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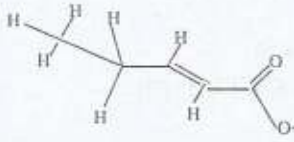
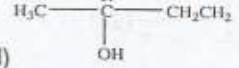
2006 Post UME Test

1. All the following will liberate a gas when reacted with dilute hydrochloric acid except
   a) Sodium tetraoxosulphate(VI) salt
   b) Sodium trioxocarbonate(IV) salt
   c) Sodium sulphide
   d) Sodium trioxonitrate(V)
2. The isomer of a compound C_5H_{10} which does NOT decolourise bromine water is
   a) 2-methylbutane b) 2,2-dimethylpropane
   c)2-methylbut-l-ene d)Methylcyclobutane
3. A mixture of nitrogen, oxygen and helium contains 0.25, 0.15 and 0.4 mole of these gases respectively. If the pressure contribution due to oxygen was 2.5 atm. The partial pressure of helium is
   a) 4.0 atm b) 0.8 atm c) 3.33 atm d) 6.67 atm
4. Elements P has atomic number of 12 while element Q has an atomic number 15. Combination of P and Q gave a compound P_mQ_n. the respective values of m and n are
   a) 2 and 2 b) 2 and 3 c) 3 and 2 d) 2 and 1
5. $C_XH_Y + 9O_2 \rightarrow 6CO_2 + 6H_2O$
   The hydrocarbon, C_XH_Y in the reaction above is most likely
   a) An alkane b) a benzene
   c) an alkene d) an alkyne
6. A 512 cm^3 sample of a gas weighed 1.236 g at 20°C and a pressure of one atmosphere. The relative molecular mass of the gas is
   [R = 8.314 J k^{-1} mol^{-1}, I atm = 101,325 J m^{-3}]
   a) 58.07 b) 588.367 c) 5.88 d) 197.9
7. The amount of methane molecules, CH_4 in 8.0grams of methane is
   a) 8 mol b) 128 mol
   c) 0.5 mol d) 3.01 x 10^{23} mol
8. The concentration of a solution obtained by dissolving 0.53 g of pure anhydrous Na_2CO_3 in water to make 250 cm^3 of solution.
   a) 2.0 x 10^{-5} mol dm^{-3} b) 2.1 g dm^{-3}
   c) 2.0 x 10^{-2} mol dm^{-3} d) 5.0 x 10^{-3} mol dm^{-3}
9. What is the maximum volume of CO_2 at s.t.p. that can be obtained when dilute hydrochloric acid is added to 10grams of $CaCO_3$?
   [Ca = 40, C = 12, O = 16]
   a) 2.24 dm^3 b) 22.4 dm^3 c) 0.224 dm^3 d) 22.4dm^3
10. Sulphur (IV) oxide travels a given distance in 10sec. How long will it take equal volume of helium to travel the same distance under the same conditions?
    [S = 32, O = 16, He = 4]
    a) 1.6 sec b) 40 sec c) 5.0 sec d) 2.5 sec
11. The volume of hydrogen gas produced at s.t.p. when 100 cm^3 of 2 M hydrochloric acid reacts with excess Zinc is
    a) 2.24 dm^3 b) 4.48 dm^3 c) 1.12 dm^3 d) 44.8 dm^3
12. During electrolysis, two cells each containing molten Al_2O_3 and fuse $CaCl_2$ were connected in series. A current of 15 Amp was passed through the cells for a given period of time. At the end of the electrolysis 9 g of calcium was found to have been deposited at the cathode what mass of aluminium would be deposited in the second cell? [Al = 27,Ca = 40]
    a) 8.82 g b) 4.44 g c) 17.60 g d) 4.05 g
13. The balanced equation for the reaction of tin(ii) salt with potassium heptaoxodichromate(VI) in a acidic medium can be represented as:
    $eSn^{2+} + fCr_2O_7^{2-} + gH^+ \rightarrow hSn^{4+} + iCr^{3+} + jH_2O$
    e,f,g,h,i and j are respectively
    a) 3, 5, 6, 3, 1 and 4 b)3, 1, 14, 3, 2 and 7
    b) 3, 2, 6, 1, 5 and 6 d)5, 2, 1, 5, 3 and 2
14. The pH of a solution containing 0.5 x 10^{-6} M H_2SO_4 is
    a) 6.3 b) 6.5 c) 6.0 d) 5.0
15. Which of the following oxides will NOT dissolve in both dilute hydrochloric acid and 2 M sodium hydroxide solution?
    a) Lead (II) oxide b) Aluminium oxide
    c) Zinc(II) oxide d) Calcium oxide
16. The I.U.P.A.C. name for the compound



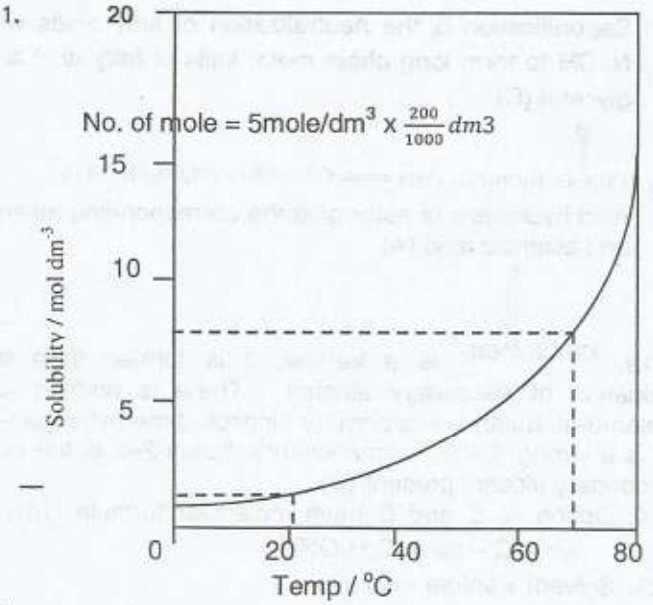
    is
    a) Pent-3-enoic acid b)Pent-4-enoic acid
    c)Pent-2-enoic acid d)Pent-3-ene-l-oic acid
17. Metal salts of long chain fatty acids are known as
    a) Detergents b)double salts
    c) soaps d) grease
18. The compound $CH_3\text{-}\overset{O}{\overset{\|}{C}}\text{-}O\text{-}CH_2CH_2CH_3$, when refluxed with dilute HCl, is hydrolyzed to give
    a) CH_3COOH and $CH_3CH_2CH_2OH$
    b) CH_3COOH and $CH_3CH_2CH_3$
    c) CH_3COOH and CH_3CH_2OH
    d) CH_3COOH and $CH_3CH_2CH_2Cl$
19. The compound $CH_3\text{-}CH_2\text{-}\overset{O}{\overset{\|}{C}}\text{-}CH_3$, is the product of oxidation of
    a) butan-3-ol b) butan-l-ol
    b) 3-methylpropan-2-ol d) Butan-2-ol
20. Which of the following structural formulas is NOT isomeric with the others?
    a) $CH_3CH_2CH_2CH_2\text{-}OH$ b) $CH_3\text{-}O\text{-}CH_2CH_2CH_3$

    c)



    d)

21.



The curve above represents the solubility curve of $KClO_3$. The number of moles of $KClO_3$ crystals produced by cooling 200 cm^3 of a saturated solution of the salt from 65°C to 25°C is

a) 6.30 mole b) 3.26 mole c) 0.63 mole d) 7.30 mole

22. During a compression process involving an ideal gas at pressure P_1, when the volume, V_1 of the gas was halved, the temperature in Kelvin increases by half its initial value. The final pressure P_2 is given by

a) $3P_1$ b) $12P_1$ c) $6P_1$ d) $1.5P_1$

23. Cellulose and starch can be classified as one of the following:

a) Hydrocarbons b) sugars
c) carbohydrates d) alkaloids

Answers Key

1.	D	6. A	11. A	16. C	21. B
2.	D	7. D	12. D	17. C	22. A
3.	D	8. C	13. B	18. A	23. C
4.	C	9. A	14. C	19. D	
5.	C	10. D	15. D	20. C	

Explanations to Answers

1. The equations of the reactions are represented below:
   a) $Na_2SO_4 + 2HCl \rightarrow 2NaCl + H_2O + SO_3$
   b) $HCl + NaCO_3 \rightarrow NaCl + H_2O + CO_2$
   c) $HCl + Na_2S \rightarrow NaCl + H_2S$
   d) $NaNO_3 + HCl \rightarrow HNO_3 + NaCl$
   Option A produce SO_2 (gas), Option B yield CO_2, option C yield H_2S (gas) & option D yield HNO_3 (aqueous) and NaCl (salt) (D)
2. C_5H_{10} is an hydrocarbon by inspection expected to be an alkene. Bromine water is used to test for unsaturation in organic compounds but for C_5H_{10} to test negative to bromine water indicates that it is a saturated organic compound with one double bond equivalent and must be a cyclic compound, option A & B have molecular formula C_5H_{12} - a saturated alkane, option C is an alkene and it will test positive to bromine water(D)
3. Total No. of mole = 0.25 + 0.15 + 0.4 = 0.8 mole
   Partial pressure of oxygen = $\frac{No.of\ mole\ of\ Oxygen}{Total\ No.of\ mole}$ x Total pressure of mixture

   $Total\ pressure\ of\ mixture = \frac{0.8 \times 2.5}{0.15}$ = 13.3 atm

   Partial pressure of helium = $\frac{0.4}{0.8}$ x 13.3 atm
   = 6.66 atm (D)
4. P = 12 = $1s^2 2s^2 2p^6 3s^2$
   Q = 15 = $1s^2 2s^2 2p^6 3s^2 3p^3$
   Element P have 2-electrons in its outermost shell i.e P^{2+} Element Q have 5-electrons in its outermost shell. i.e Q^{3-} Element Q needs 3-electrons to go achieve octet configuration. It will need 6-electrons from 3-atoms of P to complete its configuration while 2 atoms of Q is needed, the compound is P_3Q_2
   OR;

	P	Q
Combining power (valency):	2	3
Exchange of valency :	3	2

   Molecular mass of the compound is P_3Q_2
5. $C_xH_y + x + \frac{y}{4}O_2 \rightarrow XCO_2 + \frac{y}{2}H_2O$
   $X = 6$ & $\frac{y}{2} = 6$
   $Y = 12$, C_6H_{12} (Alkenes) ⇨ n-hexene (C)
6. Vol = 0.512 dm^3 = 0.512 m^3
   T = 20 + 273 = 293 K
   Pressure = 1atm = 101,235 Jm^{-3}

   $\eta = \frac{PV}{RT} = \frac{101.325\ Jm^{-3} \times 0.512\ m^3}{8{,}314\ Jkmol^{-1} \times 293\ K}$ = 0.0219 mole

   Molar mass = $\frac{1.236\ g}{0.0129\ mole}$ = 58.07 (A)
7. No. of mole = $\frac{8.0g}{16\ gmol^{-1}}$ = 0.5 mole
   1mole of CH_4 molecules contains 6.02 x 10^{23} molecules
   0.5 moles of methane molecules will contain
   = 0.5 x 6.02 x 10^{23} molecule
   = 3.02 x 10^{23} molecule (D)

8. Molar mass of Na_2CO_3
   = (23 x 2) + 12 + (12 x 3) = 106 g/mol
   No. of mole = $\frac{0.53}{106}$ = 5 x 10^{-3} mole
   Conc. in mol/dm^3 = $\frac{No.of\ mole}{Vol.\ in\ dm^3}$

   $= \frac{5 \times 10^{-3}\ mole}{250/1000 dm^3}$ = 0.02 mol/dm^3 (C)
9. $2HCl_{(aq)} + CaCO_3 \rightarrow CaCl_2 + H_2O + CO_2$
   2 mole 1 mole 1 mole 1 mole
   No. of mole of $CaCO_3$ = $\frac{10}{100}$ = 0.1 mole
   Since 1 mole of $CaCO_3$ produce 1 mole of CO_2 at s.t.p
   0.1 mol of $CaCO_3$ produce 0.1 mol of CO_2
   :.1 mole of CO_2 is produced in 22.4 dm^3 at s.t.p
   0.1mole of CO_2 will be produced in $\frac{0.1\ mole \times 22.4\ dm^3}{1\ mole}$
   = 2.24 dm^3 of CO_2 (A)
10. Vapour density of SO_2 = ½ x 64 = 32
    Vapour density of helium = ½ x 4 = 2
    $R_{SO2} = {}^{a}/_{10secs}$

$R_{He} = \frac{a}{X}$

$\frac{R_{He}}{R_{SO_2}} = \sqrt{\frac{P_{SO_2}}{P_{He}}}$, $\frac{a}{X} \times \frac{10}{a} = \sqrt{\frac{32}{2}}$

$\frac{10}{x} = \sqrt{16}$

$\frac{10}{x} = 4$

$x = 2.5\ secs\ (D)$

11. $2HCl_{(aq)} + Zn_{(s)} \rightarrow ZnCl_2 + H_{2(g)}$
2 mole 1 mole 1 mole
No. Of mole of HCl = 2 mole/dm^3 x $\frac{100}{1000}$ dm^3
= 0.2 mole
2 mole of HCl produces 1 mole of hydrogen gas at s.t.p
0.2 mole of HCl produces 0.1 mole of H_2
1 mole of H_2 requires 22.4 dm^3 of s.t.p
0.1 mole of H_2 will require $\frac{22.4\ dm^3 \times 0.1\ mole}{1\ mole}$ = 2.24 dm^3 (A)

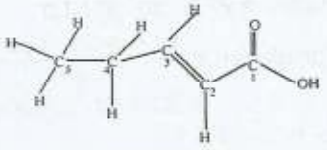
12. $Ca^{2+}_{(aq)} + 2e^- \rightarrow Ca_{(s)}$
No. of mole of Ca^{2+} = $\frac{9}{40}$ = 0.225 mole
1 mole of $Ca^{2+}_{(aq)}$ is deposited by 2 F
0.225 mole of Ca^{2+} will be deposited by 2 F x 0.225 = 0.450 F
$Al^{3+}_{(aq)} + 3e^- \rightarrow Al_{(s)}$
$3\ F\ deposit \quad 1\ mole\ of\ Al$
1 F would deposit $\frac{^1/_3 \times 0.45\ F}{1\ F}\ mole$ = 0.150mole
Mass of aluminium deposited= 0.150mole x 27 = 4.05g (D)

13. $eSn^{2+} + fCr_2O_7^{2-} + gH^+ \rightarrow hSn^{4+} + cCr^{3+} + jH_2O$
$Sn^{2+} \rightarrow Sn^{4+} + 2e^-$ .....(i)
$6e^- + Cr_2O_7^{2-} + 14H^+ \rightarrow 2Cr^{3+} + 7H_2O$....(ii)
Multiply equation (i) by 3 and add to equation (ii)
$3Sn^{2+} + 14H^+ + Cr_2O_7^{2-} + 6e^- \rightarrow 3Sn^{3+} + 6e^- + 2Cr^{3+} + 7H_2O$
{e=3, f=1, g=14, h=3, i=2, j=7} (B)

14. $H_2SO_4 \rightleftharpoons 2H^+ + SO_4^{2-}$
1mole 2 mole
0.5x 10^{-5}mol/dm^3 of H_2SO_4 produces 2(0.5 x 10^{-6}mol/dm^3) of hydrogen ions
[H^+] = 1.0 x 10^{-6}mol/dm^3
pH = -log[1x 10^{-6}]
= 6log 10 – log$^1_{10}$
= 6 – 0 = 6 (C)

15. Lead(II) oxide, aluminium oxide and zinc oxide are amphoteric oxide, they behave both as basic oxides and as acidic oxides while CaO is basic oxide, it only react with dilute acid, hydrochloric and not with sodium hydroxide and also CaO is a base like NaOH (D)

16.



Pent-2-enoic acid (C)

17 Saponification is the neutralization of fatty acids with NaOH to form long chain metal salts of fatty acid and glycerol (C)

18 $CH_3C(=O)OCH_2CH_2CH_3 + HCl \rightleftharpoons CH_3COOH + CH_3CH_2CH_2OH$ (A)
Acid hydrolysis of ester give the corresponding alkanol and alkanoic acid (A)

19. $CH_3CH_2C(=O)CH_3$ is a ketone, it is formed from the oxidation of secondary alcohol. There is nothing like butan-3-ol, butan-l-ol is primary alcohol, 3-methylpropan-2-ol is a wrong IUPAC nomenclature, butan-2-ol is the only secondary alcohol present (D).

20. Option A, B and D have molecular formula $C_4H_{10}O$ while C – have C_4H_8O(C).

21. Solvent + solute = solution
At 65°C
Solubility = 7 mol/dm^3 of 200 cm^3 of $KClO_3$
No. of mole = 7 mol/dm^3 x $\frac{200}{1000}$ dm^3
= 1.4 mole of $KClO_3$
Mass of $KClO_3$ crystals formed = 1.4 mol x 122.5 g/mol
= 171.5 grams
At 25°C, 1 mol/dm^3 of 200 cm^3 of $KClO_3$
No. of mole = 1 mol/dm^3 x $\frac{200}{1000}$ dm^3 = 0.2 mole
Mass of $KClO_3$ crystal = 0.2mol x 122.5 g/mol
= 24.5 grams
Mass of crystals = 171.5 – 24.5 = 147.0 g
No. of mole = $\frac{147g}{122.5\ g/mol}$ = 1.2 mole (B)

22. $P_1 = P_1$, $V_2 = ½V_1$
$V_1 = V_1$, $T_2 = ^3/_2T_1$
$T_1 = T_1$, $P_2 = ?$
$P_2 = \frac{P_1V_1T_2}{T_1V_2} = \frac{P_1 x V_1 x\ ^3/_2T_1}{T1\ x\ ^1/_2V_1} = 3P_1$ (A)

23. Cellulose and starch are **carbohydrates**, made up of non-reducing sugar (C)

OBAFEMI AWOLOWO UNIVERSITY, ILE IFE
2008 POST UME TEST

1. Inter-atomic combinations involve the
   a) Neutrons in the nucleus only
   b) Protons in the nucleus only
   c) Electrons in the outer shell only
   d) Electrons in all the shells
2. Which of the following is not a characteristic property of ionic compounds?
   a) Solubility in polar solvents
   b) Low melting points
   c) Conduction of electricity in aqueous solution
   d) Fast reactions in solution.
3. The compound with the highest ionic character among the following is
   a) PCl_5 b) CCl_4 c)BCl_3 d) CsCl
4. Why is the hydrogen gas not found in the atmosphere? It readily reacts with
   a) Carbon(IV) oxide b) oxygen
   c) Nitrogen d) carbon(II) oxide
5. Apart from water, the other product(s) of the neutralization reaction between NaOH solution and nitrogen(IV) oxide is/are
   a) $NaNO_2$ b) $NaNO_3$
   c) $NaNO_3$ and HNO_3 d) $NaNO_2$ and $NaNO_3$
6. Silver trioxonitrate(V) on heating, gives
   a) Ag, N_2O and O_2 b) Ag_2NO, N_2 and O_2
   c) Ag_2O and N_2O d) Ag, NO_2 and O_2
7. The most reactive halogen is:
   a) Cl_2 b) Br_2 c) F_2 d) I_2
8. 0.79g of a gas at s.t.p. occupied a volume of 250cm^3. What is the relative molecular mass of the gas?
   a. 17 b. 32 c. 64 d. 71
9. The relationship between the density (d) of a gas and the rate (r) at which the gas diffuses is
   a. R = Kd b. $r = Kd^{\frac{-1}{2}}$ c. $r = Kd^{\frac{1}{2}}$ d. $r = Kd^{-1}$
10. The pressure exerted by a sample of a gas confined in 5.86 dm^3 container at 20°C is 4.1atm. what is the number of moles of the gas in the sample?
    (R = 0.082 dm^3 atm mol^{-1} K^{-1})
    a. 1.00 b. 2.00 c. 3.00 d. 4.00
11. 50 cm^3 of hydrogen are sparked with 100 cm^3 of oxygen at 110°C and 1 atm. If the whole reaction mixture passes through an alkaline solution of pyrogallol, the volume of the residual gas is
    a. 125 cm^3 b. 100 cm^3 c. 75 cm^3 d. 50 cm^3
12. The decreasing order of the magnitude of energy changes is
    a. Phase, chemical, nuclear
    b. Chemical, nuclear, phase
    c. Nuclear, phase, chemical
    d. Nuclear, chemical, phase
13. 0.92 g of ethanol raised the temperature of 100 g of water from 298 K to 312 K when burned completely. What is the heat of combustion of ethanol?
    a. +300 kJ mol^{-1} b). +3000 kJ mol^{-1}
    c. -300 kJ mol^{-1} d. -3000 kJ mol^{-1}
    (C = 12; H = 1; O = 16, specific heat capacity of water = 4.2kJg^{-1}K^{-1})
14. The highest level of molecular disorderliness is found in
    a. ice at -10°C b. water at 1000°C
    c. steam at100 C d. ice at 0 C
15. A reaction is spontaneous at all temperature if

a. $\Delta G = 0$ b. $\Delta G > 0$
c. $\Delta S<0$ & $\Delta H>0$ d. $\Delta S > 0$ & $\Delta H < 0$

16. Which of the following reactions of marble with fastest?
a. 5g of marble lump at 50°C
b. 5g of marble powder at 50°C
c. 5g of marble powder at 25°C
d. 5g of marble lump at 25°C

17. $A_{(g)} + 2B_{(g)} \rightarrow C_{(g)}$
In the reaction represented by the equation above, the rate of appearance of C is found experimentally to be independent of the concentration of A and to increase four folds when the concentration of B is doubled. The rate law for the reaction is
a. Rate = $K[A]^0[B]^4$ b.Rate = $K[A]^{10}[B]^2$
c. Rate = $K[A][B]^2$ d. Rate = $K[A]^2[B]^0$

18. How is the equilibrium constant for the forward reaction of an equilibrium (K_f) related to that of the reverse react (K_r)?
a. (K_r) is the additive inverse of (K_f)
b. (K_r) is the multiplicative inverse of (K_f)
c. (K_r) is the same as (K_f)
d. The product (K_r) and (K_f) is zero.

19. What is the concentration of OH^- ions of an aqueous solution of pH 4.4?
a. 9.600×10^{-10} mol dm^{-3} b) 2.512×10^{-10} mol dm^{-3}
C .9.600×10^{-11} mol dm^{-3} d. 2.512×10^{-11} mol dm^{-3}

20. An acid and its conjugate base
a. Are oppositely charged
b. Differ only by a hydroxide ion
c. Differ only by an electron
d. Differ only by a proton

21. A complex salt is
a. $KAl(SO_4)\bullet 12H_2O$ b.$Cu(NH_3)_4Cl_2$
c.$K_2S_2O_3)\bullet 5H_2O$ d.$Mg(OH)Cl$

22. What happens to the conductivity of an electrolyte as its concentration reduces?
a. Increases b. decreases
c. is unaffected d. becomes resistivity

23. If the cost of electricity required to deposit 1 g of aluminium is N4.00, how much would it cost to deposit 24 g of copper? (Al = 27, Cu = 64)
a. N 27.02 b. N 37.02
c.N 47.02 d. 57.02

24. The overall reaction in an electrochemical cell is
$Mg_{(s)} + Cu^{2+}_{(aq)} \rightarrow Mg^{2+}_{(aq)} + Cu_{(s)}$
What is the symbolic representation of the cell?
a. $Mg_{(s)}/Mg^{2+}_{(aq)} \,||\, Cu^{2+}_{(aq)} / Cu_{(s)}$
b. $Mg_{(aq)}/Mg^{2+}_{(s)} \,||\, Cu^{2+}_{(s)} / Cu_{(aq)}$
c. $Cu^{2+}_{(aq)}/Cu_{(s)} \,||\, Mg_{(s)}/Mg^{2+}_{(aq)}$
d. $Cu_{(s)}/Cu^{2+}_{(aq)} \,||\, Mg^{2+}_{(aq)}/Mg_{(s)}$

25. Which of the following metals can be used as sacrificial cathode for preventing corrosion of a length f iron pipe?
a. Ag b. Cu c. Mg d. Mn

26. A particle that contains 8 protons, 9 neutrons and 7 electrons could be written as
a. ${}^{16}_{8}O$ b. ${}^{17}_{8}O^+$ c. ${}^{17}_{9}O^+$ d. ${}^{17}_{8}O^-$

27. The solubility product of a sparingly soluble salt, MX_2 is 1.09×10^{-7} mol^3 dm^{-9} at 25°C. What is the solubility of the salt at 25°C?
a. 3.0×10^{-9} mol dm^{-3} b. 3.0×10^{-3} mol dm^{-3}
c.6.0×10^{-9} mol dm^{-3} d.6.0×10^{-9} mol dm^{-3}

Answer Key

1 C	6 D	11 D	16 B	21 B	26 B
2 B	7 C	12 D	17 C	22 A	27 B
3 D	8 D	13 C	18 B	23 A	
4 B	9 B	14 C	19 B	24 A	
5 D	10 A	15 D	20 D	25 C	

Explanations to Answers

1. It is the electrons in the outer most shell of an atom that take part in bonding and inter-atomic combination (C)
2. Ionic compounds are formed between two ions of atoms having a large electronegativity differences e.g. metals and non-metals. They are usually hard solids with high melting points or liquid with high boiling points (B)
3. Since electropositivity increase down the group, Ceasium is the only metal in the compounds. PCl_5, CCl_4 and BCl_4 are all covalent bonded compounds but CsCl is an ionic compound (D)
4. This is due to the fact that hydrogen readily combine with oxygen to form water. Hence it occurs as water, acids and organic substances (B)
5. $2NaOH + 2NO_2 \rightarrow NaNO_3 + NaNO_2 + H_2O$
NO_2 is a mixed acid anhydride, it reacts with alkaline to yield a corresponding mixture of dioxonitrate(III) and trioxonitrate(V) salts (D)
6. $2AgNO_3 \xrightarrow{\Delta} Ag_{(s)} + O_{2(g)} + 2NO_{2(g)}$ (D)
7. Fluorine is the most reactive of the halogen group, this is because it is the most electronegative of al the members of the group, electronegativity decrease down the group (C)
8. No. of moles of the gas = $\frac{0.250\ dm^3}{22.4 dm^3 mol^{-1}}$
= 0.01116 mole
Relative molar mass = molar mass
$= \frac{mass}{no.of\ mole} = \frac{0.79g}{0.01116 mole} = 70.78 = 71$ (D)
9. $R \propto \frac{1}{\sqrt{d}} \Rightarrow R = \frac{K}{\sqrt{d}}$ (B)
10. Pressure = 4.1 atm
Volume = 5.86 dm^3
Temperature = 20°C + 273 = 293 K
R = 0.082 dm^3 atm $mol^{-1}K^{-1}$
$n = \frac{PV}{RT} \frac{4.1\ atm\ x\ 5.86\ dm^3}{0.082\ dm^3\ atm\ mol^{-1}\ x\ 293K} = 1$ mole (A)
11.

	$2H_{2(g)}$	+ $O_{2(g)}$	$\rightarrow 2H_2O_{(l)}$
Reacting:	2 mole	1 mole	2 mole
Starting volume:	50 cm^2	100 cm^3	-
Reacting volume:	50 cm^3	25 cm^3	50 cm^3
Volume after sparking:	-	75 cm^3	50 cm^3

∴ Residual gases = unreacted oxygen+ H_2O
= 75 + 50 = 125 cm^3
The pyrogallol solution removes the oxygen components of the residual gas. The volume of the residual gas left = (125 – 75) = 50 cm^3 (D)
12. D.
13. Heat evolved = mass x specific heat capacity x temperature rise
= 100 g x 4.2 $Jg^{-1}K^{-1}$ x (312.3 – 298) K
= 6006 J
No of mole of ethanol = $\frac{0.92}{46}$ = 0.02mole

Combustion of 0.02 mole of ethanol produces 6006J of heat

1 mole of ethanol produces: $\frac{6006\ J \times 1\ mole}{0.02\ mole}$

$= 300300\ J\ mole^{-1} = 300.3\ kJ\ mole^{-1}$

The reaction is exothermic (-300.3 kJ mole) (C).

14. Molecular disorderliness in a substance is the measure of its entropy and entropy increases with increase in temperature. At 100°C, water molecule becomes move energetic and move more freely (C).
15. If ΔG is positive ($\Delta G > 0$), the charge is non-spontaneous and $\Delta G = 0$ means the reaction is at equilibrium. A reaction is spontaneous, if $\Delta G < 0$. This can be achieved at all temperature, if OH <0 (exothermic) and the reaction occurs with increase randomness ($\Delta S > 0$)

$\Delta G = \Delta H - T\Delta S$

-ve +ve

From the Gibb's equation, ΔG will be less than zero at all temperature if $\Delta H < 0$ & $\Delta S > 0$ (D)

16. The rate of reaction increases with increase in temperature and surface area (B)
17. Rate of appearance of C = Rate of reaction

Rate law is represented as $R=K[A]^p[B]^q$

$[A] = a\ mol/dm^3$ & $[B] = b\ mol/dm^3$

$R = k(2a)^p(b)^q$ ..... (i)

If [A] is doubled & [B] is constant, rate is unaffected, i.e.$[A]=2a$ &$[B]=b$, $R_2=R_1$

$R_2 = K(2a)^p(b)^q$ ..... (ii)

If [A] is constant & [B] is doubled, Rate is four-fold i.e. $[A]=a$, $[B] = 2b$, $R_3=4R_1$

$R_3 = K(a)^p(2b)^q$ ..... (iii)

To determine p, divide equation(ii) by (i)

$\frac{R_1}{R_2} = \frac{R_1}{R_1} = \frac{K(2a)^p(b)^q}{K(a)^p(b)^q} = \frac{(2a)^p}{(a)^p}$

$= 2^p = 1 = 2^0$

$\Rightarrow P = 0$

To determine q, divide equation(iii)by (i)

$\frac{R_3}{R_2} = \frac{4R_3}{R_1} = \frac{4}{1} = \frac{K(a)^p(2b)^q}{K(a)^p(b)^q} = \frac{(2b)^q}{(b)^q}$

$= 2^q = 4$

$= 2^q = 2^2$

$= q = 2$

Hence, rate law is $R = [A]^0[B]^2$ (C)

18. $C_{(g)} \rightleftharpoons D_{(g)}$

$K_f = \frac{[D]}{[C]}$: $K_r\frac{[C]}{[D]}$

$[D] = K_f[C]$

$\Rightarrow K_r = \frac{[C]}{Kf[C]}$

Kr is the multiplicative inverse of K_f (B)

19. pH + pOH = 14

4.4 + pOH = 14

pOH = 9.6

pOH = -log[OH⁻]

9.6 = - log [OH]

[OH⁻] = anti log [-9.6]

$= 2.512 \times 10^{-10}\ mol/dm^3$ (B)

20. HA + B ⇌ HB^+ + A^-

acid base conjugate acid conjugate base

The original acid gives up its proton and becomes a conjugate base. The difference between them is a proton (D)

21. Complex salts in which the positive and negative ions are complex or possess a coordinate sphere. In a complex salt, there is a metal ion that is joined to electron pair donors (ligands) via a coordinate bond.

$Cu(NH_3)Cl$ is a complex salt

$KAl(SO_4)\bullet 12H_2O$ (alum) is a double salt

$K_2S_2O_3.5H_2O$ is a normal salt

Mg(OH)Cl - is a base salt (B)

22. Normally, conductivity increases with increase in dilution or decrease in concentration. (A)
23. $Al^{3+}_{(aq)} + 3e^- \rightarrow Al_{(s)}$

3F

no of mole $Al^{3+} = \frac{1}{27} = 0.037\ mol$

1 mole of Al^{3+} deposited by 3F at s.t.p

0.037mol of Al^{3+} will require $\frac{0.037 \times 3F}{1mole} = 0.111F$

$Cu^{2+}_{(aq)} + 2\ e^- \rightarrow Cu_{(s)}$

No. of mole of $Cu^{2+} = \frac{24}{64} = 0.375\ mole$

1 mole of Cu^{2+} deposited by 2F

0.375moleofCu^{2+}required= $\frac{2F \times 0.375\ mole}{1\ mole}$

$= 0.75F$

0.111F of Al^{3+} costs N4

0.75F of Cu^{2+} will cost $\frac{0.75F \times N4}{0.111F} = N27.02$ (A)

24. $Mg_{(s)} + Cu^{2+}{}_{aq} \rightarrow Mg^{2+}_{(aq)} + Cu_{(s)}$

At Anode: $Mg(s) \rightarrow Mg^{2+} + 2e^-$ (Oxidation, loss of electron)

At cathode: $Cu^{2+} + 2e \rightarrow Cu_{(s)}$ (reduction gain of electron).

Therefore, the symbolic representation of the cell is

$Mg_{(s)}/\ Mg^{2+}//\ Cu^{2+}{}_{(aq)}/Cu_{(s)}$ (A)

25. As a principle, the sacrificial cathode metal must be above the metal to be protected in the electromotive series. The cathode metal goes into solution to form its ion (become corroded) and evolves hydrogen. Here, the length of iron is its anode while Magnesium act as Cathode and goes into Solution to form ions while it is corroded. Therefore, the iron is protected from rusting.

$Mg(s) \longrightarrow Mg^{2+} + 2e^-$

$2H^+ + 2e^- \longrightarrow H_{2(g)}$

$Mg_{(s)} + 2H^+ \longrightarrow Mg^{2+}{}_{(aq)} + H_{2(g)}$

Magnesium is chosen because it is above Iron in electrochemical series (C)

26. No of Neutron = 9

No of Proton = 8, No of electron = 7

The superscript (mass no) = no of neutron + proton = 9 + 8 = 17

The Subscript is the Atomic number = no of proton = 8

Therefore, one electron is lost with the introduction of positive sign (+) at superscript of the element. This can be represented: $^{17}_{8}O^+$ (B)

27. $MX_2 \rightleftharpoons M^+ + 2X^-$

Initially: x : 0 0

At the end of the reaction: x : x 2x

Solubility product. $Ksp = [M^+]\ [X^-]^2$

$1.08 \times 10^{-7}\ mol^3dim^{-9} = (x)\ (2x)^2$

$1.08 \times 10^{-7}\ mol^3\ dm^{-9} = 4x^3$

$$X^3 = \frac{1.08 \times 10^{-7}}{4} \text{ mol}^3 \text{ dm}^{-9}$$

$$X = \sqrt[3]{2.7 \times 10^{-8} \text{ mol}^3 \text{ dm}^{-9}}$$

$X = 3 \times 10^{-3}$ mol/ dm^3 (B)

OBAFEMI AWOLOWO UNIVERSITY
2009 POST UME TEST

1. The flame used by welders in cutting metal is
   a) Butane gas flame b) Acetylene-hydroflame
   c) Kerosine flame d) Oxy-acetylene
   e) Oxygen flame
2. Consequiture members of an alkane homogenous series differ by
   a) CH b) CH_2
   c) CH_3 d) C_3H_3 e) C_nH_{2n+2}
3. Which of these will dilute in HCl? Mg, Fe, Pb and Cu
   a) All the metals b) Mg, Fe and Cu
   c) Mg, Fe and Pb d) Mg and Fe only e) Mg only
4. Stainless steel is an alloy of
   a) carbon, iron and lead b) carbon, iron and chromium
   c) carbon, iron and copper d) carbon, iron and silver
   e) carbon and iron only
5. What volume of 0.50M H_2SO_4 will exactly neutralize $20cm^3$ of 0.1M NaOH solution?
   a) $2.0cm^3$ b) $5.0cm^3$ c) $6.8cm^3$
   d) $8.3cm^3$ e) $10.4cm^3$
6. A gas that can behave as a reducing agent towards chlorine and as an oxidizing agent toward hydrogen sulphide is
   a) O_2 b) NO c) SO_2 d) NH_3 e) CO_2
7. An element that can exist in two or more different structural forms which possess the same chemical properties is said to exhibit
   a) polymerism b) isotopy
   c) isomorphism d) isomerism
   e) allotropy
8. The hybridization of the carbon atom in ethyne is
   a) Sp b) SP^2 c) SP E d) Sp^3 e) ES
9. In the Haber process for the manufacturer of ammonia, finely divided iron is used as
   a) an ionizing agent b) a reducing agent
   c) a catalyst d) a dehydrating agent
   e) an oxidizing agent
10. Nitrogen can best be obtained from a mixture of oxygen and nitrogen by passing the mixture over
    a) potassium hydroxide b) heated gold
    c) heated magnesium d) heated phosphorus
    e) calcium chloride

.1. At STP how many litres of hydrogen can be obtained form the reaction of $500cm^3$ of 0.5M H_2SO_4 excess zinc metal
a) $22.4dm^3$ b) $11.2dm^3$ c) $65dm^2$ d) $5.6dm^3$ e) $0.00dm^3$

12. Tetraoxosulphate(VI) ions are final test using
a) acidified silver nitrate b) acidified barium chloride
c) lime-water d) dilute hydrochloric acid
e) acidified hard nitrate

13. Which of the following is NOT the correct product formed when the parent metal is heated in air?
a) calcium oxide (CaO) b) sodium oxide (Na_2O)
c) copper(II) oxide (CuO) d) aluminium oxide (Al_2O_3)

14. Which of the following roles does sodium chloride play in soap preparation? It
a) reacts with glycerol b) purifies the soap
c) accelerates the decomposition of the fat and oil
d) separates the soap from the glycerol
e) converts the fat acid to its sodium salt

15. The function of sulphur during the vulcanization of rubber is to
a) act as catalyst for the polymerization of rubber molecules
b) convert rubber from thermosetting to thermo plastic polymer
c) form chains which bind rubber molecules together
d) break down rubber polymer molecule
e) shorter the chain length of rubber polymer

16. An element with atomic number twelve is likely to be
a) electrovalent with a valency of 1
b) electrovalent with a valency of 2
c) Covalent with a valency of 2
d) Covalent with a valency of 4

17.Which of the following is an acid salt?
a) $NaHSO_4$ b) Na_2SO_4 c) CH_3COONa
d) Na_2S_2 e) C_2H_5

18. Which of the following compounds is NOT formed by the action of chlorine on methane?
a) CH_3Cl b) C_2H_5Cl c) CH_2Cl_2
d) $CHCl_3$ e) CH_4Cl

19. Starch can be converted to ethyl alcohol by
a) distillation b) fermentation
c) isomerization d) cracking e) osmosis

20. How many isomers can be formed from organic compounds with the formula C_3H_6O
a) 2 b) 3 c) 4 d) 5 e) 1

21. When platinum electrodes are used during the electrolysis of copper(II) tetraoxosulphate(VI) solution, the solution gets progressively
a) acidic b) basic
c) neutral d) atmospheric

22 Which of the following physical properties decreases across the periodic table
a) Ionization potential b) electron affinity
c) electron negativity d) atomic radius
e) electro-positive reaction

23.Which of these has the lowest pH value?
a)Calcium trioxocarbonates
b)Sodium trioxocarbonate (IV)
c)Hydrochloric acid
d) Ethanoic acid e)Hydrocarbon acid

24.Which of the following is used in fire extinguishers
a) carbon (II) oxide b) carbon (VI) oxide
c) sulphur (IV) oxide d) ammonia
e) sulphur (VI) oxide

25. Mortal is NOT used for under water construction because
a) It hardens by loss of water
b) Its hardening does not depend upon evaporation
c) It requires concrete to harden
d)It will be washed away by the flow of water
e) It softens when exposed.

Answer Key

1. D	6. C	11. D	16. B	21. A
2. B	7. E	12. B	17. A	22. D
3. D	8. A	13. B	18. B	23. C
4. B	9. C	14. D	19. B	24. B
5. A	10.C	15. C	20. B	25. D

Explanations to Answers

1. Oxy-acetylene flame is made from the mixture of oxygen and acetylene (ethyne)to produce a gas that burn at very high temperature (D)
2. Consequetive member of an alkane homologous serves differ by CH_2. For example, CH_4 and C_2H_6 differ by CH_2 (B)
3. Mg, Fe will dissolve in dilute HCl to liberate hydrogen gas, Pb and Cu do not dissolve or react will dilute HCl and H_2SO_4 because they do not displace hydrogen.(D)
4. Alloy of metal is primarily formed to improve the quality of the metallic compound to desired properties. Stainless steel is formed in other to have hard, corrosion resistant and very attractive in appearance. It is formed form the combination of carbon, chromium and iron. Fe and C is used for ordinary steel (B)
5. $H_2SO_4 + 2NaOH \rightarrow Na_2SO_4 + 2H_2O$
   1 mole 2 mole 1 mole 2 mole

$$\frac{C_A\ V_A}{C_B\ V_B} = \frac{n_a}{n_b}$$

$$V_A = \frac{C_B\ V_B\ n_a}{C_A\ n_b} = \frac{0.1mol/dm^3 \times 20cm^3 \times 1}{0.5mol/dm^3 \times 2} = 2cm^3 \text{ (A)}$$

6. The sulphur(IV) oxide reduces the coloured solution of Cl_2, Br_2 and I_2 to the colourless of their ionic compound.

$Cl_{2(g)} + SO_2 + 2H_2O \rightarrow SO^{2-}_{4(aq)} + 2Cl^- + 4H^+_{(aq)}$

and as an oxidizing agent in the presence of stronger reducing agent

$2H_2S + SO_{2(g)} \rightarrow 2H_2O + 3S_{(s)}$ (C)

7. Allotropy is the phenomenon described here (E)
8. Ethyne is formed by the overlapping of s-orbital of hydrogen and p-orbital of the carbons with 3σ-bonds and 2π-bonds (sp hybridized) (A)
9. (C) - check. Chemistry textbook for the preparation of ammonia.
10. Potassium hydroxide is used to remove droplet of water vapour. Magnesium can be used because it will combine with nitrogen to form nitride.

    $Mg_3 + N_2 \rightarrow Mg_3N_2$

    Gold is very unreactive.

    Heated phosphorous will react with only oxygen to form phosphorus(V) oxide, P_4O_{10}(C)
11. $Zn_{(s)} + H_2SO_{4(aq)} \rightarrow ZnSO_4 + H_{2(g)}$
    1 mole I mole 1 mole 1 mole

no of mole of H_2SO_4 =

$\frac{500}{1000} dm^3 \times 0.5 mole/dm^3 = 0.25$ mole

Since 1 mole of H_2SO_4 produces 1 mole of H_2

0.25mole of H_2SO_4 will also produce 0.25 mole of H_2

⇨ volume of gas = 0.25 mole x 22.4 dm^3 mol^{-1}

= 5.6dm^3 (D)

12. (B) $Ba^{2+} + SO_4^{2-} \rightarrow BaSO_4$ – white precipitate.

13. $2Ca + O_2 \rightarrow 2CaO$

$2Na + O_2 \rightarrow Na_2O_2$

$2Cu + O_2 \rightarrow 2CuO$

$8Fe + 2O_2 \rightarrow Fe_3O_4$

$4Al + 3O_2 \rightarrow 2Al_2O_3$

Sodium oxide can only be prepared in limited supply of oxygen, if not the product formed is Na_2O_2. (B)

14. Soap preparation involves the addition of fatty acid to concentrated NaOH solution. Sodium chloride is added to decrease the solubility of the soap (i.e. alkaline salt), so that it separates out as a hard cake on the surface on cooling (D)

15. Vulcanization is the heating of rubber (styrene-butadiene polymer) with sulphur. Hence, disulphide bonds cross-link parallel polymers-chains of the rubber at the double bond positions of the repeat units thereby resulting into harden and high tensile strength SBR (C).

16. An element with atomic number 12 has 2-electrons in its valency, thus makes it belongs to s-block element (metals) in the periodic table. Metallic elements are known to form electrovalent bond (B).

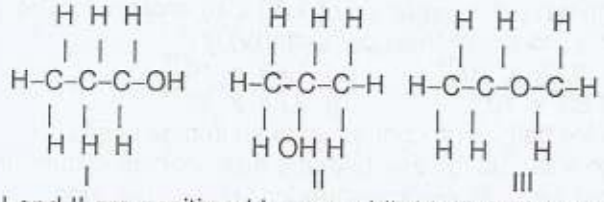
17. Acid-salt is formed by incomplete displacement of hydrogen ion from an acid by metal, as we have in option A.

$H_2SO_4 + NaOH \rightarrow NaHSO_4 + H_2O$ (A)

18. These are products of substitution reaction of methane, C_2H_5Cl is formed by the chlorination of ethane not methane (B)

19. Fermentation is the slow decomposition by micro-organism of large organic molecules (such as starch) into smaller molecular (such as ethanol) (B).

20.



I and II are positional isomer while(I, II) & III are functional group isomer (B)

21. $CuSO_{4(aq)} \rightleftharpoons Cu^{2+}_{(aq)} + SO^{2-}_{4(aq)}$

$H_2O \rightleftharpoons H^{+}_{(aq)} + OH^{-}_{(aq)}$

Cu^{2+}/H^+ - migrate to the cathode while SO_4^{2-} & OH^- migrates towards the anode. At the anode, OH- is lower in the electrochemical serves so it is discharged in preference to SO_4^{2-}

$4OH^- \rightarrow 2H_2O + O_2 + 4e^-$

Oxygen is produced at the anode. The discharge of OH^- disturbs the ionic equilibrium of water; Therefore H^+ is produced in excess. This causes increase in acidity at the anode.

At the cathode, Cu^{2+} is discharged in preference to H^+

$Cu^{2+} + 2e^- \rightarrow Cu_{(s)}$

Copper is deposited and the ionic equilibrium is not altered. The electrolyte solution becomes more acidic (A).

22. Atomic radius decrease across the periodic table, this is because it is noted that the attraction by the nucleus increases more rapidly across the period than the forces of mutual repulsion between electrons. As a result, the radius of the atom decreases with increasing atomic number (D).

23. HCl is a stronger acid, than ethanoic acid, the measure of acidic, pH value of HCl will be lower than that of the ethanoic acid (C).

24. CO_2 is used in fire extinguishers because it does not support combustion. It is produced from calcium carbonate (B).

25. Mortal is prepared by mixing one part of slake lime and three parts of sand with water. The mixture hardness or sets to bind the grains of sand by reacting with carbon(IV) oxide in the atmosphere to form the trioxocarbonate. Mortal is used to bind the brick in walls and buildings.

$Ca(OH)_2 + CO_2 \rightarrow CaCO_3 + H_2O$ (D)

OBAFEMI AWOLOWO UNIVERSITY, ILE IFE
2010 POST UME TEST

1. Whose experiment showed that the atom has a tiny positively charged nucleus?
   a) Thompson b) Rutherford
   c) Millikan d) Dalton

2. Which of the quantum number divides shells into orbitals?
   a) Principal b) subsidiary
   c) magnetic d) spin
3. Which of these statements is/are correct of a proton?
   i. The mass of a proton is one-twelfth the molar mass of carbon
   ii. The mass of a proton is 1840 times the mass of an electron
   iii. The mass of a proton is 1.0008g
   a) ii only b) i, ii and iii
   c) i only d) i and ii only
4. The following are chemical entities identifiable during qualitative analysis
   i) SO_4^{2-} ii) H_3O^+ iii) NH_4^+
   iv) OH^-. Which of them can be detected by litmus paper?
   a) ii and iv only b) ii only
   c) i & iii only d) I & ii only
5. i) $NaHCO_3$ ii) $NaHSO_4$ iii) NaCl. Which of these will dissolve in water to give alkaline solution?
   a) i, ii and iii b) ii only
   c) i only d) i & ii only
6. Burning of 0.46 g of ethanol produced heat that raised the temperature of 100 g of water by 30°C. Calculate the heat of combustion of ethanol, C_2H_5OH.
   (C = 12, H = 1; O = 16)
   a) 50 $kJmol^{-1}$ b) 900 kJmol
   c) 1200 $kJmol^{-1}$ d)1000 $kJmol^{-1}$
7. When chlorine is bubbled into potassium iodine solution
   a) A white precipitate is seen
   b) reddish brown colour develops
   c) solution remains colourless
   d) blue colour is seen
8. $PCl_5 \rightleftharpoons PCl_{3(aq)} + Cl_{2(g)}$. In reaction above, an increase in pressure will
   a) Decelerate the reaction b) increase the yield of PCl_3
   c) increase the yield of PCl_5 d) accelerate the reaction.
9. A saturated solution of silver trioxocarbonate(IV), was found to have concentration of 1.30×10^{-5} mol dm^{-3}. The solubility product of trioxocarboate(IV) is
   a) 8.79×10^{-15} b) 1.69×10^{-10}
   c) 1.82×10^{-1} d) 9.84×10^{-10}
10. A zinc half-cell is connected to an iron half-cell through a salt bridge and both are also connected through a copper wire. At which electrode is reduction taking place and which electrode is positively charged?
    a) Zinc, zinc b) iron, iron
    c) zinc, iron d) iron, zinc
11. Which of the following is the difference between an electrolytic cell X and electrochemical cell Y
    a) Anode in X is –ve while anode in Y is +ve
    b) In X, oxidation takes place at the anode while in Y reduction takes place at the anode
    c) In X, anode is positive while in Y anode is negative.
    d) In X, chemical energy is converted into electrical energy while in Y electrical energy is converted into chemical energy.
12. What mass of bromine will saturate completely 6.8 g of 3-methybut-1-yne (H = 1; C = 12; Br = 80)
    a) 16 g b) 32 g c) 12 g d) 24 g

13. 100cm^3 of oxygen and 10cm^3 of butane measured at room temperature and pressure were mixed and exploded. Determine the volume of the mixture when brought back to the original conditions of measurements.
a) 125 cm^3 b) 110 cm^3
c) 75 cm^3 d) None of these

14. Sulphur
a) Forms two alkaline oxides
b) is spontaneously inflammable
c) burns with a blue flame
d) conducts electricity in the molten state.

15. Candidate devised the following for the separation of the components of some mixtures
i. Components of ink, principles involved is chromatography
ii. Components of water and kerosene principle involved is separating funnel
iii. Components of iodine and sodium chloride, principles involved is sublimation.
In which of the above is the principle correct?
a) i only b) ii only c) iii only d) i, ii & iii

16. Which of the following procedures will separate a mixture of sand, sodium chloride and iodine into its components?
a) Add water, filter, sublime, evaporate to dryness
b) Add water, sublime, filter, evaporate to dryness
c) Sublime, filter, add water, evaporate to dryness
d) Sublime; add water; filter; evaporate to dryness

17. The type of bonds in ammonium chloride are
a) Covalent and electrovalent
b) dative and covalent
c) dative and electrovalent
d) covalent, dative and electrovalent

18. Which of the following types of bonding does not produce a compound ?
a) ionic bonding b) covalent bondin
c) dative bonding d) metallic bonding

19. The combining powers of HCO_3; O; Na; Cl; respectively are
a) -2 +1, -1, +1 b) 1, 2, 1,
c) +1, -2, +1, -1 d) none of these

20. What is the chemical formula of the compound containing 6.02 x 10^{23} atoms of hydrogen, 35g of chlorine, and 4 moles of oxygen atoms?
a) HCl_4O b) HClO c) $HClO_4$ d) HCl_2O_4

21. 20 cm^3 of hydrogen were collected over water at 30^{0}C and 740mm of Hg. Calculate the volume of the gas at s.t.p. if the vapour pressure of water at the temperature of the experiment is 14mm of Hg.
a) 16.82 cm^3 b) 17.64 cm^3
c) 18.54 cm^3 d) 17.21 cm^3

22. A given mass of gas occupies a certain volume at 300K. At what temperature will its volume be double?
a) 400K b) 480K c) 550K d) 600K

23. The basic assumption in the kinetic theory of gas that "forces of attraction and repulsion between gaseous molecules are negligible" implies that:
a) Molecules will continue their motion indefinitely
b) Gases will occupy any available space
c) Gases can be compressed
d) None of the above

24. Which of the following is true of a sample of hydrogen gas whose mass is 4.00g under a pressure of 2atm and a temperature of 27^{o}C ?(H = 1, R = 0.032 lit atm. mol^{-1} deg^{-1})
a) Its volume is 24.6 litres
b) it contains 6.02 x 10^{23} molecules
c) it exists as atoms because of temperature
d) none of the above

25. Which of the following combination of reagents will react to give chlorine gas?
a) Sodium chloride, conc. H_2SO_4 and Manganese(IV) oxide
b) Potassium tetraoxomagnate
c) Potassium trioxochloride(v) and conc. H_2SO_4
d) Potassium tetraoxomagnate(VI) and conc. H_2SO_4

Answer Key

1 B	6 -	11 C	16 D	21 D
2 B	7 B	12 B	17 D	22 D
3 B	8 C	13 A	18 D	23 D
4 C	9 A	14 C	19 B	24 A
5 C	10 B	15 D	20 C	25 A

Explanations to Answers.

1. Rutherford suggested an atomic model (the nuclear model) in which an atom has a small-positively charged centre (nucleus) where nearly all the mass is concentrated, surrounding the nucleus is a large space (extra-nuclear point) containing the electrons (B)
2. The subsiding or azimuthal quantum number, l has integral values ranging from 0 to (n – 1). The electrons with subsidiary quantum numbers 0, 1, 2, and 3 are usually referred to as the s, p, d and f – electrons respectively. Thus, this quantum number shows how many energy level that are in each electron shell (B)
3. (B) – check relevant chemistry for clarification.
4. NH_4^+ will release NH_3 gas(basic) while SO_4^{2-} will release SO_2 gas (acidic) (C)
5. $NaHCO_3 + H_2O \rightarrow H_2CO_3 + NaOH$
$NaHSO_4 + H_2O \rightarrow Na^+ + SO_4^{2-} + H_3O^+$
NaCl is neutral, NaOH is alkaline. (C)
6. $\Delta H = mc\theta = 100g \times 4.\ Jg^{-1}k^{-1} \times 303K$
$= 127{,}260J$
No of mole $= \frac{0.46}{46} = 0.01\ mole$
Combustion of 0.01 mole of ethanol produces 127,270 J
1 mole of ethanol produces $\frac{127{,}260\ J}{0.01\ mole} = 12{,}726{,}000\ Jmol^{-1}$
$= -12{,}726\ kJmol^{-1}$ (exothermic)
7. $Cl_2 + 2KI \rightarrow 2KCl + I_2$
The colouration is due to the formation of iodine (B)
8. $PCl_{5(g)} \rightleftharpoons PCl_{3(g)} + Cl_{2(g)}$
Since the products are in gaseous form, increase in pressure will lead to decrease in volume, this force the products to move closer and combine to form parent compound, thereby cause increase in the yield of PCl_5 (C)
9. $Na_2CO_3 \rightleftharpoons 2Na^+ + CO_3^{2-}$

Initially;	x	O	O
At the end;	x 1.30x10^{-5}	2x 2(1.30 x 10^{-5})	x (1.30 x 10^{-5})

Solubility products, $Ksp=[(Na^+)]^2\left[CO_3^{2-}\right]$
$= (2.6\times10^{-5}\ mol/dm^3)^2(1.30\times10^{-5}\ mol/dm^3)$
$= 8.788 \times 10^{-15} mol^3dm^{-9}$ (A)

10. Iron (Fe) is below zinc in the electrochemical series, hence iron is a less electropositive element compared to zinc. This makes zinc to be a stronger reducing agent hence oxidation takes place at the anode while reduction takes place at Iron electrode, hence iron is used as the cathode. The set up is an electrochemical cell, reduction takes place at the cathode which is the positive electrode.Thus, iron is the positive electrode(B)
11. In electrolyte cell, the cathode is the negative electrode while anode is the positive electrode. In electrochemical cell, the cathode is positive electrode while the anode is negative (C)
12. $CH_3CH(CH_3)C{\equiv}CH + 2Br_2 \rightarrow CH_3CH(CH_3)CH(Br)_2{-}CH(Br)_2$
    1 mole 2mole 1 mole

    No. of mole of $C_5H_8 = \frac{6.8}{68} = 0.10$ mole

    1 mole of 3-methylbut-1-yne requires 2 moles of Br_2

    0.10 mole of 3-methylbut-1-yne produces $\frac{2 \times 0.10}{1}$ of Br_2

    $= 0.20$ mole of Br_2

    Mass of Br_2 = 0.2 x 160 = 32grams (B)

13. $C_4H_{10} + \frac{13}{2}O_2 \rightarrow 4CO_2 + 5H_2O$

Reacting mole:	1 ;	6½	4	5
Available vol.:	10	100	-	-
Reacting vol.:	10	65	40	50
Unreacting gas			$35cm^3$	

Residual gas = 35 + 40 + 50 = 125 cm^3 (A)

14. When sulphur is heated in a partial supply of air, it burns with bright blue flame to form sulphur(IV) oxide and small amount of SO_3
    $S_{(s)} + O_{2(g)} \rightarrow SO_{2(g)}$ (C)
15. (D)
16. Heat the mixture to sublime iodine which will go into gaseous form and collected separately. The left mixture is dissolve in water while the hall dissolve in water and it is filtered to separate sand from the mixture while the residual is heated to dryness to recover the NaCl (D)
17. In NH_4Cl, there is ionic bond between NH_4^+ &Cl^-.

    There are three pure covalent bonds and one coordinate covalent (dative) bond. The bond types in NH_4Cl are ionic, covalent and coordinate covalent (three types) (D)
18. Metallic bonds join atoms of metals together, this is favoured by large atomic radius, low ionization energy. (D)
19. Combining power of HCO_3^- = 1

    O^{2-} = 2

    Alkaline metal, Na^+ = 1

    Halogen, Cl^- =1 (B)

20. 6.02×10^{23} atoms of hydrogen give 1mole of hydrogen
    35 g of chlorine give 1mole of chlorine.
    4moles of oxygen atoms give 4 oxygen atoms
    Combination give $HClO_4 \Rightarrow$ (C)
21. P_1 = 740 - 14 = 726 mmHg
    V_1 = 20 cm^3
    T_1 = 30°C + 273 = 303K
    P_2 = S.t.p = 760 mmHg
    T_2 = s.t.p = 273K
    $V_2 = \frac{P_1V_1T_2}{P_2T_1}$

    $= \frac{726 \times 20 \times 273}{760 \times 303} = 17.21cm^3$

22. V_1 = a
    T_1 = 300K
    V_2 = 2a, T_2 = ?
    $\frac{V_1}{T_1} = \frac{V_2}{T_2}$

    $T_2 = \frac{2a \times 300}{a} = 600$ K (D)

    This obeys Charles law which states that the volume of a given mass of gas is directly proportional to its temperature (at Kelvin) at constant pressure.
23 This implies that gaseous molecules are independent of one another (D)
24. No of mole = $^4/_2 = 2$mole

    $V = \frac{nRT}{P}$

    $= \frac{2\text{mole} \times 0.082\text{lt atom mol}^{-1}\text{ K}^{-1} \times 300\text{K}}{2\text{ atm}}$

    = 24.6lit (A)
25. (A) $2NaCl_{(s)} + 2H_2SO_{4(aq)} + MnO_{2(aq)} \rightarrow MnSO_4 + Cl_{2(g)} + Na_2SO_4 + 2H_2O_{(l)}$ (A)

1. What condition favours the formation of the product for the endothermic reaction,

$$N_2O_{4(g)} \rightleftharpoons 2NO_{2(g)}$$

a) A decrease in pressure b) A decrease in volume
c)An increase in pressure d)A constant volume

2. What is the percentage yield of water if 0.90g of water is obtained when 29.0g of butane is burned in excess oxygen?
a) 0.02% b) 0.20% c) 2.0% d) 10.0%

3. The order of reactivity of five metals is
P > Q > R > S > T. Which of the following reactions can occur spontaneously?
a) $T + P^+ \rightarrow T^+ + P$ b) $Q + T^+ \rightarrow Q^+ + T$
c) $R + Q^+ \rightarrow R^+ + Q$ d) $T + R^+ \rightarrow T^+ + R$

4. An element, Y has the electronic configuration of $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^3$
a) Y is a period III element
b) Y contains three electrons in the outer shell
c) Y is a transition metal
d) Y can engage in bonding with the s and p orbitals

5. Which of the following is NOT implicated as a major cause of global warming?
a)NO_2 b) CO_2 c) $CFCl_3$ d) CF_2Cl_2

6. Which of the following shows little or no net reaction when the volume of the system is decreased?
a) $2O_{3(g)} \rightleftharpoons 3O_{2(g)}$ b) $2NO_{2(g)} \rightleftharpoons N_2O_{4(g)}$
c)$H_{2(g)} + I_{2(g)} \rightleftharpoons 2HI_{(g)}$ d) $PCl_{5(g)} \rightleftharpoons PCl_{3(g)} + Cl_{2(g)}$

7. A solution of 0.20 mole of NaBr and 0.20 mole of $MgBr_2$ in 2.0dm^3 of water is to be analysed. How many moles of $Pb(NO_3)_2$ must be added to precipitate all the bromide as insoluble $PbBr_2$?
a) 0.30 mol b) 0.10 mol c) 0.20 mol d) 0.40 mol

8. A given volume of methane diffuses in 20 s. how long will it take the same volume of sulphur(IV) oxide to diffuse under the same conditions? [C = 12, H = 1, S = 32, O -= 16)]
a) 5s b) 20s c) 40s d) 60s

9. The reaction, A + B → C, can be represented by the equation, r = k[A][B], k in this equation is
a) Proportionally constant b) Rate constant
c)Equilibrium constant d) Boltzmann constant

10. The reaction that take place in Daniel cell is
a) $Zn / Zn^{2+} // Cu^{2+} / Cu$
b) $Zn / Zn^{2+} // Cu / Cu^{2+}$
c) $Zn^{2+} / Zn // Cu^{2+} / Cu$
d) $Zn^{2+} / Zn // Cu / Cu^{2+}$

11. Which of the following is composed of the elements, H, O, Al and Si?
a) Urea b) Silica c) Bauzite d) Clay

12. Which of the following is not a chemical reaction?
a) Burning of bush b) Rusting of iron
c)Decay of bitter leaves
d) Dissolution of potassium hydroxide pellets

13. 100.0g of $KClO_3$ was added to 40.0cm^3 of water to give a saturated solution of 298K. If the solubility of the salt is 20.0 mol dm^{-3} at 298K, what percentage of the salt is left undissolved? [K = 39, Cl = 35.5, O - 16]
a) 80% b) 60% c) 5% d) 2%

14. A tertiary amine is
a) Ethylamine b) diethylamine
c) triethylamine d) tetraethylamine

15. Which of the following statements is true when sulphur atom forms its ion?
a) It achieves an inert configuration
b) It transfers two electrons in the process
c) It accepts one electron in the process
d) It gets oxidized in the process

16. An electron described by the quantum number, n = 4, l = 3 can be located in what orbital?
a) 4f b) 3s c) 3d d) 4p

17. An aqueous solution of a crystalline salt reacts with dilute HCl to give a yellow precipitate and a gas that turned dichromate paper green. The crystalline salt may be,
a) $Na_2S_2O_3\ 5H_2O$ b) $Na_2CO_3 \cdot 10H_2O$
c)Na_2S d) $NaHCO_3$

18. The oxidation states of nitrogen in ammonium nitrate are
a) -3, +3 b) -3, +5 c) +3, -5 d) -3, +4

19. Which of these reagents can confirm the presence of a triple bond?
a) Hypochlorous acid b) Bromine water c)Acidified $KMnO_4$ d) Copper chloride

20. An excess 0.10 mol dm^{-3} HCl was poured into a big beaker containing 2g of limestone. The unreacted acid required 25cm^3 of 0.10mol dm^{-3} potassium carbonate to neutralize it. What is the original volume of the acid? (Ca = 40, C = 12, O = 16)
a) 250 cm^3 b) 260 cm^3
c) 400 cm^3 d) 450 cm^3

21. $^{226}_{88}Ra \rightarrow {}^{x}_{86}Rn + \alpha$ - particle. What is the value of x in the nuclear reaction?
a) 226 b) 220 c) 222 d) 174

22. In the electrolysis of copper(II) sulphate using copper electrodes, the processes that occur at the anode and cathode respectively are
a) Dissolution and evolution
b)Dissolution and deposition
c)Deposition and evolution
d)Evolution and deposition

Explanations to Answers

1. Note that options B and C are the same and can not be right. Decrease in pressure will shift the equilibrium position to the right therefore, favour the formation of product (A)

2. % Yield = $\frac{\text{Actual yield}}{\text{Expected yield}} \times 100\%$

$2C_4H_{10(g)} + 13O_{2(g)} \rightarrow 8CO_2 + 10H_2O$

2 mole : 13 moles 8 moles : 10 moles

$C_4H_{10} = (12 \times 4) + 1 \times 10$

$= 58$ g/mole

No. of mole $= \frac{29.0g}{58g/mole}$

$= 0.5$ mole of Butane

At s.t.p. 2 mole of butane produces 10moles of water

$\therefore$ 0.5mole of butane will produce $= \frac{0.5 \times 10}{2} = 2.5$

$\Rightarrow$ mass of water $= 2.5 \times 18$

$= 45g$ of H_2O

% Yield $= \frac{0.9}{45} \times 100 = 2\%$ (B)

3. The most electropositive metal will readily displace the less electropositive ions from their salt. So, Q is more electropositive than R, S, T, it will readily displace any of this from their salt and will readily displace a less electropositive (T) as we have in option B

Therefore $Q + T^+ \rightarrow Q^+ + T$ (B)

4. $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^3$ – has atomic number 15, with 3-shells, it belongs to period III element, it has 5-electrons in the outer most shell, forming bond(s) with the 3-electrons in 3p-orbitals. It is NOT a transition metal since transition metal start from Scandium with atomic No. 20(A)

5. Global warming is caused by depletion of ozone layer. Ozone layers prevent the direct effect of UV-radiation on the earth surface. Radicals are released by $CFCl_3$, CF_2Cl_2 which combine with ozone(O_3) and destroy it. CO_2 also retain a certain amount of the infrared ray that is radiated by earth and this gives rise to green house effect and a global warming of the earth. NO_2 cause acid rain.(A)

6. In option C, the number of mole on the reactant side equals to the number of mole on the product side, decrease in volume will show no effect (C)

7. Ist reaction:

$2NaBr + Pb(NO_3)_2 \rightarrow 2NaNO_3 + PbBr_2$

2mol : 1mol $\rightarrow$ 1mol + 1mol

0.2mole : 0.1mol $\rightarrow$ 0.2mole : 0.1mol

2nd reaction:

$MgBr_2 + Pb(NO_3)_2 \rightarrow Mg(NO_3)_2 + PbBr_2$

1mol : 1mol $\rightarrow$ 1mol + 1mol

0.2mole : 0.2mol $\rightarrow$ 0.2mole : 0.2mol

Total No. of mol of $Pb(NO_3)_2$

$= 0.1mol + 0.2mol = 0.3mol$ (A)

8. $R_{CH_4} = \frac{\text{Volume}}{\text{Time}} = \frac{V_{CH_4}}{20_{(s)}}$

$R_{SO_4} = V_{SO_2}/t_{SO_2}$

$\Rightarrow$ Apply Graham's law of Diffusion,

$$\frac{R_{CH_4}}{R_{SO_2}} = \frac{\sqrt{M_{SO_2}}}{\sqrt{M_{CH_4}}}$$

Since,

$$\frac{V_{CH_4}}{20s} \div \frac{V_{SO_2}}{t_{SO_2}} = \frac{\sqrt{64}}{\sqrt{16}}$$

$$\frac{V_{CH_4}}{20secs} \times \frac{t_{SO_2}}{V_{SO_2}} = \sqrt{4}$$

Since,

$V_{CH_4} = V_{SO_2}$

$$\frac{t_{SO_2}}{20secs} = \sqrt{4}$$

$t_{SO_2} = 20 \times 2 = 40secs$ (C)

9. Looking at this equation, this is not a reversible reaction, so K can not be an equilibrium constant. But K is a proportionality constant called Specific Rate Constant (B)

10. In Daniel's cell, the electrolytes are $CuSO_4$ (Cathode) and $ZnSO_4$ (Anode) in different container connected with salt bridge

$\Rightarrow$ Anode reaction: $Zn_{(s)} \rightarrow Zn^{2+} + 2e^-$

Cathode reaction: $Cu^{2+} + 2e^- \rightarrow Cu_{(s)}$

Net reaction: $Zn_{(s)} + Cu^{2+} \rightarrow Cu + Zn^{2+}$

$\Rightarrow Zn_{(s)} / Zn^{2+} // Cu^{2+}/Cu_{(s)}$ (A)

11. Kaolin/clay $\Rightarrow Al_2O_3 \bullet 2SiO_2 \bullet 2H_2O$ (D)

12. Decay of bitter leaves is achieved by micro-organism, this is a chemical change. Dissolution of KOH is a physical change since the alkaline can be recovered.(D)

13. Molar – mass of $KClO_3$ = 122.5g

100.g of $KClO_3$ $= \frac{100.0g}{122.5} = 0.816$mole

$\therefore$ 40g of water at 298K dissolved 0.816mole of $KClO_3$

$1000cm^3$ of water at 298K dissolved $\frac{1000 \times 0.816}{40}$

$= 20.41$mole

$\Rightarrow$ Solubility of $KClO_3 = 20.41mol/dm^3$

$\Rightarrow$ % of undissolved $KClO_3$

$$= \frac{\text{Saturated solution - unsaturated}}{\text{Unsaturated}} \times 100$$

$$= \frac{20.41 - 20.00}{210.00} \times 100 = 2.05\%$$ (D)

14. Tertiary amine have the general formula RR'R"N where R,R'R" represent the alkyl group, i.e. the nitrogen atom is surrounded by 3-alkyl group (C)

15. $S_{(s)} + 2e^- \rightarrow S^{2-}_{(aq)}$

Sulphur ionizes to gain two electrons, and the atomic number increase from 16 (Neutral sulphur) to 18 (sulphide ion). This is octet or inert configuration (A)

16. Where, Principal quantum number, n = 4

Azimutal quantum number, l=n–1=4–1=3

for l = 0, electrons are the s-orbital

for l = 1, electrons are the p-orbital

for l = 2, electrons are the d-orbital

for l = 3, electrons are the f-orbital

$\Rightarrow$ therefore, for l = 3, electrons are in 4s, 4p, 4d, 4f-orbitals, here we have only 4f-orbitals (A)

17. Aqueous solution + HCl $\rightarrow$

Yellow precipitate & gas evolve that turn dichromate Green $\rightarrow$ The gas is a reducing agent

Option B & D are not feasible because they are not reducing agent and yellow precipitate, the only element with yellow colouration is sulphur. The aqueous solution is NaS_2 and it evolves H_2S gas as a reducing agent when reacted with acid

($Na_2S + HCl \rightarrow NaCl(s) + H_2S_{(g)}$) (C)

18. $NH_4NO_3 \Rightarrow NH_4^+ + NO_3^-$

$\Rightarrow NH_4^+ = +1$ $NO_3^- = -1$

$X_N + 4 \times 1 = +1$ $X_N + 3X - 2 = -1$

$X_N = +1 - 4$ $X_N = -2 = -1 + 6$

$= -3$ $X_N = +5$

$\Rightarrow$ oxidation state is from -3, +5 (B)

19. Hypochlorous acid, Bromine water, Acidified $KMnO_4$ will only confirm that the compound is unsaturated while copper chloride will confirm the presence of terminal triple bond by forming reddish-brown precipitate of copper(I) dicarbide (D)

20. $CaCO_3 + 2HCl \rightarrow CaCl_3 + CO_2 + H_2O$

Limestone

$2HCl + K_2CO_3 \rightarrow 2KCl + CO_2 + H_2O$

No. of mole of limestone $CaCO_3 = \frac{2g}{100g/mole}$

$= 0.02mole$

1mole of $CaCO_3$ reacts with 2-mole of HCl

$\therefore 0.02mole$ of $CaCO_3$ requires $\frac{0.02 \text{ mole} \times 2\text{mole of HCl}}{1\text{mole}}$

$= 0.04mole$ of HCl

$\Rightarrow$ Conc. In $mol/dm^3 = \frac{\text{No. of mole}}{\text{Col. in } dn^3}$

$Vol./dm^3 = \frac{0.04 \text{ mole}}{0.10mole/dn^3}$

$= 0.4dm^3$

$= 400cm^3$ (C)

21. α-particle = ^4_2He. Therefore, 226 - 4 = 222 (C)

22. During the electrolysis $CuSO_4$ using copper as electrode, there is dissolution of copper at the Anode and it is deposited at the cathode

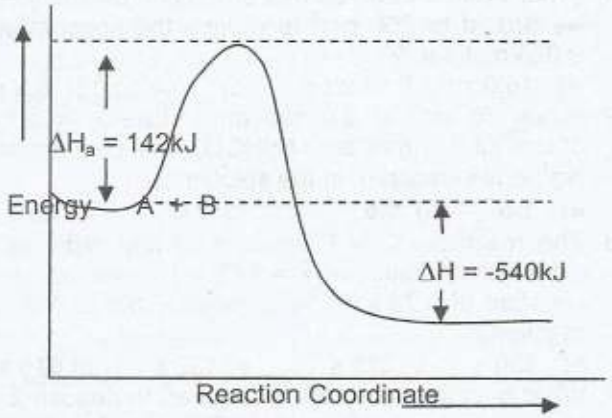
At anode: $Cu^{2+} + 2e^- \rightarrow Cu_{(s)}$

At cathode: $Cu_{(s)} \rightarrow Cu^{2+} + 2e^-$ (B)

1. During the electrolysis dilute tetraoxosulphate(VI) acid solution, 0.05 mole of electrons were passed. What volume of gas was produced at the anode?
   a) 2.24 dm^3 b) 0.560 dm^3
   c) 0.280 dm^3 d) 0.224 dm^3
2. Platinum electrodes are dipped into copper sulphate solution in a voltameter. The solution left after electrolysis is,
   a) Clear b) blue c) pale blue d) sky blue
3. What volume of water is produced when a mixture of 150cm^3 of hydrogen and 100cm^3 of oxygen is exploded in a eudiometer?
   a) 250 cm^3 b) 150 cm^3 c) 100 cm^3 d) 50 cm^3
4. Given the half cell reaction, $2Br^- \rightarrow Br_2$, how many moles of electron will be required to produce 0.56 dm^3 of bromine at s.t.p.?
   [molar volume of gas at s.t.p. = 22.4 dm^3].
   a) 0.05 b) 0.10 c) 0.20 d) 1.00
5. The equilibrium constant, K_c for the reaction, $NO_{(g)} + ½O_{2(g)} \rightarrow NO_{2(g)}$, is 35.2. What is the value of Kc for the reaction, $NO_{2(g)} \rightarrow NO_{(g)} + ½O_{2(g)}$?
   a) 35.2 b) 17.6 c) 284×10^{-2} d) 1.24×10^3
6. An atom has a core and outside the core an electron occupies an orbital for which the principal quantum number, n = 4, l = 0, m = 0 and s = +½. The atom is likely to be
   a) Boron b) sodium c) potassium d) fluorine
7. An element B, has two isotopes $^{20}_{10}B$ and $^{22}_{10}B$ present in ratio 2 : 3. The relative atomic mass of B is,
   a) 20.5 b) 21.2 c) 23.4 d) 25.0
8. A chloroform solution of pure organic compound was spotted at a distance 0.80 cm from the base of a 20 cm long chromatoplate. If the compound has the r_t – value of 0.505 and moves half way up the 20 cm long plate, what is the distance of the solvent front from the top of the plate upon elution?
   a) 0.80 cm b) 1.0 cm c) 1.2 cm d) 1.4cm
9. The main organic product formed when bromine water is added to but-1-ene is
   a) 1-bromobutane b) 2-bromobutan-1- ol
   c) 2-bromobutan-1- ol d) 2-bromobutan-2- ol
10. Valence shell electron pair theory through hybridization predicts that boron trichloride is
    a) Arrhenius acid b) Lewis base
    c) Lewis acid d) Lowry-Bronsted base
11. What volume of 0.750 mol dm^{-3} Na_2CO_3 solution could be diluted to 250 cm^3 to reduce the concentration to 0.025 mol dm^{-3}?
    a) 16.0cm^3 b) 14.2 cm^3 c) 10.4 cm^3 d) 8.3 cm^3
12. When 70 cm^3 of 3.0 mol dm^{-3} Na_2CO_3 is added to 30cm^3 of 1.0 mol dm^3 $NaHCO_3$, the concentration of Na^+ ions in mol dm^3 in the solution is,
    a) 1.5 b) 4.5 c) 2.0 d) 3.5
13. The reaction, Y → Product is of first order with the initial concentration of Y = 3.55×10^3 mol dm^3 and rate constant of 5.25×10^{-3} s^{-1}. What is the half-life of the reaction?
    a) 350 s b) 215 s c) 132 s d) 615 s
14. What quantity of current is required to deposit 2.4 g of copper in a period of 750 seconds during an electrolytic deposition process?
    (Cu = 64, 1F = 96500 coul mol^{-1})
    a) 9.65 A b) 10.81 A c) 12.33 A d) 15.54 A
15. The standard reduction potentials for the following half-cell reactions are,
    $2H_2O_{(l)} = O_{2(g)} + 4H^+_{(aq)} + 4e^-$ $E^o = 1.23V$
    $2H_2O_{(l)} = 2O_{2(g)} + 4H^+_{(aq)} + 4e^-$ $E^o = 1.23V$
    What is the E^o for the reaction, $2H_2O_{(l)} = 2H_2O_{(l)} + O_{2(aq)}$ at 298 K?
    a) -0.68V b) -1.23V c) +0.55V d) +1.91V
16. Bonding in ammonium chloride is
    a) Ionic covalent and dative b) Ionic and covalent
    c) Covalent and dative d) Ionic
17. A chemical equilibrium is established when
    a) Concentration of the reactants and products are equal
    b) Reactants in the system stop forming the products
    c) Concentrations of the reactants and products remain unchanged
    d) Reactants in the system are completely transformed to products
18. The basic tenet of valence bond electron pair repulsion theory is that the pairs of electrons making the sigma bonds dictate the shape of molecules. The pi-bonds often encounter in some molecules serve to,
    a) Distort the shape of molecules
    b) Alter the angle between the atoms in molecules
    c) Shorten the sigma bonds in molecules
    d) Explain the shape of molecules
19. Excess ethanol was sparked with 3g of pure oxygen in a combustion chamber. How many molecules of CO_2 are produced? [N = 6.02×10^{23} molecules mol^{-1}]
    a) 6.02×10^{23} b) 3.01×10^{23}
    c) 3.76×10^{22} d) 2.84×10^{21}
20. Oxygen is extracted from water by
    a) Displacement reaction b) Oxidation reaction
    c)Reduction reaction d) Decomposition reaction
21. Forty (40) grams of sodium nitrate were added to 50cm^3 of water to give a saturated solution at 298K. If the solubility of the salt is 10.50mol dm^{-3} at the same temperature, what percentage of the salt is left undissolved? [Na = 23, N – 14 and O = 16]
    a) 11.56% b) 2.55% c) 5.88% d) 12.45%

22. The energy for the dissociation of molecule AB in kJ in the diagram of energy against the reaction coordinate shown below is,

a) 146 b) -540 c) 682 d) 398



Explanations to Answers

1. At the Anode: SO_4^{2-} and OH^- migrate to this electrode, OH^- is discharged in preference because it is in lower position than SO_4^{2-} in the activity series.

$4OH^- \rightarrow 2H_2O + O_{2(g)} + 4e^-$

Oxygen gas is therefore produced at this electrode.

4 moles of OH^- produces 4 moles of electrons at s.t.p.

∴ 0.05moles of OH will produce 0.05 moles of electrons

In the same vein,

4 moles of OH^- produces 1 mole of oxygen gas

∴ 0.05moles of OH^- will produce $\frac{0.05 \text{ mole} \times 1 \text{ mole}}{4 \text{ mole}}$

$= 1.25 \times 10^{-2}$ moles of oxygen

Volume occupied (dm^3) $= 1.25 \times 10^{-2}$ mole $\times$ 22.4 dm^3 mol^{-1}

$= 0.280\ dm^3$ (C)

2. In the electrolysis of $CuSO_4$ using platinium as electrode. At the cathode, Cu^{2+} is selected for preferential discharge because it is below H^+ in the activity series. Thus, copper deposits as a brown layer on the cathode of the blue solute of the electrolyte fades in colour (C)

3. $2H_{2(g)} + O_{2(g)} \rightarrow 2H_2O_{(g)}$

By Gay-Lussac's law:

Combining Vol: 2moles :1mole 2moles

Vol. before sparking: 150 cm^3 100 cm^3 -

Reacting vol:150 cm^3 75 cm^3 150 cm^3

Therefore, 150 cm^3 of water is produced (B)

4. $2Br^- \rightarrow Br_2 + 2e^-$

2 moles 1mole 2 moles

No. of mole of $Br_2 = \frac{0.56\ dm^3}{22.4\ dm^3/mol} = 0.025$ mole

Therefore,1mole of Br_2 is produced by 2 moles of electrons

0.025mole of Br_2 will be produced by 2(0.025)mole of electrons

No of mole of electrons = 0.05 mole (A)

5. $NO + \frac{1}{2}O_2 \rightarrow NO_2$ $K_c = 35.2$

$NO_{2(g)} \rightarrow NO_g + \frac{1}{2}O_2$ $K_c = ?$

1st reaction: $K_c = \frac{[NO_2]}{[NO][O_2]^{1/2}}$

2nd reaction: $K_c = \frac{[NO][O_2]^{1/2}}{[NO_2]}$

The 2nd reaction is the reverse of the 1st reaction. Therefore, the K_c of the 2nd reaction is the reciprocal of the 1st reaction for 2nd reaction,

$K_c = \frac{1}{35.2} = 0.0284$ (C)

6. n = 4 implies that the atom has 4-shells and 4 shells from the nucleus

l = o implies that the electron is in s-orbital and spherical in shape

m = o implies that it is one oriental orbital or non-degenerate.

S = +½ or - ½ means that the electron is either clockwise or anticlockwise.

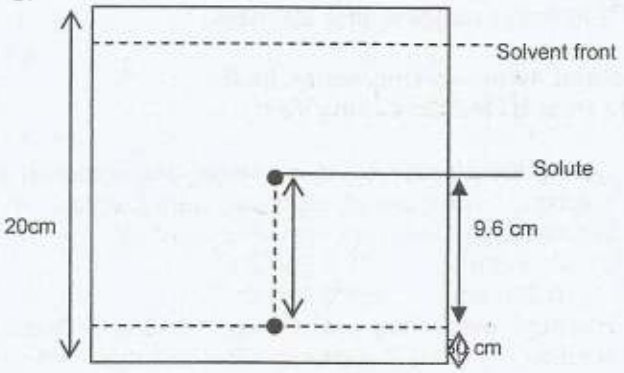
Potassium, K is the only option that suit the described terms ($1s^2 2s^2 2p^6 3s^2 3p^6 4s^1$) (C)

7. Relative atomic mass = $M_1\alpha_1 (^{20}_{10}B) + M_2\alpha_2 (^{22}_{10}B)$

$= {}^2/_5 \times 20 + {}^3/_5 \times 22$

$= 21.2$ (B)

8.



Since the solute moved half way up the plate, the distance moved by solute $= \frac{20 - 0.8}{2}$

$= 9.6$cm

$R_f = \frac{\text{distance moved by solute}}{\text{distance moved by solvent}}$

Distance moved by Solvent $= \frac{9.6cm}{0.505} = 19.01$cm

∴ Distance of the solvent front from the top of the plate upon elution

$= 20.00 - 19.01 = 0.99$cm $\approx$ 1.0cm (B)

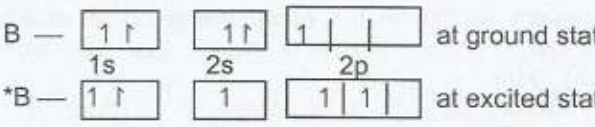
9. $CH_3CH_2CH{=}CH_2 + Br_2 + H_2O \rightarrow$

But-1-ene

$CH_3CH_2CH(Br)CH(OH) + CH_3CH_2CH(Br)CH(Br) + HBr$

2-bromobutan-2-ol (major product)

10. From Boron electronic configuration



The 2s orbital is then mixed with two orbitals of 2p to form three sp^2 hybrid orbitals that are trigonally arranged. At the excited state, Boron has vacant orbital to accommodate lone pair of electrons. This favour Lewis theory which state that an acid is an electron pair acceptor.(C)

11. Using dilution principle;

$C_1V_1 = C_2V_2$

$0.750 \times V_1 = 0.025 \times 250cm^3$

$V_2 = \frac{0.025 \times 250}{0.750} = 8.33cm^3$

Therefore, 8.38cm^3 of Na_2CO_3 is diluted to 250cm^3 (D)

12. $Na_2CO_3 \rightleftharpoons 2Na^+ + CO_3^{2-}$

No of mole = 3.0 mol/dm^3 $\times \frac{70}{1000}$ dm^3 = 0.21 mole

1 mole of Na_2CO_3 produces 2 moles of Na^+

$\therefore$ 0.21 mole of Na_2CO_3 will produce 2 x 0.21 mole of Na^+

$NaHCO_3 \rightleftharpoons Na^+ + HCO_3^-$

No. of mole = $\frac{30}{1000}$ x 1.0mole/dm^3

= 0.03 mole

1 mole of $NaHCO_3$ produces 1 mole of Na^+

0.03 mole of $NaHCO_3$ will produce 0.03 mole of Na^+

Concentration of Na^+ = $\frac{\text{Total numebr of mole}}{\text{Added volume}}$

= $\frac{(0.03 + 0.42)\text{mole}}{\left(\frac{70+30}{1000}\right)\text{dm}^3}$ =4.5 mole/dm^3 (B)

13. First order rate reaction, have half life,

$t_{1/2} = \frac{\ln 2}{K}$ Where K is the rate constant

$$t_{\frac{1}{2}} = \frac{\ln 2}{5.25 \times 10^{-3}} = 132.0\ s \quad (C)$$

14. $Cu^{2+} \rightarrow Cu(s) - 2e^-$

No of mole = $\frac{2.4}{64} = 0.0375\ mole$

1 Mole of Cu will require 2F

0.0375 mole of Cu will require $\frac{2F \times 0.0375\ \text{mole}}{1\ \text{mole}}$ = 0.075F

Quantity of electricity, Q = It

1F ≡ 96500 coul mol^{-1}

0.075F = 7,275.5 coulomb

Q = It

Electric current, I = $\left(\frac{7.237.5}{750}\right)$ = 9.65 A (A)

15. Reverse equation (I) and add to equation (II)

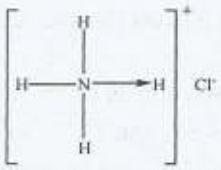
$2H_2O_{2(l)} \rightarrow 2O_2 + 4H^+ + 4e^-$ $E^0 = -0.68V$

$4e^- + 4H^+ + O_{2(g)} \rightarrow 2H_2O_{(l)}$ $E^0 = (+1.23 - 0.68)$ $Eo = +1.23V$

$2H_2O_2 \rightarrow 2H_2O_{(l)} + 2O_{2(g)}$ $Eo = +0.55V$

Ans: (C)

16.



The N — H bond is covalent, the N — H bond is derive because nitrogen contribute the lone pair of electron used in the bond. The bond between NH_4^+ and Cl^- is ionic (A)

17. A state of rest or no change in concentration or motion of a system is described as equilibrium. For equilibrium to take place, the rate of forward process is equal to the rate of backward process. Therefore, option C is correct (C)

18. π-bond is formed when a p-orbital overlaps with another parallel p-orbital laterally. It affects the angle between the atoms in molecules (B)

19. $C_2H_5OH + 3O_2 \rightarrow 2CO_2 + 3H_2O$

Reaction 1 mole : 3 mole 2 mole : 3 moles

Mole:

No. of O_2 = $\frac{3\ g}{16 \times 2}$ = 0.09375 mole

3 moles of O_2 produces 2 moles of CO_2

9.375 x 10^{-2} mole of O_2 produces $\frac{2\ \text{moles} \times 9.375 \times 10^{-2}}{3\ \text{moles}}$ of CO_2

= 6.25 x 10^{-2} mole

1 mole of CO_2 contain 6.02 x 10^{23} molecules

6.25moles of CO_2 will contain 6.25 x 10^{-2} x 6.02 x 10^{23}

= 3.76 x 10^{22} molecules (C)

20. This is decomposition of water

$2H_2O \xrightarrow{\Delta} 2H_{2(g)} + O_{2(g)}$ (D)

21. $NaNO_3$ = 23 + 14 + (16 x 3)

= 85g/mol

40g of $NaNO_3$ is dissolved in 50cm^3 of water.

⇒The mass of $NaNO_3$ in 10.50mol/dm^3 is calculated below

No. of mole = 10.50mol/dm^3 x $\frac{50}{1000}$ dm^3

= 0.525 mole

Mass = 0.525 x 85 = 44.625 grams

Mass left undissolved = 44.625 - 40.00

= 4.625g

% left undissolved = $\frac{4.625}{40}$ x 100%

= 11.56% (A)

22. The dissociation energy is the heat energy absorbed in breaking a covalent bond in the gas phase to its constituents element, also in gas phase. It is also used to describe enthalpy change in a reaction. The dissociation energy ΔH_a = -540 kJ (B)

2013 POST UTME SCREENING EXERCISE

1. Lithium with atomic number of 3 is a
   A. Strong reducing agent B. Strong oxidizing agent
   C. Weak reducing agent D. Weak oxidizing agent
2. The correct name for $HCOOC_2H_5$ is
   A. methylethanoate B. ethylethanoate
   C. ethylmethanoate D. propylethanoate
3. When CaC_2 reacts with water, the organic product form is
   A. ethanol B. ethanoic acid C. ethane D. ethyne
4. 100 cm^3 of ethyne was mixed with 240 cm^3 of oxyger in a combustion chamber. What volume of carbon (iv) oxide is produced? A. 100 cm^3 B. 24 cm^3 C. 138 cm^3 D. 192 cm^3
5. Uranium – 235 explores when bombarded with a slow moving neutron according to the equation below:
   $^{235}_{92}U + ^{1}_{0}n \rightarrow ^{94}_{36}Kr + Ba + 3(^{1}_{0}n)$
   The atomic number and mass of Ba respectively are
   A. 46 and 126 B. 36 and 116 C. 56 and 139 D. 66 and 146
6. The reduction potential of two electrodes are
   $X^{2+} + 2e^- \rightarrow X$, $E^\circ = 0.042$ V
   $Y^+ + e^- \rightarrow Y$ $E^\circ = 0.012$ V
   Calculate the free energy change for the cell that is made up of the electrodes [F = 96500 Coulomb mol^{-1}]
   A. 4.20 kJ B. 5.79 kJ C. 6.86 kJ D. 10.55 kJ
7. Which of SF_4, SiH_4, CO_2, ICl, CH_2Cl_2, SO_2 and XeO_3 will not show the property of permanent dipole?
   A. CO_2 and SiH_4 only B. SF_4 and SiH_4 only
   C. CO_2, SiH_4 and XeO_3 D. SF_4, SiH_4, CO_2 and ICl
8. A sample of water weighs 200.0 g at 298 K. What is the volume of this quantity of water in cubic meters given that the density of water at 298 K is 0.98 gcm^{-3}?
   A. 2.04×10^{-3} m^3 B. 2.04×10^{-6} m^3
   B. 2.04×10^{-9} m^3 D. 2.04×10^{-4} m^3
9. What is the pH of 500 cm^3 of 0.02 mol/dm^3 tetraoxosulphate (iv) acid?
   A. 1.456 B. 1.333 C. 1.455 D. 1.699
10. The main product of electrophilic addition of HCl to 2 – methylpropene A. 2 – chloro-2-methylbutane
    B. 2-chloro-2-methylbutene C.2-methyl-2-chloropropane
    D. 2-chloro-2-methylpropene
11. Consider the following reactions
    (i) $2LiOH + CO_2 \rightarrow Li_2CO_3 + H_2O$
    (ii) $2H_2 + O_2 \rightarrow 2H_2O$
    (iii) $2Cu + O_2 \rightarrow 2CuO$
    (iv) $HCl + AgNO_3 \rightarrow AgCl + HNO_3$

Which of these reactions are redox reactions?

A. i and iii only B. i, ii, iii only C. ii and iv only D. ii and iii only

12. Which of the following metals cannot displace hydrogen from steam? A. copper B. iron C. strontium D. lithium

13. Consider the exothermic reaction $2SO_{2(g)} + O_{2(g)} \rightarrow SO_{3(g)}$ If the temperature of the reaction is reduced from 60°C to 300°C and no other changes take place then,

A. the reaction rate increases B. concentration of SO_3 decreases C. concentration of SO_3 increases D. SO_2 gas becomes unreactive

14. The molarity of 5% by weight of aqueous solution of tetraoxosulphate (VI) acid (molecular weight = 98)

A. 0.537 mol/dm^3 B. 0.208 mol/dm^3

C. 0.551 mol/dm^3 D. 0.333 mol/dm^3

15. A motor truck release an average of 5.0 g CO into air for every km covered. The many molecules of CO will be emitted into the air. If the truck travels 8 km?

[C = 12, O = 16, $N_A = 6.02 \times 10^{23}$]

A. 4.32×10^{22} B. 2.48×10^{23} C. 8.6×10^{23} D. 6.82×10^{21}

16. A sample of an organic compound was weighed to be 0.250 g and subjected to Kjeldal treatment. The ammonia produced was neutralized by 27.0 cm^3 of 0.1 mol/dm^3 HCl. What is the percentage of nitrogen in the compound? [N =14 ,H =1]

A. 18.4% B. 17.8% C. 15.1% D. 13.3%

17. Given the half redox reaction $O_2 + 4H^+ + 4e^- \rightarrow 2H_2O$, how many moles of electron will be required to produce 3.0×10^{22} molecules of water?

A. 0.05 B. 0.10 C. 0.15 D. 2.0

18. The quatum number, l in an atom defines

A. the shell K, L, M B. orbitals

C. multiplicity D. degeneracy of orbitals

19. The hybridization of the central atom in a molecule

A. dictates the shape of the molecule B. shortens the sigma bond in the molecule C. distorts the shape of the molecule D. serves to explain the shape of the molecule

20. Which of the following compounds would you expect to show positive iodoform test? (i) butanone (ii) propanoic acid (iii) ethanol (iv) benzaldehyde (v) but -2- one

A. i and ii B. I and iii C. iv and v D. ii and iii

21. The below combustion of one mole of an alkanol is shown below: $C_nH_{2n+1}OH + xO_2 \rightarrow yCO_2 + 2H_2O$.

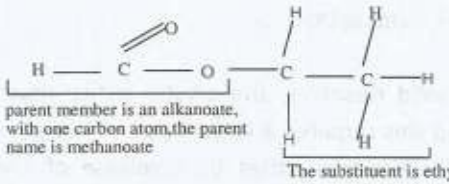
What is the value of x in term of n?

A. $\frac{3n+1}{2}$ B. $\frac{3n-1}{2}$ C. $\frac{3n}{2}$ D. $\frac{3n+3}{2}$

22. An ion has a charge of +3. The nucleus of the ions has a mass of 120. The number of neutrons in the nucleus is 1.50 times that of the number of protons. How many electrons are in the ion? A. 55 B. 48 C. 45 D. 42

EXPLANATIONS TO THE ANSWERS

1. Lithium ($1s^2 2s^1$) with 1 electron in its outermost shell(2s) is in group 1 element in the periodic table, it is an electropositive metal, ionizes with lose of electron, so, it is a reducing agent, therefore, it is a metal. Lithium is the first metallic member of the group and metallic properties increases down the group. Lithium is a weak reducing agent (C)

2. 

This gives the IUPAC ethylmethanoate (C)

3. $CaC_2 + H_2O \rightarrow C_2H_2 + Ca(OH)_2$ (D)

4. $2C_2H_2 + 5O_2 \rightarrow 4CO_2 + 2H_2O$

Beginning: 100 cm^3 240 cm^3 - -

Gay Lussac's law: 2 vol. 5 vol. 4 vol. 2 vol.

Reaction : 96 cm^3 240 cm^3 - -

End of reaction: 4 cm^3 - 192 cm^3 96 cm^3

The volume of CO_2 = 192 cm^3 (D)

5. $^{235}_{92}U + {}^{1}_{0}n \rightarrow {}^{94}_{36}Kr + {}^{y}_{x}Ba + 3({}^{1}_{0}n)$

Balancing the atomic number (subscript)

92 +0 =36 +$_x$Ba + 3(0)

92 = 36 +$_x$Ba

$_x$Ba = 56

balancing atomic mass (mass number): superscript

235 + 1 = 94 + $_y$Ba + 3(1)

236 = 97 + $_y$Ba

$_y$Ba = 139

The atomic number and mass of Ba are 56 and 139 respectively (C)

6. $X^{2+} + 2e^- \rightarrow X$ $E^\circ = 0.042$ V ..... (i)

$Y^+ + e^- \rightarrow Y$ $E^\circ = 0.012$ V .....(ii)

Multiply equation ii by 2

$2Y^+ + 2e^- \rightarrow 2Y$ $E^\circ = -0.012$ V..... (iii)

Reverse equation (iii) & Add (i)

$X^{2+} + 2e^- \rightarrow X$ $E^\circ = 0.042$ V

$2Y \rightarrow 2Y^+ + 2e^-$ $E^\circ = 0.012$ V

$X^{2+} + 2Y \rightarrow 2Y^+ + X$ $E^\circ = 0.03$ V

Free energy, $\Delta G = -nFE$

n = 2 (number of electrons taking part in the process)

$\Delta G = -(2 \times 96500 \times 0.03)$

$= -5790$ J

Free energy, $\Delta G = -5.79$ kJ (B)

7. Permanent dipole is a property or feature of polar molecules (i.e unsymmetrical molecules). Such molecules have dipole – dipole attraction as force of attraction existing between them, such molecules are line up such that the positive pole of one molecule attracts the negative pole of another e.g HCl

- CO_2 ($^{O} = C = ^{O}$) is a non polar symmetrically bonded molecule

- SO_2  is a polar – covalent molecule due to distortion by the two lone pairs of electron on oxygen and the different in electronegativity of the two elements.
- XeO_3 is a pyramidal polar covalent bond molecule like ammonia
- SF_4 is a polar covalent molecule, it is sp^3d – hybridized with one lone pair of electron to form irregular tetrahedron. It has permanent dipole
- ICl is a polar covalent compound , with Iodine as the positive end and Cl as the negative end, it is unsymmetrical, it has permanent diple.
- SiH_4 like hydrocarbon are non – polar covalent molecule because both elements are electropositive.
- CH_2Cl_2 is a polar covalent molecule because of the electronegative element chlorine.

Therefore, CO_2 and SiH_4 show the property of a permanent dipole (A)

8. Density = $\frac{mass}{volume}$

Volume = $\frac{mass}{density} = \frac{200.00\ g}{0.98\ g/cm^3} = 204.08\ cm^3$

$10^6 cm^3 \equiv 1\ m^3$

$204.08\ cm^3 \equiv x$

$$x = \frac{1\ m^3}{10^6 cm^3}\ x\ 204.08\ cm^3$$

$$= 204.08\ x\ 10^{-6}\ m^3 \text{(B)}$$

9. $H_2SO_4 \leftrightarrow 2H^+ + SO_4^{2-}$

1 mole 2 mole 1 mole

No of mole = $\frac{500}{1000}$ x 0.02 mol/dm^3

= 0.01 mole

1 mole of H_2SO_4 produces 2 moles of H^+

0.01 mole of H_2SO_4 will produce 2 x 0.01 mole

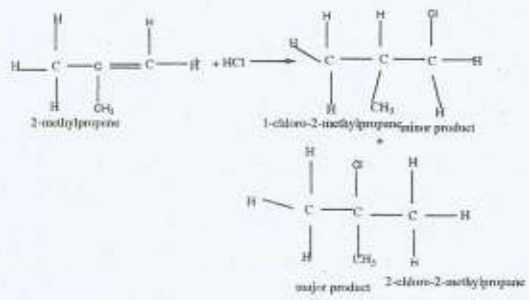
pH = - log [H^+]

= - log [0.02]

= - (-1.699)

pH = 1.699 (D)

10.



This reaction follows Marconicoff's rule where the hydrogen atom goes to the carbon atom with the highest number of hydrogen atoms (D)

11. $2LiOH + CO_2 \rightarrow Li_2CO_3 + H_2O$ (Neutralization)

Alkaline acid

$H_2 + O_2 \rightarrow H_2O$ (Redox reaction)

$2Cu^o + O_2^o \rightarrow 2Cu^{2+}O^{2-}$ (Redox reaction)

$HCl + AgNO_3 \rightarrow AgCl + HNO_3$ (Precipitation reaction)

Equation II and III are REDOX reaction (D)

12. Hydrogen can only be displaced from steam by metals higher than hydrogen in the activity series

e.g $2Fe + 3H_2O \rightarrow Fe_2O_3 + 3H_2$

$2Li + 2H_2O \rightarrow 2LiOH + H_2$

Copper is below hydrogen in the activity series, it cannot displace hydrogen from water (A)

13. The reaction is exothermic, where the forward reaction is favoured by decrease in temperature. This cause increase in the formation or concentration of SO_3 (C)

14. This means ,5% by weigh of H_2SO_4 will contain 5 g in 95 g of H_2SO_4

i.e 5 % = $\frac{solute}{solute+solvent}$ x 100

∴ 5 g of H_2SO_4 in 95 g of H_2SO_4

$x\ g\ of H_2SO_4\ in\ 1000\ g\ of\ H_2O$

x = $\frac{1000\ x\ 5}{95} = 52.63\ g/dm^3$

concentration in mol/dm^3 = $\frac{52.63\ g/dm^3}{98\ gmol^{-1}}$

= 0.537 mol/dm^3 (A)

15. Molar mass of CO = 12 + 16 =28 g/mol

1 mole of CO contains 28 g

1 mole of CO contain 6.02 x 10^{23} molecules

At s.t.p, 28 g of CO contain 6.02 x 10^{23} molecules

5.0 g of CO will contain $\frac{5.0\ g\ x\ 6.02\ x\ 10^{23}}{28}$ = 1.075 x 10^{23} molecules

In 1 km, 1.075 x 10^{23} molecule is emitted

Therefore,in 8km, $\frac{8\ km\ x\ 1.075\ x\ 10^{23}\ molecule}{1\ km}$ will be emitted

We have, 8.6 x 10^{23} molecules (C)

16. Organic compound = 0.250 g

Kjeldal is used for the determination of nitrogen in an organic compound. Here, a known mass of the compound is converted to ammonia

$HCl + NH_3 \rightarrow NH_4Cl$

No of mole of HCl = $^{27}/_{1000}$ dm^3 x 0.100 mol/dm^3

= 2.7 x 10^{-3} mole

Since, 1 mole of HCl reacts with 1 mole of NH_3

2.7 x 10^{-3} mole of HCl will also react with 2.7 x 10^{-3} mole

Mass of ammonia = 2.7 x 10^{-3} x 17 = 0.0459 g

Mass of nitrogen = $\frac{N}{NH_3}$ x 0.0459 g

= $\frac{14}{17}$ x 0.0459 g = 0.0379 g

% of nitrogen in the compound

= $\frac{mass\ of\ Nitrogen}{mass\ of\ the\ organic\ compound}\ x\ 100\%$

= $\frac{0.0379}{0.250}$ x 100

= 15.1% (C)

17. $4H^+ + O_2 + 4e^- \rightarrow 2H_2O$

4 moles of electrons produce 2 moles of H_2O

1 mole of electron will produce ½ mole of H_2O

1 mole of e^- will produce ½ (6.02×10^{23}) molecules of H_2O

If 3.02×10^{23} molecules of water require 1 mole of e's

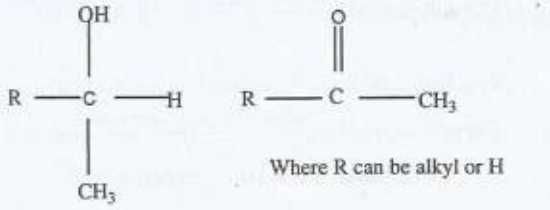
3.0 x 1023 molecules of water will require $\frac{1\ mole \times 3.0 \times 10^{22}\ molecules}{3.02 \times 10^{23} molecules}$

= 0.10 mole of electrons (B)

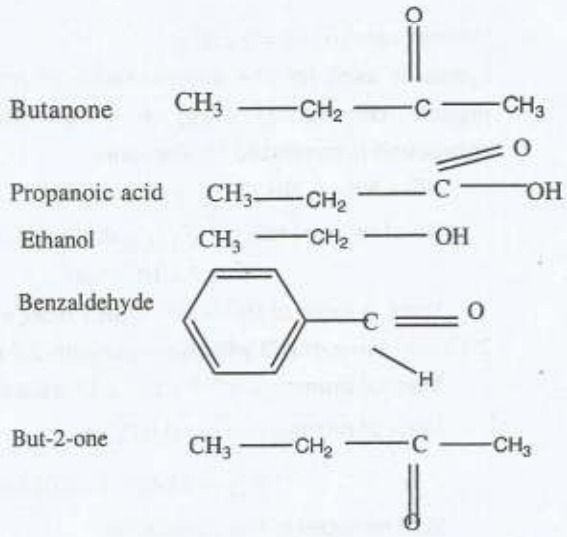
18. Each orbital of an atom & the electrons accommodated are described completely by a set of four quantum numbers. The quatum numbers are : principal quatum number (n) represent the main energy level in which the orbital is located. Azimuthal quatum number (l) gives the shape of the orbitals in subshells accommodating electrons. Magnetic quatum number (m_l) gives the number of spartial orientation or degeneracy of the orbitals in subshells. Spin quatum number (m_s) describes the spinning of an electron in either clockwise or anti clockwise direction in an orbital (B)

19. If an atom is bounded to two or more other kinds of atoms as in many covalent molecules and ions, the shape of the system is determined by the geometry of bonds around the central atom. The variations in the bond angles of such molecules can be explained by hybridization (D)

20. Iodoform test is used to identify alkanol and carbonyl compounds having the general structural formula.



Where R can be alkyl or H



Butanone and but - 2 – one are the same structure, compound i and ii have structures that will give positive test to iodoform test (B)

21. $C_nH_{2n+1}OH + xO_2 \rightarrow y\ CO_2 + 2H_2O$

Here, n =y

By comparing with a balanced alkanol combustion equation,

$CH_3OH + O_2 \rightarrow CO_2 + 2H_2O$

$C_2H_5OH + O_2 \rightarrow 2CO_2 + 3H_2O$

By inspection, $x = \frac{3n}{2}$ (C)

22. Let represent the ion as A^{3+} (charge of +3)

The nucleus mass = 120 (number of proton and neutron because proton and neutron are the massive centre of the nucleus)

No of proton + no of neutron =120

Number of neutron, n = 1.5p, of proton

p + n = 120

p +1.5p = 120

2.5 p = 120

$P = \frac{120}{2.5} = 48$

For a neutral atom, number of proton equal number of electron

For A^{3+} ion, it means the ions has lost 3- electrons

Therefore, number of electron = 48 – 3 =45 electrons (C)

2. Which of the quantum number divides shells into orbitals?
   a) Principal b) subsidiary
   c) magnetic d) spin
3. Which of these statements is/are correct of a proton?
   i. The mass of a proton is one-twelfth the molar mass of carbon
   ii. The mass of a proton is 1840 times the mass of an electron
   iii. The mass of a proton is 1.0008g
   a) ii only b) i, ii and iii
   c) i only d) i and ii only
4. The following are chemical entities identifiable during qualitative analysis
   i) SO_4^{2-} ii) H_3O^+ iii) NH_4^+
   iv) OH^-. Which of them can be detected by litmus paper?
   a) ii and iv only b) ii only
   c) i & iii only d) I & ii only
5. i) $NaHCO_3$ ii) $NaHSO_4$ iii) NaCl. Which of these will dissolve in water to give alkaline solution?
   a) i, ii and iii b) ii only
   c) i only d) i & ii only
6. Burning of 0.46 g of ethanol produced heat that raised the temperature of 100 g of water by 30°C. Calculate the heat of combustion of ethanol, C_2H_5OH.
   (C = 12, H = 1; O = 16)
   a) 50 $kJmol^{-1}$ b) 900 kJmol
   c) 1200 $kJmol^{-1}$ d)1000 $kJmol^{-1}$
7. When chlorine is bubbled into potassium iodine solution
   a) A white precipitate is seen
   b) reddish brown colour develops
   c) solution remains colourless
   d) blue colour is seen
8. $PCl_5 \rightleftharpoons PCl_{3(aq)} + Cl_{2(g)}$ In reaction above, an increase in pressure will
   a) Decelerate the reaction b) increase the yield of PCl_3
   c) increase the yield of PCl_5 d) accelerate the reaction.
9. A saturated solution of silver trioxocarbonate(IV), was found to have concentration of 1.30×10^{-5}mol dm^{-3}. The solubility product of trioxocarboate(IV) is
   a) 8.79×10^{-15} b) 1.69×10^{-10}
   c) 1.82×10^{-1} d) 9.84×10^{-10}
10. A zinc half-cell is connected to an iron half-cell through a salt bridge and both are also connected through a copper wire. At which electrode is reduction taking place and which electrode is positively charged?
   a) Zinc, zinc b) iron, iron
   c) zinc, iron d) iron, zinc
11. Which of the following is the difference between an electrolytic cell X and electrochemical cell Y
   a) Anode in X is –ve while anode in Y is +ve
   b) In X, oxidation takes place at the anode while in Y reduction takes place at the anode
   c) In X, anode is positive while in Y anode is negative.
   d) In X, chemical energy is converted into electrical energy while in Y electrical energy is converted into chemical energy.
12. What mass of bromine will saturate completely 6.8 g of 3-methybut-1-yne (H = 1; C = 12; Br = 80)
   a) 16 g b) 32 g c) 12 g d) 24 g