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**DEPARTMENT OF CHEMISTRY**

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**O-LEVEL CHEMISTRY QUESTIONS**

1. (a) Define the terms:
2. Solubility of a solute
3. Saturated solution

(b) The solubility’s of potassium nitrate at certain temperatures are shown in the table below.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Temperature /oC |  | 0 | 10 | 20 | 30 | 40 | 50 | 60 |
| Solubility (g per 100g of water) | Salt A | 13 | 20 | 32 | 45 | 63 | 85 | 110 |
| Salt B | 32.5 | 34 | 35 | 36 | 37 | 38 | 39 |

1. Plot a graph of solubility against temperature for salt A and salt B using the same axis.

(ii) Which one of the salt is more soluble?

(c) (i) A saturated solution of salt A was cooled from 450 to 250. Determine the mass of the salt deposited.

(ii) If the relative formula mass of A is 101, calculate the number of moles of the salt crystal deposited.

1. 2. (a) Dilute nitric acid was added to copper (II) carbonate in a test tube.

(i) State what was observed.

(ii) Write an ionic equation for the reaction that took place

(b) The resultant solution in (a) was divided into 2 parts. To the first part was added sodium hydroxide drop wise until in excess.

(i) State what was observed.

(ii) Write an ionic equation for the reaction that took place

(c) To the second portion was added ammonia solution dropwise until in excess.

(i) State what was observed.

(ii) Write an ionic equation for the reaction that took place

(d) (i) Define the term enthalpy of combustion.

(ii) When 448cm3 of ethane measured at standard temperature and pressure is completely burnt in oxygen the heat produced raises the temperature of 100g of water by 12oC.(Specific heat capacity of water = 4.2Jg-1 oCj-1 1 mole of a gas occupies 22.4dm3 at s.t.p) Calculate the heat of combustion ethane.

3. (a) Chlorine can be prepared in the laboratory from hydrochloric acid.

(i) Name the other reagent that is used in the preparation of chlorine.

(ii) State the conditions for the reaction.

(iii) Write an equation for the reaction which takes place between hydrochloric acid and the reagent you have named in a (i) above.

(b) (i) Draw a labeled diagram to show the preparation of Iron (III) chloride using chlorine.

(ii) State what would be observed if aqueous ammonia was added to a solution of Iron (III) chloride.

(iii) Write an ionic equation for the reaction in b(ii) above.

(iv) State what is observed when silver nitrate solution is added to sodium chloride solution.

4. (a) What is meant by rate of a chemical reaction?

(b) State and explain how the following factors affect the rate of a chemical reaction:

1. Temperature
2. Concentration

(c) The table below shows the volume of hydrogen collected at various time intervals when magnesium was reacted with a 1M hydrochloric acid.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Time (s) | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Volume of hydrogen collected (cm3) | 0 | 20 | 40 | 60 | 70 | 76 | 77 | 77 |

1. Plot a graph of volume of hydrogen against time.
2. Determine the rate of reaction at 4 seconds.
3. Determine the volume of hydrogen evolved at 4.5 seconds.

(d) State how the reaction at 4 seconds would be affected if a 2M hydrochloric acid was used.

5. (a) Describe how a dry sample of copper (II) sulphate can be prepared from copper (II) oxide.

(b) Crystals of copper (II) sulphate were heated gently and then strongly until no further change. Write equation(s) for the reaction(s) that took place.

(c) (i) Draw a labelled diagram for the electrolysis of copper (II)sulphate using carbon electrodes.

(ii) Write the equation for the reactions hat take place at each electrodes

6. (a) (i) Draw a labelled diagram to show how a dry sample of sulphurdioxide can be prepared in the laboratory.

(ii) Write an equation for the reaction that took place

(b) State what is observed when;

(i) Sulphurdioxide is bubbled into acidified potassium dichromate solution

(ii) Burning magnesium is lowered into a gas jar of sulphurdioxide, also give equation of reaction.

(c) (i) Using equations only, show how concentrated sulphuric acid can be manufactured on large scale using the contact process.

(ii) 24.0cm3 of 0.1M sodium carbonate solution reacted completely with 26.8cm3 of sulphuric acid. Calculate the concentration of sulphuric acid in grams per litre.

7. (a) Describe how nitric acid can be manufactured using hydrogen and nitrogen as raw materials. (Illustrate your answer with equations.)

(b) Write equations to show the effect of heat on;

1. NH4NO3
2. Zn(NO3)2
3. KNO3

(c) Potassium nitrate was heated with concentrated sulphuric acid. Write equation for the reaction that took place.

8. (a) (i) Draw a well labelled diagram to show how a dry sample of ammonia can be prepared from ammonium chloride in the laboratory

(ii) Write an equation for the reaction leading to the formation of ammonia***.***

(b) Dry ammonia gas was passed over heated lead (II) oxide.

1. State what was observed.
2. Write equation for the reaction that takes place.

(c) 3 drops of ammonia solution were added to copper (II) sulphate solution in a test tube.

1. State what was observed.
2. Write an ionic equation for the reaction that took place.

(d) 5.35g of ammonia chloride was heated with excess calcium hydroxide. Calculate the volume of ammonium gas produced at room temperature. (1 mole of a gas at room temperature occupies 24dm3).

10. (a) Define the terms:

1. Morality
2. Standard solution
3. Primary standard

(b) 3.2g of impure sodium carbonate was dissolved in water to make 500cm3 of solution. 25cm3 of the solution required exactly 24cm3 of 0.1M hydrochloric acid for complete reaction .calculate

(i) Concentration in moles per litre of sodium carbonate solution

(ii) Percentage impurity of the original sample of sodium carbonate.

(c) 20cm3 of nitric acid solution containing 6.3g/l of solution required 25cm3 of a metal carbonate M2CO3, solution containing 5.52g/l of solution for neutralization. Calculate the relative atomic mass of metal M

(d) 2.5g of silver nitrate solid was heated to constant mass and two gaseous products were produced.

(i) Identify the gaseous products

(ii) State and identify how the gaseous product named above can be tested

1. Write the equation for the reaction that take place
2. Calculate the total volume of the gaseous product named above at room temperature.(1mole of a gas at room temperature occupies 24dm3 Ag=108,N=14,O=16)

(d) 50cm3 of 0.2M sulphuric acid was diluted to 100cm3 by adding distilled water. Calculate the concentration in moldm3 of the diluted solution.

11. (a) (i) Outline with the aid of equation, how a dry sample of hydrogen chloride can be prepared in the laboratory from sodium chloride. ***(No diagram is required, but your answer should include a reason for the method of collection used.)***

(ii) Name a reagent that you would use to test for hydrogen chloride and state what would be observed if hydrogen chloride was tested with the reagent that you have named.

(iii) Write equation for the reaction to explain the observation which you have stated in (a)(ii).

(b) Hydrogen chloride cannot be dried using calcium oxide. Give a reason for this fact.

(c) Hydrogen chloride can be synthesized directly without causing an explosion.

(i) Write equation for the reaction leading to direct synthesis of hydrogen chloride.

(ii) State what would be observed and write ionic equation for the reaction that would occur if a solution containing hydrogen carbonate ions was added to a solution of hydrogen chloride in water.

12. Under suitable conditions, oils and fats can react to produce soap.

(a) (i) Define the term soap and give one example of it.

(ii) State the word which means soap formation.

(b) Name one;

(i) Locally available material in each case which is a source of oil and fat.

(ii) Substance which when reacted with oil or fat can produce soap.

(c) Describe briefly how;

(i) Soap solution can be prepared in the laboratory using oil or fat from the source you have named in (b)(i) and the substance you have named in (b)(ii).

(ii) A sample of solid soap can be obtained from the solution you have prepared in (c)(i).

(d) Soap solution was shaken separately with a sample of;

(i) Rain water

(ii) Water in which calcium hydrogen carbonate was dissolved. In each state what was observed, and write equation for any reaction that took place

13. (a) (i) Explain the term addition polymerization

(ii) Name the natural polymer and one synthetic polymer formed by addition polymerization

(iii) State one limitation of synthetic polymers

(b) Organic compound A contains 66.7% carbon, 13% hydrogen, the rest being oxygen. 0.46g of A on vaporization occupied 224cm3 at s.t.p.

(i) Determine the empirical formula of A

(ii) Calculate the molecular mass and hence the molecular formula of A.

(c) Describe how A can be prepared from millet flour

14. (a) (i) State two properties which show that air is a mixture.

(i) Name two other gases other than oxygen that are constituents of air and give their approximate percentages in air.

(b) Describe an experiment to determine the percentage of oxygen in air. Show how the percentage can be calculated from the results.

(c) (i) State what is observed when burning iron is lowered into a jar of oxygen.

(ii) Write the name and formula of the product of the reaction between sulphur and oxygen

15. An experiment to prepare carbon monoxide and investigate its effect on copper (II) oxide was carried out using apparatus in the diagram below. Use it to answer questions that follow.

C

Dry gas Q

Heat

Charcoal

Copper (II) oxide

D

Heat

Potassium hydroxide solution

1. (i) Name gas Q.

(ii) Write equation for the reaction that took place in tube C.

1. (i) Explain using an equation the purpose of potassium hydroxide solution.

(ii) State what was observed in the tube D.

(iii) Write an equation and name for the reaction that took place.

1. (i) Why is this experiment carried out in a fume board?

(ii) Give one industrial application of carbon monoxide gas.

1. Using equations, briefly describe what happens when;

(i) Burning magnesium is lowered into a gas jar of carbon dioxide.

(ii) Excess carbon dioxide is passed into a solution of calcium hydroxide and then heat.

16. (a). Sulphuric acid is strong dibasic acid. Explain the terms

1. Strong acid
2. Basicity

(b) Write an equation for the ionization of sulphuric acid in water.

(i) Describe briefly how you would prepare a pure sample of lead(ii) bromide

(c) A solution of potassium carbonate was added to a solution of calcium ions.

1. State what was observed
2. Write the equation for the reaction that took place

17. State what is observed when each of the following salts are heated strongly

1. Sodium carbonate crystals
2. Copper (ii) carbonate
3. Lead (ii) nitrate
4. Iron (ii) sulphate crystal
5. Explain the observation in a(i),(ii) and a(iv) above.

18. Carbondioxide is used in the manufacture of sodium carbonate by the solvay process

(a) State any other two industrial uses of carbon dioxide

(b) Name the raw materials that supply carbondioxide in the solvay process

(c) Describe how sodium carbonate is manufactured by the solvay process.

(d) Mention two uses of sodium carbonate.

19. The atomic number of elements M, X and Q are 6, 11 and 17 respectively

1. Explain what is meant by the term atomic number
2. Which of the following elements is a salt maker? Using an equation show how the element named forms a a salt with heated iron metal
3. Write the electronic configuration of ,M ,X and Q
4. Use the valency electrons to explain briefly how atom M,X and Q form compounds
5. Write the structural formula of the compound formed when Q combines with X
6. Which one of the element react vigorously with cold water
7. Write an equation for the reaction between the element with water and state what is observed when the solution is tasted with litmus paper.

(c) State two properties of the compound formed between

1. M and X
2. M and Q.

20. Explain each of the following observations;

(a) When chlorine is bubbled through aqueous potassium iodide, the solution turns brown

(b) When carbon dioxide gas is bubbled in to fairly concentrated sodium hydroxide, no visible change at first but on further bubbling and a white precipitate is formed.

1. A concentrated calcium hydroxide solution turns milky when exposed in air for some time
2. Crystals sodium carbonate-10-water turn in to a white powder exposed to air for some days
3. Detergents are more efficient in washing clothes even when used in hard water where as soap is not.
4. Graphite is a good conductor of electricity where as diamond is not

21. Two gases X and W are described, X does not burn, fumes in moist air. W burns in air enriched with oxygen, turns red litmus blue

(a) (i) Identify and state the drying agent used in the laboratory preparation of X and W

(ii) State the reason why sulphuric acid cannot be used to dry W

1. Write an equation for the laboratory preparation of X and W
2. Write an equation for the combustion of W in presence of platinum catalyst
3. X was bubbled through silver nitrate solution
4. State what was observed
5. Write equations for the reactions that took place
6. W was dissolved in water to form an aqueous solution. the solution was added to zinc sulphate solution drop wise until in excess

(i) State what was observed

(ii) Write equations for the reactions that took place

22. (a) Distinguish between an acid and a salt

(b) Starting from lead (ii) carbonate, briefly explain how pure lead (ii) nitrate crystals can be prepared in the laboratory

(c) Part of lead (ii) nitrate crystals prepared in (b) was heated strongly in a dry test tube

(i) State what was observed

(ii) Write equation for the reaction

1. When V cm3 of 0.1M sodium sulphate solution was added to excess lead (ii) nitrate solution, 3.03g of lead (ii) sulphate was precipitated.

Calculate the;

1. Moles of sodium sulphate that reacted
2. Volume, Vcm3 of sodium sulphate used.

23. (a) Explain briefly what is meant by the term enthalpy of neutralization

(b) The table below shows the maximum temperature of the resultant solution formed when various volumes of 2M potassium hydroxide solution was added to 20cm3 portion of 2M nitric acid.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Volume of KOH (cm3) | 0 | 4 | 10 | 15 | 20 | 25 | 30 | 35 |
| Volume of HNO3 +KOH(cm3) | 20 | 25 | 30 | 35 | 40 | 45 | 50 | 55 |
| Temperature (oc) | 22 | 25.6 | 29.2 | 32.8 | 35.6 | 31.8 | 27.8 | 23.8 |

Plot a graph of temperature against volume of sodium hydroxide

(c) Using the graph, determine

1. The volume of potassium hydroxide required to completely neutralize 20.0cm3 of 2M nitric acid
2. Temperature of the resultant solution at the neutralization point
3. Calculate
4. Number of moles of nitric acid used
5. Molar enthalpy of neutralization of nitric acid.(SHC IS 4.2jg-10c-1,density of the resultant solution 1gcm-3)
6. State how the neutralization of ethanoic by potassium hydroxide would compare with that of nitric acid. Explain your answer.

24. (a) Write equation for the reaction which can take place to show that nitric acid,

1. Decomposes
2. Is an oxidizing agent
3. Zinc nitrate decomposes when heated to give a gaseous mixture of nitrogen dioxide and oxygen according to the following equation

2Zn (NO3)2(S) 2ZnO(S) + 4NO2(g) + O2(g)

Calculate the total volume of the gaseous mixture that would be evolved at S.T.P if 7.4g of zinc nitrate was heated to constant mass (Zn(NO3)2=189, 1 mole of a gas occupies 22.4dm3 at s.t.p)

25. Describe the hardness of water, using the following guide lines

1. The meaning of hard water
2. The types of hardness
3. The causes of hardness
4. One chemical method and one physical method employed for softening the water in each case
5. One disadvantage and two advantages of hard water

(Your description should include equations of reaction where necessary)

26. The manufacture of ammonia by the Haber process is purposely carried out under a relatively high pressure imposed on the gaseous mixture by industrial standards.

(a) (i) sate the role of iron in the Haber process.

(ii) Write equation for the reaction leading to formation of ammonia in the Haber process

1. Give a reason(s) why low temperature is used during the Haber process
2. Briefly explain why
3. High pressure is applied in the Haber process
4. The iron over which the gaseous mixture is passed during the Haber process in finely divided

(c) The ammonia obtained by the Haber process is mostly used as a starting material for the industrial preparation of nitric acid.

(i) Outline with aid of equations the reactions which occur during the industrial preparation of nitric acid

(ii) State one industrial use of nitric acid

27. Sulphuric acid is manufactured by the contact process

(i) Name the raw materials used in the process

(ii) State the source of the raw material you named above

1. Explain two precautions that are usually taken in to consideration during the process.
2. Explain what is observed and write equation of reaction when concentration sulphuric acid is to;

Heated sugar

1. Hot copper
2. Name the property shown by concentrated sulphuric acid.in (i) and (ii)

(iv) State three uses of sulphuric acid

28. Copper is extracted from an ore. In the final stage it is obtained by roasting copper (i) sulphide in a current of air.

(a) (i) Write an equation that takes place in the final stage.

(ii) Name and write the formula of the ore from which copper is extracted

1. Write the equation for the initial roasting process of the ore you have named in (a) (ii)
2. What is the name of the chemical process by which copper (i) sulphide is converted to copper
3. The copper obtained from above is impure, name the process by which it is purified

(c) State two uses of copper.

29. Name the particle which conduct electric current in

(i) Electrolyte

(ii) Electrode

1. A dilute copper (ii) chloride solution was electrolyzed using platinum electrodes
2. Identify the substance that was produced at the anode
3. Write equation for the reaction that took place at the cathode

(c) Name the substance that would be produced at the anode if electrolysis in (b) was repeated using

1. Copper electrodes
2. Concentrated copper (ii) chloride solution with graphite electrode
3. Potassium iodide solution with graphite electrodes

(d) A solution of potassium iodide in water is neutral (PH=7) explain why the PH increases to 11 near the cathode during electrolysis of potassium iodide solution using carbon electrodes.

30. (a) Name a reagent that can be used to distinguish between each of the following pairs of compounds/ions. In each case state what will be observed.

(i) SO42-(aq) and CO32-(aq)

(ii) C2H6 and C2H4

(b) (i) What is an ore

(ii) Name two ores from which iron can be extracted

(iii) Write an equation leading to the formation of iron in the blast furnace.

(c) Describe the process of vulcanization of rubber. In your description include,

(i) The importance of vulcanization in rubber industry

(ii) Two use full items of vulcanized rubber

(d) Sometimes when soap is used for washing clothes, a scum is formed.

(i) What is a scum?

(ii) What causes scum formation?

(iii) What name is given to the water which forms scum with soap?

(e) (i) Name two detergents which can be used instead of soap

(ii) State two advantages and two disadvantages of using detergents instead of soap.

31. Excess zinc granules were reacted with 25cm3 of 0.1M hydrochloric at room temperature

(a) Write an equation for the reaction that took place.

(b) Draw and label a diagram of the set up of the apparatus that can be used to determine the rate of reaction in (a) above.

(c) Calculate the

1. Mass of zinc granules that reacted
2. The volume of hydrogen gas formed at that temperature

(d) (i) Draw a sketch graph to show how the volume of hydrogen changed with time

(ii) On the some axes in (d) (i) draw a sketch graph to show how the volume of hydrogen changes with rime if the some mass of zinc powder was used instead of zinc granules

(e) State one other way of increasing the rate of reaction between zinc and hydrochloric acid.