නව නිර්දේශය/புதிய பாடத்திட்டம்/New Syllabus



අධ්‍යයන පොදු සහතික පත්‍ර (උසස් පෙළ) විභාගය, 2020
கல்விப் பொதுத் தராதரப் பத்திர (உயர் தர)ப் பரீட்சை, 2020
General Certificate of Education (Adv. Level) Examination, 2020

රසායන විද්‍යාව I
இரசாயனவியல் I
Chemistry I

02 E I

පැය දෙකයි
இரண்டு மணித்தியாலம்
Two hours

**Instructions:**

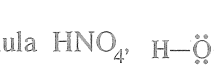
* *Periodic Table is provided.*
* *This paper consists of* **09** *pages.*
* *Answer* ***all*** *the questions.*
* ***Use of calculators is not allowed.***
* *Write your* ***Index Number*** *in the space provided in the answer sheet.*
* *Follow the instructions given on the back of the answer sheet carefully.*
* *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*** (×) ***in accordance with the instructions given on the back of the answer sheet.***

Universal gas constant $R = 8.314\ J\ K^{-1}\ mol^{-1}$ Planck's constant $h = 6.626 \times 10^{-34}\ J\ s$
Avogadro constant $N_A = 6.022 \times 10^{23}\ mol^{-1}$ Velocity of light $c = 3 \times 10^{8}\ m\ s^{-1}$

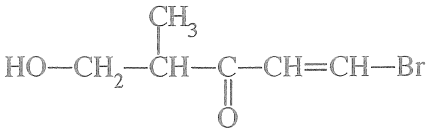
1. Consider the following discoveries made with regard to the atomic structure.
   I. Positive rays inside a cathode ray tube
   II. Radioactivity by certain types of nuclei
   The two scientists who discovered the above stated I and II respectively, are,
   (1) J. J. Thomson and Henry Becquerel
   (2) Eugen Goldstein and Robert Millikan
   (3) Henry Becquerel and Eugen Goldstein
   (4) J. J. Thomson and Ernest Rutherford
   (5) Eugen Goldstein and Henry Becquerel

2. The number of electrons in the manganese atom (Mn, Z = 25) that have quantum numbers $l = 0$ and $m_l = -1$ respectively are,
   (1) 6 and 4 (2) 8 and 12 (3) 8 and 5 (4) 8 and 6 (5) 10 and 5

3. M is an element that belongs to the second period in the Periodic Table. It forms a covalent molecule $MCl_3$ which has a dipole moment. The group of the Periodic Table to which M belongs is,
   (1) 2 (2) 13 (3) 14 (4) 15 (5) 16

4. The number of **unstable** Lewis dot-dash structures that can be drawn for the peroxynitric acid molecule (formula $HNO_4$,  ) is,
   (1) 1 (2) 2 (3) 3 (4) 4 (5) 5

5. The IUPAC name of the given compound is,
   (1) 1-bromo-4-methyl-5-hydroxypent-1-en-3-one
   (2) 5-bromo-1-hydroxy-2-methylpent-4-en-3-one
   (3) 1-bromo-5-hydroxy-4-methylpent-1-en-3-one
   (4) 5-bromo-2-methyl-3-oxopent-4-en-1-ol
   (5) 1-bromo-4-methyl-3-oxopent-1-enol



[See page two

6. The **decreasing** order of radii of the species O, $O^{2-}$, F, $F^-$, $S^{2-}$, $Cl^-$ is,

(1) $S^{2-} > Cl^- > O^{2-} > F^- > O > F$
(2) $S^{2-} > Cl^- > O^{2-} > F^- > F > O$
(3) $Cl^- > S^{2-} > O^{2-} > F^- > O > F$
(4) $Cl^- > S^{2-} > F^- > O^{2-} > O > F$
(5) $S^{2-} > Cl^- > O^{2-} > O > F^- > F$

7. A rigid-closed container contains $n_1$ moles of an ideal gas at temperature $T_1$(K) and pressure $P_1$(Pa). When an additional amount of the gas was inserted into the container, the new temperature and pressure were $T_2$ and $P_2$, respectively. The total number of moles of the gas now in the container is,

(1) $\frac{n_1 T_1 P_1}{T_2 P_2}$ (2) $\frac{n_1 T_1 P_2}{T_2 P_1}$ (3) $\frac{T_2 P_2}{n_1 T_1 P_1}$ (4) $\frac{n_1 T_2 P_2}{T_1 P_1}$ (5) $\frac{n_1 T_2 P_1}{T_1 P_2}$

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. Which compound of the following, can undergo aldol condensation, when reacted with aqueous NaOH?

(1) $CH_3\overset{O}{\overset{\|}{C}}-OH$ (2) $CH_3\overset{O}{\overset{\|}{C}}-OCH_3$ (3) $H-\overset{O}{\overset{\|}{C}}-OCH_3$ (4) $CH_3CH_2\overset{O}{\overset{\|}{C}}-H$ (5) $(CH_3)_3C\overset{O}{\overset{\|}{C}}-H$

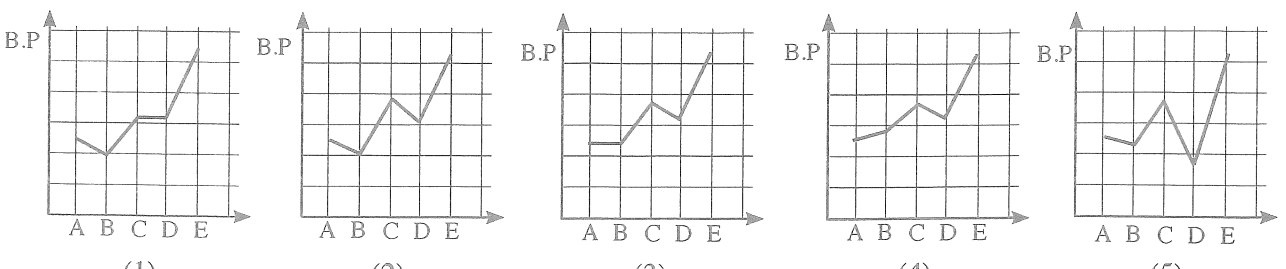
10. AX(s), $A_2Y$(s) and AZ(s) are sparingly soluble salts in water having $K_{sp}$ values of $1.6 \times 10^{-9}$, $3.2 \times 10^{-11}$ and $9.0 \times 10^{-12}$, respectively at 25 °C. Which of the following shows the order of the three saturated solutions of these salts in decreasing concentration of cation $A^+$(aq) , at 25 °C ?

(1) AX(s) > $A_2Y$(s) > AZ(s)
(2) $A_2Y$(s) > AX(s) > AZ(s)
(3) AX(s) > AZ(s) > $A_2Y$(s)
(4) $A_2Y$(s) > AZ(s) > AX(s)
(5) AZ(s) > $A_2Y$(s) > AX(s)

11. Consider the following compounds.

| | A | B | C | D | E |
|---|---|---|---|---|---|
| | $CH_3CH_2CH_2CH_2CH_2CH_3$ | $CH_3\overset{CH_3}{\overset{\|}{C}}HCH_2CH_3$ (i.e. $CH_3CH(CH_3)CH_2CH_3$) | $CH_3CH_2CH_2CH_2CHO$ | $CH_3\overset{CH_3}{\overset{\|}{C}}HCHO$ (i.e. $CH_3CH(CH_3)CHO$) | $CH_3CH_2CH_2CH_2CH_2OH$ |
| Relative molecular mass | 86 | 86 | 86 | 86 | 88 |

Variation of boiling points of these compounds is best shown by,




[See page three

12. The **increasing** order of covalent character of the chemical species NaCl, $Na_2S$, KF and KCl is,

(1) KF < NaCl < KCl < $Na_2S$
(2) KCl < NaCl < KF < $Na_2S$
(3) KF < KCl < NaCl < $Na_2S$
(4) $Na_2S$ < NaCl < KCl < KF
(5) KF < $Na_2S$ < NaCl < KCl

13. Standard combustion enthalpies of $H_2(g)$, C(s) and $CH_3OH(l)$ at 298 K are –286 kJ $mol^{-1}$, –393 kJ $mol^{-1}$ and –726 kJ $mol^{-1}$, respectively. Enthalpy of vaporization of $CH_3OH(l)$ is +37 kJ $mol^{-1}$. Enthalpy of formation (kJ $mol^{-1}$) of one mole of **gaseous** $CH_3OH$ at 298 K is,

(1) –276 (2) –239 (3) –202 (4) +84 (5) +202

14. Phosphorous can be prepared in an electric furnace as given by the following balanced chemical equation.

$$2\,Ca_3(PO_4)_2 + 6\,SiO_2 + 10\,C \longrightarrow 6\,CaSiO_3 + 10\,CO + P_4$$

When 620 g of $Ca_3(PO_4)_2$, 180 g of $SiO_2$ and 96 g of C were reacted, 50 g of $P_4$ were obtained. Under these conditions, the limiting reagent (reagent that is completely consumed) and percentage yield of $P_4$ respectively are, (C = 12, O = 16, Si = 28, P = 31, Ca = 40)

(1) $Ca_3(PO_4)_2$ and 80.7% (2) $SiO_2$ and 80.7% (3) C and 50.4%
(4) $SiO_2$ and 40.3% (5) C and 25.2%

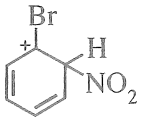
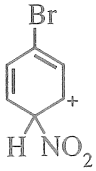
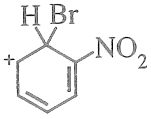
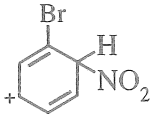
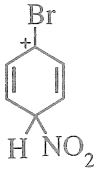
15. Consider the following two equilibria occurring in two separate rigid-closed containers under the same conditions.

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g) \;;\; K_{P_1} = 3.0 \times 10^{-4}$$
$$NH_3(g) + H_2S(g) \rightleftharpoons NH_4HS(g);\; K_{P_2} = 8.0 \times 10^{-4}$$

Under these conditions $K_p$ for the equilibrium $2\,H_2S(g) + N_2(g) + 3\,H_2(g) \rightleftharpoons 2\,NH_4HS(g)$ is,

(1) $5.76 \times 10^{-12}$ (2) $7.2 \times 10^{-10}$ (3) $1.92 \times 10^{-8}$ (4) $3.40 \times 10^{-6}$ (5) $3.75 \times 10^{-2}$

16. Consider the nitration reaction of bromobenzene. Resonance stabilized carbocation intermediates are formed during this reaction. Which of the following is **not** a resonance structure of these intermediates?

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

17. A reaction which is non-spontaneous at room temperature and 1 atm pressure becomes spontaneous at high temperature at the same pressure. Which of the following is correct for this reaction at room temperature? (Assume that $\Delta H$ and $\Delta S$ do not change with temperature and pressure.)

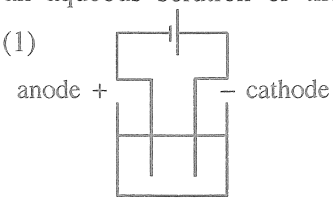
| | $\Delta G$ | $\Delta H$ | $\Delta S$ |
|---|---|---|---|
| (1) | Positive | Positive | Positive |
| (2) | Positive | Negative | Negative |
| (3) | Positive | Negative | Positive |
| (4) | Negative | Positive | Negative |
| (5) | Negative | Negative | Negative |

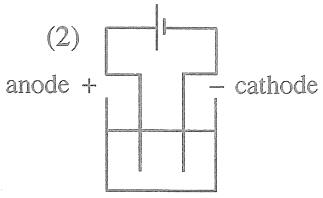
18. The de Broglie wavelength of a neutron travelling with a velocity $v$ is $\lambda$. If the kinetic energy $E$ ($E = \frac{1}{2}mv^2$) of this neutron is increased four times, the new de Broglie wavelength would be,

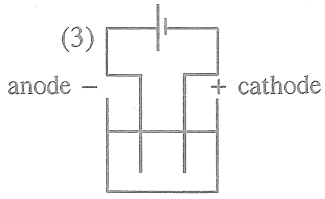
(1) $\frac{\lambda}{2}$ (2) $\frac{\lambda}{4}$ (3) $2\lambda$ (4) $4\lambda$ (5) $16\lambda$

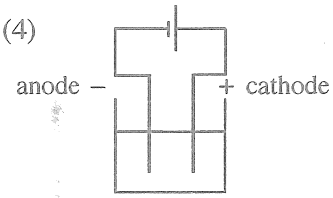
[See page four

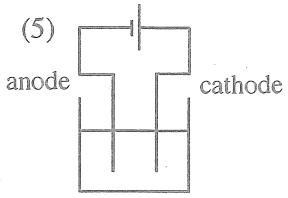
19. Which of the following correctly shows the electrolytic cell constructed for the electrolysis of an aqueous solution of the salt MX?

(1) 


(2) 


(3) 


(4) 


(5) 


20. Which of the following statements is correct regarding the reaction between a carboxylic acid and an alcohol to give an ester?

(1) The overall reaction is a nucleophilic addition reaction of a carbonyl compound.
(2) It is a reaction in which the alcohol acts as a nucleophile.
(3) It is a reaction which occurs with the cleavage of the O–H bond of the carboxylic acid.
(4) It is a reaction which occurs with the cleavage of the C–O bond of the alcohol.
(5) It is an acid-base reaction.

21. Decomposition of 1 mol of $CH_3OH(l)$ occurs at high temperatures as follows.

$$CH_3OH(l) \rightarrow CO(g) + 2H_2(g);\ \Delta H = +128\ kJ$$

Which of the following is **incorrect** for the above reaction? (H = 1, C = 12, O = 16)

(1) The heat absorbed when 1 mol of $CH_3OH(g)$ is decomposed is less than 128 kJ.
(2) Enthalpy of $CO(g) + 2H_2(g)$ is higher than the enthalpy of $CH_3OH(l)$.
(3) 128 kJ of heat is released when 1 mol of CO(g) is formed.
(4) 128 kJ of heat is absorbed during the decomposition of a mole of reactant.
(5) 128 kJ of heat is absorbed when 32 g of products are formed.

22. Identify the **incorrect** statement from the following.

(1) Electron gain energy of nitrogen [N(g)] is positive.
(2) Dilution of $BiCl_3(aq)$ solution with water gives a white precipitate.
(3) $H_2S$ gas can act both as an oxidizing agent and a reducing agent.
(4) The effective nuclear charge (Z*) felt by a valence electron in He is less than 2.
(5) Aluminium is inert towards $N_2$ gas even when heated to a high temperature.

23. The concentration of a dilute aqueous solution of a weak acid HA is C mol $dm^{-3}$ and its acid dissociation constant is $K_a$ at 298 K. Which of the following expressions gives the pH of the solution at 298 K?

(1) $pH = \frac{1}{2} pK_a - \frac{1}{2} \log C$

(2) $pH = -\frac{1}{2} pK_a - \frac{1}{2} \log C$

(3) $pH = -\frac{1}{2} pK_a + \frac{1}{2} \log C$

(4) $pH = -\frac{1}{2} pK_a - \frac{1}{2} \log (1/C)$

(5) $pH = \frac{1}{2} pK_a - \frac{1}{2} \log (1/C)$

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**24.** The strength of a $H_2O_2$ solution can be expressed as the volume of $O_2$ produced at standard temperature and pressure (STP). For example, a litre of 20 **volume strength** $H_2O_2$ solution will produce 20 litres of $O_2$ gas at STP ($2\,H_2O_2(aq) \rightarrow 2\,H_2O(l) + O_2(g)$). (Assume that 1 mole of gas has 22.4 litres volume at STP.)

A bottle labelled **X** contains $H_2O_2$ solution. When 25.0 $cm^3$ of solution **X** was titrated with 1.0 mol $dm^{-3}$ $KMnO_4$ in the presence of dilute $H_2SO_4$ the volume required to reach the end point was 25.0 $cm^3$. The volume strength of solution **X** is,

(1) 15 (2) 20 (3) 25 (4) 28 (5) 30

**25.** $M(OH)_2(s)$ is a sparingly water soluble salt formed by the reaction between $M^{2+}(aq)$ and $OH^-(aq)$ ions at 298 K. The solubility (mol $dm^{-3}$) of $M(OH)_2(s)$ in water at pH = 5 is, ($K_{sp\,M(OH)_2} = 4.0 \times 10^{-36}$ at 298 K).

(1) $\sqrt{2} \times 10^{-18}$ (2) $2 \times 10^{-18}$ (3) $1 \times 10^{-18}$ (4) $\sqrt[3]{2} \times 10^{-12}$ (5) $1 \times 10^{-12}$

**26.** Which of the following correctly denotes the standard galvanic cell constructed by using a standard hydrogen electrode, a standard Mg–electrode and a salt-bridge at 298 K?

(1) $Mg(s) \mid Mg^{2+}(aq, 1.00\ mol\ dm^{-3}) \parallel H^+(aq, 1.00\ mol\ dm^{-3}) \mid H_2(g) \mid Pt(s)$

(2) $Pt(s) \mid H_2(g) \mid H^+(aq, 1.00\ mol\ dm^{-3}) \parallel Mg^{2+}(aq, 1.00\ mol\ dm^{-3}) \mid Mg(s)$

(3) $Mg(s), Mg^{2+}(aq, 1.00\ mol\ dm^{-3}) \parallel H^+(aq, 1.00\ mol\ dm^{-3}) \mid H_2(g) \mid Pt(s)$

(4) $Mg(s) \mid Mg^{2+}(aq, 1.00\ mol\ dm^{-3}), H^+(aq, 1.00\ mol\ dm^{-3}), H_2(g) \mid Pt(s)$

(5) $Pt(s), H_2(g) \mid H^+(aq, 1.00\ mol\ dm^{-3}) \parallel Mg^{2+}(aq, 1.00\ mol\ dm^{-3}), Mg(s)$

**27.** The following procedure was carried out at 298 K to determine the distribution coefficient $K_D$ of a monobasic organic acid between dichloromethane and water. 50.00 $cm^3$ of a 0.20 mol $dm^{-3}$ aqueous solution of acid were mixed vigorously with 10.00 $cm^3$ of dichloromethane and the two layers were allowed to separate. Thereafter, the dichloromethane layer in the bottom of the flask was drained out. 10.00 $cm^3$ of 0.02 mol $dm^{-3}$ NaOH(aq) solution were required to neutralize the acid remaining in the aqueous layer. (Assume that the acid does not dimerize in the organic phase.)

$K_D$ of the acid between **dichloromethane and water** at 298 K is,

(1) 0.05 (2) 0.25 (3) 4.00 (4) 20.00 (5) 245.00

**28.** A reaction $C_2H_4(g) + 3O_2(g) \rightarrow 2CO_2(g) + 2H_2O(g)$ occurs in a rigid-closed container at a given temperature. After a certain time, it was found that the rate of the reaction with respect to consumption of $C_2H_4(g)$ was $x$ mol $dm^{-3}\ s^{-1}$. Which of the following shows the rates of consumption of $O_2(g)$, formation of $CO_2(g)$ and formation of $H_2O(g)$ respectively, during that time?

| | rate / mol $dm^{-3}\ s^{-1}$ | | |
|---|---|---|---|
| | $O_2(g)$ | $CO_2(g)$ | $H_2O(g)$ |
| (1) | $\frac{3}{x}$ | $\frac{2}{x}$ | $\frac{2}{x}$ |
| (2) | $x$ | $x$ | $x$ |
| (3) | $\frac{x}{3}$ | $\frac{x}{2}$ | $\frac{x}{2}$ |
| (4) | $\frac{1}{x}$ | $\frac{1}{x}$ | $\frac{1}{x}$ |
| (5) | $3x$ | $2x$ | $2x$ |

**29.** Consider the following reaction occurring in a rigid-closed container at temperature $T$.

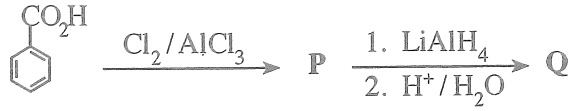
$$\mathbf{M}(g) + \mathbf{Q}(g) \rightarrow \mathbf{R}(g) + \mathbf{Z}(g)$$

The rate of reaction doubled when the concentration of **M** was doubled. The rate of reaction is $5.00 \times 10^{-4}$ mol $dm^{-3}\ s^{-1}$ when the concentrations of **M** and **Q** are $1.0 \times 10^{-5}$ mol $dm^{-3}$ and 2.0 mol $dm^{-3}$ respectively. The rate constant of the reaction under these conditions is,

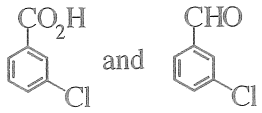
(1) $2.5 \times 10^{-4}\ s^{-1}$ (2) $12.5\ s^{-1}$ (3) $25\ s^{-1}$ (4) $50\ s^{-1}$ (5) $500\ s^{-1}$

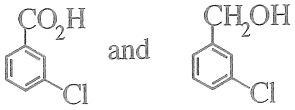
[See page six

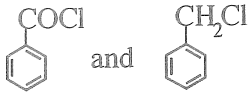
**30.** Consider the following reaction scheme.

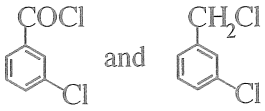


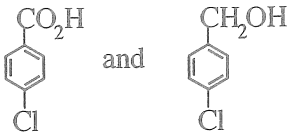
**P** and **Q** respectively could be,

(1) 

(2) 

(3) 

(4) 

(5) 

- 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. 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 |

**31.** Which of the following statement/s is/are correct with regard to 3*d*-block elements and their compounds?

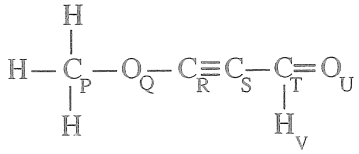
(*a*) Among the 3*d*-block elements, Sc is not considered as a transition element.

(*b*) The radii of atoms (Sc to Cu) decrease from left to right.

(*c*) $[Ni(NH_3)_6]^{2+}$ is blue in colour whereas $[Zn(NH_3)_4]^{2+}$ is colourless.

(*d*) The IUPAC name of $K_2NiCl_4$ is dipotassium tetrachloronickelate(II).

**32.** Which statement/s is/are correct regarding the following molecule?



(*a*) Atoms labelled P, Q, R and S lie on a straight line.

(*b*) Atoms labelled Q, R, S and T lie on a straight line.

(*c*) Atoms labelled R, S, T, U and V lie on the same plane.

(*d*) Atoms labelled R, S, T and U lie on a straight line.

**33.** 0.01 moles of $N_2(g)$, 0.10 moles of $H_2(g)$ and 0.40 moles of $NH_3(g)$ were inserted into a 1.0 $dm^3$ rigid-closed container and allowed to reach equilibrium at 500 K as given below.

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g) \qquad K_C = 2.0 \times 10^2\ mol^{-2}\ dm^6$$

Which of the following statement/s is/are correct for the changes in the system from the initial stage to equilibrium? $Q_C$ is the reaction quotient.

(*a*) Initially $Q_C > K_C$; $NH_3(g)$ starts to produce $N_2(g)$ and $H_2(g)$ and the system reaches equilibrium.

(*b*) Initially $Q_C < K_C$; $NH_3(g)$ starts to produce $N_2(g)$ and $H_2(g)$ and the system reaches equilibrium.

(*c*) Initially $Q_C < K_C$; $N_2(g)$ and $H_2(g)$ react to form $NH_3(g)$ and the system reaches equilibrium.

(*d*) Initially $Q_C > K_C$; $N_2(g)$ and $H_2(g)$ react to form $NH_3(g)$ and the system reaches equilibrium.

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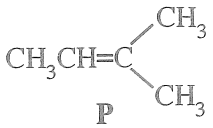
34. Which of the following statement/s regarding the reaction between compound **P** and HCl to form an alkyl halide is/are correct?



**P**

(*a*) The major product is 2-chloro-2-methylbutane.
(*b*) A secondary carbocation is formed as an intermediate in this reaction.
(*c*) In one of the steps of the reaction, the HCl bond is cleaved to give a chlorine radical ($Cl^{\bullet}$).
(*d*) In one of the steps of the reaction, a nucleophile reacts with a carbocation.

35. A binary liquid mixture prepared by mixing two liquids in a closed evacuated container at a given temperature shows a negative deviation from Roult's Law. Which of the following statement/s is/are correct for this system?
(*a*) Total vapour pressure of the mixture is less than the expected total vapour pressure should it behave as an ideal mixture.
(*b*) Heat is released when the mixture is formed.
(*c*) Number of molecules in the vapour phase of the mixture is greater than the expected number of molecules should it behave as an ideal mixture.
(*d*) Heat is absorbed when the mixture is formed.

36. Which of the following statement/s is/are correct with regard to CFC, HCFC and HFC?
(*a*) Both classes of compounds CFC and HCFC have the ability to produce chlorine free radicals in the upper atmosphere (stratosphere).
(*b*) Both classes of compounds HFC and HCFC have the ability to produce chlorine free radicals in the upper atmosphere (stratosphere).
(*c*) All three classes of compounds CFC, HCFC and HFC are strong greenhouse gases.
(*d*) All three classes of compounds CFC, HCFC and HFC contribute significantly to ozone layer depletion.

37. Which of the following statement/s is/are correct with regard to halogens, noble gases and their compounds?
(*a*) Hypochlorous ion disproportionates rapidly in acidic solutions.
(*b*) Xe forms a series of compounds with $F_2$ gas, among which $XeF_4$ has a square planar geometry.
(*c*) Among the hydrogen halides, HF has the highest bond dissociation energy per mole.
(*d*) Boiling points of halogens increase down the group as a result of increasing strength of London forces.

38. Which of the following statement/s is/are correct regarding the Daniell cell when it operates at room temperature? ($E^{\circ}_{cell}$ = +1.10 V)
(*a*) Net electron flow occurs from Zn to Cu.
(*b*) The equilibrium $Zn^{2+}(aq) + 2e \rightleftharpoons Zn(s)$ shifts to the right.
(*c*) A liquid-junction potential is created due to the presence of a salt-bridge.
(*d*) The equilibrium $Cu^{2+}(aq) + 2e \rightleftharpoons Cu(s)$ shifts to the right.

39. Which of the following statement/s is/are correct for ideal gases and real gases at constant temperature?
(*a*) At very high pressures, the volume of a real gas is higher than that of an ideal gas.
(*b*) At high pressures, real gases tend to behave as ideal gases.
(*c*) At very high pressures, the volume of a real gas is lower than that of an ideal gas.
(*d*) At low pressures, real gases tend to behave as ideal gases.

40. Which of the following statement/s is/are correct regarding some industrial processes?
(*a*) The first two steps involved in the manufacture of $Na_2CO_3$ by Solvay Process are endothermic.
(*b*) The presence of $Mg^{2+}$, $Ca^{2+}$ and $SO_4^{2-}$ ions in brine, hinders the production of NaOH using the membrane cell method.
(*c*) The first step involved in the manufacture of nitric acid by Ostwald method is the oxidation of $NH_3$ gas using $O_2$ in air in the presence of a catalyst to give $NO_2$ gas.
(*d*) High temperature and low pressure conditions are employed in the manufacture of $NH_3$ gas using Haber-Bosh process.

[*See page eight*

- In question Nos. **41** to **50**, 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 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 |
|---|---|---|
| **41.** | Among the oxides of Cr and Mn, CrO and MnO are acidic, while $CrO_3$ and $Mn_2O_7$ are basic. | The acidic/basic nature of the oxides of Cr and Mn is dependant on the oxidation number of the metal. |
| **42.** | An acidic buffer solution can be prepared by mixing a weak acid HA(aq) with its sodium salt NaA(aq). | When $OH^-(aq)$ or $H^+(aq)$ ions are added to a buffer solution, the added amounts of $OH^-(aq)$ or $H^+(aq)$ ions are removed through the reactions; $OH^-(aq) + HA(aq) \rightarrow A^-(aq) + H_2O(l)$ and $H^+(aq) + A^-(aq) \rightarrow HA(aq)$ respectively. |
| **43.** | Essential oils can be extracted from plants by steam distillation at a temperature below 100 °C. | At the temperature at which a mixture of essential oil and water boils, the total vapour pressure of the system is less than the atmospheric pressure. |
| **44.** | At a given temperature and pressure the molar volumes of two different ideal gases are different from each other. | At 0 °C temperature and 1 atm pressure, the molar volume of an ideal gas is 22.4 $dm^3\ mol^{-1}$. |
| **45.** | All compounds having a C=C bond show diastereoisomerism. | Any two isomers which are not mirror images of each other are diastereoisomers. |
| **46.** | Hydrogenation of benzene is more difficult than hydrogenation of alkenes. | Addition of hydrogen to benzene results in the loss of aromatic stabilization. |
| **47.** | The reaction that takes place between $SO_3$ gas and water in the production of sulphuric acid is endothermic. | $SO_3$ gas reacts with concentrated $H_2SO_4$ to give oleum. |
| **48.** | Reaction between ammonia and an alkylhalide gives a mixture of primary, secondary and tertiary amines and a quaternary ammonium salt. | Primary, secondary and tertiary amines can react as nucleophiles. |
| **49.** | If $P + Q \rightarrow R$ is a first order reaction with respect to the reactant P, the graph of rate against concentration of P gives a straight line passing through the origin. | Initial rate of a first order reaction is independent of the concentration of reactant(s). |
| **50.** | On a sunny day, strong photochemical smog can be seen in a city with heavy traffic congestion. | Photochemical smog is caused entirely by scattering of solar radiation by small particles and water droplets that are emitted by vehicle exhaust systems. |

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[*See page nine*

## The Periodic Table

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | | | | | | | | | | | | | | | | 2 |
| 1 | H | | | | | | | | | | | | | | | | He |
| | 3 | 4 | | | | | | | | | | | 5 | 6 | 7 | 8 | 9 | 10 |
| 2 | Li | Be | | | | | | | | | | | B | C | N | O | F | Ne |
| | 11 | 12 | | | | | | | | | | | 13 | 14 | 15 | 16 | 17 | 18 |
| 3 | Na | Mg | | | | | | | | | | | Al | Si | P | S | Cl | Ar |
| | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 |
| 4 | K | Ca | Sc | Ti | V | Cr | Mn | Fe | Co | Ni | Cu | Zn | Ga | Ge | As | Se | Br | Kr |
| | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 |
| 5 | Rb | Sr | Y | Zr | Nb | Mo | Tc | Ru | Rh | Pd | Ag | Cd | In | Sn | Sb | Te | I | Xe |
| | 55 | 56 | La- | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 |
| 6 | Cs | Ba | Lu | Hf | Ta | W | Re | Os | Ir | Pt | Au | Hg | Tl | Pb | Bi | Po | At | Rn |
| | 87 | 88 | Ac- | 104 | 105 | 106 | 107 | 108 | 109 | 110 | 111 | 112 | 113 | 114 | 115 | 116 | 117 | 118 |
| 7 | Fr | Ra | Lr | Rf | Db | Sg | Bh | Hs | Mt | Ds | Rg | Cn | Nh | Fl | Mc | Lv | Ts | Og |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 57 | 58 | 59 | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 |
| La | Ce | Pr | Nd | Pm | Sm | Eu | Gd | Tb | Dy | Ho | Er | Tm | Yb | Lu |
| 89 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 100 | 101 | 102 | 103 |
| Ac | Th | Pa | U | Np | Pu | Am | Cm | Bk | Cf | Es | Fm | Md | No | Lr |