

G.C.E. (A/L) Examination
2002 April
Chemistry I/Two hours

Important

- (i) Answer all the questions.
- (ii) Use of calculators is not allowed.
- (iii) Write your Index Number in the space provided in the answer sheet and then indicate your Index Number by shading the appropriate numbers in the grid immediately below it.
- (iv) In each of the questions 1 to 60 pick one of the alternatives (1), (2), (3), (4), (5) which is correct or most appropriate and shade its number on the answer sheet in accordance with the instructions given therein.

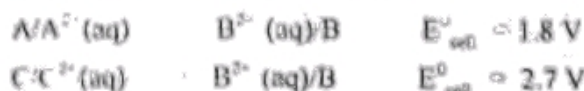
Universal gas constant $R = 8.314 \text{ JK}^{-1} \text{ mol}^{-1}$
 Avogadro Constant $N_A = 6.022 \times 10^{23} \text{ mol}^{-1}$

1. A certain sample of CO has only $^{12}\text{C}_x$ and $^{16}\text{O}_y$ isotopes. Another sample of CO has $^{13}\text{C}_x$ and $^{18}\text{O}_y$ 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.
2. W, X, Y and Z are four non transition elements with consecutive atomic numbers. The first ionization enthalpies of W, X and Y are in the order $W < X < Y$. The oxide formed by Z is basic. The electronic configuration of the outermost shell of Z is of the type
 (1) $ns^1 np^0$ (2) $ns^2 np^1$ (3) $ns^2 np^2$
 (4) $ns^2 np^3$ (5) $ns^2 np^4$
3. The element with the highest first ionization enthalpy out of the following is
 (1) C (2) N (3) Si (4) O (5) P
4. Which is the smallest ion out of the following ions in the gaseous state?
 (1) O^{2-} (2) F^{-} (3) Na^{+} (4) Mg^{2+} (5) N^{3-}
5. The electronic configuration of the valence shell of the element that has the least tendency to form a diatomic molecule is
 (1) $s^1 p^0$ (2) $s^2 p^0$ (3) $s^3 p^1$ (4) $s^4 p^4$ (5) $s^2 p^1$
6. Which of the following statements is correct regarding the atomic emission spectrum of hydrogen?
 (1) The radiation corresponding to the $n = 2$ to $n = 1$ transition has the longest wavelength.
 (2) The $n = 3$ to $n = 2$ transition corresponds to the H_α line.
 (3) The first series of the lines (Lyman) occurs in the infra-red region.
 (4) In a given series, the separation between adjacent lines increases in the direction of increasing energy.
 (5) Emission of radiation occurs when electrons undergo transition to higher levels from lower levels.
7. In the reaction between $\text{Cr}_2\text{O}_7^{2-}$ and H_2O_2 in an acidic medium, H_2O_2 is oxidised to O_2 and $\text{Cr}_2\text{O}_7^{2-}$ is converted to Cr^{3+} . The correct equation for this reaction is
 (1) $\text{Cr}_2\text{O}_7^{2-} + 8\text{H}^{+} + \text{H}_2\text{O}_2 \longrightarrow 2\text{Cr}^{3+} + 5\text{H}_2\text{O} + \text{O}_2$
 (2) $\text{Cr}_2\text{O}_7^{2-} + 8\text{H}^{+} + 3\text{H}_2\text{O}_2 \longrightarrow 2\text{Cr}^{3+} + 7\text{H}_2\text{O} + 3\text{O}_2$
 (3) $\text{Cr}_2\text{O}_7^{2-} + 8\text{H}^{+} + 5\text{H}_2\text{O}_2 \longrightarrow 2\text{Cr}^{3+} + 9\text{H}_2\text{O} + 5\text{O}_2$
 (4) $\text{Cr}_2\text{O}_7^{2-} + 8\text{H}^{+} + 7\text{H}_2\text{O}_2 \longrightarrow 2\text{Cr}^{3+} + 11\text{H}_2\text{O} + 7\text{O}_2$
 (5) $\text{Cr}_2\text{O}_7^{2-} + 8\text{H}^{+} + 9\text{H}_2\text{O}_2 \longrightarrow 2\text{Cr}^{3+} + 13\text{H}_2\text{O} + 9\text{O}_2$

8. The SO_3^{2-} molecule which has a shape significantly different from the SO_4^{2-} ion is
 (1) NH_3 (2) BCl_3 (3) SF_6 (4) $\text{S}_2\text{O}_3^{2-}$ (5) CH_4
9. The products of dissociation of HOBr are most unlikely to be
 (1) H^+ and OBr^- (2) OH^- and Br^- (3) HO^- and Br^-
 (4) HO^- and Br^+ (5) H^+ and OBr^-
10. A white inorganic salt was dissolved in dilute HCl . This solution when basified with excess NH_4OH gave a colourless clear solution. One part of this solution when treated with H_2S gave a white precipitate. The other part of the solution when treated with aqueous $\text{Ba}(\text{OH})_2$ also gave a white precipitate. The salt is
 (1) ZnCl_2 (2) AlCl_3 (3) MgSO_4
 (4) ZnSO_4 (5) NaAlO_2
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 ($\text{H} = 1$, $\text{Cl} = 35.5$, $\text{S} = 32$, $\text{O} = 16$). The relative atomic mass of the metal is
 (1) 20 (2) 24 (3) 27 (4) 35 (5) 43
12. A, B, C are three cations which form precipitates with NH_4OH . A, B, C are. These precipitates are soluble in excess NH_4OH . A, B, C are
 (1) Cu^{2+} , Ni^{2+} , Cr^{3+} (2) Cu^{2+} , Ni^{2+} , Al^{3+} (3) Zn^{2+} , Cu^{2+} , Ni^{2+}
 (4) Zn^{2+} , Cu^{2+} , Cr^{3+} (5) Ag^+ , Zn^{2+} , Al^{3+}
13. The molar ratio $\text{NaOH} : \text{Na}_2\text{CO}_3$ 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 of 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_4 125 cm^3
 (1) 0.0375 (2) 0.0625 (3) 0.0875 (4) 0.15 (5) 0.30
16. Which one of the following chlorides in 1.0 mol dm^{-3} aqueous solution shows the highest pH value?
 (1) AlCl_3 (2) HCl (3) PCl_5 (4) MgCl_2 (5) NH_4Cl
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
18. A dilute HCl solution of salt A
 (i) is colourless (ii) give an orange precipitate with H_2S and
 (iii) forms a white precipitate when added to water
 The cation contained in salt A is
 (1) Cd^{2+} (2) Sb^{3+} (3) Pb^{2+} (4) Bi^{3+} (5) Sn^{2+}
19. Which one of the following would represent the formation of covalent bonds?
 (1) A non-metal taking electrons from a metal
 (2) A non-metal taking electrons from another non-metal
 (3) A metal giving a pair of electrons to a non-metal
 (4) A non-metal giving a pair of electrons to a metal
 (5) A metal and non-metal sharing electrons

20. At a constant pressure of 25°C and a pressure of 10^5 Pa , air contains 21% by volume of oxygen. 10 m^3 of air is compressed to 1 m^3 at the same temperature. The partial pressure of oxygen in the compressed air (in units of Pa)
- (1) 1.0×10^5 (2) 2.1×10^5 (3) 2.1×10^4
 (4) 1.0×10^4 (5) 2.1×10^3

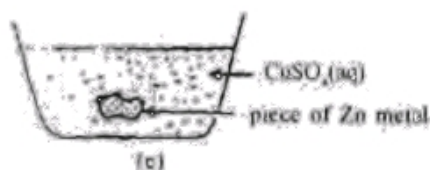
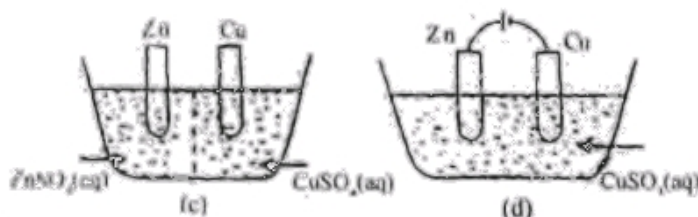
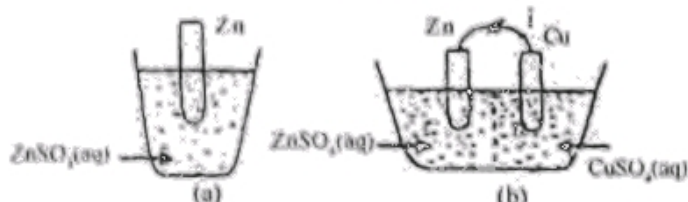
21. At 25°C , the standard cell e.m.f. (E°_{cell}) values for two electrochemical cells are given below



Which one of the following is true for the cell with $\text{A}^+(\text{aq})/\text{A}$ and $\text{C}^{2+}(\text{aq})/\text{C}$ as electrodes at 25°C ?

- (1) $E^\circ_{\text{cell}} = 4.5\text{ V}$; C electrode negative
 (2) $E^\circ_{\text{cell}} = 4.5\text{ V}$; A electrode negative
 (3) $E^\circ_{\text{cell}} = 0.9\text{ V}$; C electrode negative
 (4) $E^\circ_{\text{cell}} = 0.9\text{ V}$; A electrode negative
 (5) $E^\circ_{\text{cell}} = 0.9\text{ V}$; C electrode negative

22. Consider the following system (a) to (e)



Which of the following pairs can be considered equilibrium systems?

- (1) (a) and (b) (2) (b) and (c) (3) (a) and (e)
 (4) (d) and (e) (5) (c) and (e)

23. The following thermochemical data is available in units of kJ mol^{-1}
- Lattice enthalpy of AgI(s) $= -876$
 Standard hydration enthalpy of $\text{Ag}^+(\text{g})$ $= -464$
 Standard hydration enthalpy of $\text{I}^-(\text{g})$ $= -293$
- The standard enthalpy of solution of AgI(s) in water is represented by

in units of kJ mol^{-1} is

- (1) -719 (2) $+119$ (3) -119 (4) -1633 (5) $+1633$

24. In a particular reaction involving P and Q , the experimental data obtained at 32°C are given below

Initial concentration of P (mol dm $^{-3}$)	Initial concentration of Q (mol dm $^{-3}$)	Initial rate of reaction (mol dm $^{-3}$ s $^{-1}$)
1.2×10^{-2}	2.5×10^{-2}	1.75×10^{-3}
3.2×10^{-2}	5.0×10^{-2}	8.00×10^{-3}
1.6×10^{-2}	2.5×10^{-2}	8.75×10^{-3}

The relevant rate equation for the reaction is

- (1) rate $\propto [\text{P}]$ (2) rate $\propto [\text{Q}]$ (3) rate $\propto [\text{P}][\text{Q}]$
 (4) rate $\propto [\text{P}][\text{Q}]^2$ (5) rate $\propto [\text{P}]^2[\text{Q}]$

- Questions 25 and 26 refer to the following data:

One gas bulb contains gas A and another gas bulb containing gas B. Both gas bulbs are at the same temperature. The density of gas A is half that of gas B. The mean square speed of gas B is twice the mean square speed of gas A. Pressure of gas A = 1000 kPa .

25. the pressure of gas B in kPa is
 (1) 4000 (2) 2000 (3) 1000 (4) 500 (5) 250
26. If the volumes of the two gas bulbs are the same, the ratio of the number of molecules of gas A : number of molecules of gas B is
 (1) 4 : 1 (2) 2 : 1 (3) 1 : 1 (4) 1 : 2 (5) 1 : 4
27. Which of the following is not a characteristic of catalysts?
 (1) Catalysts are chemically unchanged at the end of the reaction
 (2) Catalysts are specific in action
 (3) Catalysts reduce the enthalpy change accompanying a reaction
 (4) Catalysts provide an alternative route for a reaction
 (5) Catalysts lower the activation energy barrier of a reaction
28. Which one of the following polymers
 (i) is thermoplastic (ii) has no cross-links and (iii) is a product of addition polymerisation?
 (1) Nylon (2) Polyester
 (3) Polyvinyl chloride (4) Urea-formaldehyde
 (5) Vulcanised rubber
29. Which of the following statements is correct regarding $[\text{Co}(\text{NH}_3)_5\text{Cl}]\text{Cl}_2$?
 (1) It has only co-ordinate and covalent bonds
 (2) Its IUPAC name is pentamminechlorocobalt(II) chloride
 (3) It has co-ordinate, covalent and ionic bonds
 (4) Its IUPAC name is pentamminechlorocobalt(III) dichloride
 (5) It does not give a precipitate with aqueous AgNO_3

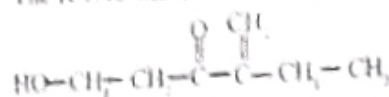
30. Which one of the following compounds reacts with H_2S in acidic solution and does not produce sulphate as one of the products?
 (1) FeCl_3 (2) Na_2AsO_4 (3) NaAsO_2
 (4) K_2CrO_4 (5) Na_2SO_4

31. The standard enthalpies of combustion (kJ mol^{-1}) of gaseous acetylene and liquid benzene at 25°C and 1 bar are respectively x and y . The standard enthalpy change (kJ mol^{-1}) for the reaction



- (1) $3y - 5x$ (2) $3y - x$ (3) $3x - 5y$
 (4) $x - 3y$ (5) $x - 3y$

12 The IUPAC name of the compound

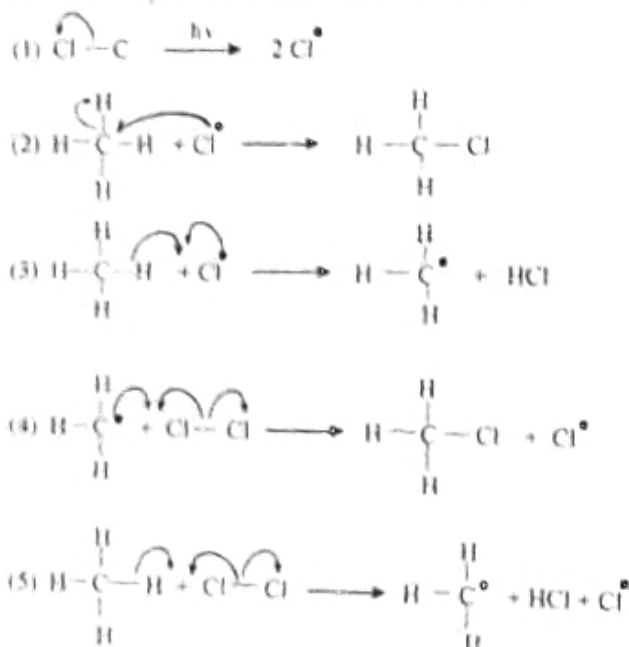


- 4-ethyl-3-oxopent-4-en-1-ol
- 2-ethyl-5-hydroxy-3-oxo-pent-1-ene
- 4-ethyl-1-hydroxypent-4-en-3-one
- 2-ethyl-5-hydroxypent-1-en-3-one
- 2-ethyl-1-ene-5-hydroxy-3-pentanone

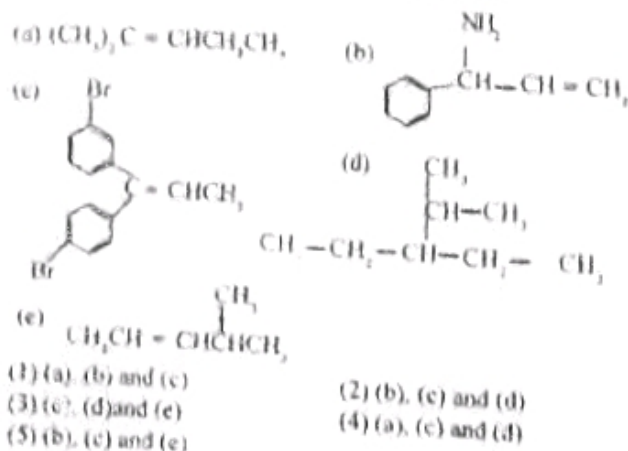
13 Which of the following statements is **incorrect**?

- Amides are less basic than ammonia
- Phenol readily reacts with formaldehyde in an alkaline medium
- Phenols are more acidic than alcohol
- Phenol readily undergoes an addition reaction with $\text{Br}_2/\text{H}_2\text{O}$ to give a white precipitate
- Boiling points of carboxylic acids are higher than those of aldehydes with comparable relative molecular masses

14 Which of the following most correctly depicts a step in the reaction of Cl_2 with methane in the presence of sunlight?

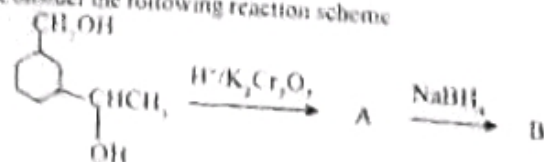


15 Which of the following show stereo-isomerism?

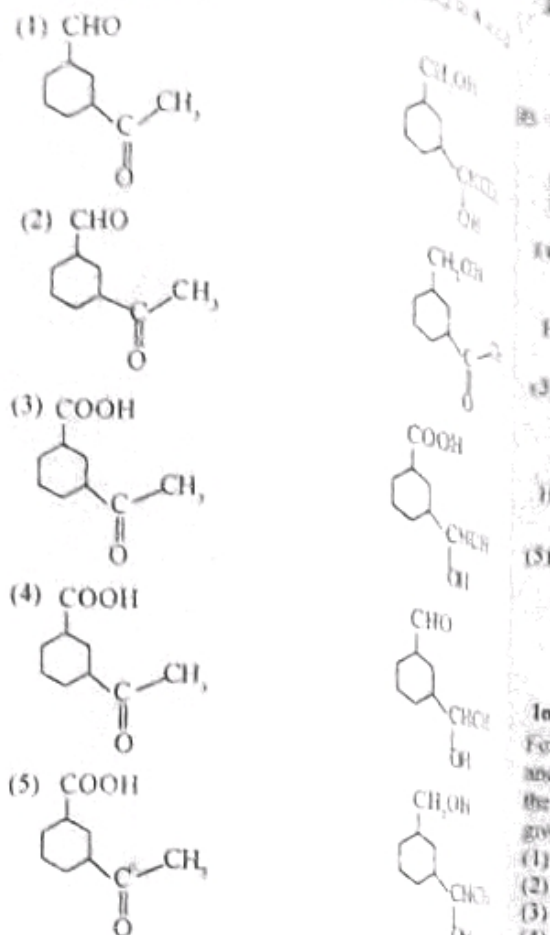


- (a), (b) and (c)
- (b), (c) and (d)
- (c), (d) and (e)
- (a), (c) and (d)
- (b), (c) and (e)

16 Consider the following reaction scheme

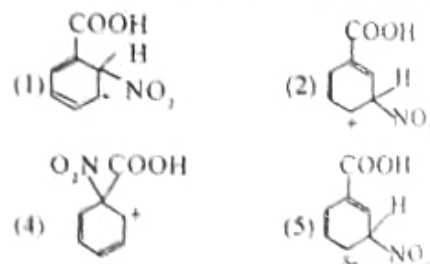


The most likely compounds corresponding to A and B respectively are

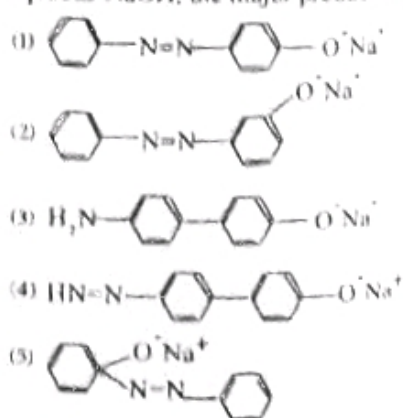


(37) Nitration of benzoic acid is an electrophilic substitution

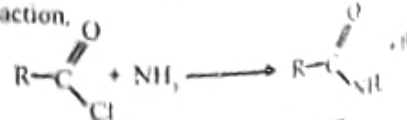
The intermediate most likely to be formed during the reaction is



(38) When aniline is reacted with NaNO_2/HCl at $5-10^\circ\text{C}$, the reaction mixture obtained is added to a solution of aqueous NaOH , the major product formed is

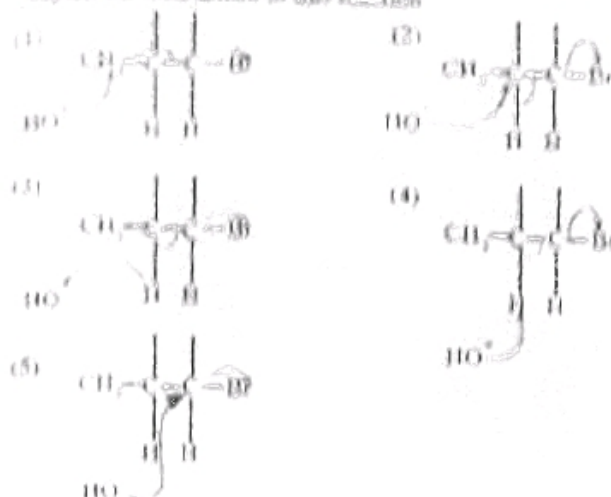


(39) The reaction



- an electrophilic substitution reaction
- an electrophilic addition reaction
- a nucleophilic substitution reaction
- a nucleophilic addition reaction
- an elimination reaction

40. Consider the reaction between ethyl iodide and hydroxide ions, EtI , which produces ethanol. Using your knowledge of principles of reactive intermediates, predict which of the following is/are likely to be the mechanism of this reaction.



• Instructions for questions No. 41 to 50 :

For each of the questions 41 to 50, four responses (a), (b), (c) and (d) are given, one or more of these is/are correct. Select the correct response/responses. In accordance with the instructions given on your answer sheet, mark

- (1) if only (a) and (b) are correct
(2) if only (b) and (c) are correct
(3) if only (c) and (d) are correct
(4) if only (d) and (a) are correct

(5) if any other number or combination of responses is correct.

Summary of above instructions				
(1)	(2)	(3)	(4)	(5)
Only (a) and (b) are correct	Only (b) and (c) are correct	Only (c) and (d) are correct	Only (d) and (a) are correct	Any other number or combination of responses is correct

41. In which of the following groups of compounds/ ions do all members of the group have nearly the same colour?
- (a) CuS , AgI , K_2CrO_4
(b) $[\text{Co}(\text{NH}_3)_6]^{3+}$, $[\text{Ni}(\text{NH}_3)_6]^{2+}$, $[\text{CoCl}_4]^{2-}$
(c) CuS , NiS , ZnS
(d) CuI_2 , NiCl_2 , MnI_2
42. Which of the following statement(s) is/are true regarding calcium carbide?
- (a) It can be produced by heating CaO and carbon
(b) It is used in the commercial manufacture of bleaching powder
(c) It is used as a fertilizer
(d) It decolorizes aqueous KMnO_4
43. Which of the following statement(s) is/are true regarding air?
- (a) It contains more H_2 than Ar
(b) It contains approximately, 78 mole percent of N_2 and 21 mole percent of O_2
(c) It contains more Ar than CO_2
(d) It contains more He than Ar
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



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

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

45. Which of the following may be used to distinguish between SO_2 and CO_2 ?

- (a) A solution of NaOH
(b) A filter paper moistened with lead acetate
(c) A solution of BaCl_2
(d) A piece of red-coloured flower petal

46. Liquids A and B form ideal solutions with each other. One mole each of A and B are mixed in a bottle and the bottle is stoppered. The vapour pressures of pure A and pure B under the conditions of the experiment are 120 mm Hg and 140 mm Hg respectively. At equilibrium, the mole fractions of A and B in the liquid phase are X_A and X_B respectively, the mole fractions of A and B in the vapour phase are then Y_A and Y_B respectively.

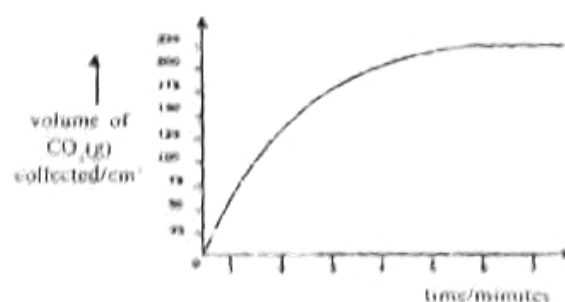
- (a) $X_A = X_B$ (b) $Y_A = Y_B$ (c) $X_A > X_B$
(d) $Y_A = Y_B$

47. MX and NX_2 are ionic compounds of which the solubility products at 300 K are $1 \times 10^{-8} \text{ mol}^2 \text{ dm}^{-3}$ and $4 \times 10^{-12} \text{ mol}^3 \text{ dm}^{-3}$ respectively. Here, M is a univalent metal and N is a divalent metal.

Which of the following statement(s) is/are true regarding a saturated solution of MX (solution A) and a saturated solution of NX_2 (solution B) at 300 K?

- (a) Concentration of M^+ in solution A is equal to the concentration of N^{2+} in solution B
(b) Concentration of X^- in solution A is twice the concentration of X^- in solution B
(c) Concentration of N^{2+} in solution B is twice the concentration of M^+ in solution A
(d) Concentration of X^- in solution B is twice the concentration of X^- in solution A

48. 1.0 g of uniformly powdered CaCO_3 (relative molecular mass = 100) was reacted with 100 cm^3 of 0.2 mol dm^{-3} HCl solution. When the volume of CO_2 collected was plotted against time, the following graph was obtained.



According to this graph

- (a) the rate at which $\text{CO}_2(\text{g})$ is liberated decreases with time
(b) Approximately 6 minutes after starting the reaction, an equilibrium is reached
(c) the rate at which $\text{CO}_2(\text{g})$ is liberated increases with time
(d) Approximately 6 minutes after starting the reaction, the concentrations of different species present in the solution become constant

49. Correct statement(s) regarding benzene is/are

- (a) benzene has six π electrons
(b) benzene readily undergoes reaction with nucleophiles
(c) benzene has three localized π bonds
(d) benzene characteristically undergoes substitution reactions



- (a) gives a silver mirror with ammoniacal silver nitrate and an orange precipitate with Brady's reagent
 (b) reacts with ammoniacal silver nitrate but does not give a silver mirror
 (c) decolorises $\text{Br}/\text{H}_2\text{O}$
 (d) does not react with ammoniacal silver nitrate

• Instructions for No. 51 to 60

In questions No. 51 to 60, two statements are given in respect of each question.

From the Table given below, select the response out of the responses (1), (2), (3), (4) and (5) that best fits the two statements given for each of the questions and mark appropriately on your answer sheet.

Response	First Statement	Second Statement
(1)	True	True, and correctly explains the first statement
(2)	True	True, but does not explain the first statement correctly
(3)	True	False
(4)	False	True
(5)	False	False

	First Statement	Second Statement
51	The boiling point of propanone ($M_r = 58$) is higher than that of 2-methylpropane ($M_r = 58$)	Propanone molecules cannot form hydrogen bonds amongst themselves.
52	Butan-2-ol gives a turbidity with conc. HCl/ZnCl_2 within a shorter time than does 2-methylpropan-2-ol	Tertiary carbonium ions are more stable than secondary carbonium ions.
53	Glucose is soluble in water while cholesterol is insoluble in water.	Cholesterol cannot form hydrogen bonds with water.
54	Elements higher up in the electrochemical series are better reducing agents than those lower down.	An element lower in the electrochemical series can be displaced from a solution of its salt by an element higher up in the series
55	Graphite anodes are used in one of the electrolytic processes for the manufacture of caustic soda	Graphite is a good electrical conductor and is not corroded by caustic soda
56	Water boiling in a kettle and its vapour form an equilibrium system	At a constant external pressure, the temperature of any boiling liquid is a constant
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. ($\text{C} = 12$, $\text{O} = 16$)	If two elements can combine to form more than one compound, they do so in simple atomic ratios
58	Phosphorus is stored under water to prevent its reaction with atmospheric O_2	O_2 dissolved in water does not react with phosphorus.
59	A Ni^{2+} solution in dilute HCl does not give a black precipitate of NiS with H_2S .	NiS is easily soluble in dilute HCl
60	The pH of a 0.01 mol dm^{-3} solution of H_2SO_4 is lower than that of a 0.01 mol dm^{-3} solution of HCl	In dilute aqueous solutions, H_2SO_4 is a stronger acid than HCl