2023 Chemistry Prelims Paper 1 Answers

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

1	**Answer: A** X consists of two substances R and Y. Therefore it is a mixture. Since Y cools at a fixed temperature, it is a pure substance.
2	**Answer: B** Bromine and molecules in the air are in constant random motion.
3	**Answer: D** When silver nitrate is added to barium iodide, a yellow precipitate of silver iodide is formed. The filtrate is aqueous barium nitrate. When dilute sulfuric acid is added to the filtrate, a white precipitate of barium sulfate is formed. The filtrate contains nitric acid, which is made up of hydrogen ions and nitrate ions.
4	**Answer: C** Helium, having a proton number of 2, has an electronic configuration of 2, and has 2 electrons in the outer shell. Lithium, having a proton number of 3, has an electronic configuration of 2,1, has 1 electron in the outer shell. Neon, having a proton number of 10, has an electronic configuration of 2,8, has 8 electrons in the outer shell.
5	**Answer: C** since X forms cation of X^{2+}, the ionic compound formed with fluorine is XF_2.
6	**Answer: A** Ammonium chloride consists of ammonium ion and chloride ion – an ionic bond exists between them. Ammonium ion has covalent bonds between nitrogen and hydrogen atom
7	**Answer: A** The intermolecular forces of attraction between covalent molecules are overcome when the covalent liquid boils.
8	**Answer: C** No. of moles of chlorine gas = $\frac{71}{71} = 1$ mol Since volume ratio = mole ratio for gases, No. of moles of phosphorus vapour = 1 mol Molar mass of phosphorus molecule = $\frac{\text{mass}}{\text{no. of moles}} = \frac{124}{1} = 124$ g/mol No. of moles of phosphorus atoms in a molecule of phosphorus = $\frac{\text{mass}}{\text{atomic mass}} = \frac{124}{31} = 4$ mol Therefore, the formula is P_4.

9	**Answer: C** Molar mass of metal chloride = 74.5 Mass of metal = 74.5 – 35.5 = 39 Therefore, the metal is in group I and the formula of the chloride formed is YC*l*.
10	**Answer: C** $H^+(aq) + OH^-(aq) \rightarrow H_2O(l)$ Since 0.1 mol of H^+ and 0.1 mol of OH^- are used, both reactants are limiting. 0.1 mol of water would be formed. The energy given out would be 0.1 x 54 = 5.40 kJ
11	**Answer: C** Relative atomic mass = $\frac{1}{5} \times 10 + \frac{4}{5} \times 11 = 10.8$
12	**Answer: D** Ammonium salt reacts with alkali to produce ammonia, which turns damp red litmus paper blue. Based on the given information, ammonium nitrate, NH_4NO_3, is present in the fertiliser. The empirical formula is $N_2H_4O_3$.
13	**Answer: D** The spoon should be the negative electrode so that copper(II) ions can be reduced to plate the spoon with copper. This is a electrolytic cell.
14	**Answer: A** Chemical equation for the electrolysis of concentrated sodium chloride $2H^+(aq) + 2Cl^-(aq) \rightarrow H_2(g) + Cl_2(g)$ No. of moles of sodium chloride = $\frac{58500}{23+35.5} = 1000$ mol No. of moles of Cl^- discharged = 1000 mol No. of moles of H^+ ions discharged = 1000 mol $2Cl^-(aq) \rightarrow Cl_2(g) + 2e^-$ Mass of Cl_2 formed = $\frac{1000}{2} \times (35.5 \times 2)$ = 35500 g = 35.5 kg $2H^+(aq) + 2e^- \rightarrow H_2(g)$ Mass of H_2 formed = $\frac{1000}{2} \times 2$ = 1000 g = 1 kg
15	**Answer: D** Option A: New products, elemental bromine and silver are formed. Option B: Reddish-brown bromine gas is formed at the anode. Option C: Silvery molten metal is formed at the negative terminal. Option D: The volume of molten lead(II) bromide decreases over time as reddish-brown gas escapes from the set up.

16	**Answer: D** The enthalpy change (ΔH) of the backward reaction is +23.0 kJ/mol. Hence, the activation energy of the backward reaction is the sum of the activation energy and the enthalpy change of the backward reaction. E_a of the backward reaction = 23 + 5.4 = +28.4 kJ/mol
17	**Answer: B** In an exothermic reaction, the energy given out when bonds are formed is greater than the energy absorbed to break the bonds.
18	**Answer: A** Option A: Energy change when one mole of potassium chloride dissolves in water $= \frac{+720}{\frac{4}{39+35.5}} = +13.4$ kJ/mol Option B: Powdered potassium chloride will dissolve in a faster rate but the energy change will be the same. Option C: Since the energy change is positive, it is an endothermic reaction. The energy level of the products is higher than the reactants. Option D: Since it is an endothermic reaction, the temperature of the reaction mixture after the reaction will be lower than water before the experiment. The temperature change, $T_{final} - T_{initial}$, will be negative.
19	**Answer: B** Statement 1: the reaction time remained constant at 10 s when 0.92 mol/dm^3 to 1 mol/dm^3 of sulfuric acid was used. Hence, when 1.5 mol/dm^3 of sulfuric acid was used, the approximate reaction time is also 10 s. Statement 2: the rate of reaction is inversely proportional to reaction time. Since the reaction time decreases with increasing concentration, the rate of reaction increases with increasing concentration. Statement 3: since sulfuric acid is in excess, and the same mass of magnesium is used in each experiment, the same volume of hydrogen gas would be produced in each experiment.

20	**Answer: A** In step 1: Bromine oxidised sulfur in SO_2 from an oxidation state of +4 in SO_2 to +6 in H_2SO_4. Sulfur dioxide reduced bromine in Br_2 from an oxidation state of 0 in Br_2 to -1 in HBr. Hence Br_2 is the oxidising agent and SO_2 is the reducing agent. In step 2: Hydrogen bromide reduced chlorine in Cl_2 from an oxidation state of 0 in Cl_2 to an oxidation state of −1 in 2HCl. Chlorine oxidised bromine in HBr from an oxidation state of −1 in HBr to 0 in Br_2. Hence Cl_2 is the oxidising agent and HBr is the reducing agent.
21	**Answer: B** Hydrogen sulfide acts as an acid and reacts with lead carbonate to form a salt, water, and carbon dioxide gas. This reaction is not a redox reaction.
22	**Answer: A** Sodium hydroxide, being an alkali, has the highest pH compared to the other solutions which are acids. Sulfuric acid, being a dibasic acid, has the highest concentration of H^+ ions, so it has the lowest pH. Ethanoic acid, being a weak acid, has a lower concentration of H^+ ions compared to hydrochloric acid. Hence, it has a higher pH than hydrochloric acid.
23	**Answer: C** Option A: Copper does not react with acid. Option B: Lead(II) sulfate is an insoluble salt. Option C: Magnesium chloride can be prepared by reacting magnesium with hydrochloric acid or magnesium carbonate and hydrochloric acid. Option D: Sodium carbonate is soluble in water.
24	**Answer: A** Gas Q is an **element** that can be obtained by the cracking of crude oil.
25	**Answer: A** Option A: The reactivity of halogens decreases down the group. It is less able to be reduced down the group. Thus, the ability as an oxidizing agent decreases down the group. Option B, C, D: The boiling points, colour intensity and density <u>increases</u> down the group.

26	**Answer: D** T is magnesium, U is aluminium, V is silicon, W is phosphorus. Melting point - V > W: Silicon, having a giant molecular structure, has a higher melting point than W, which has a simple molecular structure. Electrical conductivity – T > W: Magnesium, having a giant metallic structure, is able to conduct electricity unlike W, phosphorus, which has a simple molecular structure. Forms basic oxides – T: Magnesium reacts with oxygen to form magnesium oxide, which is basic as it reacts with acids.
27	**Answer: B** Iron is magnetic – it can be obtained through Step 1 Aluminium is lighter than chromium and copper. Transition metals such as chromium and copper has high density. Thus aluminium can be obtained through Step 2.
28	**Answer: B** Option 1: electrolysis of molten metal oxide enables metal X to be obtained at the cathode. Option 2: metal X is below carbon in the reactivity series; it can be obtained by reduction of metal oxide with carbon. Option 3: metal X is more reactive than copper. Copper is unable to displace metal X from the oxide of metal X.
29	**Answer: A** Copper, being a less reactive metal than magnesium, forms a carbonate that is less thermally stable than magnesium carbonate. Thus, the time taken for a white precipitate to form in limewater is shorter for copper(II) carbonate than for magnesium carbonate. Potassium carbonate is a thermally stable metal carbonate which does not decompose on heating.
30	**Answer: D** Option A, B and C: redox reactions Option D: this is an acid-base reaction – silicon dioxide is an acidic oxide and calcium oxide is a basic oxide.

31	**Answer: C** Option A: The increase in population of cattle would lead to an increase in the amount of carbon dioxide because of respiration. Option B: The use of electric cars reduces the emission of carbon dioxide. Option C: When there are more trees, they can take in more carbon dioxide and this reduces the amount of carbon dioxide in the air. It does not produce any methane so the amount of methane remains negligible. Option D: With a decrease in ocean size, there is less ocean uptake which would lead to less carbon dioxide being trapped, leading to an increase in amount of carbon dioxide in the air.
32	**Answer: C** Nitrogen dioxide and sulfur dioxide are acidic gases which, when dissolved in water, forms acid rain.
33	**Answer: B** Option A: it has double bonds between carbon atoms (due to its unsaturation). Option B: it reacts with hydrogen to form margarine, which exists as a solid at room temperature. Option C: it reacts with hydrogen to form margarine. Option D: it turns aqueous bromine from brown to colourless.
34	**Answer: C** Option A: Fraction I contains a mixture of hydrocarbons with a small number of carbon atoms, not just methane. Option B: Fraction II is used as fuel Option C: The fraction that is the highest in the fractionating column has the lowest boiling point. Option D: Fraction I is most flammable.

35 **Answer: A**

$C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$

Volume of carbon dioxide formed = 30 cm^3

Volume of oxygen used = 50 cm^3

$2C_3H_6 + 9O_2 \rightarrow 6CO_2 + 6H_2O$

Volume of carbon dioxide formed = 30 cm^3

Volume of oxygen used = $\frac{10}{2} \times 9$ = 45 cm^3

At the end of the reaction,

Volume of carbon dioxide produced = 30 + 30 = 60 cm^3

Volume of oxygen left = 100 – 50 – 45 = 5 cm^3

Statement 1: 60 cm^3 of carbon dioxide is produced.

Statement 2: the resultant mixture consists of carbon dioxide, water and 5 cm^3 of unreacted oxygen.

Statement 3:

$C_3H_6 + H_2 \rightarrow C_3H_8$

Since the mole ratio of propene to hydrogen is 1:1, 10 cm^3 of propene requires 10 cm^3 of hydrogen to be converted to propane.

36 **Answer: B**

Option A: addition

Option B: fermentation

Option C: substitution

Option D: cracking

37 **Answer: B**

Functional group	solubility in water	Na_2CO_3 (aq)	acidified $KMnO_4$ (aq)
Carboxylic acid (P)	√	√	x
Ester (Q)	x	x	x
Alcohol (R)	√	x	√

38 **Answer: C**

C is identical to the structure given in the question.

39 **Answer: D**

Propanoyl chloride has 3 carbon atoms while methanol as 1 carbon atom. The ester produced has 4 carbon atoms.

Since an ester functional group is formed, the molecular formula of the compound formed will be $C_4H_8O_2$.

40 **Answer: B**

Nylon-6 has an amide functional group while terylene has an ester functional group.