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MARKING SCHEME CHEMISTRY PAPER 233/1 2001

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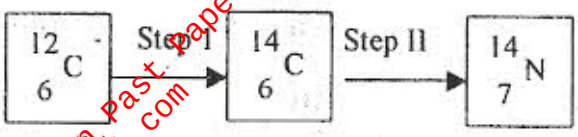
1. **Study the nuclear reactions given in the scheme below and answer the questions that follow**



a) **$^{12}_{6}C$ and $^{14}_{6}C$ are isotopes. What is meant by the term isotope?**

Atoms of the same element that differ in mass numbers, same number of protons but different number of neutrons

b) **Write an equation for the nuclear reaction in step II**

$^{14}_{6}C \rightarrow ^{14}_{7}N + ^{0}_{i}e$ or $^{14}_{6}C - ^{14}_{7}N \rightarrow ^{0}_{i}e$

c) **Give one use of $^{14}_{6}C$**

Carbon dating // Isotopic tracers // tracing of biological processes.

2. **In an experiment, 0.8g of magnesium powder were reacted with excess dilute sulphuric acid at 25^{0}C. The time for the reaction to come to completion was recorded. The experiment was repeated at 40^{0}C. In which experiment was the time taken shorter? Explain your answer.**

Experiment II at high temperature the particles have more energy, hence rate of high energy collisions increase.

3. **The electronic structures for elements represented by letters A,B, C and D are**
A) 2.8.6; B) 2.8.2; C) 2.8.1; D) 2.8.8.

a) **Select the element which forms:**

i) **A double charge cation**
B // Magnesium // 2.8.2

ii) **A soluble carbonate**
C // Sodium // 2.8.1

b) **Which element has the shortest atomic radius**
D // Argon // 2.8.8.2

4. **Study the scheme and answer the questions that follow**

a) **Identify solid E**
Any suitable ammonium salt $(NH_4)_2SO_4$, NH_4Cl etc

b) **Write an ionic equation for the reaction in step II that produces solid F**

$Al^{3+}_{(aq)} + 3OH^-_{(aq)} \longrightarrow Al(OH)_{3\,(s)}$

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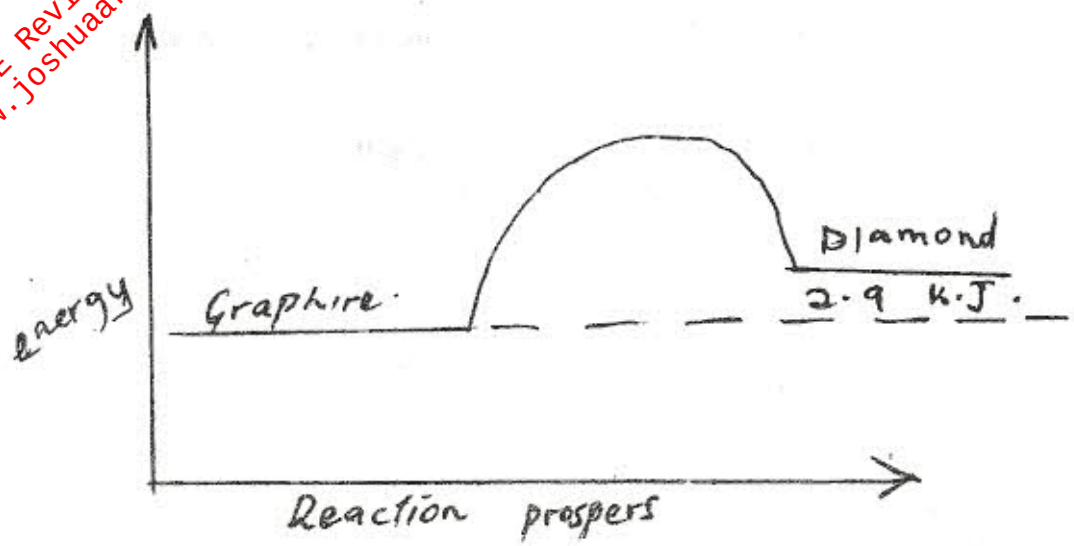
5. **Give a reason why phosphorous is stored under water**
   To keep away air/oxygen which would react with it

6. **At 298K and 1 atmosphere pressure, graphite changes into diamond according to the equation.**

   C (graphite) ⟶ C(diamond); ⟶ $\Delta H = 2.9 kJmol^{-1}$

   in the space provided, sketch a simple energy level diagram for the above change



7. **How would you obtain a sample of pure iodine from a mixture of iodine and lead sulphate?**
   Heat the mixture, iodine sublimes and can be collected from the cool part of the test tube.

8. **10g of sodium hydrogen carbonate were dissolved in $20cm^3$ of water in a boiling tube. Lemon juice was then added dropwise with shaking until there was no further observable change.**
   a) **Explain the observation which was made in the boiling tube when the reaction was in progress**
      Effervescence due to production of Carbon dioxide // Hissing // Fizzling // Bubble

   b) **What observation would have been made if the lemon juice had been added to copper turnings in a boiling tube? Give a reason.**
      No change observable. Copper is below hydrogen in the activity series therefore cannot displace hydrogen.

9. **Sample solutions of salts were labelled as I, II, III and IV. The actual solutions, not in that order, are lead nitrate, zinc sulphate, potassium chloride and calcium chloride**
   a) **When aqueous sodium carbonate was added to each sample separately, a white precipitate was formed in I, III and IV only. Identify solution II**
      Potassium Chloride // KCL

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b) **When excess aqueous sodium hydroxise was added to each sample separately, a white precipitate was formed in III only, identify solution III**
Calcium chloride // $CaCl_2$

c) **When dilute sulphuric acid was added separately to each sample, a white precipitate was formed in III only. Identify solution III**
Lead (II) nitrate // $Pb(NO_3)_2$

10. **A weighed sample of crystalline sodium carbonate, ($Na_2CO_3nH_2O$) was heated in a crucible until there was no further change in mass. The mass of the sample reduced by 14.5%. Calculate the number of moles (n) of the water of crystallisation.**
(Na = 23, O = 16, C = 12 H = 1)

Rmm of H_2O = 2 + 16 = 18

Rmm of Na_2CO_3 = 46 + 12 + 48 = 106

Moles of $H_2O = \frac{14.5}{18} = 0.805$

Moles of $Na_2CO_3 = \frac{85.5}{100} = 0.866$

Mole ration $Na_2CO_3 : H_2O$

n = 1: 1

Alternative

106 + 18 = 100%

$\frac{18n}{106+18n} = \frac{14.5}{100}$

18n × (-100) = 14.5 (106 + 18n)

1800n = 1537 +261n

1539n = 1537

$\frac{1537}{1539} = 0.9987$

11. **A certain match stick head contains potassium chlorate and sulphur. On striking the two substances react to produce sulphur dioxide and potassium chloride. Explain the environmental effect of using such matches in large numbers.**
SO_2 which is poisonous is released in the air. Acid rain which may cause corrosion will be formed.

12. **Describe a simple laboratory experiment that can be used to distinguish between sodium sulphide and sodium carbonate.**
Add dilute acid (e.g. HCL or H_2SO_4) to each substances separately. If Na_2S, colourless gas, smell of rotten eggs.
If Na_2CO_3 – Effervescence, gas turns lime water to white precipitate/ suspension/milky.

13. **The information in the table below relates to elements in the same group of the periodic table. Study it and answer the question that follows:**

Element	Atomic size
G1	0.19
G2	0.23
G3	0.15

Which element has the highest ionisation energy? Give reason

G3, Because it has the smallest atomic radius . Its outer most electron is tightly held by the nucleus or it requires a lot of energy to remove it.

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14. **When the oxide of element H was heated with powdered carbon, the mixture glowed and carbon dioxide gas was formed. When the experiment was repeated using the oxide of element J, there was no apparent reaction.**
    a) **Suggest one method that can be used to extract element J from its oxide (1)**
    Electrolysis of fused or molten oxide

    b) **Arrange the elements H, J and Carbon in the order of their decreasing reactivity**
    JCH // J, Carbon, H

15. **When a sample of concentrated sulphuric acid was left in an open beaker in a room for two days, the volume was found to have increased**
    a) **What property of concentrated sulphuric acid is shown by the above reaction?**
    Hygroscopy

    b) **State one use of concentrated sulphuric acid that depends on the property**
    Drying of gases // Drying agent

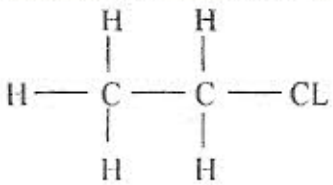
16. **The diagram shows an iron bar which supports a bridge. The iron bar is connected to a piece of magnesium metal.**
    Explain why it is necessary to connect the piece of magnesium metal to the iron bar
    Magnesium is above iron in the activity series. It supplies electrons to the iron bar hence preventing it from rusting.

17. a) **State one cause of temporary hardness in water**
    Presence of $Ca(HCO_3)_2$ or $Mg(HCO_3)_2$

    b) **How does distillation remove hardness from water**
    Water vapourises and distils off leaving behind ions that cause hardness

18. **In the presence of U.V Light ethane gas undergoes substitution reaction with chlorine**
    a) **What is meant by the term Substitution reaction**
    The idea of H being replaced by a halogen // Reaction where one hydrogen atom of an alkane is replaced by a halogen atom

    b) **Give the structural formula and the name of the organic product formed when equal volumes of ethane and chlorine react together**



OR CH_3CH_2CL Chloroethane or Ethlchloride

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19. **Explain why burning magnesium continues to burn in a gas jar full of sulphur dioxide while a burning split would be extinguished.**
The burning magnesium produces more heat energy than the burning splint. The heat energy from the magnesium is enough to break the sulphur oxygen bond setting free oxygen. Magnesium uses the freed oxygen to continue burning.

20. a) **What observation would be made if hydrogen sulphide gas was bubbled through a solution of zinc nitrate**
A black solid formed

b) **Write an equation for the reaction that takes place in (a) above**
$Z(NO_3)_{2(aq)} + H_2S_{(g)} \longrightarrow Zns + 2HNO_{3(aq)}$

OR $Zn^{2+}_{(aq)} + S^{2-}_{(g)} \longrightarrow Zns(s)$

OR $Zn^{2+}_{(aq)} + H^{S-}_{(g)} \longrightarrow Zns_{(s)} + H^{+}_{(aq)}$

21. **The apparatus shown was used to investigate the effect of carbon monoxide on copper (II) Oxide**
a) **State the observation that was made in the combustion tube at the end of the experiment**
Reddish brown/ Brown solid formed

b) **Write an equation for the reaction that took place in the combustion tube**
$CuO_{(s)} + CO_{(g)} \longrightarrow Cu_{(s)} + CO2_{(g)}$

c) **Why is it necessary to burn the gas coming out of tube K**
It is poisonous // harmful // dangerous // toxic // pollutant

22. **Explain why hydrogen forms compounds in which its oxidation state is either $^{+}1$ or $^{-}1$**
It has one electron in its outermost energy level which it can lose to form H^{+} showing oxidation state of $^{+}1$ or gain an electron to form H^{-} showing and oxidation state of $^{-}1$.

23. **The table below shows the properties of subtances K, L, M and N**

Substances	Reaction with oxygen at 25°C	Melting point	Conductivity	
			Solid	Molten
K	Unreactive	High	Poor	Good
L	Reactive	Low	Poor	Poor
M	Unreactive	High	Good	Good
N	Unreactive	Low	Good	Good

Select the substances which is likely to be
a) **Copper metal**
M
b) **Magnesium chloride**
K

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24. An element P has a relative atomic mass of 88. When a current of 0.5 amperes was passed through the fused chloride of P for 32 minutes and 10 seconds, 0.44g of P were deposited at the cathode.
Determine the charge on an ion of P (1 Faraday = 96500 Coulombs) (3 marks)

$T = 32 \times 60 + 10 = 1930S$

$Q = 1930 \times 0.5 = 965C$

$0.44g = 965C$

$$88g = \frac{965 \times 88}{0.44}$$

$= 193000$

$$\text{Charge} = \frac{193000}{96500}$$

$= +2$

25. The melting point of phosphorus trichloride is –91°C. while that of magnesium chloride is 715°C. In terms of structure and bonding, explain the difference in their melting points. (3 marks)

PCL_3 has a simple molecular structure. Molecules are held together by weak Van der Walls force of attraction

$MgCl_2$ has giant ionic structure. Particles held together by strong electrostatic force of attraction/strong ionic bonds

26. The pH of a sample of soil was found to be 5.0. An agricultural officer recommended the addition of calcium oxide in the soil (2 marks)

- To neutralize soil audity/increase soil pH
- To be used as fertilise/ Add Ca^{2+} to the soil

27. Hydrogen peroxide decomposes according to the equation given below.

$H_2O_{2(l)} \rightarrow H_2O_{(l)} + \frac{1}{2}O_{2(g)}$; $\Delta H = -98kJ$

8.5 of hydrogen peroxide contained in 100cm³ of solution with water were completely decomposed.
Determine the rise in temperature due to the reaction.
(Specific heat capacity of water = $4.2Jg^{-1}K^{-1}$, density of water = 1g/cm³ O = 16 H = 1) (3 marks)

$64 + 4 = 68$

68g of $H_2O_2 = 196$

$$8.5g = \frac{196 \times 8.5}{68} = 24.50kJ$$

$100 \times \Delta T \times 4.2$

$= 24500$

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