metal, the higher the voltage[1] | 4 |
| (c) | number of moles of $Cu^{2+}$ used = 0.5 x 1.0 = 0.5 mol<br>number of moles of Cu deposited = 19.2 ÷ 64 = 0.3 mol<br>calc of mole for both – 1m<br>number of moles of $Cu^{2+}$ remaining = 0.5 – 0.3 = 0.2 mol<br>concentration of $Cu^{2+}$ remaining = 0.2mol ÷ 0.5$dm^3$ = 0.4 mol/$dm^3$ [1] | | 2 |
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| 9(a) | C, A, B, D [1]<br>The more reactive the metal, the higher the thermal stability of the nitrates, [1] thus the higher the temperature/more energy needed to decompose its nitrate.[1] | | 3 |
| (b) | - Add metal E to aqueous nitrate of D ( or any metal the student identify as the most reactive ); [1]<br>- If solid metal D is seen to be deposited/coated on E/ E gets smaller;[1]<br>- E displaces D, therefore the most reactive. [1] | | 3 |
| (c) | - E is Mg/Al [0.5] extract by electrolysis [0.5] of its molten oxide [1]/<br>- E is Zn[0.5], extract by heating [0.5] the oxide with C or CO [1]/<br>- E is Fe[0.5], extract by heating ]0.5] the oxide with C/CO/$H_2$ [1] | | 2 |
| (d) | Mole of $Mg(NO_3)_2$ = 200000/[24 +2(14+16x3)] = 1351 mol<br>Mole of $NO_2$ = 2702 mol [1]<br>Mass of $NO_2$ = 2702 x 46 x 0.9= 111863 g[1] | | 2 |