Form three chemistry holiday package 2021

1. Explain the use of a chemical equation and the information which it conveys.
2. Why chemical reactions important? Give four (4) points.
3. Complete and balance the following reactions:
   (a) Aluminium + oxygen →
   (b) Calcium carbonate + sulphuric acid→
   (c) Sodium + water →
   (d) Aluminium hydroxide + nitric acid →
   (e) Ammonia solution + hydrochloric acid →
4. Write net ionic equation for the following reactions:
   (a) Calcium carbonate + sulphuric acid →
   (b) Aluminium hydroxide + nitric acid →
   (c) Magnesium + silver nitrate solution →
   (d) Silver nitrate solution + sodium chloride solution →
5. Will a precipitation reaction occur? If so, identify the precipitate.
   (a) $Ca(NO_3)_{2(aq)} + KBr_{(aq)} \rightarrow$
   (b) $NaOH_{(aq)} + FeCl_{2(aq)} \rightarrow$
6. There are many types of chemical reactions. Examples of some of the reactions are given below:
   A. $2Cl^-_{(aq)} \rightarrow Cl_{2(g)} + 2e^-$
   B. $Mg_{(s)} + Zn^{2+}_{(aq)} \rightarrow Mg^{2+}_{(aq)} + Zn_{(s)}$
   C. $Pb^{2+}_{(aq)} + 2I^-_{(aq)} \rightarrow PbI_{2(s)}$
   D. $MnO^-_{4(aq)} + 8H^+_{(aq)} \rightarrow Mn^{2+}_{(aq)} + 4H_2O_{(l)}$
   E. $SO^{2-}_{3(aq)} + H_2O_{(l)} \rightarrow SO^{2-}_{4(aq)} + 2H^+_{(aq)} + 2e^-$
   F. $Fe_{(s)} + 2H^+_{(aq)} \rightarrow Fe^{2+}_{(aq)} + H_{2(g)}$
   (a) Identify redox reaction(s)
   (b) Identify oxidation reaction(s)
   (c) Identify reduction reaction(s)
   (d) Identify displacement reaction(s)
7. When copper metal is added to the colourless solution of silver nitrate, the solution turns blue.
   (a) Write a symbol equation for the reaction occurred
   (b) Write net ionic equation in part (a)
   (c) Name the blue solution
   (d) Give the substance oxidized or reduced in (a)

8. (a) Chemical equations can also be used to represent physical processes. Write a chemical reaction for the boiling of water, including the proper phase labels.
   (b) Explain why 4Na(s) + 2Cl₂(g) → 4NaCl(s) should not be

considered a proper chemical equation.
   (a) Does the chemical reaction represented by:
       $3Zn(s) + 2Al(NO_3)_3(aq) \rightarrow 3Zn(NO_3)_2(aq) + 2Al(s)$ proceed as written? Why or why not?
   (b) Explain what is wrong with this double-replacement reaction.
       $NaCl(aq) + KBr(aq) \rightarrow NaK(aq) + ClBr(aq)$
9. Make a list of the main methods of softening hard water. In each case write a suitable equation(s) to summarize the chemical reactions involved.
10. One of the substances found in some temporary hard waters is magnesium hydrogencarbonate. Write word and balanced chemical equations to show the effect of heat on this substance in aqueous solution.
11. Lead carbonate and lead iodide are insoluble.
   a) Which two soluble salts could you use in the preparation of each substance?
   b) Write
       (i)   a word equation
       (ii)   a symbol equation
       (iii)   an ionic equation to represent the reactions taking place.
   c) An analytical chemist working for an environmental health organization has been given a sample of water which is thought to have been contaminated by a sulfate, a carbonate and a chloride.
       i) Describe how she could confirm the presence of these three types of salt by simple chemical tests.
       ii) Write ionic equations to help you explain what is happening during the testing process.

12. Suggest why barium reacts with dilute hydrochloric acid but appears not to react with dilute sulphuric acid.
13. When solid X is added to solution Y, copper (II) chloride and carbondioxide are formed. However, when solid Z is added to solution Y, zinc chloride and hydrogen gas are produced. Deduce the identities of X, Y and Z.
14. Explain why solid citric acid does not conduct electricity but a solution of citric acid in water does.
15. Name two bases that react with dilute sulphuric acid to form zinc sulphate. Write equations for the reactions.
16. How many grams of zinc contain 6×10^{20} atoms?
    ($Zn = 65, L = 6 \times 10^{23}$)
17. What mass of magnesium oxide is obtained from the complete combustion of 12g of magnesium?
18. Calculate the mass of carbondioxide produced by the decomposition of 15g of limestone.
19. Calculate the mass of anhydrous sodium carbonate formed when 4.2g of sodium hydrogen carbonate is heated.
    ($Na = 23, H = 1, C = 12, O = 16$)

20. 3.5g of a mixture of potassium carbonate and potassium sulphate (both anhydrous) were made up to $250cm^3$ of aqueous solution. $25cm^3$ of this solution required $40cm^3$ of 0.1M hydrochloric acid for neutralization. What is the percentage by mass of potassium carbonate in the mixture?

21. 20 cm^3 of a solution containing 7g/dm^3 of a metal hydroxide, XOH, were exactly neutralized with 25 cm^3 of 0.10M hydrochloric acid.
    (a) Write a balanced chemical equation for the neutralization of the metal hydroxide, XOH, with hydrochloric acid.
    (b) Calculate the concentration of the metal hydroxide in moles per dm^3.
    (c) Calculate the molar mass of XOH and identify element X.

22. 1.6g of impure sodium carbonate solution was dissolved in water to make 500 cm^3 of solution. 20 cm^3 of this solution was titrated against 20.50 cm^3 of 0.04M hydrochloric acid. Calculate the percentage purity of the sodium carbonate solid.

23. When a current of 0.156amperes is passed through a solution of lead (II) nitrate, lead is deposited on the cathode. How long will it take to deposit 0.10g of lead? (Pb = 207)

24. A metal of relative atomic mass 27 is deposited by electrolysis. If 0.201g of the metal is deposited on the cathode when 0.2amperes flow for three hours, what is the charge on the cations of this metal?

25. State the names and calculate the volumes of gases formed at the cathode and anode at s.t.p when 15milliamperes of current are passed for 6 hours through a solution of sulphuric acid.

26. A current of electricity passes through two cells in series. One contains silver nitrate solution, and the other contains lead (II) nitrate solution. In the first, 0.54g of silver are deposited on the cathode. What mass of lead is deposited in the second cell? (Ag = 108, Pb = 207)

27. A current pass through a solution of copper (II) sulphate, and 0.635g of copper is deposited on the cathode. What volume of oxygen at s.t.p is evolved at the cathode? (Cu = 63.5)

28. A current of 1 ampere is passed for 16minutes, and 0.32g of copper is deposited on the cathode. The Fraday constant is 96500coulombs per mole.
    (a) How many coulombs of electricity passed through the cell?
    (b) How many moles of copper were deposited? (Cu = 63.5)
    (c) Calculate the number of moles of electrons needed to deposit one mole of copper atoms from aqueous solution.

29. A current pass through a solution of sodium chloride, and the hydrogen and chlorine are collected. If 2400 coulombs of charge flow:
    (a) What is the mass and volume of hydrogen evolved at s.t.p?
    (b) What is the mass and volume of chlorine evolved at s.t.p?

30. Aqueous copper (II) sulphate was electrolyzed with copper electrodes. A current of 2amperes was passed for 8 minutes. During this time the mass of the copper cathode increased by 0.32g.
    (a) How many coulombs were passed during the experiment?

(b) Calculate the number of moles of copper atoms deposited during the experiment. (Cu = 64)

(c) Calculate the number of Faradays (moles of electrons) needed to deposit one mole of copper atoms from aqueous solution.

(d) Write an equation for the reaction at the cathode during electrolysis.

31. A pupil electrolyzed a solution of copper (II) sulphate in series with dilute sulphuric acid. A constant current was passed for 30minutes and $24cm^3$ of hydrogen were collected at the cathode of the dilute sulphuric acid cell at r.t.p.

    (a) Calculate the maximum volume of oxygen gas collected at the anode in the dilute sulphuric acid cell.

    (b) If the pupil had doubled the original steady current and allowed it to pass for 15minutes rather than 30minutes, what would be the volume of hydrogen gas liberated at the cathode of dilute sulphuric acid cell?

    (c) What mass of copper was formed at the cathode of copper (II) sulphate solution cell? (Cu = 63.5)

32. Calcium is a metal with a relative atomic mass of 40. Calcium powder reacts with sulfuric acid according to the equation
    $$Ca_{(s)} + H_2SO_{4(aq)} \rightarrow CaSO_{4(aq)} + H_{2(g)}$$

    (a)   Describe and explain, using ideas about collisions between particles, how the rate of this reaction changes when the concentration of sulfuric acid is decreased. (All other conditions stay the same.)

    (b)   Describe and explain how the rate of this reaction changes when large pieces of calcium are used instead of calcium powder. (All other conditions stay the same.)

    (c)   The reaction of calcium with sulfuric acid is exothermic. Complete the energy profile diagram to show the enthalpy change for this reaction.

energy

progress of reaction
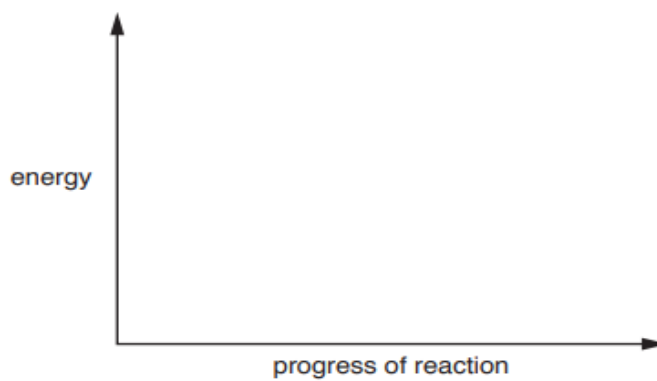
(d)   Calculate the maximum volume of hydrogen, in dm^3, formed when 12.6g of calcium reacts with excess sulfuric acid at room temperature and pressure.

33. Iron is manufactured by passing a blast of hot air through a mixture of iron ore, coke and calcium carbonate.
   (a) Explain carefully, with equations, the function of
      (i) The air
      (ii) The coke
      (iii)The calcium carbonate
   (b) Give the reason why pig iron is brittle?
   (c) State briefly what has to be done to pig iron to convert it into steel
   (d) If you were to build a new factory for manufacturing steel from imported iron ore, suggest two factors which would influence your choice.

34. Answer the following question about the manufacture of iron and steel. (No diagrams are required.)
   (a) Give the name and formula of one mineral from which iron is extracted.
   (b) Explain how carbon monoxide is formed in the blast furnace.
   (c) Write the equation for one reaction by which metallic iron is formed in the furnace.
   (d) Explain clearly why limestone (calcium carbonate) is used in the blast furnace and suggest what you think would happen if the limestone were not present.
   (e) Name three impurities likely to be present in the 'pig iron' formed in the blast furnace. Give one effect of these impurities on the physical properties of the iron.
   (f) Explain how these impurities are removed during the conversion of pig iron into steel.