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 கல்விப் பொதுத் தராதரப் பத்திர (உயர்தர) பரீட்சை
General Certificate of Education (Adv. Level) Examination

රසායන විද්‍යාව I
 இரசாயனவியல் I
 Chemistry I

02 S I

පැය දෙකයි
 இரண்டு மணித்தியாலம்
 Two hours

Instructions:

- Answer all the questions.
- Use of calculation is not allowed.
- In each of the questions 1 to 50, pick one of the alternatives from (1), (2), (3), (4), (5) which is correct or most appropriate and mark your response on the answer sheet with a cross (X) in accordance with the instruction given.

Universal gas constant . $R = 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$ Avagadro constant $N_A = 6.022 \times 10^{23} \text{ mol}^{-1}$

Plank's constant $h = 6.626 \times 10^{-34} \text{ J s}$

Velocity of light $C = 3 \times 10^8 \text{ m s}^{-1}$

01. Consider the following statements.

- Radiation emitted by a metal surface behaves as small energy packets.
- Electrons in an atom around the nucleus circulate in definite energy levels.

The above statements were respectively presented by,

- Max Planck, Ernest Rutherford
- Ernest Rutherford, Niels Bohr
- Albert Einstein, Niels Bohr
- Niels Bohr, Ernest Rutherford
- J.J. Thomson, Niels Bohr

2. The pair of species with equal number of electrons with auguler momentum (azimuthal) quantum number (l) = 0 is,

- (1) V, Sc^{3+}
- (2) K, Ca^{2+}
- (3) Fe^{2+} , Cu^{+}
- (4) Cr^{3+} , Ag^{+}
- (5) Co^{3+} , Sc

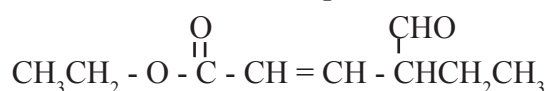
03. The correct increasing order of the electronegativity of S atom of the species SOCl_2 , SO_3 , SO_2 , and SO_4^{2-} is,

- (1) $\text{SO}_3^{2-} < \text{SOCl}_2 < \text{SO}_4^{2-} < \text{SO}_3 < \text{SO}_2$
- (2) $\text{SO}_4^{2-} < \text{SOCl}_2 < \text{SO}_3^{2-} < \text{SO}_2 < \text{SO}_3$
- (3) $\text{SOCl}_2 < \text{SO}_3^{2-} < \text{SO}_4^{2-} < \text{SO}_3 < \text{SO}_2$
- (4) $\text{SO}_4^{2-} < \text{SOCl}_2 < \text{SO}_3^{2-} < \text{SO}_3 < \text{SO}_2$
- (5) $\text{SOCl}_2 < \text{SO}_3^{2-} < \text{SO}_4^{2-} < \text{SO}_2 < \text{SO}_3$

04. Assume that following molecules are obtained by replacing chlorine atoms of PCl_5 . The axial Cl atoms being replaced first, then equatorial atoms. Which of the following does not have a dipole moment,

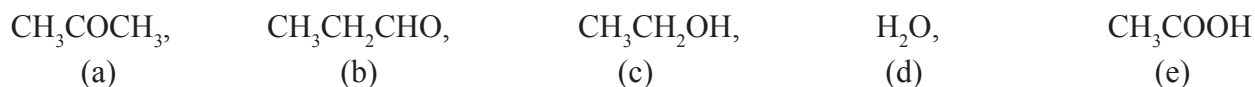
- (1) PCl_4F
- (2) PCl_3F_2
- (3) PCl_2F_3
- (4) PClF_4
- (5) All of the above molecules have a dipole moment.

05. IUPAC name of the compound



- (1) ethyl-4-ethyl-5-oxopent-2-enoate (2) ethyl-4-ethylpent-3-enal
 (3) ethyl 4-ethyl-5-oxopent-2-enoate (4) ethyl 4-formylhex-2-enoate
 (5) ethyl 4-ethylpent-3-en-1-one

06. The correct increasing order of the boiling points of the compounds,



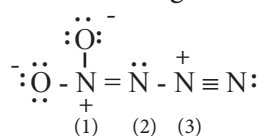
- (1) $d < b < a < e < c$ (2) $b < a < c < d < e$ (3) $b < a < c < e < d$
 (4) $d < a < b < c < e$ (5) $a < d < b < c < e$

07. A portion of 50.00 cm^3 from an aqueous solutions of KMnO_4 of the concentration $0.004 \text{ mol dm}^{-3}$ was acidified with 50.00 cm^3 dilute HCl and, an excess of SO_2 was bubbled through it. Then this solution was heated to expel excess SO_2 in solution. Then the solid MCl_2 was gradually added. The concentration of $\text{M}^{2+}(\text{aq})$ at the point of the start of the precipitation of MSO_4 is,

$$K_{\text{sp}}[\text{MSO}_4] = 1.0 \times 10^{-10} \text{ mol}_2 \text{ dm}^{-6} \text{ (Assume that HCl does not react with } \text{MnO}_4^- \text{)}$$

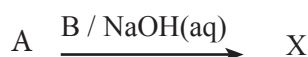
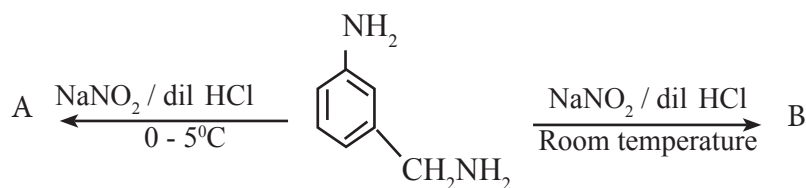
- (1) $2.0 \times 10^{-6} \text{ mol dm}^{-3}$ (2) $1.0 \times 10^{-7} \text{ mol dm}^{-3}$ (3) $2.0 \times 10^{-8} \text{ mol dm}^{-3}$
 (4) $2.0 \times 10^{-7} \text{ mol dm}^{-3}$ (5) $2 \times 10^{-5} \text{ mol dm}^{-3}$

08. Which of the following is correct regarding the Lewis structure of N_4O_2 given below,

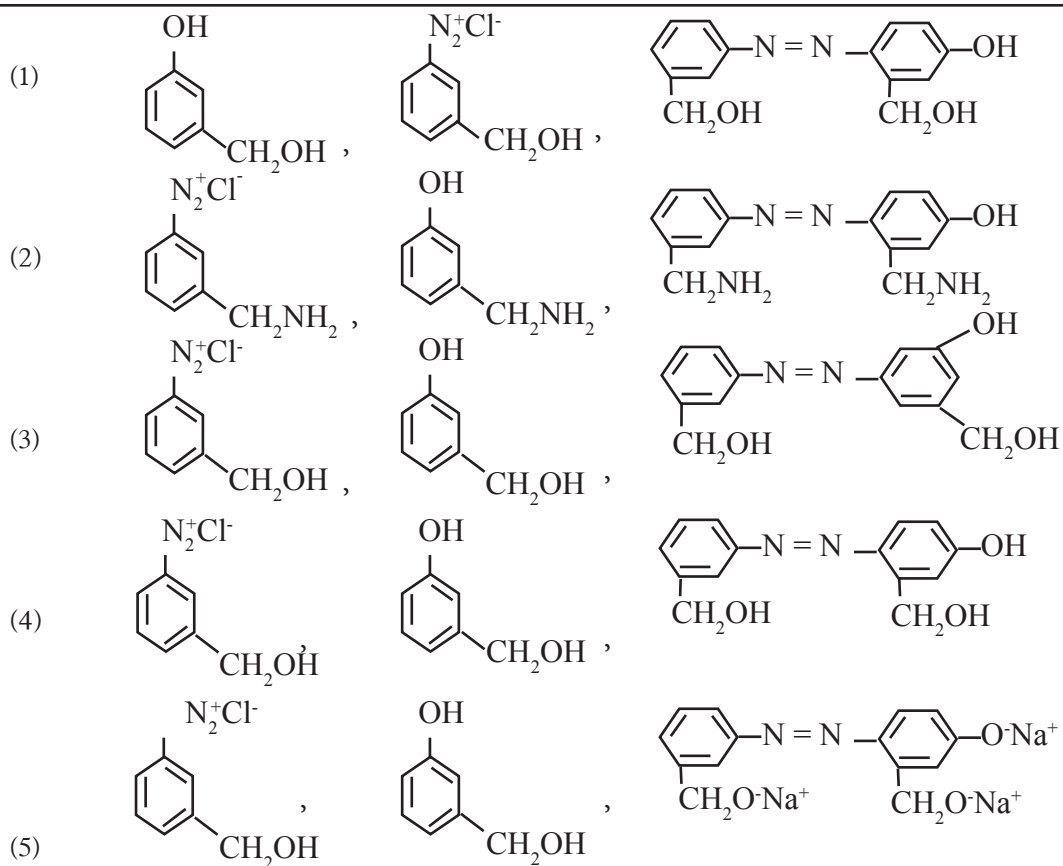


	Oxidation state of N atoms			Electrons pair geometry around N atoms		
	N_1	N_2	N_3	N_1	N_2	N_3
1	+2	0	+1	Trigonal planer	Trigonal planer	Linear
2	+1	0	+1	Trigonal planer	Angular	Linear
3	+3	0	+1	Trigonal planer	Trigonal planer	Linear
4	+1	+3	+4	Trigonal planer	Angular	Linear
5	+3	0	+3	Trigonal planer	Angular	Linear

09.



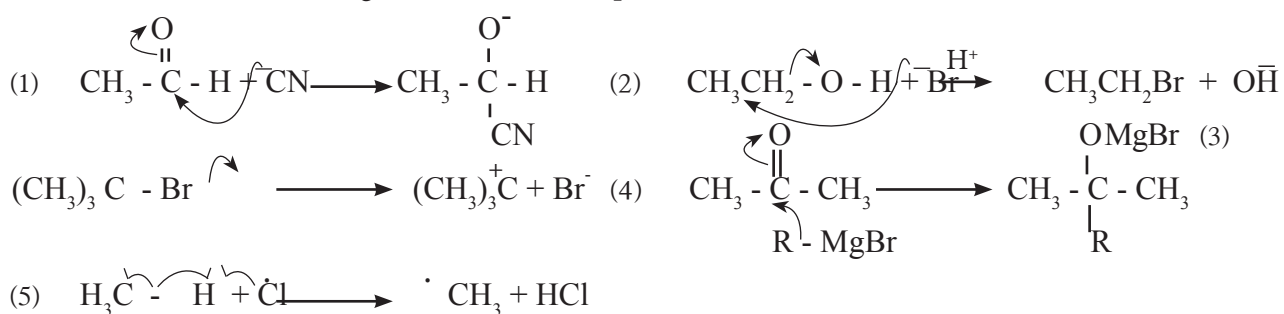
A, B and X respectively are,



10. The reaction $A(g) + 2B(g) \rightarrow C(g) + D(g)$ is an elementary reaction. The initial partial pressures of A and B are $P_A = 0.60$ atm and $P_B = 0.80$ atm respectively. After 30 seconds, the partial pressure of C, $P_C = 0.20$ atm. The rate of the reaction after 30 seconds, with respect to the initial rate is (temperature remains constant during the period of the reaction)

- (1) $\frac{1}{24}$ (2) $\frac{1}{16}$ (3) $\frac{1}{6}$ (4) $\frac{1}{3}$ (5) $\frac{1}{4}$

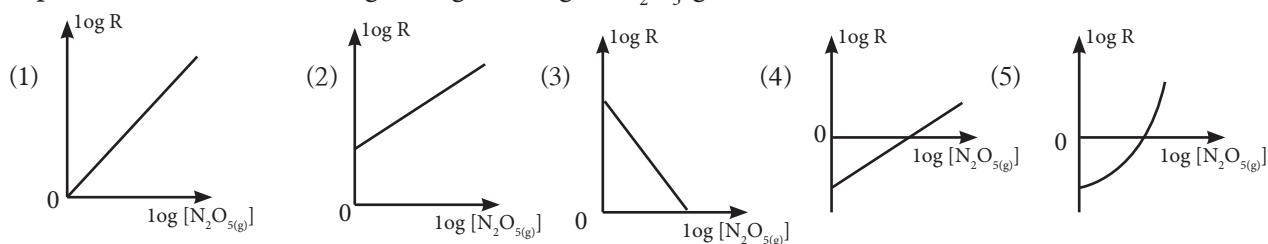
11. Which of the following is not a correct step of a mechanism.



12. The percentage purity (w/w%) of a monobasic acid with density d g cm^{-3} and molar mass M is 15 %. V_1 volume of this acid required V_2 volume of NaOH. The concentration of NaOH solution in mol dm^{-3} is given by

- (1) $\frac{1.5 \times 10^2 d V_1}{M V_2}$ (2) $\frac{15 \times d V_1}{100 \times M V_2}$ (3) $\frac{1.5 \times 10^{-2} d V_1 \times 10^{-3}}{M V_2}$
- (4) $\frac{15 \times 10^3 d V_2}{M V_1}$ (5) $\frac{1.5 \times 10^2 d V_2}{M V_1}$

13. The rate constant of the reaction, at 340 K is $k = 4.7 \times 10^{-3} \text{ s}^{-1}$. Which of the following graphs correctly represent the variation of $\log R$ against $\log [N_2O_5(g)]$

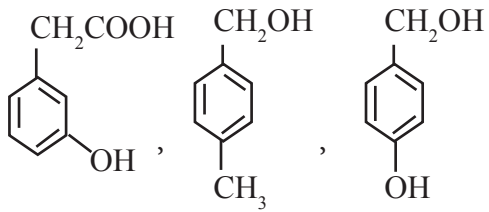
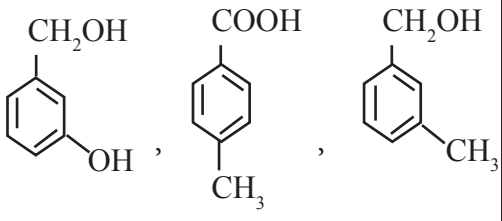
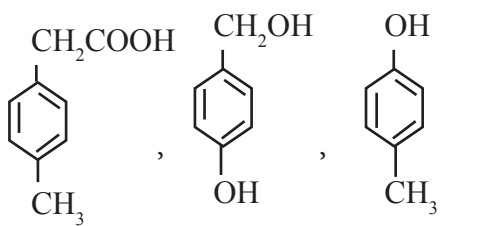
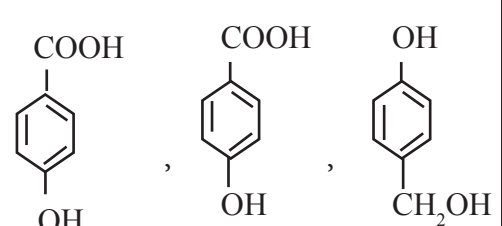
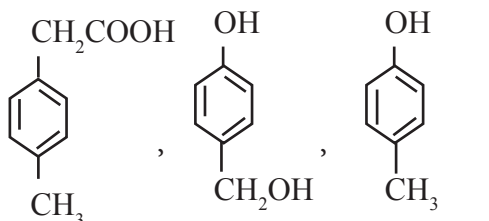


14. Which of the following is false regarding the kinetics of a reaction.
- If the overall order is n , the units of the rate constant, $k = (\text{units of concentration})^{1-n} \text{ s}^{-1}$
 - The equilibrium point of a reversible reaction is changed by the catalyst.
 - The rate of a reaction always increases when the rate constant increases.
 - The effective collisions per unit time and unit volume increases when the total number of collisions increases.
 - The order of a reaction can only be calculated by experiment.
15. The reaction $A \rightarrow B + C$ is a first order reaction. It takes 30 minutes to decrease the concentration of A by 75%. Time taken to reduce the concentration by 98.4375 %, in minutes is
- 105
 - 90
 - 60
 - 45
 - 30
16. The compound A with the molecular formula C_5H_{10} does not show enantiomerism or diastereomerism. The product B formed by the reaction of A with HBr shows enantiomerism. The product D formed by the reaction of B with aqueous KOH shows enantiomerism. The product E is formed by D when treated with Tollen's reagent. The compounds A and E respectively are,
- $CH_3 - \overset{\overset{H}{|}}{C} = \overset{\overset{CH_3}{|}}{C} - CH_3$, $CH_3CH_2 - \overset{\overset{CH_3}{|}}{CH} - COO^-$
 - $H_2C = \overset{\overset{CH_3}{|}}{C} - CH_2CH_3$, $CH_3CH_2 - \overset{\overset{CH_3}{|}}{CH} - COOH$
 - $CH_3 - \overset{\overset{CH_3}{|}}{C} = \overset{\overset{CH_3}{|}}{C} - H$, $CH_3CH - \overset{\overset{CH_3}{|}}{C} - H$
 - $H_2C = \overset{\overset{H}{|}}{C} - CH_2CH_2CH_3$, $CH_3CH_2CH_2CH_2COOH$
 - $H_2C = \overset{\overset{CH_3}{|}}{C} - CH_2CH_3$, $CH_3CH_2\overset{\overset{CH_3}{|}}{CH} - COO^-$
17. $PbCl_2$ is a solid which is sparingly soluble in water. Which of the following is correct regarding a saturated aqueous solution of $PbCl_2$ at 25 °C.
- The chloride ion concentration increases when a small amount of $Pb(NO_3)_2(s)$ is added.
 - The $Pb^{2+}(aq)$ concentration decreases when the temperature is increased.
 - The solubility of $PbCl_2(s)$, does not change. When a small amount of $NaI(s)$ is added.
 - The solubility of $PbCl_2$ decreases when concentrated HCl is added.
 - The solubility of $PbCl_2$ does not change when a small amount of solid $Cl_3CCOONa$ is added to the solution.
18. The solution S is prepared mixing 50.00 cm³ of 0.020 mol dm⁻³ solution of $Al(NO_3)_3$ and 50.00 cm³ of 0.030 mol dm⁻³ $Mg(NO_3)_2$ solution. The density of the solution is 1.05 g cm⁻³. The composition of Nitrogen in ppm in this solution is ($Mg = 24$, $Al = 27$, $N = 14$, $O = 16$)
- 84
 - 168
 - 800
 - 840
 - 1680

19. Which of the following reactions has a negative enthalpy change ,

- (1) $\text{Na(s)} \rightarrow \text{Na(g)}$ (2) $\text{O}^-(\text{g}) + \text{e} \rightarrow \text{O}^{2-}(\text{g})$
 (3) $\text{NaCl(s)} \rightarrow \text{Na}^+(\text{g}) + \text{Cl}^-(\text{g})$ (4) $\text{N}^-(\text{g}) \rightarrow \text{N(g)} + \text{e}$ (5) $\text{Cl}^-(\text{g}) \rightarrow \text{Cl(g)} + \text{e}$

20. A, B and C are three organic compound containing C, H and O. All three compounds give H_2 gas when reacted with Na. Only A and C react with NaOH. Only A reacts with NaHCO_3 liberating CO_2 . A, B and C respectively are,

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

21. Which of ten following is true regarding the van der Waal's equation and its uses.

- (1) It cannot be applied to an ideal gas at high pressures.
 (2) The correction used at high pressure remains almost unchanged for the real gas
 (3) A correction for the pressure is not required for real gases at low temperature
 (4) The correction nb used for the volume does not change based on the gas
 (5) Vander Waals equation can not be applied for a saturated vapour.

22. A sample of 0.73 g of $\text{K}_2\text{CrO}_4 \cdot \text{Cr}_2(\text{SO}_4)_3 \cdot \text{H}_2\text{O}$ was dissolved in 100.00 cm^3 of water. A portion of 25.0 cm^3 of this solution was acidified with H_2SO_4 and it was then titrated against $0.075 \text{ mol dm}^{-3}$ solution of Fe^{2+} . The volume of Fe^{2+} which is used at the end point is, (Molar mass of $\text{K}_2\text{CrO}_4 \cdot \text{Cr}_2(\text{SO}_4)_3 \cdot 8\text{H}_2\text{O}$ is 730 g mol^{-1})

- (1) 10.0 cm^3 (2) 20.0 cm^3 (3) 40.0 cm^3 (4) 60.0 cm^3 (5) 80.0 cm^3

23. The root mean square speed of a gas in which the density is 4.0 mg cm^{-3} and the pressure is $1.2 \times 10^5 \text{ N m}^{-2}$ is,

- (1) $3 \times 10^{-2} \text{ m s}^{-1}$ (2) $3 \times 10^3 \text{ m s}^{-1}$ (3) $3 \times 10^2 \text{ m s}^{-1}$ (4) $3 \times 10^4 \text{ m s}^{-1}$ (5) $9 \times 10^2 \text{ m s}^{-1}$

24. The pH value of the solution formed by addition of 1.0 cm^3 of 0.10 mol dm^{-3} solution of NaOH (aq) in to a 25.00 cm^3 of a solution containing equal volume of $0.010 \text{ mol dm}^{-3}$ NH_4Cl and 0.010 mol d^{-3} NH_4OH at 25°C is, (K_b of NH_4OH at 25°C is $1.8 \times 10^{-5} \text{ mol dm}^{-3}$)

- (1) 3.8 (2) 7.0 (3) 10.2 (4) 11.0 (5) 11.8

25. Which of the following is not a water quality parameter,
- (1) Concentration of heavy metal ions
 - (2) Chemical oxygen demand
 - (3) Biological oxygen demand
 - (4) Conductivity of water
 - (5) Chloride ion concentration in water
26. Which of the following is not true regarding metals in s block,
- (1) All metals of group 2 react with N_2 gas
 - (2) Their oxides are basic
 - (3) All hydroxide are strong bases
 - (4) Some of their sulfates are insoluble in water
 - (5) Their peroxide and superoxide undergo thermal decomposition
27. A portion of 1.498 g of solid KIO_3 was dissolved in water and mixed with an excess of a solution of KI. This solution was then acidified by 30.0cm^3 of 0.50mol dm^{-3} solution of H_2SO_4 . The liberated I_2 was titrated with an aqueous solution of $Na_2S_2O_3$ and the average titre at the end point was 24.00 cm^3 . Concentration of $Na_2S_2O_3$ solution in mol dm^{-3} units is, (K=39, I=127, O=16)
- (1) 0.125
 - (2) 0.25
 - (3) 0.625
 - (4) 1.25
 - (5) 1.75
28. The pressure of the vapour phase Which is in an equilibrium with an ideal binary solution is P. The mole fractions of two compounds in the liquid phase are x_1 and x_2 and their saturated vapor pressures are P_1^0 and P_2^0 respectively. Which of the following expressions is true,
- (1) $X_2 = \frac{P - P_2^0}{P_1^0 - P_2^0}$
 - (2) $\frac{1}{X_1} = \frac{P - P_2^0}{P_1^0 - P_2^0}$
 - (3) $X_1 = \frac{P - P_2^0}{P_1^0 - P_2^0}$
 - (4) $X_1 = \frac{P_1^0 - P_2^0}{P - P_1^0}$
 - (5) $X_2 = \frac{P - P_1^0}{P_1^0 - P_2^0}$
29. The inorganic solid X gives a colourless gas and a colluded solution when treated with dilute HCl. This gas decolourises an acidified solution of $KMnO_4$, forming a colourless solution. X forms a yellow-coloured solution when treated with concentrated HCl. When a solution of KI is added to an aqueous solution of X, a white precipitate and a reddish-brown solution are formed. Which of the following correctly represents the formula of X,
- (1) $Cu(SO_3)_2$
 - (2) CuS
 - (3) NiS
 - (4) $NiSO_3$
 - (5) $Fe_2(SO_3)_2$
30. Which of the following is not a product formed when the mixture of $CH_3CH_2COCH_3$ and C_6H_5CHO is reacted with an aqueous solution of NaOH?
- (1)
$$CH_3CH_2-\overset{\overset{OH}{|}}{\underset{\underset{CH_3}{|}}{C}}-\overset{\overset{O}{||}}{CH}-CH_3$$
 - (2)
$$CH_3CH_2-\overset{\overset{OH}{|}}{\underset{\underset{CH_3}{|}}{C}}-CH_2-\overset{\overset{O}{||}}{C}-CH_2CH_3$$
 - (3)
$$C_6H_5-\overset{\overset{OH}{|}}{\underset{\underset{H}{|}}{C}}-\overset{\overset{O}{||}}{CH}-CH_3$$
 - (4)
$$C_6H_5-\overset{\overset{OH}{|}}{\underset{\underset{H}{|}}{C}}-CH_2CH_2-\overset{\overset{O}{||}}{C}-CH_3$$
 - (5)
$$C_6H_5-\overset{\overset{OH}{|}}{\underset{\underset{H}{|}}{C}}-CH_2-\overset{\overset{O}{||}}{C}-CH_2CH_3$$

- For each of the questions 31 to 40, one or more responses out of the four responses (a), (b), (c), and (d) given is/ are correct response/ responses. In accordance with the instruction 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 response 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 response is correct

31. Which of the following forms the major product when treated with cold concentrated H_2SO_4 , which turns the orange colour of acidifies $\text{K}_2\text{Cr}_2\text{O}_7$ to green colour,

- (a) $\text{CH}_2 = \text{CHCH}_3$ (b) $\text{CH}_2 = \overset{\text{CH}_3}{\underset{|}{\text{C}}} - \text{CH}_2 - \text{CH}_3$
 (c) $\text{CH}_3 - \overset{\text{CH}_3}{\underset{|}{\text{C}}} = \overset{\text{CH}_3}{\underset{|}{\text{C}}} - \text{H}$ (d) $\text{CH}_3\text{CH}_2 - \overset{\text{H}}{\underset{|}{\text{C}}} = \overset{\text{H}}{\underset{|}{\text{C}}} - \text{CH}_3$

32. Which of the following statement(s) is correct,

- (a) Presence of a small amount of free fatty acids in plant oils is favourable for the process production of bio diesel
 (b) The distillation of the mixture is suitable after 4 days in the production of ethanol from coconut toddy.
 (c) The elasticity of rubber increases during vulcanization
 (d) Glycerol is formed as a by-product during the production of biodiesel

33. Which of the following statement (s) correctly describes the function of the salt bridge?

- (a) Maintenance of the electrical neutrality of half cells
 (b) Keeping the conductivity of electrolytes constant
 (c) Avoiding the mixing of solutions in half cells
 (d) Minimizing the potential of the liquid junction

34. Which of the following is a nucleophilic addition reaction?

- (a) $\text{CH}_3\text{COCl} + \text{NaOH}$ (b) $\text{CH}_3\text{CHO} + \text{HCN}$
 (c) $\text{CH}_3\text{COCH}_3 + \text{CH}_3\text{MgBr}$ (d) $\text{CH}_3\text{CH}_2\text{Br} + \text{CH}_3\text{O}^-$

35. Consider the electrochemical cell represented $\text{Ag(s)} | \text{Ag}^+(\text{aq}) || \text{NO}_3^-(\text{aq}) | \text{NO(g)} | \text{Pt(s)}$ Which of the following is/ are true ?

- (a) Main purpose of the use of Pt is as a catalyst.
 (b) The mass of Ag(s) electrode decreases when a current flows through the cell.
 (c) The potential of the cell can be increased by the addition of a small amount of $\text{KNO}_3(\text{s})$ into the cathode half-cell.
 (d) The electromotive force of the cell can be increased by increasing the $\text{Ag}^+(\text{aq})$ concentration.

36. Which of the following show(s) the correct relationship between the environmental problem and the species mentioned in front of it
- (a) acid rain : CO_2 , SO_2 (b) greenhouse gases : CH_4 , N_2O
 (c) Depletion of the the ozone layer : HFC , HCFC (d) Photochemical smog : NO ,OH
37. Which of the following statements is correct regarding the group 14 and 15 of the periodic table?
- (a) POCl_3 is formed by hydrolysis of PCl_5 (b) H_2SiO_3 is formed by hydrolysis of SiCl_4
 (c) HCl is formed by the hydrolysis of NCl_3 (d) HOCl is formed by the hydrolysis of CCl_4
38. Which of the following properties is/are the same for all gas phase isomers of $\text{C}_2\text{H}_6\text{O}$?
- (a) Vapor pressure at a given temperature (b) Number of collisions in a closed container
 (c) Mean speed at a given temperature (d) Density of gases at a given temperature
39. The following equilibrium is attained when the solute X is distributed in two immiscible. liquids A and B,
- $$\text{X}_{(\text{A})} \rightleftharpoons \text{X}_{(\text{B})}$$
- Which of the following requirements should be satisfied, in order to apply Nernst distribution law.
- $$\frac{[\text{X}]_{\text{A}}}{[\text{X}]_{\text{B}}}$$
- for this equilibrium
- (a) The molecular state of the solute should be the same in the solvents.
 (b) The concentration of the solute should be high in both solvents.
 (c) The temperature remains constant during the period of experiment
 (d) Two solvents should be immiscible
40. Which of the following is /are true regarding the production of NaOH using the membrane cell
- (a) In the membrane cell, the anode is a graphite rod.
 (b) Only cations can move through the membrane which separates the anode and the cathode.
 (c) Hydrogen gas is formed at the cathode.
 (d) NaOH and NaCl are contained in the solution which is removed from the cell.

- For each of the questions 31 to 40, one or more responses out of the four responses (a), (b), (c), and (d) given is/ are correct response/ responses. In accordance with the instruction given on your answer sheet, mark

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
41. NH_3 cannot react as an acid.	NH_3 turns moist red litmus blue.
42. The reaction in between NaOH and HCl in a closed system increases the entropy of the surroundings.	Any reaction which increase the entropy of the surroundings, occurs spontaneously.
43. NaOH solution can be used to distinguish between NH_4Cl and NaCl solutions.	Both NaOH and NH_4OH are readily soluble in water.
44. Yield of a reversible reaction always increases when the temperature is increased.	Activation energy of a reaction decreases when the temperature is increased.
45. The basicity of amines is greater than that of alcohols.	The stability of alkyl oxonium ion relative to the alcohol is greater than the stability of alkyl ammonium relative to the amine.
46. solubility of pentanol in water is significantly less than that of ethanol.	Both ethanol and pentanal form hydrogen bonds with water.
47. Application of low temperature during the production of NH_3 from N_2 and H_2 increases the Yield of NH_3 .	ΔH and ΔS are negative in the reaction of the manufacture of NH_3 .
48. $\text{CH}_3\text{CH}_2\text{OH}$ and $\text{C}_6\text{H}_5\text{OH}$ are formed as products when the product formed by the reaction of $\text{CH}_3\text{COOC}_6\text{H}_5$ with LiAlH_4 is treated with $\text{H}^+ / \text{H}_2\text{O}$.	Here, a nucleophilic substitution reaction occurs as the H^- ion formed by LiAlH_4 acts as a nucleophile
49. Colour changing pH range of an acid base indicator is determined by the dissociation constant of the indicator.	The equivalent point pH of weak acid – weak base titrations is independent of the concentrations of the acid and the base.
50. HFCs and HFOs contribute to deplete the ozone layer.	$\dot{\text{F}}$ free radicals are formed by HFC whereas $\dot{\text{O}}\text{H}$ free radicals are formed by HFO.

Chemistry Part I

MCQ Answers

(01)	3	(11)	2	(21)	2	(31)	4 (a,d)	(41)	4
(02)	3	(12)	1	(22)	1	(32)	3 (c,d)	(42)	3
(03)	5	(13)	2	(23)	3	(33)	5 (a,c,d)	(43)	2
(04)	2	(14)	2	(24)	3	(34)	2 (b,c)	(44)	5
(05)	4	(15)	2	(25)	5	(35)	2 (b,c)	(45)	3
(06)	2	(16)	5	(26)	4	(36)	5 (b,d)	(46)	2
(07)	3	(17)	5	(27)	4	(37)	1 (a,b)	(47)	1
(08)	3	(18)	3	(28)	3	(38)	3 (c,d)	(48)	3
(09)	4	(19)	4	(29)	1	(39)	5 (a,c,d)	(49)	3
(10)	3	(20)	1	(30)	4	(40)	2 (b,c)	(50)	5