

Suggested Answers to 2019 O level Chemistry 6092 Paper 1

Question	Answer	Explanation
1	A	From the description of the gas, we should be able to conclude that the gas is ammonia. To collect a gas that is soluble in water and less dense than air, we would use upward delivery. Furthermore, since ammonia is an alkaline gas, concentrated sulfuric acid cannot be used as the drying agent. Putting all these together, the answer would be option A.
2	B	In this question, we want the precipitate that forms to only contain sulfate ion. Adding excess aqueous barium nitrate will form barium sulfate precipitate with the other products being soluble. Hence, we can measure the amount of sulfate ions present by drying and weighing the precipitate formed. Option A also gives lead (II) chloride as a precipitate. Option C gives all the compounds present in the solution after evaporation to dryness and option D measures the electrical conductivity due to all the mobile ions present in the solutions. Hence, only option B is correct.
3	C	In fractional distillation, the first liquid to be collected has the lower boiling point. That would be Y. In the separating funnel, the lower liquid is the denser one. That would be X.
4	D	For statement 1, acidified potassium manganate is an oxidizing agent and will turn from purple to colourless in presence of reducing agent sulfur dioxide. For statement 2, when universal indicator is added to a weak acid, it will turn orange from the neutral green colour. Statement 3 is a test for iodide anion. Adding nitric acid followed by aqueous silver nitrate to potassium iodide will form yellow silver iodide precipitate.
5	D	The isotope of Q has 16 protons, 16 electrons and 16 neutrons. Since R contains 4 more neutrons, 1 more proton and 1 more electron, R must have 17 protons and $16+4+17=37$ nucleon number. Option D is the answer.
6	D	By elimination, we can conclude that D is the answer. Both diamond and graphite are allotropes of carbon and they can react with oxygen to form carbon dioxide. For option A, each carbon atom in graphite forms only 3 covalent bonds. For option B, only graphite has the capability to act as a lubricant. For option C, only diamond is an electrical insulator while graphite can conduct electricity.
7	C	Only statement 2 is true as calcium chloride has the chemical formula CaCl_2 while potassium chloride has the chemical formula KCl .
8	B	X must be a hydrocarbon as it burns to produce carbon dioxide and water. Since it is a gas at room temperature, it must be small molecule methane instead of octane. Y is a macromolecule that has small units joined by amide linkages. We can conclude that it is nylon polymer.
9	A	Aluminium forms the highest charged ion of +3. Hence, it would have the most electrons in the 'sea of electrons'.

10	C	Organic compounds burn in oxygen to form carbon dioxide and water. As the carbohydrate contains 6 carbon atoms, it will burn in excess oxygen to give 6 moles of carbon dioxide as well. Since the question asked for the volume of gas collected, we only need to take into account the number of moles of carbon dioxide, which is 6 moles. Hence, volume of gas collected is $6 \times 24 = 144 \text{dm}^3$
11	D	Working out the number of moles for each species, we found that 0.1mol of Mg reacts with 0.1mol of H_2SO_4 to give 0.1 mol of H_2 . If we now want to product 4.8dm^3 of hydrogen which is 0.2mol, we need 0.2mol of the limiting reactant so option D is the answer.
12	C	$\text{XO}_2 \rightarrow \text{X} + \text{O}_2$; $4.00 - 3.15 = 0.85 \text{g}$ of oxygen. No. of moles of $\text{O}_2 = 0.85 / (16 \times 2) = 0.02656 \text{mol}$ No. of moles of X = 0.02656mol Ar of X = $3.15 / 0.02656 = 118.5 \approx 119$ From the periodic table, the element with mass number 119 is Sn.
13	B	The green gas formed would be chlorine gas. For statement 1, since concentrated aqueous sodium chloride is used, the halide ion would be preferentially discharged at the anode and chlorine gas is produced. For statement 2, hydroxide ion will be preferentially discharged at the anode to form oxygen gas. For statement 3, since molten sodium chloride is used, sodium ions will be discharged at the cathode and chloride ions at the anode. For statement 4, solid sodium chloride does not conduct electricity and hence, no electrolysis will take place. Thus, only 1 and 3 will produce green chlorine gas.
14	C	Since aqueous copper(II) sulfate is electrolyzed using inert electrodes, copper ions and hydrogen ions will be attracted to the negative electrode with copper ions being preferentially discharged to give copper metal since it is lower in the reactivity series. Sulfate ions and hydroxide ions will be attracted to the positive electrode and hydroxide ion is preferentially discharged to give oxygen gas.
15	A	Since the products have higher energy than the reactants, the forward reaction is endothermic. From the energy profile diagram, we can see that the activation energy for the reverse reaction is lower than that for the forward reaction.
16	D	From the table, we are given the enthalpy of combustion per mole of fuel burnt. Statement 1 is incorrect as octane produces more heat than hydrogen and methane for each MOLE of fuel burnt. Statement 2 is incorrect as 1g of hydrogen gives 0.5mol of hydrogen and thus, only 143kJ of energy should be produced. Only statement 3 is correct as combustion reaction is exothermic and the energy required for bond breaking must be less than that released on bond forming.
17	D	By calculating the number of moles of magnesium and hydrochloric acid, we can see that magnesium is the limiting reactant. Thus, changing the volume or concentration of hydrochloric acid will not affect the product yield. In experiment 2, a higher concentration of hydrochloric acid is used which will cause the speed of reaction to be faster. Thus, experiment 2 graph should be steeper but both experiment graphs should plateau off at the same level.

18	B	The addition of catalyst to a reaction provides an alternative pathway with lower activation energy. However, altering any other variables that change the speed of reaction (eg temperature) have no effect on the activation energy.
19	B	For option A, acidified potassium manganate (VII) is an oxidizing agent and will decolourise in presence of a reducing agent which gets oxidized in the process. Thus, X gets oxidized, For option C, the oxidation state of X increases from 0 in X to +2 in X^{2+} . Hence, it gets oxidized. For option D, the oxidation state of X increases from +1 in XO^- to +5 in XO_3^- . Thus, it gets oxidized. For option B which is the correct answer, adding aqueous potassium iodide which is a reducing agent to X gives a brown colour which shows that X is an oxidising agent and is reduced in the process.
20	A	Both sulfur dioxide and carbon dioxide are acidic oxides and can decrease the pH of sodium hydroxide. Calcium oxide is a basic oxide and will not neutralize the basic sodium hydroxide.
21	C	Since the mixture of Y can dissolve in water, options A and B are incorrect as calcium carbonate and copper carbonate are both insoluble. Bubbles are produced when dilute hydrochloric acid is added to Y which means Y contains either a metal or a carbonate. When chlorine is bubbled through an aqueous solution of Y, the solution turns red-brown which means that bromine gets displaced. Thus, initial mixture of Y must contain sodium carbonate and sodium bromide.
22	A	Adding sodium hydroxide to ammonium chloride and heating gently will cause ammonia gas to be produced. Ammonia is an alkaline gas and will turn universal indicator blue. This is a test for ammonium ion.
23	C	Copper will react with oxygen in the air to form copper oxide. Since excess copper is used, all 21% oxygen in the air would be used up. Hence, 79% of 50cm^3 of air will remain.
24	C	Since Z forms a positive ion when reacted with non-metal oxygen, Z must be a metal. By elimination, option C is the answer.
25	A	Lithium is in group 1 and thus will react with water to form metal hydroxide and hydrogen gas. When lithium hydroxide is added to sulfuric acid, lithium sulfate is formed. Li is in group 1 and forms +1 charged ion. Hydroxide ion has formula OH^- and sulfate ion has formula SO_4^{2-} .
26	B	Vanadium is a transition metal and thus, has high density and high melting point. Given that it can exhibit variable oxidation states, vanadium is useful as a catalyst. If the solution changes colour from violet V^{2+} to blue-green V^{3+} , oxidation has taken place.
27	B	From the periodic table, the element with proton number 24 is chromium. An element that can be cut easily with a knife belongs to group 1, in this case, it would be Na. The constituents of brass are zinc and copper. Magnesium burns in oxygen with a bright white light to give magnesium oxide. Haber process uses finely divided iron as catalyst.

28	A	Since the oxides of W is reduced by heating with carbon and by heating with hydrogen, W must be below hydrogen and carbon in the reactivity series. In comparison, X cannot be reduced by either hydrogen or carbon hence it must be above these two elements in the reactivity series. W displaces Y from salt solution of Y which means that W is more reactive than Y. Hence, the reactivity order is as follows: $X > W > Y$.
29	A	Since metal M can be obtained from its oxide by heating with carbon, metal M must be below carbon in the reactivity series. Metal M forms aqueous chloride which means that the chloride of M must be soluble. Since the metal can also be extracted from its chloride by electrolysis, the metal must be below hydrogen to be preferentially discharged at the electrode. Hence, metal M must be copper.
30	A	The first three statements are all correct. Recycling of iron uses less energy than extraction from its ore in the blast furnace.
31	D	To form acid rain, the acidic gases must dissolve in rain water. Both SO_2 and NO_2 are acidic oxides that will dissolve in rainwater to give sulfuric acid and nitric acid respectively.
32	A	Alkanes used in polishes and waxes are found in the lubricating oil fraction which have higher boiling point than those used in diesel fuel. All of the fractions can be used as fuel as during combustion of the fuel, heat energy is released. The fraction used for petrol has a lower boiling point and hence is found higher up in the fractionating column than the fraction used for paraffin. Different compounds in variable ratio are found at any particular point in the fractionating column as we are heating a mixture. Thus, only statements 1,2 and 3 are correct.
33	C	Isomers are compounds having the same molecular formula but different structural formula.
34	A	Since X contains 2 carbon atoms and decolourises aqueous bromine, it must be ethene. Cracking is the process of breaking down a large hydrocarbon molecule into shorter chain hydrocarbon and maybe hydrogen gas. We are left with 4 carbon atoms and 8 hydrogen atoms to give as C_4H_8 as compound Y.
35	B	Hydrogenation is used to convert polyunsaturated vegetable oils into solid margarine.
36	B	Statements 1 and 3 are correct. As both isomers are alkenes, they can decolourise bromine water. When reacted with hydrogen, both isomers form butane. However, as the double bonds of the isomers are at different positions, the addition products with bromine and polymers formed would be different.
37	B	Ethanol can undergo combustion to produce heat energy and hence can be used as a source of energy in car engines. It is also used to dissolve active ingredients in perfumes and to make it volatile. Ethanol can react with acid to form esters but to form polyesters we need diol and diacid. Thus, only statements 1 and 2 are correct.



38	C	Ethanoic acid reacts with magnesium according to the following equation: $\text{Mg} + 2\text{CH}_3\text{COOH} \rightarrow (\text{CH}_3\text{COO})_2\text{Mg} + \text{H}_2$ Hence, we can see that the O-H bond is broken.
39	D	Ester is formed from the esterification reaction of an alcohol and acid. So we will break the ester bond to obtain option D as the answer.
40	A	The polymer is made up of the same repeating units and hence must be formed by addition polymerization of an alkene and not condensation polymerization. The monomer has a molecular formula $\text{C}_4\text{H}_6\text{Cl}_2$. Reacting alkane with chlorine is a substitution reaction and we get alkane as the product which cannot be the monomer.