Chemical Calculations – MCQs

2019 AL

8. $TiCl_4(g)$ reacts with liquid magnesium metal ($Mg(l)$) to give Ti(s) metal and $MgCl_2(l)$ at high temperature. When 0.95 kg of $TiCl_4(g)$ is made to react with 97.2 g of $Mg(l)$, the reactant that is completely consumed (this is commonly referred to as limiting reactant) and the amount of Ti(s) metal formed respectively are, (Molar mass: $TiCl_4 = 190\ g\ mol^{-1}$; $Mg = 24.3\ g\ mol^{-1}$; $Ti = 48\ g\ mol^{-1}$)
(1) $TiCl_4$ and 96 g (2) Mg and 96 g (3) Mg and 48 g
(4) $TiCl_4$ and 192 g (5) Mg and 192 g

2019 Model

10. The mole fraction of NH_4NO_3 is $\frac{5}{6}$ in a solid mixture that consists only NH_4NO_3 and $CaCO_3$. The percentage mass of $CaCO_3$ in the mixture is, (N = 14, H = 1, O = 16, Ca = 40, C = 12)
(1) 20% (2) 40% (3) 60% (4) 67% (5) 80%

2018 AL

6. The molarity (mol dm^{-3}) of a NaI solution which has a density of 1.03 g cm^{-3} and is 3% NaI by mass is,
(Na = 23, I = 127)
(1) 0.21 (2) 0.23 (3) 0.25 (4) 0.28 (5) 0.30

2016 AL

8. An organic compound **A** contains 39.97% of C, 6.73% of H and 53.30% of O, by weight. What is the empirical formula of **A**? (H = 1, C = 12, O = 16)
(1) $C_6H_8O_2$ (2) $C_2H_4O_2$ (3) $C_3H_7O_3$ (4) $C_3H_6O_3$ (5) CH_2O

2015 AL

15. O_2 gas formed by the thermal decomposition of $KClO_3$ is collected by downward displacement of water. The volume of O_2 gas collected in such an experiment at 27 °C and 1.13×10^5 Pa pressure was 150.00 cm^3. Given that the saturated vapour pressure of water is 0.03×10^5 Pa at 27 °C, the mass of O_2 gas collected is, (O = 16)
(1) 0.212 g (2) 0.217 g (3) 198 g (4) 212 g (5) 217 g

2014 AL

6. What mass of NaCl (to the nearest gram) would contain the same total number of ions as 285 g of $MgCl_2$?
(Na = 23, Mg = 24, Cl = 35.5)
(1) 176 g (2) 263 g (3) 303 g (4) 351 g (5) 527 g

13. The density of an 18.0% (by mass) solution of $(NH_4)_2SO_4$ is 1.10 g cm^{-3}. The molarity of this $(NH_4)_2SO_4$ solution is (H = 1, N = 14, O = 16, S = 32)
(1) 1.4 M (2) 1.5 M (3) 1.7 M (4) 2.0 M (5) 2.1 M

2013 AL

7. A mixture of Fe_2O_3 and FeO is found to contain 72.0% Fe by mass. The mass of Fe_2O_3 in 1.0 g of this mixture is (O = 16, Fe = 56)
(1) 0.37 g (2) 0.52 g (3) 0.67 g (4) 0.74 g (5) 0.83 g

8. Samples of $F_2(g)$ and Xe(g) are mixed in a container of fixed volume. The partial pressures of $F_2(g)$ and Xe(g) before they react are 8.0×10^{-5} kPa and 1.7×10^{-5} kPa respectively. When all of the Xe(g) has reacted, forming a solid compound, the partial pressure of the remaining $F_2(g)$ was 4.6×10^{-5} kPa. The system was maintained at a constant temperature during the above process. What is the formula of the solid compound formed?
(1) XeF_2 (2) XeF_3 (3) XeF_4 (4) XeF_6 (5) XeF_8

30. A solid sample contains only $CaCO_3$ and $MgCO_3$. To completely react the $CaCO_3$ and $MgCO_3$ present in the sample, 42.00 cm^3 of 0.088 M HCl were required. The anhydrous chloride salts from the reaction, obtained by evaporation of the filtrate weighed 0.19 g. The mass of $CaCO_3$ present in the solid sample is
(C = 12, O = 16, Mg = 24, Ca = 40, Cl = 35.5)
(1) 0.05 g (2) 0.07 g (3) 0.09 g (4) 0.11 g (5) 0.12 g

2012 AL

7. A gaseous hydride of nitrogen, N_aH_b (20 cm^3) was burnt in excess O_2 to give 10 cm^3 of N_2 and 30 cm^3 of water vapour. The formula of the gaseous hydride is,
(1) NH_3 (2) N_2H_2 (3) N_2H_4 (4) N_3H (5) N_3H_5

8. Thermal decomposition of 15.6 g of a hydrated metal carbonate, $MCO_3.4H_2O$ produces 4.0 g of the metal oxide. The relative atomic mass of the metal M is, (H = 1, C = 12, O = 16)
(1) 63.5 (2) 56 (3) 40 (4) 26 (5) 24

10. A solution has been prepared by mixing 250 cm^3 of a Na_2SO_4 solution of concentration 0.150 mol dm^{-3} and 750 cm^3 of a NaCl solution of concentration 0.100 mol dm^{-3}. The composition of this solution in terms of ppm Na is, (O = 16, Na = 23, S = 32, Cl = 35.5)
(1) 3450 (2) 2588 (3) 1725 (4) 3.45 (5) 0.15

2011 AL

8. The mass of a sample containing only $SrCO_3$ and $BaCO_3$ is 0.800 g. When the sample is dissolved in excess dilute acid, the volume of CO_2 gas liberated at standard temperature and pressure is 0.112 dm^3. The mass percentage of $SrCO_3$ in the sample is, (C = 12, O = 16, Sr = 88, Ba = 137)
(1) 30 (2) 56 (3) 70 (4) 80 (5) 84

- Questions **28** and **29** are based on solutions **A**, **B**, **C** and **D** given below.

  A : Solution prepared by dissolving 10.2 g of pure potassium hydrogen phthalate (molar mass = 204 g mol^{-1}) which is a weak monobasic acid in water, and then diluting up to 1.00 dm^3

  B : Solution prepared by dissolving 2.0 g of NaOH (molar mass of pure NaOH = 40 g mol^{-1}), containing an inert compound in water, and then diluting up to 1.00 dm^3

  C : Conc. HCl (molar mass = 36.5 g mol^{-1}) solution of density 1.2 g cm^{-3} and of strength 36.5% (w/w)

  D : Solution prepared by diluting 10.0 cm^3 of solution **C** up to 1.00 dm^3

28. A sample of 25.00 cm^3 of solution **B** requires 22.00 cm^3 of solution **A** for complete reaction. The purity of NaOH used to prepare solution **B** is,
(1) 76% (2) 88% (3) 91% (4) 94% (5) 97%

29. Volume of solution **B** required to react completely with 12.50 cm^3 of solution **D** is,
(1) 17.10 cm^3 (2) 26.40 cm^3 (3) 30.00 cm^3 (4) 33.60 cm^3 (5) 34.10 cm^3

2010 AL

4. When 100 cm^3 of a hydrocarbon was completely burnt in 600 cm^3 of oxygen, 300 cm^3 of carbon dioxide and 400 cm^3 of water vapour were formed. The oxygen remained unreacted after the combustion was 100 cm^3. All volumes were measured at the same temperature and pressure. The formula of the hydrocarbon is,
(1) C_2H_4 (2) C_2H_6 (3) C_3H_6 (4) C_3H_8 (5) C_4H_8

8. An aqueous solution of $Ca(NO_3)_2$ contains 20 mg of Ca^{2+} ions in 0.500 dm^3. The concentration of NO_3^- in the solution (in mol dm^{-3}) is, (Ca = 40)
(1) 5.0×10^{-4} (2) 1.0×10^{-3} (3) 2.0×10^{-3} (4) 4.0×10^{-3} (5) 1.0×10^{-2}

14. When a mixture of 4.0 g of sodium carbonate and sodium hydrogencarbonate was heated, the loss in mass was 0.31 g. The percentage of mass of sodium carbonate in the mixture is,
(H = 1, C = 12, O = 16, Na = 23)
(1) 95 (2) 90 (3) 83 (4) 79 (5) 63

21. A 0.331 g sample of $Pb(NO_3)_2$ contaminated with $NaNO_3$ was dissolved in 100.0 cm^3 of water. Excess H_2S gas was then bubbled through this solution until the precipitation was complete. The mass of the dried precipitate was 0.200 g. The percent purity (w/w) of the sample is approximately,
(N = 14, O = 16, S = 32, Pb = 207)
(1) 16 (2) 47 (3) 68 (4) 79 (5) 84

33. 1.0 dm^3 of an aqueous solution of H_2O_2 was heated to complete dissociation. The volume of oxygen evolved was 8.0 dm^3 at S.T.P. The concentration of the H_2O_2 solution (in mol dm^{-3}) is,
(Volume of 1 mole of O_2 at S.T.P. = 22.4 dm^3)
(1) 0.31 (2) 0.35 (3) 0.62 (4) 0.71 (5) 3.2

36. A well water sample was found to contain Ca^{2+}, NO_3^-, HCO_3^- and Cl^- ions. A 25.0 cm^3 portion of the water sample was titrated with 0.010 mol dm^{-3} H_2SO_4 using methyl orange as the indicator. The colour of the solution changed from yellow to pink when the burette reading was 5.00 cm^3. The temporary hardness of the well water expressed as $CaCO_3$ (mg dm^{-3}) is, (Ca = 40, O = 16, C = 12)

(1) 200 (2) 100 (3) 75 (4) 50 (5) 25

2009 AL

5. A solution of Na_2SO_4 has been prepared by dissolving 142 mg of pure Na_2SO_4 in water, in a 500 cm^3 volumetric flask and by diluting up to the mark. The Na^+ ion content in mg dm^{-3} units in this solution is, (O = 16.0, Na = 23.0, S = 32.0)

(1) 2.00×10^{-3} (2) 4.00×10^{-3} (3) 46 (4) 92 (5) 184

8. The mass percentage of $Na_2S_2O_3.5H_2O$ in an aqueous solution is 20%. The density of this solution at room temperature is 1.24 g cm^{-3}. The molarity of $Na_2S_2O_3$ in this solution is, (H = 1.0, O = 16.0, Na = 23.0, S = 32.0)

(1) 1.0 (2) 1.0×10^{-3} (3) 0.050 (4) 1.6 (5) 0.10

15. The relative molecular masses of X and Y are in the ratio 2:3. In a mixture of X and Y the mole fraction of X is $\frac{1}{3}$. The mass percentage of X in the mixture is,

(1) 10% (2) 25% (3) 33.3% (4) 50% (5) 75%

2008 AL

4. $MSO_4 \cdot xH_2O$ has 36% of H_2O by mass. The value of x is (H = 1.0, O = 16.0, S = 32.0, M = 64.0)

(1) 3 (2) 4 (3) 5 (4) 6 (5) 7

18. When TiO_2 is heated in the presence of $H_2(g)$ another oxide of titanium is formed. If 1.600 g of TiO_2 produces 1.440 g of this oxide, the formula of the oxide is (O = 16.0, Ti = 48.0)

(1) TiO (2) Ti_2O_3 (3) Ti_2O (4) Ti_3O_4 (5) Ti_2O_2

21. A metal M was converted to its sulphate $M_2(SO_4)_3$. A solution of this sulphate was treated with $Pb(NO_3)_2$ to give $PbSO_4$. If 1.04 g of M gave 9.09 g (dry mass) of $PbSO_4$, the metal M is (Al = 27.0, Cr = 52.0, Fe = 55.8, Co = 58.9; Ga = 69.7, $PbSO_4$ = 303.0)

(1) Al (2) Cr (3) Fe (4) Co (5) Ga

27. A solution of urea (NH_2CONH_2) is decomposed on heating as follows.

$$NH_2CONH_2 + 3H_2O \rightarrow CO_2 + 2NH_4OH$$

The mass of urea required to precipitate Al present in 100.0 cm^3 of 0.20 mol dm^{-3} $Al(NO_3)_3$ solution is (H = 1.0, C = 12.0, N = 14.0, O = 16.0)

(1) 1.80 g (2) 0.90 g (3) 2.70 g (4) 3.60 g (5) 1.20 g

30. NaOH ප්‍රමාණයෙන් 50% ක් Na_2CO_3 බවට පරිවර්තනය වන තුරු $0.10\ mol\ dm^{-3}$ NaOH ද්‍රාවණ $25.00\ cm^3$ ක් තුළින් CO_2 යවන ලදී. ෆීනොල්ප්තැලින් දර්ශකය ලෙස යොදාගනිමින් මෙම ද්‍රාවණය $0.10\ mol\ dm^{-3}$ HCl ද්‍රාවණයක් සමඟ අනුමාපනය කරන ලදී. අනුමාපනයේ අන්ත ලක්ෂ්‍යය විය හැක්කේ

(1) $18.75\ cm^3$ (2) $20.00\ cm^3$ (3) $37.50\ cm^3$ (4) $25.00\ cm^3$ (5) $12.50\ cm^3$

31. m_1 g of NaCl and m_2 g $MgCl_2$ were dissolved in water and diluted upto $1.00\ dm^3$. $25.00\ cm^3$ of this solution was treated with excess $AgNO_3$ solution. The mass of AgCl precipitate obtained was m_3 g.

(Relative molar mass : NaCl = M_1, $MgCl_2$ = M_2, AgCl = M_3)

Which of the following expressions is correct?

(1) $m_3 = \frac{m_1}{M_1} + \frac{2m_2}{M_2} \times M_3$ (2) $m_3 = \left[\frac{m_1}{M_1} + \frac{2m_2}{M_2}\right] \times M_3$

(3) $m_3 = \frac{25}{1000} \times \left[\frac{m_1}{M_1} + \frac{m_2}{M_2}\right] \times M_3$ (4) $m_3 = \frac{1}{1000}\left[\frac{m_1}{M_1} + \frac{m_2}{M_2}\right] \times M_3$

(5) $m_3 = \frac{25}{1000}\left[\frac{m_1}{M_1} + \frac{2m_2}{M_2}\right] \times M_3$

40. The molar concentration of an ammonium molybdate $(NH_4)_2MoO_4$, solution which contains 48 ppm of Mo is

(1 ppm = 1 mg dm^{-3}, Mo = 96)

(1) $2.5 \times 10^{-5}\ mol\ dm^{-3}$ (2) $7.5 \times 10^{-5}\ mol\ dm^{-3}$

(3) $5.0 \times 10^{-3}\ mol\ dm^{-3}$ (4) $2.5 \times 10^{-4}\ mol\ dm^{-3}$

(5) $5.0 \times 10^{-4}\ mol\ dm^{-3}$

2007 AL

6. Which one of the following statements is not true in relation to diluting a 0.1 mol dm^{-3} H_2SO_4 solution two-fold?

(1) The $[H_3O^+]$ decreases. (2) The $[SO_4^{2-}]$ decreases.

(3) The $[HSO_4^-]$ decreases. (4) The $[OH^-]$ decreases.

(5) The density of the solution decreases.

8. A 0.744 g sample of a mixture of $BaCl_2.2H_2O$ (Relative molar mass = 244) and KCl was heated to a cons mass at 150 °C. The mass of the product was 0.708 g. The mass of KCl in the sample is

(H = 1.0, O = 16.0, K = 19.0, Cl = 35.5)

(1) 0.500 g (2) 0.425 g (3) 0.300 g (4) 0.250 g (5) 0.150 g

23. 1 mol of an organic compound X required 2 mol of O_2 for complete combustion, and produced 2 mol of CO_2 and 2 mol of H_2O as the only products.

The molecular formula of X is

(1) C_2H_4 (2) C_2H_6 (3) C_2H_4O (4) CH_4O (5) $C_2H_4O_2$

28. An iron plate with a mass of 40 g was dipped into 250 cm^3 of a $CuSO_4$ solution. After a certain time the mass of the plate was 42 g. The mass of the deposited Cu is (Fe = 56, Cu = 64),
(1) 42 g (2) 16 g (3) 14 g (4) 8 g (5) 2 g

- **The following data/information applies to questions No. 39 and 40.**

Four monobasic acid solutions A, B, C and D are mixed together as indicated in the table given below to form solution R.

Acid Solution	Concentration/mol dm^{-3}	Volume mixed/cm^3
A	0.07	500.0
B	0.06	1000.0
C	0.12	1000.0
D	0.05	500.0

Two of the four acids are strong acids; the other two are weak acids with equal dissociation constants. A few drops of the two indicators, methyl orange and phenolphthalein, were added separately to two 30.0 cm^3 portions of solution R which when titrated with Z mol dm^{-3} NaOH solution, gave end points at 10.0 cm^3 and 40.0 cm^3, respectively.

39. The two strong acids are,
(1) A and B (2) B and C (3) C and D (4) B and D (5) A and D

40. The value of Z is
(1) 0.02 (2) 0.04 (3) 0.06 (4) 0.08 (5) 0.10

42. An aqueous solution of $MgSO_4$ has a concentration of 0.001 mol dm^{-3}. Which of the following statements is/ are true regarding this solution?

(*a*) The $MgSO_4$ concentration of this solution is 24.0 ppm.

(*b*) The SO_4^{2-} concentration of this solution is 96.0 ppm.

(*c*) The $MgSO_4$ concentration of this solution is 120.0 ppm.

(*d*) The Mg^{2+} concentration of this solutionis 2.4 ppm.

(1 ppm = 1 mg dm^{-3}; Mg = 24.0, S = 32.0 O = 16.0)

2006 AL

7. The mass of $K_2SO_4 . Cr_2(SO_4)_3 . 24H_2O$ (relative molar mass = 894) required to prepare 1.00 dm^3 of 10.4 ppm Cr^{3+} solution (1 ppm = 1 mg dm^{-3} ; Cr = 52.0) is,
(1) 8.940 mg (2) 8.940 g (3) 17.88 mg (4) 178.8 mg (5) 89.40 mg

18. A 10.0 cm^3 sample of coconut vinegar (density = 1.07 g cm^{-3}) was titrated with a 0.428 mol dm^{-3} NaOH solution, using a suitable indicator. If the end point was 25.00 cm^3, the mass percentage (w/w%) of acetic acid (relative molar mass of CH_3COOH = 60.0) in the vinegar, is
(1) 0.060 (2) 0.60 (3) 3.0 (4) 6.0 (5) 12.0

27. Solution S is prepared by mixing equal volumes of 0.2 mol dm^{-3} aqueous H_2SO_4 and 0.2 mol dm^{-3} aqueous CH_3COOH. 25.0 cm^3 portions of S are titrated separately with 0.1 mol dm^{-3} NaOH solution (in burette) using (A) phenolphthalein and (B) methyl orange as indicators. The end-points of the two titrations are respectively
(1) (A) 75.0 cm^3 (B) 25.0 cm^3.
(2) (A) 25.0 cm^3 (B) 25.0 cm^3.
(3) (A) 75.0 cm^3 (B) 50.0 cm^3.
(4) (A) 50.0 cm^3 (B) 75.0 cm^3.
(5) (A) 25.0 cm^3 (B) 50.0 cm^3.

2005 AL

23. NaOH reacts with urea as follows.

$$2NaOH + NH_2CONH_2 \rightarrow Na_2CO_3 + 2NH_3\uparrow$$

0·6 g of urea (relative molecular mass of urea = 60·0) reacted completely with 25·0 cm^3 of 1·0 mol dm^{-3} NaOH All NH_3 was expelled by boiling. The volume of 0·5 mol dm^{-3} HCl necessary to neutralise the resulting solutic is
(1) 10·0 cm^3. (2) 12·5 cm^3. (3) 20·0 cm^3. (4) 25·0 cm^3. (5) 50·0 cm^3.

26. A closed vessel contains water in contact with CO_2 gas at 3 atm pressure. A number of equilibria exist ir this system. If CO_2 and H_2O behave ideally in the gas phase, the number of equilibria in the system is
(1) 3. (2) 4. (3) 5. (4) 6. (5) 7.

50. S is a solution of Na_2CO_3 and $NaHCO_3$ in water By which method / methods given below can the concentrations of Na_2CO_3 and $NaHCO_3$ in S be determined by titrating 25·0 cm^3 of S with standard HCl?
(*a*) Using phenolphthalein as indicator
(*b*) First using methyl orange as indicator and further titrating the same solution using phenolphthalein as indicator
(c) First using phenolphthalein as indicator and further titrating the same solution using methyl orange as indicator
(*d*) Tirate using phenolphthalein as indicator and thereafter titrate a separate 25·0 cm^3 of S using methyl orange as indicator

33. 1·0 dm^3 of 0·2 mol dm^{-3} H_2SO_4 and 1·0 dm^3 of 0·2 mol dm^{-3} HCl were mixed to obtain 2·0 dm^3 of solution. The H^+ ion concentration of the resulting solution, if H_2SO_4 is fully dissociated under these conditions, is
(1) 0·1 mol dm^{-3}. (2) 0·15 mol dm^{-3}. (3) 0·2 mol dm^{-3}.
(4) 0·3 mol dm^{-3}. (5) 0·4 mol dm^{-3}.

2004 AL

10. 1·92 g of the hydrocarbon C_9H_{20} gave on complete combustion, 5·94 g of CO_2(g) and 2·70 g of water vapour. The mass of oxygen reacted is (H = 1, C = 12, O = 16)
(1) 6·72 g (2) 4·02 g (3) 3·86 g (4) 8·64 g (5) 3·24 g

16. A primary standard is a solid of exactly known composition, which can be obtained in a high level of purity and which is stable when stored either as a solid or as a solution. The substance suitable as a primary standard for the standardization of an acid is

(1) $Mg(OH)_2$ (2) $MgCO_3$ (3) NaOH (4) Na_2CO_3 (5) KOH

48. Which of the following is a correct step/are correct steps, in the measurement of a given volume of solution using a pipette?

(*a*) When the level of solution in the pipette is adjusted to coincide with the graduated mark, the tip of the pipette must be held immersed in the solution.

(*b*) In transferring the solution to the titration flask the pipette tip should be held against the inner surface of the titration flask.

(*c*) In transferring the solution to the titration flask the pipette should be held vertical and the flask held inclined.

(*d*) The little bit of solution remaining in the tip of the pipette, after the transfer, should be blown into the flask.

2003 AL

7. What volume (in cm^3) of dilute HNO_3 solution of density 1.10 g cm^{-3} and 20% HNO_3 by mass contains 10 g of HNO_3?

(1) 6 (2) 15 (3) 23 (4) 45 (5) 55

11. Crystalline sodium carbonate has the formula $Na_2CO_3.10H_2O$. What is the mass of anhydrous sodium carbonate required to make up 2·5 litres of 4·0 mol dm^{-3} solution? (H = 1; C = 12; O = 16; Na = 23)

(1) 106 g (2) 286 g (3) 530 g (4) 1060 g (5) 2860 g

12. A student intends to titrate 25·00 cm^3 of solution **Y** with solution **X**. Which of the following washing procedures is most suitable in preparation for this titration?

	Washing burette with	Washing titration flask with
(1)	distilled water	solution **Y**
(2)	solution **X**	solution **Y**
(3)	solution **X**	distilled water
(4)	solution **Y**	distilled water followed by solution **X**
(5)	distilled water followed by solution **X**	distilled water

13. When 25·00 cm^3 of a Na_2CO_3 solution is titrated with an HCl solution (in burette), using phenolphthalein as indicator, the end point was observed at 25·00 cm^3.
When the titration was repeated using 25·00 cm^3 of the same HCl solution and the same Na_2CO_3 solution (in burette) and using the same indicator, what will be the observed end point?

(1) 25·00 cm^3 (2) 12·50 cm^3 (3) 50·00 cm^3
(4) 37·50 cm^3 (5) an end point cannot be obtained.

24. Xenon is one of the least abundant inert gases in air. The amount of xenon in air is 0·076 parts per million (0·076 ppm) by volume. What volume of xenon gas, in dm^3, can be isolated from a given 1000 km^3 sample of air at the same temperature and pressure?

(1) 76 (2) 76×10^3 (3) 76×10^6 (4) 76×10^9 (5) 76×10^{12}

28. 0·6 mole of zinc nitrate and 0·6 mole of iron (III) sulphate are dissolved in water to give a solution with a total volume of 2 dm^3. Which one of the following has a concentration of 0·3 mol dm^{-3}?

(1) sulphate ions
(2) negatively charged ions
(3) positively charged ions
(4) zinc ions
(5) nitrate ions

29. What is the ratio of the mass percentages of carbon to that of chlorine in the compound $C_6H_{12}Cl_2$?

(C = 12; H = 1; Cl = 35·5)

(1) 6 : 2 (2) 6 : 1 (3) 1 : 3 (4) 1 : 1 (5) 1 : 6

● **Read the passage given below and answer questions 58 and 59.**

Properties of Solutions

Concentration, molality, mole fraction and **mole percent** are different ways in which the composition of solutions can be expressed.

Concentration equals the number of moles of solute dissolved per unit volume of solution. It is dependent on the temperature

Molality equals the number of moles of solute dissolved per unit mass of the solvent.

Extensive properties are those properties which **depend** on the extent of the system. Examples for these are volume and enthalpy. We refer to the enthalpy per mole as molar enthalpy.

Intensive properties are those properties which **do not depend** on the extent of the system. Examples for these are concentration, molality, molar volume and temperature. Since temperature is an intensive property, we do not have a property referred to as molar temperature.

58. Which one of the following statements is **incorrect**?

(1) Molality of a solution of glucose in water at 20 °C is equal to the molality of the same solution at 30 °C.
(2) Molar enthalpy is an intensive property.
(3) Pressure is an intensive property.
(4) Concentration of a NaOH solution containing 0·1 moles of NaOH dissolved in 1 dm^3 of water is 0·1 mol dm^{-3}
(5) Concentration of a solution depends on the temperature since the volume of the solution depends on the temperature.

59. Which one of the following statements is correct?

(1) Concentration is an extensive property.
(2) Mole percent is equal to the molality multiplied by 100.
(3) Mole fraction of glucose in an aqueous solution is dependent on the pressure.
(4) Molality of a Na_2CO_3 solution containing 0·1 moles of Na_2CO_3 dissolved in 1·0 kg of water is 0·1 mol dm^{-3} provided the density of water is 1 kg dm^{-3}
(5) Molality of a solution is independent of the temperature since mass is independent of temperature.

60. When a non-volatile solute is dissolved in a solvent, the vapour pressure exerted by the solvent in the solution is reduced. The boiling point of such a solution is therefore higher than that of the pure solvent. The said lowering of vapour pressure as well as the resultant elevation of boiling point are examples of what are referred to as **colligative properties.**

Colligative properties are defined as those properties which depend on **the number of dissolved particles (such as molecules, atoms and ions)** present in a given mass of solvent but not on their nature or structure.

Based on the above passage and your knowledge of ionic solutions, answer the question given below:-

Which one of the following aqueous solutions will have the highest boiling point if in each case 0·1 mole of solute molecules is dissolved in 1 kilogram of water?

(1) glucose solution
(2) oxalic acid solution
(3) sodium chloride solution
(4) sucrose solution
(5) barium hydroxide solution

2002 AL

1. A certain sample of CO has only $^{14}C_6$ and $^{16}O_8$ isotopes. Another sample of CO has $^{12}C_6$ and $^{18}O_8$ isotopes only. The property that shows a significant difference between the two samples is
(1) chemical reactivity.
(2) molar mass.
(3) molar volume.
(4) density at S.T.P
(5) percentage compositions of C and O by mass.

11. 5·0 g of the anhydrous chloride of a monovalent metal when completely converted to its anhydrous sulphate, gave 6·0 g of the anhydrous sulphate. (H = 1; Cl = 35·5; S = 32, O = 16)
The relative atomic mass of the metal is
(1) 20 (2) 24 (3) 27
(4) 35 (5) 43

13. The molar ratio NaOH : Na_2CO_3 in an aqueous solution of NaOH and Na_2CO_3 is 1 : 2. When 25·00 cm^3 of this solution is titrated with 0·1 mol dm^{-3} HCl with phenolphthalein as indicator, the end point is 15·00 cm^3. When the same titration is repeated using methyl orange instead of phenolphthalein as indicator, the end point (cm^3) is
(1) 15·00 (2) 20·00 (3) 25·00
(4) 30·00 (5) 40·00

14. The solubility of KNO_3 in water at 25°C is 300 g per kilogramme of water. If a hot solution containing 540 g KNO_3 in 600 g water is cooled the maximum mass of KNO_3 that would crystallise out of the solution at 25°C is
(1) 40 g (2) ~~180~~ g (3) 240 g
(4) 360 g (5) 540 g

15. The number of moles of ions present in a solution made by mixing 125 cm^3 of 0·2 mol dm^{-3} NaOH and 125 cm^3 of 0·1 mol dm^{-3} H_2SO_4 is
(1) 0·0375 (2) 0·0625 (3) ~~0·0875~~
(4) ~~0·15~~ (5) 0·30

57.	CO contains 0·430 g of carbon per gram of oxygen whereas CO_2 contains 0·215 g of carbon per gram of oxygen. (C = 12 ; O = 16)	If two elements can combine to form more than one compound, they do so in simple atomic ratios.

2001 AL

13. The number of atoms in 0·0240 g of the ^{12}C isotope is

(1) $12{\cdot}044 \times 10^{15}$ (2) $12{\cdot}044 \times 10^{20}$ (3) $12{\cdot}044 \times 10^{21}$

(4) $6{\cdot}022 \times 10^{19}$ (5) $6{\cdot}022 \times 10^{20}$

17. An aqueous solution of $K_2SO_4.Cr_2(SO_4)_3.12H_2O$ contains 1·04 g dm^{-3} of Cr^{3+} ions. What is the SO_4^{2-} concentration, in units of mol dm^{-3}, in this solution?
(relative atomic masses H = 1; O = 16; S = 32; K = 39; Cr = 52)

(1) 0·01 (2) 0·02 (3) 0·03 (4) 0·04 (5) 0·05

19. Iodine is produced when 10·0 cm^3 of a 0·010 mol dm^{-3} solution of $K_2S_2O_8$ is added to a solution contain I^- ions according to the equation

$$S_2O_8^{2-} + 2\ I^- \longrightarrow 2\ SO_4^{2-} + I_2$$

The minimum volume of 0·015 mol dm^{-3} solution of $Na_2S_2O_3$ required to completely react with iodine so produced in cm^3 is

(1) 5·0 (2) 6·7 (3) 13·3 (4) 20·0 (5) 26·7

30. 164·6 g of sodium amalgam on complete reaction with water liberates a gas whose volume measured is 2·24 dm^3. Assume that the gas behaves ideally.
(Relative atomic masses : Na = 23; Hg = 200)
The mole fraction of Na in the amalgam is

(1) 0·1 (2) 0·2 (3) 0·4 (4) 0·6 (5) 0·8

47. When an aqueous 0·1 mol dm^{-3} Na_2SO_4 solution is electrolysed, $12{\cdot}044 \times 10^{22}$ $H_2(g)$ molecules were $O_2(g)$ is the only other product formed. Given that the relative atomic mass of oxygen is 16·0 information required to calculate the mass of $O_2(g)$ produced is/are

(a) Faraday's Law of electrolysis (b) Avogadro constant.

(c) Universal gas constant. (d) Faraday constant

32. Which one of the following statements is true regarding titrations?

(1) In an acid base titration, the acid should always be placed in the burette.
(2) The burette should always be filled up to the zero mark at the beginning of a titration.
(3) The solution remaining at the pipette tip after delivering, should be very carefully blown i titration flask.
(4) Some titrations do not require an indicator to be added to detect the end-point.
(5) For the calculation, the average of the two burette readings at the end point should be taken two readings are widely different to each other.

2000 AL

9. How many moles of hydrogen atoms are present in 0·10 kg of a solution of ethanol in water containing 10% by mass of ethanol (C_2H_5OH)? (relative atomic masses : H = 1; C = 12; O = 16)
(1) 1·3 (2) 10·0 (3) 11·3 (4) 5·2 (5) 5·7

10. Calculate the mass of $Ca_3(PO_4)_2$ required to produce 100 g of $Ca(H_2PO_4)_2$ according to the equation
$$Ca_3(PO_4)_2 + 4H_3PO_4 \rightarrow 3Ca(H_2PO_4)_2$$
(relative atomic masses : H = 1; O = 16; P = 31; Ca = 40)
(1) 22 g. (2) 44 g. (3) 75 g. (4) 132 g. (5) 226 g.

11. 100·0 cm^3 of a 0·050 mol dm^{-3} NaOH solution and 50·0 cm^3 of a 0·020 mol dm^{-3} H_2SO_4 solution were mixed and the total volume of the mixture made up to 250·0 cm^3 with distilled water. The concentration of OH ions in the resultant solution is
(1) 0·012 mol dm^{-3} (2) 0·016 mol dm^{-3} (3) 0·020 mol dm^{-3}
(4) 0·120 mol dm^{-3} (5) 0·012 mol cm^{-3}

12. An HCl solution contains 36·5% by mass of HCl. The density of the solution is 1·15 g cm^{-3}. What is the concentration of HCl in the solution, in units of mol dm^{-3}?
(relative atomic masses : H = 1; Cl = 35·5)
(1) 0·869 (2) 1·15 (3) 11·5 (4) 115 (5) 8·69

22. In the titration of 25·0 cm^3 portions of NaOH solution with HCl solution, which of the following activities is the most essential?
(1) Washing the pipette out with HCl solution.
(2) Washing the titration flask with NaOH solution.
(3) Measuring the temperatures of the titrating solutions.
(4) Filling the burette up to the zero mark with HCl solution.
(5) Rinsing the inside of the burette with the HCl solution.

38. Which of the following statement/ statements pertaining to the composition ot a solution prepared by dissolving 18 g of glucose in 180 g of water at 277 K is/are true? (molar masses of glucose and water are 180 and 18 g mol^{-1}, respectively; Density of water at 277 K is 1·0 g cm^{-3}.)
(*a*) The concentration of glucose in the solution is 0·55 mol dm^{-3}.
(*b*) The mass fraction of glucose in the solution is 0·10.
(*c*) The molality of glucose in the solution is 0·10 mol kg^{-1}.
(*d*) The mole fraction of glucose in the solution is $\frac{1}{101}$

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General Certificate Of Education (Adv. Level) Examination, August 2023

රසායන විද්‍යාව I Chemistry I	02	S/E	I

Universal gas constant $R = 8.314\ J\ K^{-1}\ mol^{-1}$ Plank's constant $h = 6.626\times10^{-34} J\ s$

Avogadro constant $N_A = 6.022\times10^{23}\ mol^{-1}$ Velocity of light $c = 3\times10^{8} m\ s^{-1}$

CHEMICAL CALCULATIONS

Term Test Challenge 02 (Essay) -2023 A/L

❖ **Answer all the Questions.**

1. More concentrated $Na_2C_2O_4$ solution was prepared by dissolving 1.34 g of $Na_2C_2O_{4(S)}$ in 100 cm^3 of 0.5 mol dm^{-3} $Na_2C_2O_4$ solution, without a volume change in the solution. If 25 cm^3 of this solution was separated and diluted up to 500. 0 cm^3 using distilled water, calculate the concentration of the final solution.

2. Conc. HCl solution contains 36.5 % HCl by mass. Density of this solution is 1.16 g cm^{-3}. What volume of this solution required to prepare 500.0 cm^3 of 0.2 mol dm^{-3} HCl solution ?

3. Concentration of a certain Na_2SO_4 solution is 0. 005 mol dm^{-3}. If the density of this solution is 1.12 g cm^{-3}, calculate its SO_4^{2-} concentration in p.p.m. .
(Density of pure water is 1.0 g cm^{-3})

4. 20 g of lime stone was dissolved completely in 100.0 cm^3 of 2. 0 mol dm^{-3} HCl solution and the solution obtained was diluted up to 250.0 cm^3, using distilled water. To react with 25.0 cm^3 of this solution, 20.0 cm^3 of 0. 2 mol dm^{-3} HCl solution was reqüired. Calculate the percentage of $CaCO_3$ in lime stone.
(Ca = 40, C = 12, O = 16)

5. (a) Label of a commercial HCl acid bottle consists with following data.

Density ,
$d = 1.12 g\ cm^{-3}$
w/w = 25%
$M = 36.5\ g\ mol^{-1}$

What is the volume of this acid to be taken to prepare $500cm^3$ of 0.2 $moldm^{-3}$ HCl solution.

(b) 0.21g of bivalent metal M is subjected to react completely with $100cm^3$ of 0.25 mol dm^{-3} H_2SO_4 acid which is in excess. 32.5 cm^3 of 1 $moldm^{-3}$ NaOH is used for the neutralization of the excess acid. Find the relative atomic mass of M.

(N.B. During the reaction only metal sulphate and Hydrogen are formed as the products.)

6. 25.0 cm^3 of a 0.2 mol dm^{-3} $BaCl_2$ solution is mixed 25.0 cm^3 of a 0.3 mol dm^{-3} Na_3PO_4 solution. Here white precipitate was formed.

(i) Write the balanced chemical equation for the reaction taking place here.
(ii) Through a calculation identify the limiting reactant.
(iii) Calculation the concentration of Na^+ ions in the solution after the reaction.
(iv) Calculate the mass of precipitate formed.

7. Density of a NaOH solution is 2 g cm^{-3}. Mole fraction of NaOH in this solution is 1/6. Calculate following things.

I. Percentage of NaOH by mass
II. Molarity of NaOH

8. i) The density and purity percentage of a H_2SO_4 acid solution provided to school is 1.84 g cm^{-3} and 98% (w/w) respectively. Calculate the concentration of this H_2SO_4 acid solution in mol dm^{-3}. (H = 1, S = 32, O = 16)

ii) Explain how you would prepare 500 cm^3 of a 0.1 mol dm^{-3}, H_2SO_4 acid solution using the acid solution provided in (1) above.

iii) 25.00 cm^3 of a NaOH solution with unknown concentration is reacted with H_2SO_4 solution prepared in above (ii). If 12.5 cm^3 of H_2SO_4 acid solution was consumed,

I. Calculate concentration of NaOH solution in mol dm^{-3}.
II. If the density of NaOH solution is 1 g cm^{-3}, indicate composition of NaOH in ppm.

9.

(i) The lable of concentrated acid bottle supplied to the lab has following details.

Concentrated suplhuric acid
$H_2SO_4 = 98.0\ gmol^{-1}$
$w / w = 96\%$
$density = 1.84 gcm^{-3}$

Calculate the concentration of the acid in bottle.

(ii) Calculate the volume of the concentrated acid that should be taken to prepaire $500cm^3$ of $0.5mol\ dm^{-3}$ H_2SO_4 solution.

(iii) What is the volume of $0.2moldm^{-3}$ NaOH necessary to neutralize $25.00cm^3$ of above solution prepared in (ii)

10.

$50.0cm^3$ from 1 mol dm^{-3} aqueous nitrate solutions of magnesium, aluminum and lithium are mixed to prepare a homogeneous solution.
(N = 14, Mg = 24, Al = 27, Li = 9)

(i) Calculate the amount of Al^{3+} ions contained in the solution.
(ii) Calculate the anion concentration of the above solution in ppm. (1 ppm = 1 mg dm^{-3})
(iii) When excess Na_2CO_3 aqueous solution is added to the above mixed solution, If carbonates of each cation precipitate. Find the molar ratio between $Al_2(CO_3)_3$ and Li_2CO_3 that formed.

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රසායන විද්‍යාව I Chemistry I	02	S/E	I

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Avogadro constant $N_A = 6.022\times10^{23}\ mol^{-1}$ Velocity of light $c = 3\times10^{8}\ m\ s^{-1}$

Chemical Calculations – Spot Test 02

CONCENTRATION

01. A solution has been prepared by mixing 250 cm^3 of a Na_2SO_4 solution of concentration 0.150 mol dm^{-3} and 750 cm^3 of a NaCl solution of concentration 0.100 mol dm^{-3}. The concentration of this solution in terms of Na^+ is, (O = 16, Na = 23, S = 32, Cl = 35.5)

02. An aqueous solution of $Ca(NO_3)_2$ contains 20 mg of Ca^{2+} ions in 0.500 dm^3. The concentration of NO_3^- in the solution (in mol dm^{-3}) is, (Ca = 40)

(1) 5.0×10^{-4} (2) 1.0×10^{-3} (3) 2.0×10^{-3} (4) 4.0×10^{-3} (5) 1.0×10^{-2}

03. **A solution of Na_2SO_4 has been prepared by dissolving 142 mg of pure Na_2SO_4 in water, in a 500 cm^3 volumetric flask and by diluting up to the mark. The Na^+ ion content in mg dm^{-3} units in this solution is, (O = 16.0, Na = 23.0, S = 32.0)**

(1) 2.00×10^{-3} (2) 4.00×10^{-3} (3) 46 (4) 92 (5) 184

04. The mass percentage of $Na_2S_2O_3.5H_2O$ in an aqueous solution is 20%. The density of this solution at room temperature is 1.24 g cm^{-3}. The molarity of $Na_2S_2O_3$ in this solution is, (H = 1.0, O = 16.0, Na = 23.0, S = 32.0)

(1) 1.0 (2) 1.0×10^{-3} (3) 0.050 (4) 1.6 (5) 0.10

05. 1·0 dm^3 of 0·2 mol dm^{-3} H_2SO_4 and 1·0 dm^3 of 0·2 mol dm^{-3} HCl were mixed to obtain 2·0 dm^3 of solution. The H^+ ion concentration of the resulting solution, if H_2SO_4 is fully dissociated under these conditions, is

(1) 0·1 mol dm^{-3}. (2) 0·15 mol dm^{-3}. (3) 0·2 mol dm^{-3}.
(4) 0·3 mol dm^{-3}. (5) 0·4 mol dm^{-3}.

06. 1·92 g of the hydrocarbon C_9H_{20} gave on complete combustion, 5·94 g of $CO_2(g)$ and 2·70 g of water vapour. The mass of oxygen reacted is (H = 1, C = 12, O = 16)

(1) 6·72 g (2) 4·02 g (3) 3·86 g (4) 8·64 g (5) 3·24 g

07. What volume (in cm^3) of dilute HNO_3 solution of density 1.10 g cm^{-3} and 20% HNO_3 by mass contains 10 g of HNO_3?

(1) 6 (2) 15 (3) 23 (4) 45 (5) 55

08. Crystalline sodium carbonate has the formula $Na_2CO_3.10H_2O$. What is the mass of anhydrous sodium carbonate required to make up 2·5 litres of 4·0 mol dm^{-3} solution? (H = 1; C = 12; O = 16; Na = 23)

(1) 106 g (2) 286 g (3) 530 g (4) 1060 g (5) 2860 g

09. 0·6 mole of zinc nitrate and 0·6 mole of iron (III) sulphate are dissolved in water to give a solution with a total volume of 2 dm^3. Which one of the following has a concentration of 0·3 mol dm^{-3}?

(1) sulphate ions (2) negatively charged ions
(3) positively charged ions (4) zinc ions
(5) nitrate ions

10. The number of moles of ions present in a solution made by mixing 125 cm^3 of 0·2 mol dm^{-3} NaOH and 125 cm^3 of 0·1 mol dm^{-3} H_2SO_4 is

(1) 0·0375 (2) 0·0625 (3) 0·0875
(4) 0·15 (5) 0·30

11. 100·0 cm^3 of a 0·050 mol dm^{-3} NaOH solution and 50·0 cm^3 of a 0·020 mol dm^{-3} H_2SO_4 solution were mixed and the total volume of the mixture made up to 250·0 cm^3 with distilled water. The concentration of OH ions in the resultant solution is

(1) 0·012 mol dm^{-3} (2) 0·016 mol dm^{-3} (3) 0·020 mol dm^{-3}
(4) 0·120 mol dm^{-3} (5) 0·012 mol cm^{-3}

12. An HCl solution contains 36·5% by mass of HCl. The density of the solution is 1·15 g cm^{-3}. What is the concentration of HCl in the solution, in units of mol dm^{-3}?
(relative atomic masses : H = 1; Cl = 35·5)

(1) 0·869 (2) 1·15 (3) 11·5 (4) 115 (5) 8·69

13. The density of an 18.0% (by mass) solution of $(NH_4)_2SO_4$ is 1.10 g cm^{-3}. The molarity of this $(NH_4)_2SO_4$ solution is (H = 1, N = 14, O = 16, S = 32)

(1) 1.4 M (2) 1.5 M (3) 1.7 M (4) 2.0 M (5) 2.1 M

14. The molarity (mol dm^{-3}) of a NaI solution which has a density of 1.03 g cm^{-3} and is 3% NaI by mass is,
(Na = 23, I = 127)

(1) 0.21 (2) 0.23 (3) 0.25 (4) 0.28 (5) 0.30

15. $TiCl_4(g)$ reacts with liquid magnesium metal ($Mg(l)$) to give Ti(s) metal and $MgCl_2(l)$ at high temperature. When 0.95 kg of $TiCl_4(g)$ is made to react with 97.2 g of $Mg(l)$, the reactant that is completely consumed (this is commonly referred to as limiting reactant) and the amount of Ti(s) metal formed respectively are, (Molar mass: $TiCl_4 = 190\ g\ mol^{-1}$; $Mg = 24.3\ g\ mol^{-1}$; $Ti = 48\ g\ mol^{-1}$)

(1) $TiCl_4$ and 96 g (2) Mg and 96 g (3) Mg and 48 g
(4) $TiCl_4$ and 192 g (5) Mg and 192 g

16. Which of the following statement/ statements pertaining to the composition ot a solution prepared by dissolving 18 g of glucose in 180 g of water at 277 K is/are true? (molar masses of glucose and water are 180 and 18 g mol^{-1}, respectively; Density of water at 277 K is 1·0 g cm^{-3}.)

(*a*) The concentration of glucose in the solution is 0·55 mol dm^{-3}.
(*b*) The mass fraction of glucose in the solution is 0·10.
(*c*) The molality of glucose in the solution is 0·10 mol kg^{-1}.
(*d*) The mole fraction of glucose in the solution is $\frac{1}{101}$

17. Density of 1moldm^{-3} solution of a compound A having the molecular mass of 58 is 0.858 gcm^{-3} What is the molality of the solution in mol kg^{-1} .

1) 0.125 2) 1.25 3) 12.5 4) 0.625 5) 6.25

18. The molefraction of ethanol (CH_3CH_2OH) which contains 54% of water by mass in the solution is (C =12 , O =16 , H=1)

1) 1/3 2) 1/4 3) 3/4 4) 2/3 5) 1/5

19. The dry mass of the precipitate formed when 200 cm^3 of 0.2 mol dm^{-3} $Ba(NO_3)_2$ is mixed with 300 cm^3 of 1 mol dm^3 K_2CrO_4 is, (N - 14 O - 16 K - 39 Cr - 52 Ba - 137)

(1) 0.04 g (2) 10.15 g (3) 75.9 g (4) 101.5 g (5) 253.0 g

20. 100 cm^3 of the solution is prepared by dissolving 11.2 g of a mixture containing KCl and KOH. Then 10.00 cm^3 of this solution is separated and 20.00 cm^3 of 0.10 mol dm^{-3} HCl solution is added this solution. All the KOH in the solution reacts with added HCl. Chloride concentrations in the final solution and the initial solution are respectively, (in mol dm^{-3})

(1) 1.45, 0.50 (2) 0.50, 1.35 (3) 1.35, 0.50 (4) 0.50, 1.45 (5) 0.50, 0.50

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General Certificate Of Education (Adv. Level) Examination, August 2023

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Avogadro constant $N_A = 6.022\times10^{23}\ mol^{-1}$ Velocity of light $c = 3\times10^{8} m\ s^{-1}$

Term Test Challenge -2023 A/L

❖ **Answer all the Questions.**

1. Mass percentage of NaOH in an aqueous solution of NaOH is 15.0%. Density of the solution is 1.2 gcm^{-3} Calculate the volume of the solution which contains 5 mol of NaOH.

(Na - 23, O - 16, H - 1)

1) 0.01 dm^3 2) 0.11 dm^3 3) 1.0 dm^3 4) 1.11 dm^3 5) 1.25 dm^3

2. What is the percentage of crystalline water in $Na_2CO_3.10H_2O$ by mass?

(Na – 23, C – 12, O – 16, H – 1)

1) 52.7% 2) 58.6% 3) 62.9% 4) 63.2% 5) 65.4%

3. The density of a 0.1 mol dm^{-3} $NaNO_3$ solution is 1.7 g cm^{-3}. Its concentration expressed in ppm is,

(Na – 23, N – 14, O – 16)

1) 8500 ppm 2) 5000 ppm 3) 1700 ppm 4) 850 ppm 5) 170 ppm

4. A closed vessel contains 3 mol of H_2 (g) and 2 mol of Cl_2 (g). In the presence of diffused sunlight all Cl_2 (g) reacts to form HCl (g).

$$H_2(g) + Cl_2(g) \longrightarrow 2HCl(g)$$

Find the mole fraction of H_2 (g) in the vessel at the end of the reaction.

1) 0.1 2) 0.2 3) 0.25 4) 0.33 5) 0.5

5. 0.0585g of solid NaCl was dissolved in 250cm^3 of 0.01 mol dm^{-3} aqueous solution of $CuCl_2$. Cl^- ion content in the solution in ppm is, (Na = 23 , Cl = 35.5)

(1) 844 (2) 848 (3) 850 (4) 852 (5) 855

6. A sample contains NH_4Cl and an inert compound. 6 g of the sample was reacted with excess NaOH.

($NH_4Cl + NaOH \longrightarrow NaCl + NH_3 + H_2O$)

All NH_3 evolved during the above reaction was allowed to react with 0.1 mol dm^{-3} HCl. The volume of HCl required for this purpose was 20.00 cm^3 . Find the mass percentage of NH_4Cl in the sample.
(N – 14, H – 1, Cl – 35.5)

1) 10.7% 2) 21.4% 3) 42.8% 4) 53.5% 5) 78.5%

7. Mass of 1 dm^3 of marine water sample is 1.03 kg. It contains 5.15 x 10^{-3} g of dissolved oxygen. What is the content of oxygen in marine water in ppm ?

(1) 0. 0625 ppm (2) 0. 157 ppm (3) 2 ppm (4) 5 ppm (5) 80 ppm

8. Lysine is an amino acid found in plant tissues. It contains 49.3 % carbon by mass. If the relative molecular mass of lysine is 146, how many carbon atoms are there in each molecule of lysine ?

(1) 2(2) 3 (3) 4 (4) 6 (5) 6

9. The composition of Cr^{3+} in an aqueous solution of $Cr_2(SO_4)_3$ solution is 1040 ppm. If the SO_4^{2-} ion concentration in this solution is 0.036 mol dm^{-3}. What is the density of the above aqueous solution?
(Cr = 52, S = 32, O = 16)

(1) 0.012 g cm^{-3} (2) 0.024 g cm^{-3} (3) 0.06 g cm^{-3}
(4) 0.12 g cm^{-3} (5) 1.04 g cm^{-3}

10. Concentration of a $(NH_4)_2SO_4$ solution with density 1.5 gcm^{-3} is 2640 ppm. Concentration of NH_4^+ in moldm^{-3} is, (N – 14 , S – 32 , O – 16 , H - 1)

1) 0.011 moldm^{-3} 2) 0.02 moldm^{-3} 3) 0.003 moldm^{-3} 4) 0.004 moldm^{-3} 5) 0.06 moldm^{-3}

11. The molar fraction of NaCℓ in an aqueous solution of NaCℓ is 0.125. The mass percentage of NaCℓ is
[Na = 23, Cℓ = 35.5, H = 1, O = 16]

(1) 12.5% (2) 32% (3) 67% (4) 87.5% (5) 90%

12. An atom emits blue light rays having a wavelength of 460 nm. The frequency and the energy per mole of photon is.

(1) $6.50 \times 10^{14}\ s^{-1}$, 260 kJ mol^{-1}
(2) $6.50 \times 10^{14}\ s^{-1}$, 4.30×10^{-19} kJ mol^{-1}
(3) $6.50\ s^{-1}$, 4.31 kJ
(4) $6.50\ s^{-1}$, 260 kJ mol^{-1}
(5) None of above.

13. $NH_3(g)$ released from 0.20 g of a compound was completely reacted with 5.00 cm^3 of 0.05 mol dm^{-3} H_2SO_4. The percentage of N in the compound is, (N=14)

$$2NH_3(g) + H_2SO_4(aq) \longrightarrow (NH_4)_2SO_4(aq)$$

(1) $\frac{0.05}{1000} \times 5 \times 2\%$
(2) $\frac{0.05}{1000} \times 5 \times 2 \times 14\%$
(3) $\frac{0.05}{1000} \times \frac{5 \times 2 \times 14}{\times 0.2} \times 100\%$
(4) $\frac{0.05}{1000} \times \frac{\times 5 \times 17}{\times 0.2} \times 100\%$
(5) $\frac{0.05}{1000} \times 5 \times 2 \times 17 \times 100\%$

14. 100 cm^3 of 0.1 $moldm^{-3}$ $Mg(NO_3)_2$, 200 cm^3 of 0.2 $moldm^{-3}$ $Mg(NO_3)_2$ and 300 cm^3 of 0.3 $moldm^{-3}$ $Mg(NO_3)_2$ are mixed together. If there is no volume changed, the NO_3^- ion concentration in the mixture is,

(1) 0.2 $moldm^{-3}$
(2) 0.1 $moldm^{-3}$
(3) 0.46 $moldm^{-3}$
(4) 0.14 $moldm^{-3}$
(5) 2.8 $moldm^{-3}$

15. 200 cm^3 of Na_2SO_4 solution was mixed with water to get 500 cm^3 of an aqueous solution. If the concentration of Na_2SO_4 in the new solution was 0.1 $moldm^{-3}$, what was the concentration of Na^+ ions in the initial solution ?

(1) 0.1 $moldm^{-3}$
(2) 0.5 $moldm^{-3}$
(3) 0.2 $moldm^{-3}$
(4) 0.4 $moldm^{-3}$
(5) 1 $moldm^{-3}$

16. 34.8 g of pure K_2SO_4 and 14.9g of pure KCl are dissolved in water to prepare 500 cm^3 solution. In this solution, $K^+_{(aq)}$ ion composition in ppm is, (K = 39 , S = 32 , O = 16 , Cl = 35.5)

(1) 47.6×10^3
(2) 48.4×10^3
(3) 36.8×10^3
(4) 43.8×10^3
(5) 4.2×10^3

17. V cm^3 of 2 $moldm^{-3}$ HCl is mixed with V cm^3 of 3 $moldm^{-3}$ HCl solution. the concentration of HCl in the resultant solution that obtained as the mixture is,

(1) 2.25 $moldm^{-3}$
(2) 2.75 $moldm^{-3}$
(3) 2.5 $moldm^{-3}$
(4) 2.15 $moldm^{-3}$
(5) 2.05 $moldm^{-3}$

18. Following information are given in the label of a commercial bottle of acid.
W/W – 92%
Density (d) - 1.25 g ml^{-1}
Molar mass - 92 g mol^{-1}
What is the volume of this acid that should be used to prepare 500 cm^3 of 2.5 mol dm^{-3}.
1) 25 cm^3 2) 50 cm^3 3) 100 cm^3 4) 125 cm^3 5) 200 ml

19. When a gaseous state Hydrocarbon gives $0.72\ g$ watervapour and $3.08\ g$ carbondioxide on combustion then what is the molecular formala of hydrocarbon
$(C - 12,\quad H - 1,\quad O - 16)$
(1) C_7H_8 (2) C_7H_4 (3) C_6H_6 (4) C_3H_4 (5) C_6H_5

20. A HCl solution contain 36.5% HCl by mass. The density of this solution is $1.15\ g\ cm^{-3}$ Then calculate the molarity of HCl $(H - 1, Cl - 35.5)$
(1) $0.869\ mol\ dm^{-3}$
(2) $1.15\ mol\ dm^{-3}$
(3) $11.5\ mol\ dm^{-3}$
(4) $115\ mol\ dm^{-3}$
(5) $8.69\ mol\ dm^{-3}$

21. In a mixture containing ethanol and water the mole fraction of ethanol is 0.5. Then what can be the mass percentage of ethanol in this solution
$(Methanol - 46,\ MH_2O - 18)$
(1) 10 %
(2) 25 %
(3) 50 %
(4) 70 %
(5) 90 %

22. $26.8\ mg\ of\ Na_2SO_4.7H_2O$ was dissolved in 5 dm^3 of water and made as a solution. Correct statement regarding this solution.
(a) The concentration of Na^+ in the solution is $0.92\ mg\ /\ dm^3$
(b) The concentration of SO_4^{2-} in the solution is $0.02\ mmol\ /\ dm^3$
(c) In the solution $2[Na^+_{(aq)}] = [SO^{2-}_{4(aq)}]$
(d) In this solution the concentration of Na_2SO_4 is $26.8g/dm^3$

23. When 10g of pure $CaCO_3$ was subjected to heat decomposition 50% of initial mass was decomposed. What is the mass of residue that obtained after the evolution of CO_2 gas?

(1) .5 g (2) 7.8 g (3) 2.08 g (4) 2.8 g (5) 0.5 g

24. What is the composition of Na^+ ions in ppm, when a solution is prepared by mixing 250 cm^3 of 0.1 $moldm^{-3}$ Na_2CO_3 and 750 cm^3 of 0.15 $moldm^{-3}$ NaCl?

(O=16, C–12, Na–23, Cl–35.5)

(1) 162.5
(2) 3737.5
(3) 37.996
(4) 3162.5
(5) 16.25

25. Total mass of a mixture of gases is 6.4 g. From this 0.3 mol is methane and the rest is oxygen. What is the mole fraction of oxygen?

(C-12, H-1, O-16)

(1) 0.35 (2) 0.014 (3) 0.035 (4) 0.05 (5) 0.14

26. To a solution prepared by mixing 50 ml of 0.1 $moldm^{-3}$ Na_2SO_4 solution with 25 ml of 0.2 $moldm^3$ Na_3PO_4 solution , 1.43g of Na_2CO_3 .10 H_2O was added and was completely dissolved in the solution. The concentration of Na^+ ions in the resulting solution in ppm is , (1 ppm = $1mgdm^{-3}$)
(Na = 23 , C = 12 , O = 16)

1) 400 2) 4600 3) 9200 4) 10733 5) 11500

27. Urea reacts with NaOH as given below.

$$2NaOH + NH_2CONH_2 \longrightarrow Na_2CO_3 + 2NH_3$$

After reacting 1.2 g of urea was completely reacted with 50.0 cm^3 of 1.0 mol dm^{-3} NaOH. The solution was then heated to remove all NH_3. The volume of 1.0 mol dm^{-3} of HCl required to neutralize the resulting solution is, (C = 12, N = 14, H = 1, O = 16)

1) 12.5 cm^3 2) 25 cm^3 3) 40 cm^3 4) 50 cm^3 5) 100 cm^3

28. Density and the purity of Conc H_3PO_4 acid solution are 1.2 g cm^{-3} and 98% respectively. What is the volume of this acid solution required to prepair 250cm^3 of 3 mol dm^{-3} H_3PO_4 acid
(H = 1, P = 32, O = 16)

1) 195.5 cm^3 2) 119.5 cm^3 3) 92.5 cm^3 4) 62.5 cm^3 5) 31.5 cm^3

29. If a pure solid sample of $NaHCO_3$ is heated till it gives a constant mass, what could be the percentage of its mass loss ?

(1) 26.19 (2) 36.91 (3) 47.62 (4) 52.38 (5) 72.68

30. If 0. 002 mol of oxygen gas is dissolved in 1.0 kg sample of pond water, what is its dissolved oxygen content in ppm ? (O = 16)

(1) 0.0625 ppm (2) 2 ppm (3) 6.25 ppm (4) 32 ppm (5) 64 ppm

********** **Term Test Spot light** **********

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අධ්‍යයන පොදු සහතික පත්‍ර (උසස් පෙළ), 2023 අගෝස්තු

General Certificate Of Education (Adv. Level) Examination, August 2023

රසායන විද්‍යාව I Chemistry I	02	S/E	I

Universal gas constant $R = 8.314\ J\ K^{-1}\ mol^{-1}$ Plank's constant $h = 6.626\times10^{-34}\ J\ s$

Avogadro constant $N_A = 6.022\times10^{23}\ mol^{-1}$ Velocity of light $c = 3\times10^{8}\ m\ s^{-1}$

Colombo School Term Test Questions Discussion-Unit 03

Introduction to paper class - 10

❖ **Answer all the Questions.**

1. Mass percentage of NaOH in an aqueous solution of NaOH is 15.0%. Density of the solution is 1.2 gcm^{-3} Calculate the volume of the solution which contains 5 mol of NaOH.

(Na - 23, O - 16, H - 1)

1) 0.01 dm^3 2) 0.11 dm^3 3) 1.0 dm^3 4) 1.11 dm^3 5) 1.25 dm^3

2. The composition of Cr^{3+} in an aqueous solution of $Cr_2(SO_4)_3$ solution is 1040 ppm. If the SO_4^{2-} ion concentration in this solution is 0.036 mol dm^{-3}. What is the density of the above aqueous solution?

(Cr = 52, S = 32, O = 16)

(1) 0.012 g cm^{-3} (2) 0.024 g cm^{-3} (3) 0.06 g cm^{-3}

(4) 0.12 g cm^{-3} (5) 1.04 g cm^{-3}

3. When 1.0 g of a sample containing sulphur was completely burnt, the resultant only gaseous product SO_2 was completely absorbed by passing through 500.0 cm^3 of 0.1 mol dm^{-3} NaOH solution. To neutralize the remaining NaOH in the solution, 24.0 cm^3 of 0.1 mol dm^{-3} $HCl_{(aq)}$ was required. The percentage of sulphur in the initial sample is, (S = 32)

(1) 1.5 % (2) 2.24 % (3) 3.25 % (4) 4.16 % (5) 8.32 %

4. In the acidic medium, if sulphite ions are converted into sulphate ions by aqueous $KMnO_4$, how many moles of $KMnO_4$ is required for the complete reaction with 0.5 mol of sulphite ions ?

(1) 1/5 (2) 2/5 (3) 4/5 (4) 5/2 (5) 5/4

5. In a reaction, 1 mol of N_2H_4 is converted into 1 mol of the compound X by releasing 10 mol of electrons. If one molecule of the compound X contain only one atom of nitrogen, the oxidation state of N in the compound X could be,

(1) − 3 (2) + 3 (3) − 1 (4) + 5 (5) − 5

6. Which of the following reaction is a REDOX reaction ?

(1) $Cr_2O_3 + 6\,HCl \longrightarrow 2\,CrCl_3 + 3\,H_2O$

(2) $CrO_3 + 2\,NaOH \longrightarrow Na_2CrO_4 + H_2O$

(3) $2\,CrO_4^{2-} + H^+ \rightleftharpoons Cr_2O_7^{2-} + OH^-$

(4) $Cr_2O_7^{2-} + 6\,I^- + 14\,H^+ \rightleftharpoons 2\,Cr^{3+} + 3\,I_2 + H_2O$

(5) $NaOH + HCl \longrightarrow NaCl + H_2O$

7. In which of the following reaction/s disproportination takes place ?

(a) $2\,NaHCO_3 \longrightarrow Na_2CO_3 + CO_2 + H_2O$

(b) $2\,H_2O_2 \longrightarrow 2\,H_2O + O_2$

(c) $2\,NO_2 + H_2O \longrightarrow HNO_3 + HNO_2$

(d) $2\,Na + 2\,H_2O \longrightarrow 2\,NaOH + H_2$

8. In a mixture of gases containing only two gases X and Y mass fraction of Y is equal to 2/7. The relative atomic mass of X is five times the relative atomic mass of Y. The mole fraction of X will be?

1) 5/7 2) 2/3 3) 1/3 4) 1/5 5) 4/5

9. A solution was prepared using 108.0 g of water and 92.0 g of a certain alcohol. If the mole fraction of water in the solution is 0.75 , what could be the relative molecular mass of the alcohol ?
(H = 1, O = 16)

(1) 11.5 (2) 23 (3) 46 (4) 85.2 (5) 102

10. 24.4 mg of hydrated Barium chloride ($BaCl_2 .2H_2O$) was dissolved in water and diluted upto 500ml. What is the content of Ba^{2+} in ppm in the solution?
(Ba = 137 , Cl = 35.5 , H = 1 , O = 16)

1) 2.74 2) 0.274 3) 2×10^{-4} 4) 0.0274 5) 27.4

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අධ්‍යයන පොදු සහතික පත්‍ර (උසස් පෙළ), 2023 අගෝස්තු
General Certificate Of Education (Adv. Level) Examination, August 2023

රසායන විද්‍යාව I Chemistry I	02	S/E	I

Universal gas constant $R = 8.314\ J\ K^{-1}\ mol^{-1}$ Plank's constant $h = 6.626\times10^{-34} J\ s$

Avogadro constant $N_A = 6.022\times10^{23}\ mol^{-1}$ Velocity of light $c = 3\times10^{8} m\ s^{-1}$

Introduction to Paper Class 05 -2023 A/L

1. Which one of the following is an oxidation-reduction reaction?

(1) $2CrO_4^{2-} + 2H^+ \rightarrow Cr_2O_7^{2-} + H_2O$
(2) $CaCO_3 \rightarrow CaO + CO_2$
(3) $N_2O \rightarrow 2NO_2$
(4) $Ca(COO)_2 \rightarrow CaCO_3 + CO$
(5) $CO_2 + H_2O \rightarrow H_2CO_3$

2. In the reaction between $Cr_2O_7^{2-}$ and H_2O_2 in an acidic medium, H_2O_2 is **oxidised** to O_2 and $Cr_2O_7^{2-}$ is converted to Cr^{3+} The correct equation for this reaction is

(1) $Cr_2O_7^{2-} + 8H^+ + H_2O_2 \longrightarrow 2Cr^{3+} + 5H_2O + O_2$
(2) $Cr_2O_7^{2-} + 8H^+ + 3H_2O_2 \longrightarrow 2Cr^{3+} + 7H_2O + 3O_2$
(3) $Cr_2O_7^{2-} + 8H^+ + 5H_2O_2 \longrightarrow 2Cr^{3+} + 9H_2O + 5O_2$
(4) $Cr_2O_7^{2-} + 8H^+ + 7H_2O_2 \longrightarrow 2Cr^{3+} + 11H_2O\ 7O_2$
(5) $Cr_2O_7^{2-} + 8H^+ + 9H_2O_2 \longrightarrow 2Cr^{3+} + 13H_2O + 9O_2$

3. Acidified MnO_4 reacts with H_2O_2 producing O_2, Mn^{2+} and H_2O only. The number of moles of MnO_4^- required for the complete reaction of one mole of H_2O_2 in an acidified medium is

(1) 0·4 (2) 0·8 (3) 2·0
(4) 2·5 (5) 5·0

4. The number of moles of $KMnO_4$ that is required to react completely with 1 mole of iron(II) oxalate (FeC_2O_4) in acidic medium is

(1) 5 (2) 3 (3) $\frac{5}{3}$ (4) $\frac{3}{5}$ (5) $\frac{1}{5}$

5. Which of the following conversions is/are neither an oxidation nor a reduction?

(a) $N_2O_3 \longrightarrow N_2O$ (b) $CrO_4^{2-} \longrightarrow Cr_2O_7^{2-}$
(c) $ClO^- \longrightarrow Cl^-$ (d) $SO_3 \longrightarrow SO_4^{2-}$

6. In the reaction,

$$2NO_2(g) + H_2O(l) \rightarrow HNO_3(aq) + HNO_2(aq)$$

(1) nitrogen undergoes oxidation only.
(2) nitrogen undergoes reduction only.
(3) nitrogen undergoes both oxidation and reduction.
(4) there is no change in the oxidation state of nitrogen.
(5) water acts both as an oxidising agent and as a reducing agent.

7. By treating industrial waste water with OCl^- in alkaline medium, cyanide ions in waste water are converted to N_2 and carbonate ions according to the following equation.

$$2\ CN^- + 5\ OCl^- + 2\ OH^- \longrightarrow 2\ CO_3^{2-} + N_2 + 5\ Cl^- + H_2O$$

Which of the following statement(s) is/are true regarding this reaction

(a) Oxidation number of oxygen in OCl^- is changed from 0 to –2
(b) Oxidation number of carbon is changed from +2 to +4
(c) Oxidation number of nitrogen is changed from –3 to 0
(d) Oxidation number of chlorine is changed from + 1 to –1

8. The total number of electrons exchanged in the reaction of the oxidation of ethanol (C_2H_5OH) to acetic acid (CH_3COOH) using acidic $K_2Cr_2O_7$ solution is,

(1) 6 (2) 8 (3) 10 (4) 12 (5) 14

9. One mole of N_2H_4 forms the compound Y by removing 10 moles of electrons. If all the "N" atoms in the initial compound are present in compound Y, what is the oxidation number of a "N" atom in Y?

(1) -3 (2) -2 (3) +1 (4) +3 (5) +5

10. Products of reaction between hydroxyl amine (NH_2OH) and Fe^{3+} are given below.

$$NH_2OH + Fe^{3+} \longrightarrow N_2O + Fe^{2+} + H^+ + H_2O$$

(i) Write oxidation half ionic equation.

.....

(ii) Write the reduction half ionic equation.

.....

(iii) Balance the above equation.

.....

********** **17.02.2022** **********

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Avogadro constant $N_A = 6.022\times10^{23}\ mol^{-1}$ Velocity of light $c = 3\times10^{8} m\ s^{-1}$

REDOX BALANCING – SPECIAL EXERCISE

- Calculate the oxidation number of the underlined atom in the follow given Molecules/ions.

1) $H_2\underline{O_2}$
2) $K\underline{O_2}$
3) $F_2\underline{O}$
4) $F_2\underline{O_2}$
5) $H_2\underline{S_2}O_3$
6) $\underline{Mn}O_4^{2-}$
7) $\underline{Mn}O_4$-
8) $\underline{Cr_2}O_7^{2-}$
9) $\underline{V}O^{2+}$
10) $\underline{V}O_2$+
11) $\underline{S}O_3$
12) $\underline{N_2}O_3$
13) $\underline{X}O_4^{3-}$
14) $K\underline{I}O_3$
15) $H\underline{C}HO$
16) $\underline{N}H_4^{+}$
17) $\underline{S_2}O_8^{2-}$
18) $NaO\underline{Cl}$
19) $\underline{N}H_2^{-}$
20) $\underline{O}_3$

- Obtain the **balanced half ionic equation** for follow given equations.

Acidic Medium

1) Fe^{2+} to Fe^{3+}
2) MnO_4^- to Mn^{2+}
3) $Cr_2O_7^{2-}$ to Cr^{3+}
4) $C_2O_4^{2-}$ to CO_2
5) SO_2 to SO_4^{2-}
6) NO_2^- to NO_3^-
7) $S_2O_3^{2-}$ to $S_4O_6^{2-}$
8) IO_3^- to I_2
9) OCl^- to Cl^-
10) H_2S to S
11) NH_3 to N_2
12) AsO_3^{3-} to AsO_4^{3-}
13) P_2O_3 to H_3PO_4
14) HNO_3 to NO_2
15) H_2O_2 to H_2O
16) H_2O_2 to O_2

Basic Medium

17) MnO_4^{2-} to MnO_2
18) Al to AlO_2^-
19) NO_3^- to NH_3
20) H_2O_2 to H_2O

- Obtain the **balanced ionic equation** for the following A) **By Using half ionic method**

  B) **By exchanging oxidation numbers**

1) MnO_4^- / Zn/ H^+
2) $Cr_2O_7^{2-}/C_2O_4^{2-}/H^+$
3) $H_2O_2/Cr_2O_7^{2-}/H^+$
4) $SO_2/H_2O_2/H^+$
5) $Fe^{3+}/I^-/H^+$
6) $MnO_4^-/H_2O_2/OH^-$
7) $C_2O_4^{2-}/H_2O_2/OH^-$
8) $Al/NO_3^-/OH^-$
9) $Cr^{3+}/H_2O_2/OH^-$
10) $Zn/NO_3^-/OH^-$

- Obtain the **Balanced Chemical equation** for the following A) **By Using half ionic method**

  B) **By exchanging oxidation numbers**

1) $KMnO_4/H_2O_2/H_2SO_4$
2) $K_2Cr_2O_7/SO_2/H_2SO_4$
3) $I_2/Na_2S_2O_3$
4) $FeC_2O_4/KMnO_4/H_2SO_4$
5) $Al/NaNO_3/NaOH$
6) $CrCl_3/H_2O_2/KOH$
7) $H_2S/KMnO_4/H_2SO_4$

********** **04.02.2022**********

Redox Calculations – MCQs

2019 AL

25. A 25.0 g sample of polluted air containing ozone (O_3) is treated with an acidic solution containing excess KI. Ozone is converted to O_2 and H_2O during this reaction. The iodine liberated is titrated with 0.002 mol dm^{-3} $Na_2S_2O_3$ solution. Volume of $Na_2S_2O_3$ required was 25.0 cm^3. The mass percent of O_3 in the air sample is, (O = 16)

(1) 4.8×10^{-3} (2) 6.4×10^{-3} (3) 9.6×10^{-3} (4) 1.0×10^{-2} (5) 3.2×10^{-2}

2019 Model

15. The volume of 0.01 mol dm^{-3} $K_2Cr_2O_7$ (cm^3) required to react completely with 25.00 cm^3 of 0.02 mol dm^{-3} of FeI_2 aqueous solution in acidic medium is,

(1) 8.33 (2) 10.00 (3) 16.67 (4) 20.00 (5) 25.00

2018 AL

4. The **correct** answer when the molecules O_2, H_2O, H_2O_2, OF_2 and O_2F_2 (structure similar to H_2O_2) are arranged in the **decreasing** order of the oxidation state of oxygen (O) is,

(1) $O_2F_2 > OF_2 > O_2 > H_2O > H_2O_2$
(2) $H_2O > H_2O_2 > O_2 > O_2F_2 > OF_2$
(3) $H_2O_2 > O_2F_2 > O_2 > OF_2 > H_2O$
(4) $OF_2 > O_2F_2 > O_2 > H_2O > H_2O_2$
(5) $OF_2 > O_2F_2 > O_2 > H_2O_2 > H_2O$

19. IO_3^- (iodate ion) oxidizes the SO_3^{2-} ion to SO_4^{2-} in acidic medium. The mass of KIO_3 required to totally oxidize the amount of Na_2SO_3 present in 25.0 cm^3 of a solution of Na_2SO_3 (0.50 mol dm^{-3}) to Na_2SO_4 is 1.07 g. (O = 16, K = 39, I = 127)

The final oxidation state of iodine after the completion of the reaction is,

(1) –1 (2) 0 (3) +1 (4) +2 (5) +3

2017 AL

19. Solid diiodine pentoxide (I_2O_5) reacts with carbon monoxide at room temperature to give carbon dioxide and iodine. This can be used to measure the amount of carbon monoxide in a sample of air. An air sample of 5.0 dm^3 was passed through a tube containing I_2O_5 and the liberated iodine was collected in an aqueous KI solution (KI in excess). The resulting solution was titrated with 0.005 mol dm^{-3} $Na_2S_2O_3$ solution using starch as the indicator. The volume of $Na_2S_2O_3$ required was 10.00 cm^3. The concentration (in ppm) of carbon monoxide in the air sample is, (C = 12, O = 16, density of the air sample = 1.40×10^{-3} g cm^{-3})

(1) 100 (2) 250 (3) 500 (4) 700 (5) 1000

2016 AL

6. A 0.60 g sample of KIO_3 was dissolved in water and excess KI was added to it. The minimum amount of 3.0 mol dm^{-3} HCl required to completely convert KIO_3 to I_3^- is, (O = 16, K = 39, I = 127)

(1) 1.0 cm^3 (2) 4.7 cm^3 (3) 5.6 cm^3 (4) 10.2 cm^3 (5) 33.6 cm^3

13. The following procedure was used to determine the sulphur content in a coal sample. A coal sample of mass 1.60 g was burned in oxygen gas. The SO_2 gas formed was collected in a solution of H_2O_2. This solution was then titrated with 0.10 mol dm^{-3} NaOH. The volume of NaOH required to reach the end point was 20.0 cm^3. The percentage of sulphur in the coal sample is (S = 32)

(1) 1.0 (2) 2.0 (3) 4.0 (4) 6.0 (5) 8.0

2015 AL

44.	The reaction of sulphur and NaOH is an example of a disproportionation reaction.	When an element is simultaneously oxidized and reduced, it is called disproportionation.

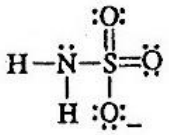
2013 AL

13. A 50.00 cm^3 sample of a solution containing Fe^{2+} is titrated with 0.02 M $K_2Cr_2O_7$ in acidic medium. The volume of $K_2Cr_2O_7$ required to react all the Fe^{2+} is 25.00 cm^3. If this titration is carried out using 0.02 M $KMnO_4$ instead of 0.02 M $K_2Cr_2O_7$, the volume of $KMnO_4$ required is

(1) 22.00 cm^3 (2) 23.00 cm^3 (3) 25.00 cm^3 (4) 27.00 cm^3 (5) 30.00 cm^3

2010 AL

31. The oxidation numbers of nitrogen and sulphur atoms in the following ion are respectively,



(1) –3 and +2 (2) –3 and +6 (3) –3 and +4 (4) +1 and +4 (5) +3 and +6

58.	A solution of $Na_2S_2O_3.5H_2O$ may be standardized using KIO_3 in the presence of dil. H_2SO_4 and excess KI.	KIO_3 reacts with KI in the presence of dil. H_2SO_4 to liberate iodine.
60.	When NaCl is heated with conc. H_2SO_4 in the presence of MnO_2, Cl_2 is produced.	MnO_2 is a stronger oxidizing agent than conc. H_2SO_4.

2009 AL

11. In which of the following groups of molecules/ions, nitrogen is in the oxidation states –3, 0, and +3 respectively?

(1) NH_4^+, N_2, NH_2^- (2) N_2O_3, N_2, NH_4^+ (3) N_2H_4, N_2, NCl_3

(4) NO_2, N_2, NO_2^+ (5) NH_4^+, N_2, N_2O_3

23. **Which of the following is the strongest reducing agent in the gas phase?**

(1) Al (2) Na (3) Zn (4) H_2 (5) F_2

48. Which of the following conversions is/are neither an oxidation nor a reduction?

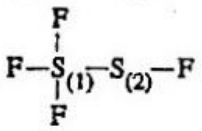
(*a*) $N_2O_3 \longrightarrow N_2O$ (*b*) $CrO_4^{2-} \longrightarrow Cr_2O_7^{2-}$

(*c*) $ClO^- \longrightarrow Cl^-$ (*d*) $SO_3 \longrightarrow SO_4^{2-}$

55.	An oxidation reaction and a reduction reaction always occur simultaneously.	All chemical reactions are disproportionation reactions.

2008 AL

6. The oxidation states of the $S_{(1)}$ and $S_{(2)}$ atoms in the following molecule are respectively,



(1) +1 and +3 (2) +4 and +2 (3) +3 and +1 (4) –3 and –1 (5) +2 and +2

10. Which of the following requires the highest number of moles to oxidize one mole of I^- ions?

(1) Cl_2 (2) K_2CrO_4 (3) $K_2Cr_2O_7$ (4) $FeCl_3$ (5) $KMnO_4$

2007 AL

3. Which of the following is not a reducing agent?

(1) Cu^+ (2) H^+ (3) Fe^{2+} (4) Cl^- (5) S^{2-}

2006 AL

53.	Fe_3O_4 can, not only be reduced to FeO, but can also be oxidised to Fe_2O_3.	Fe_3O_4 contains both Fe^{2+} and Fe^{3+}.

2005 AL

14. Which one of the following statements is not true regarding CrO_4^{2-} and $Cr_2O_7^{2-}$ ions?
    (1) Both contain Cr in its highest oxidation state.
    (2) Both oxidise I^- to I_2.
    (3) They are in equilibrium with each other in aqueous solution.
    (4) Both give precipitates with NH_4OH.
    (5) Both are reduced to Cr^{3+} by SO_2

34. Which one of the following is an oxidation-reduction reaction?
    (1) $2CrO_4^{2-} + 2H^+ \rightarrow Cr_2O_7^{2-} + H_2O$
    (2) $CaCO_3 \rightarrow CaO + CO_2$
    (3) $N_2O \rightarrow 2NO_2$
    (4) $Ca(COO)_2 \rightarrow CaCO_3 + CO$
    (5) $CO_2 + H_2O \rightarrow H_2CO_3$

48. Water from a tube well is clear as it is pumped out, but turns cloudy and brown on exposure to air for some time, due to the formation of $Fe(OH)_3$. Which of the following statements are most likely to be true in this situation?
    (*a*) $Fe(OH)_3$ dissolves in water under pressure but is deposited when the pressure is atmospheric.
    (*b*) Iron is present mainly as Fe^{2+} in the ground water feeding the well.
    (*c*) Conditions underground are reducing.
    (*d*) The solubility of $Fe(OH)_3$ is much less than that of $Fe(OH)_2$.

57.	$CuSO_4 \cdot 5H_2O$ becomes colourless on heating.	Cu^{2+} ion is reduced to Cu^+ ion on dehydration.

60.	In the fermentation of glucose ($C_6H_{12}O_6$) by yeast, some carbon atoms of the glucose molecule are oxidised while others are reduced.	The chemical products of fermentation of glucose are CO_2 and CH_3CH_2OH.

2004 AL

13. The number of moles of oxidant required to oxidize a given amount of KI to I_2 is lowest for
    (1) $K_2Cr_2O_7$ (2) $KMnO_4$ (3) $FeCl_3$ (4) K_2CrO_4 (5) MnO_2

46. A reaction in which the same chemical species undergoes simultaneous reduction and oxidation, is called disproportionation. Which of the following is a/ are disproportionation/disproportionations?
    (*a*) $2H_2O_2 \rightarrow 2H_2O + O_2$
    (*b*) $Cu^{2+} + Zn \rightarrow Cu + Zn^{2+}$
    (*c*) $Cl_2 + OH^- \rightarrow HOCl + Cl^-$
    (*d*) $2CuCl \rightarrow CuCl_2 + Cu$

2002 AL

7. In the reaction between $Cr_2O_7^{2-}$ and H_2O_2 in an acidic medium, H_2O_2 is **oxidised** to O_2 and $Cr_2O_7^{2-}$ is converted to Cr^{3+} The correct equation for this reaction is

(1) $Cr_2O_7^{2-} + 8H^+ + H_2O_2 \longrightarrow 2Cr^{3+} + 5H_2O + O_2$

(2) $Cr_2O_7^{2-} + 8H^+ + 3H_2O_2 \longrightarrow 2Cr^{3+} + 7H_2O + 3O_2$

(3) $Cr_2O_7^{2-} + 8H^+ + 5H_2O_2 \longrightarrow 2Cr^{3+} + 9H_2O + 5O_2$

(4) $Cr_2O_7^{2-} + 8H^+ + 7H_2O_2 \longrightarrow 2Cr^{3+} + 11H_2O\ \ 7O_2$

(5) $Cr_2O_7^{2-} + 8H^+ + 9H_2O_2 \longrightarrow 2Cr^{3+} + 13H_2O + 9O_2$

17. Acidified MnO_4 reacts with H_2O_2 producing O_2, Mn^{2+} and H_2O only. The number of moles of MnO_4^- required for the complete reaction of one mole of H_2O_2 in an acidified medium is

(1) 0·4 (2) 0·8 (3) 2·0
(4) 2·5 (5) 5·0

44. By treating industrial waste water with OCl^- in alkaline medium, cyanide ions in waste water are converted to N_2 and carbonate ions according to the following equation.

$$2\ CN^- + 5\ OCl^- + 2\ OH^- \longrightarrow 2\ CO_3^{2-} + N_2 + 5\ Cl^- + H_2O$$

Which of the following statement(s) is/are true regarding this reaction

(a) Oxidation number of oxygen in OCl^- is changed from 0 to –2
(b) Oxidation number of carbon is changed from +2 to +4
(c) Oxidation number of nitrogen is changed from –3 to 0
(d) Oxidation number of chlorine is changed from + 1 to –1

2001 AL

16. The number of moles of $KMnO_4$ that is required to react completely with 1 mole of iron(II) oxalate (FeC_2O_4) in acidic medium is

(1) 5 (2) 3 (3) $\frac{5}{3}$ (4) $\frac{3}{5}$ (5) $\frac{1}{5}$

2000 AL

23. In the reaction,

$$2NO_2(g) + H_2O(l) \rightarrow HNO_3(aq) + HNO_2(aq)$$

(1) nitrogen undergoes oxidation only.
(2) nitrogen undergoes reduction only.
(3) nitrogen undergoes both oxidation and reduction.
(4) there is no change in the oxidation state of nitrogen.
(5) water acts both as an oxidising agent and as a reducing agent.

38. Which of the following statement/ statements pertaining to the composition ot a solution prepared by dissolving 18 g of glucose in 180 g of water at 277 K is/are true? (molar masses of glucose and water are 180 and 18 g mol^{-1}, respectively; Density of water at 277 K is 1·0 g cm^{-3}.)

(*a*) The concentration of glucose in the solution is 0·55 mol dm^{-3}.
(*b*) The mass fraction of glucose in the solution is 0·10.
(*c*) The molality of glucose in the solution is 0·10 mol kg^{-1}.
(*d*) The mole fraction of glucose in the solution is $\frac{1}{101}$

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අධ්‍යයන පොදු සහතික පත්‍ර (උසස් පෙළ), 2023 අගෝස්තු

General Certificate Of Education (Adv. Level) Examination, August 2023

රසායන විද්‍යාව I Chemistry I	02	S/E	I

Universal gas constant $R = 8.314\ J\ K^{-1}\ mol^{-1}$ Plank's constant $h = 6.626\times10^{-34}\ J\ s$

Avogadro constant $N_A = 6.022\times10^{23}\ mol^{-1}$ Velocity of light $c = 3\times10^{8}\ m\ s^{-1}$

Answer all the Questions.

1. (i) A solution of 100 g is prepared by dissolving, a mass of 30 g of solid $MgCl_2$ in pure water at 25 °C.
   (a) State the reason for selecting water to prepare the $MgCl_2$ solution.
   (b) Calculate the composition of the $MgCl_2$ solution prepared above, as a percentage by mass (w/w).

2. The total number of atoms in one mole of CO_2 molecules is
   (1) $6.022\times10^{23}\times3$ (2) $6.022\times10^{23}\times2$ (3) $6.022\times10^{23}\times1$ (4) $6.022\times10^{23}\times\frac{1}{3}$

3. The composition of a glucose solution in terms of mass and volume is 90 g dm^{-3}. What is the concentration of that glucose solution? (Relative molecular mass of glucose is 180)
   (1) 0.25 mol dm^{-3} (2) 0.50 mol dm^{-3} (3) 0.75 mol dm^{-3} (4) 2.00 mol dm^{-3}

4. (a) Write the balanced chemical equation relevant to the production of iron from Fe_2O_3.
   (b) In this process 1680 kg of pure molten iron was obtained from a 2520 kg of mixture of Fe_2O_3 with impurities. (In this case, assume that all Fe_2O_3 reacted completely.)
      I. Find the number of moles of molten iron obtained and calculate the mass of Fe_2O_3 reacted. (Fe = 56, O = 16)
      II. What is the mass of impurities presented in the mixture?

5. What is the number of O atoms in 22 g of CO_2 gas? (C = 12, O = 16)
   (1) 2 (2) 6.022×10^{23} (3) $2\times6.022\times10^{23}$ (4) $22\times6.022\times10^{23}$

6. The relative atomic mass of iron is 56. Thus, which of the following statements is the correct statement?
   (1) The mass of an iron atom is 56 g.
   (2) A mole of iron contains 56 iron atoms.
   (3) The mass of 6.022×10^{23} iron atoms is 56 g.
   (4) The mass of 56 iron atoms is 6.022×10^{23} g.

7. Given below is the balanced equation, relating to the decomposition of potassium permanganate ($KMnO_4$).

$$2KMnO_4 \xrightarrow{\Delta} K_2MnO_4 + MnO_2 + O_2$$

How much is the amount of moles of potassium permanganate that should be decomposed to produce 3 moles of oxygen gas?

(1) 1 (2) 2 (3) 4 (4) 6

8. $$C_2H_4(g) + 3O_2(g) \longrightarrow 2CO_2(g) + 2H_2O(l) + 1400\,kJ$$

(H = 1, C = 12, O = 16)

What is the mass of water formed when one mole of ethene is subjected to complete combustion?

(1) 2 g (2) 18 g (3) 36 g (4) 44 g

9. A bottle contains 500 cm^3 of an acetic acid solution. The density of the solution is 1.04 g cm^{-3} and the mass of acetic acid contained in this solution is 26 g.

(i) Calculate the mass of the acetic acid solution contained in the bottle.

(ii) Calculate the percentage of acetic acid by mass in the above solution.

10. The homogeneous mixture of inert substances contain 8.0 g of A, 18.0 g of B and 24.0 g of C only. (molar masses A = 4.0 g mol^{-1} B = 18.0 g mol^{-1}, C = 12. 0g mol^{-1})

i) Calculate the mass fractions of A, B and C.

ii) Express the compositions of A, B and C in pph, ppt and ppm by mass.

iii) Calculate mole fractions of A, B and C.

iv) Calculate the mole percentages of A, B and C.

********** **Weekly Term Test Challenge – 17** **********