Answer Scheme for 2019 Prelims Chemistry 6092/02

Section A [50 marks]

A1 **(a)** Ar [1]

(b) Ar and Ca [1]

(c) At and C [1]

(d) Na [1]

(e) Br [1]

(f) C and Pt [1]

[Total: 6]

A2 **(a)**

mixture	separation technique
iodine + sodium chloride	**sublimation [1]**
water + calcium sulfate	**filtration [1]**
ethanol + glucose solution	**fractional distillation [1]**

(b) (i) Soluble in organic solvent but insoluble in water. Low density. [2]

(b) (ii) It was stable on heating / did not decompose when it undergoes evaporation to dryness to remove the organic solvent. [1]

[Total: 6]

A3 **(a) (i)** 450 °C, 250 atm and Iron as catalyst. [2]

(b) (i) +92 kJ [1]

(b) (ii) No of mol of NH_3 = 230 / 92 x 2

= 5 [1]

(c) The total energy taken in for breaking 1 mol of N≡N bond and 3 mol of H-H bond is less than the total energy given out for forming 6 mol of N-H bond. Therefore energy is released resulting in the reaction being exothermic. [3]

(d) (i) As the no. of bonds between nitrogen atoms increases from single to triple bond, the bond energy increases from 160 kJ/mol to 941 kJ/mol. This is due to a stronger attraction between the nitrogen atoms due to more electrons shared between them, require more energy to break the bonds.

[2]

(d) (ii) 941 kJ [1]

[Total: 10]

A4 (a) Set–up **A**: Anticlockwise [1]

Set–up **B**: Clockwise [1]

(b) (i) Zn^{2+} (aq) + 2e → Zn (s) [1]

(b) (ii) The copper electrode in A will decrease in size whereas the copper electrode in B will increase in size. The blue aq. $CuSO_4$ colour will intensify in A whereas the blue aq. $CuSO_4$ colour will fade in B. [2]

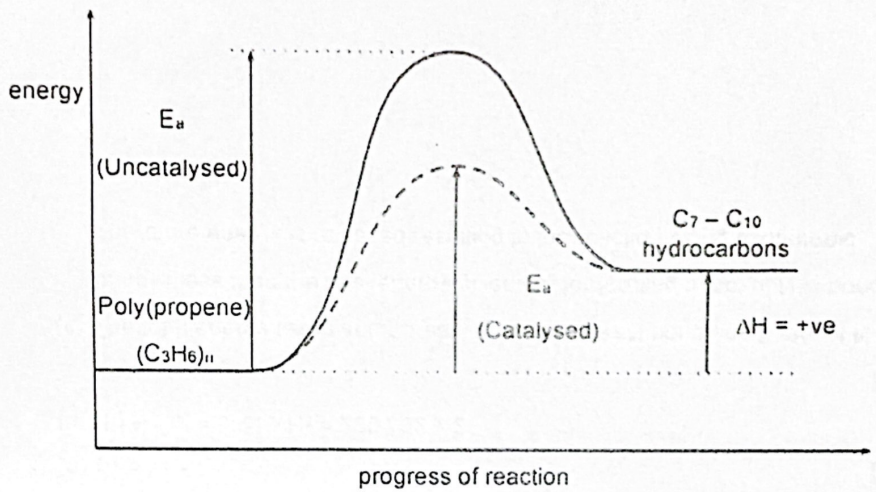
(c)

salt	formulae of starting reagents used	method used
$ZnSO_4$ (s)	**Zn (s) / ZnO (s) / $ZnCO_3$ (s)** ..... HCl (aq)	Adding of excess solid to acid **Filtration** ..... **Evaporation** ..... **Crystallization** .....
$CuSO_4$ (s)	**CuO (s) / $CuCO_3$ (s)** ..... HCl (aq)	

[2]

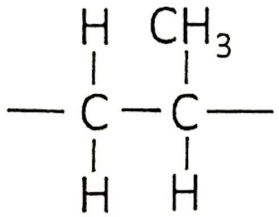
[Total: 7]

A5 (a)



[3]

(b) (i)



[1]

Empirical formula = CH_2 [1]

(For top right, diagram is not ideal. Should ensure that bond is drawn from carbon to carbon atom.)

(b) (ii) $2CH_2 + 3O_2 \rightarrow 2CO_2 + 2H_2O$ [1]

(b) (iii) No. of mol of poly(propene) = 1000 / (12+2)

= 71.42 [1]

Mole ratio of CO_2 : Poly(propene) = 2 : 2

∴ No. of mol of CO_2 = 71.42

Vol of CO_2 = 71.42 x 24

= 1714.28

= 1710 dm^3 (to 3 s.f.) [1]

(c) Advantage: Poly(propene) is durable and does not rust unlike iron. [1]

Disadvantage: Poly(propene) is non-biodegradable and would contribute to waste, pollution problems. [1]

[Total: 10]

A6 **(a) (i)** Propanedoic acid [1]

$HOOCCH_2COOH$ [1]

(a) (ii) $HOOC(CH_2)_nCOOH$ [1]

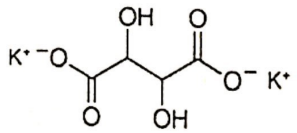
(b) The m.p. of dicarboxylic acid decreases as the no. of carbon atoms increases with the exception of butanedoic acid. [1]

(c) Disagree with the claim. It is unable to undergo condensation polymerization on its own as it only has carboxyl functional group. [1]

(d) (i) The term weak acid means the acid undergoes only partial dissociation in water to form H+ ions. [1]

The term dibasic acid means that every mole of acid produces 2 mole of H+ ions when dissociated in water. [1]

(d) (ii)



[1]

(d) (iii) Tartaric acid contain 2 carboxyl group (per molecule) whereas butanoic acid contains only 1 carboxyl group (per molecule).

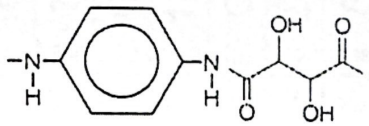
Tartaric acid contains 2 types of functional groups (per molecule), hydroxyl and carboxyl whereas butanoic acid contains only 1 type of function group (per molecule), carboxyl.

Tartaric acid contains a hydroxyl functional group (per molecule), whereas butanoic acid does not.

Tartaric acid contains 4 functional groups (per molecule), whereas butanoic acid contains only 1 functional group.

Any 2. [2]

(d) (iv)



[2]

[Total: 11]

Section B [40 marks]

B7 (a) Experiment 4. [1]

Comparing Expt 3 and 4, with the same concentration of ClO_2 and OH^-, the initial rate of reaction was higher for expt 4, 0.02014 mol/dm^3 s as compared to expt 3, 0.01104 mol/dm^3 s. Therefore expt 4 would have taken place at a higher temperature resulting in a higher initial rate of reaction. [1]

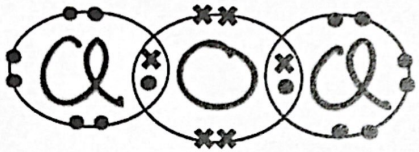
(b) (i) The rate of the reaction increases by 4 times (2^2) when the concentration of ClO_2 doubles. From experiment 1 and 3, the rate of reaction increases from 0.00276 mol/dm^3 s to 0.01104 mol/dm^3 s when the concentration increases from 0.02 mol/dm^3 to 0.04 mol/dm^3. (OR expt 2 and 4 with evidence) [2]

(b) (ii) Second order reaction. [1]

(c) 0.00023 mol/dm^3 s [1]

(d) Increased concentration increases the number of particles per unit volume OR the distances between reacting particles decreases. This increases the frequency of collisions between reacting particles. As a results, the frequency of effective collisions increases and the speed of reaction increases. [2]

(e)



[2]

[Total: 11]

B8 (a) A_r of Pb = (1.4/100 x 204)+(24.1/100 x 206)+(22.1/100 x 207)+(52.4/100 x 208)

= 207.241

= 207 (nearest whole number) [2]

(b) (i)

Element	Pb	O
%	86.8	13.2
Ar	207	16
No. of mol / 100g	86.8 / 207 = 0.4193	13.2/16 = 0.825
Mole Ratio	0.4193 / 0.4193 = 1	0.825 / 0.4193 = 1.967
Simplest ratio	1	2

∴ Empirical formula is PbO_2 [2]

(b) (ii) Lead (IV) oxide [1]

(c) (i) Energy output for 1g of octane = 5509 x 1/(8 x 12 + 18 x 1)

= 48.3kJ

Energy output for 1g of octane = 1407 x 1/(2 x 12 + 6 x 1 + 1 x 16)

= 30.6 kJ [2]

(c) (ii) Gasohol provides a lesser amount of energy as compare to gasoline hence resulting in more volume needed for the same distance travelled. [1]

Ethanol is a renewable resource as compared to gasoline. /

Ethanol is a cleaner fuel as it does not produce any soot. /

Alternative fuels like ethanol will help reduce the need for gasoline which is a finite resource. [1]

[Total: 9]

Either

B9 (a) The main group metals have got low density of 0.9 g/cm^3 and 1.5 g/cm^3 and low m.p of 64°C and 842°C as compared transition metals which have high density of more than 3.0 g/cm^3 and high m.p of more than 1084°C. Main group metals also have a fixed oxidation state, +1 for potassium and +2 for calcium, whereas transition metals have multiple oxidation states, like +2 to +7 for manganese. [3]

(b) There will be flame observed when potassium is added to dilute hydrochloric acid whereas only effervescence when iron is added to dil. HCl. This is because potassium is a more reactive metal as compared to iron.

Dil. HCl solution will remain colourless when potassium is added whereas the dil. HCl solution will turn green / yellow / brown when iron is added. This is because the resulting solution of potassium chloride is colourless and the resulting solution of iron (II) chloride is green OR iron (III) chloride is yellow / brown. [4]

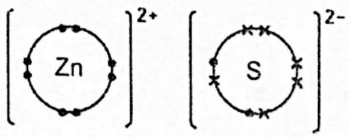
(c) (i) Step 1: Yellow, Step 2: Orange [2]

(c) (ii) The product formed, sodium, will react violently in water, also formed as a product, hence it should be carried out in a controlled environment as recommended by the student. [1]

[Total: 10]

OR

B9 (a)



[2]

(b) Zinc blende and diamond are both arranged in a tetrahedral structure.

In zinc blende, 1 Zn^{2+} ion is bonded to 4 S^{2-} ion and 1 S^{2-} ion is bonded to 4 Zn^{2+} ions which is similar to diamond where 1 C atom is bonded to 4 other C atoms.

Zinc blende has a giant ionic lattice structure whereas diamond has a giant molecular structure.

There are strong electrostatic forces of attraction between the oppositely charged Zn^{2+} and S^{2-} ions in zinc blende but strong covalent bonds between the C atoms in diamond. [3]

(c) (i) SO_2 forms acid rain when dissolved in clouds which corrodes limestone building when it falls. CO reacts with haemoglobin in blood to form carboxyhaemoglobin which reduces the ability to transport O_2 which causes breathing difficulties and even death. Treatment method for SO_2 is flue gas desulfurization and CO is catalytic converter. [3]

(c) (ii) Collect the gases formed in the blast furnace and pass them over filter paper soaked in acidified potassium manganate (VII). If the gas decolourises purple potassium manganate (VII), it would mean that it is true that the production worker added zinc blende directly as SO_2 is present.

[2]

[Total: 10]

Answer Scheme for Chemistry 6092 Prelims 2019

Paper 1 [40 marks]

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

END OF ANSWER SCHEME