G.C.E. (A/L) Examination 2010 August
Chemistry I / Two hours

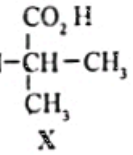
Instructions :

- *This paper consists of 09 pages (Periodic Table is provided on page 10)*
- *Answer all the questions.*
- *Use of calculators is not allowed.*
- *Write your Index Number in the space provided in the answer sheet.*
- *instructions are given on the back of the answer sheet. Follow those carefully.*
- *In each of the questions 1 to 60, 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) on the number of the correct option in accordance with the instructions given on the back of the answer sheet.*

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

1. The periods in the periodic table that contain elements found in all three physical states (solid, liquid and gas) at room temperature and atmospheric pressure are,
(1) 2 and 4 (2) 3 and 4 (3) 3 and 6
(4) 4 and 5 (5) 4 and 6

2. The IUPAC name of the compound X is



(1) 1,2 -dimethylpent-3-enoic acid
(2) 3-methylhex-4-en-2-oic acid
(3) 4,5-dimethyl-2-hexenoic acid
(4) 2,3-dimethyl-4-hexenoic acid
(5) 4-methyl-2-hexenoic acid

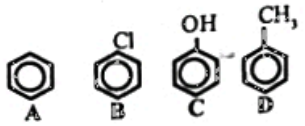
X

3. A certain salt dissolves in water and gives a coloured solution. When dil. NaOH is added to this solution, a pale green precipitate is formed. When NH_4OH is added to this precipitate, it dissolves forming a blue solution. The cation present in the salt is,
(1) Co^{2+} (2) Ni^{2+} (3) Fe^{2+} (4) Fe^{3+} (5) Cr^{3+}

4. When 100 cm3 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

5. Identify the molecule or ion from those given below whose shape is distinctly different from that SO_3^{2-}
(1) ClO_3^- (2) PCl_3 (3) $SOCl_2$ (4) H_3O^+ (5) NO_3^-

6. The increasing order in the rate of reaction of the compounds A,B,C and D given, when taking part electrophilic substitution reactions is,
(1) A< B< C<D
(2) B < D <A< C
(3) B < A <C< D
(4) B < A <D< C
(5) D < B <A< C



7. $CH_3CH_2CH_2CH_2OH$ (A) $CH_3CH_2CH_2OH$ (B) $CH_3CH_2CH_2CHO$ (C)
$CH_3CH_2CH_2CH_2Cl$ (D)

The increasing order of the solubility of the above compounds in water is,
(1) C< D < A< B (2) D < C < A< B
(3) D < C < B< A (4) C< D < B < A
(5) A< D < C< B

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}

9. Which molecule or ion from those given below has the highest dipole moment?
(1) O_3 (2) NH_3 (3) NO_2^+ (4) $AlCl_3$
(5) ICl_4^-

10. The increasing order of boiling points of CO_2, SO_2, N_2, He and Ne is
(1) He< Ne < N_2< CO_2< SO_2
(2) He< Ne<CO_2 <N_2 <SO_2
(3) He< Ne< N_2< SO_2< CO_2
(4) Ne< He< N_2< CO_2< SO_2
(5) Ne< He< CO_2< SO_2< N_2

11. A, B and C are three metals. Under standard conditions, when B is placed in a solution of either $A^{2+}(aq)$, $C^{2+}(aq)$ is oxidized. However, when C is placed in a solution $A^{2+}(aq)$, C is not oxidized.

$E^\ominus (pb^{2+}/pb) = -0.13V$; $E^\ominus (Zn^{2+}/Zn) = -0.76V$
$E^\ominus (Cu^{2+}/Cu) = +0.34V$

According to the standard reduction potentials given above, the metals A, B and C respectively are,
(1) pb, Zn and Cu (2) Zn, Cu and pb
(3) Zn, and Cu (4) pb, Cu and Zn
(5) Cu, Zn and pb

12. The compound $CH_3CH_2-\overset{O}{\overset{\|}{C}}-OCH_3$ was reacted with aqueous NaOH. The products in the flask at the end of the reaction are,
(1) $CH_3CH_2CO_2H + CH_3OH$
(2) $CH_3CH_2OH + CH_3CH_2CO_2^-Na^+$
(3) $CH_3CO_2^-Na^+ + CH_3O^-Na^+$
(4) $CH_3CH_2CO_2^-Na^+ + CH_3OH$
(5) $CH_3CH_2CO_2H + CH_3O^-Na^+$

13. Consider the enthalpy changes for the three reactions given below

$H_2(g) + O(g) \rightarrow H_2O(g)$; $\Delta H_1 = -a\ kJ\ mol^{-1}$
$H_2(g) + \frac{1}{2}O_2(g) \rightarrow H_2O(g)$; $\Delta H_2 = -b\ kJ\ mol^{-1}$
$2H(g) + O(g) \rightarrow H_2O(g)$; $\Delta H_3 = -c\ kJ\ mol^{-1}$

The decreasing order of the numerical value of the enthalpy changes is,
(1) c > a> b (2) b > a > c (3) c > b> a
(4) b > c> a (5) a > b> c

14. When a mixture of 4.0g 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

15. The equilibrium constants at a particular temperature of the reactions,

$A(g) \rightleftharpoons 2B(g)$ and $B(g) \rightleftharpoons C(g) + D(g)$

are K_1 and K_2, respectively. The equilibrium constant of the reaction,

$A(g) \rightleftharpoons 2C(g) + 2D(g)$

at the same temperature is

(1) K_1+K_2 (2) $K_1 K_2$ (3) $K_1K^2_2$
(4) $2K_1K_2$ (5) $K_1 + 2K_2$

16. Which of thje following statements is not true regarding sub-atomic particles?
(1) Electrons show both wave properties and particle properties.
(2) Electrons in an atom are dispersed in 3-dimensional regions of space around the nucleus referred to as orbitals.
(3) The neutron was detected when beryllium was bombarded with high energy α particles (helium nuclei)
(4) The neutron is an uncharged particle with its mass approxi mately equal to that of the proton.
(5) The numbers of protons in isotopes of an element are differ ent from each other.

17. Consider the statements given below regarding 1- butyne.
(a) All carbon atoms of this molecule lie on the same straight line.
(b) It reacts with $NaNH_2$ and evolves H_2.
(c) It decolourizes bromine water.
(d) It reacts with Ag^+ and forms a silver mirror.

Which of the above statements is/are true?
(1) (a), (b) and (c) only. (2) (b), (c) and (d) only
(3) (c) and (d) only. (4) (c) only.
(5) (d) only.

18. Solubility product of Hg_2Cl_2 at 25°C is 1.2×10^{-18} mol^3 dm^{-9} The concentration Hg_2^{2+} ions (in mol dm^{-3}) in a 0.040 mol dm^{-3} aqueous NaCl solution saturated with Hg_2Cl_2 at 25°C is,
(1) 1.1×10^{-9} (2) 7.5×10^{-15} (3) 7.5×10^{-16}
(4) 3.0×10^{-17} (5) 3.6×10^{-20}

19. $\overset{a}{CH_3} - C \equiv C - \overset{b}{H}$ $\overset{c}{CH_3} - \overset{O}{\overset{\|}{C}} - H$

The increasing order of acidity of H atoms marked as a,b and c of the above two compounds is,
(1) a < b < c (2) b < a < c (3) a < c < b
(4) c < a < b (5) c < b < a

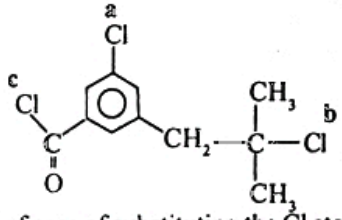
20. Which of the following statements is true regarding patterns shown in the s and p block elements in the periodic table?
(1) Atomic size decreases down a group.
(2) Atomic size increases across a period from left to right.
(3) Ionic radius decreases down a group.
(4) Metallic nature increases across a period form left to right.
(5) The basic nature of oxides and hydroxides decreases across a period from left to right.

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 com plete. The mass of the dried precipitate was 0.200 g. The per cent 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

22. The pH of a monobasic weak acid solution is 3.0. The pH of the same solution upon dilution of 100 times (at the same tempera ture) could be,
(1) 2.0 (2) 3.0 (3) 4.0 (4) 5.0 (5) 6.0

23. Which of the following statements is not true for a sample of an ideal gas according to the kinetic molecular theory of gases?
(1) The total energy of molecules does not change during colli sions at constant temperature.
(2) The root mean square velocity depends on the type of the gas.
(3) The mean kinetic energy of a gas molecule is proportional to the absolute temperature.
(4) The size of a gas molecule is considered as negligible com pared to the volume of the container.
(5) The mean kinetic energy of a gas molecule increases with increasing pressure at constant temperature.

24. Consider the following compound :



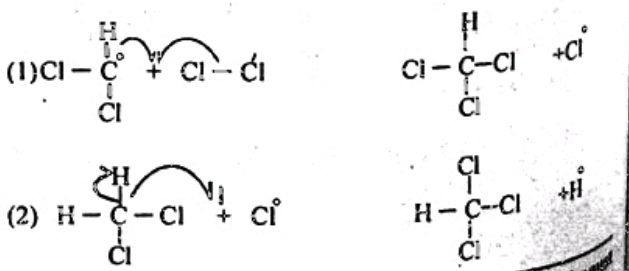
The order of ease of substituting the Cl atoms marked a,b and c in the above compound with OH by reacting the compound with hydroxyl ions is,
(1) b>a>c (2) b>c>a (3) a>b>c (4) c>b>a (5) c>a>b

25. Which one of the following statements is true regarding the kinetics of chemical reactions?
(1) The unit of the rate of a reaction depends on the overall order of the reaction.
(2) A mathematical expression for the rate of any reaction can be written using the balanced overall chemical equation.
(3) Rates of all reactions increase with increasing temperature.
(4) The overall rate of a multi-step reaction depends on the rates of all steps.
(5) The activation energy of a reaction changes when the initial concentrations of the reactants are changed.

26. The correct chemical formula of pentaamminehydroxocobalt(III) nitrate is,
(1) $[Co(OH)(NH_3)_5]NO_3$ (2) $[Co(NH_3)_5(OH)(NO_3)]$
(3) $[Co(OH)(NH_3)_5](NO_3)_2$ (4) $[Co(NH_3)_5(OH)]_2(NO_3)$
(5) $[Co(OH)(NH_3)_5](NO_3)_3$

27. Which of the following statements is true regarding the element lithium?
(1) Lithium burns in air to form Li_2O and LiN_3.
(2) Lithium forms a solid hydrogen carbonate, $LiHCO_3$.
(3) Among group I metals, lithium reacts less vigourously with water.
(4) Lithium carbonate is stable to heat.
(5) Lithium nitrate on heating gives O_2 as the only gas.

28. Which of the following correctly represents a step in the mecha nism of the chlorination of methane.?



(3) 

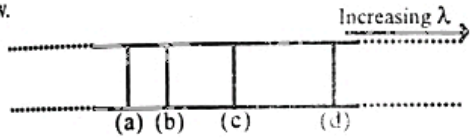
(4) 

(5) 

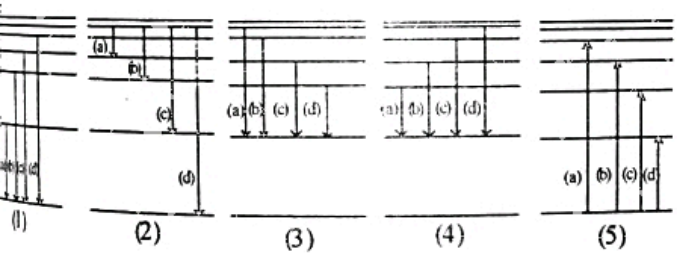
29. Consider the solubility product of $Fe(OH)_2$ in aqueous medium at constant temperature. If the pH of the solution is increased from 8.0 to 9.0, the solubility of $Fe(OH)_2$ is,

(1) unchanged (2) increased by a factor of 100
(3) decreased by a factor of 10 (4) decreased by a factor of 100
(5) decreased by a factor of 1000

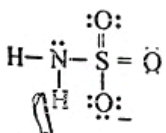
30. A part of the emission spectrum of atomic hydrogen is given below.



Which of the following diagrams represents the electronic transitions corresponding to the lines labelled as (a), (b), (c) and (d)?

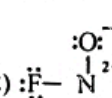


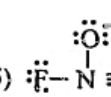
31. The oxidation numbers of nitrogen and sulphur atoms in the following ion are respectively.



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

32. The correct structural formula of NO_2F is

(1)  (2)  (3) 

(4)  (5) 

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

34. The two volatile solvents A and B mix in all proportions forming ideal solutions. At a given temperature, the vapour pressures of pure solvents of A and B are P^o_A and P^o_B respectively, and at the same temperature, the mole fractions of A and B in solution are X_A and X_B, respectively. The partial pressures of A and B in the vapour phase at equilibrium with the solution are P_A and P_B respectively. Which one of the following mathematical expressions is correct for the above system?

(1) $\frac{P^o_A - P_A}{P^o_B} = X_B$ (2) $\frac{P^o_B - P_B}{P^o_B} = X_A$

(3) $\frac{P^o_A - P_A}{P_A} = X_B$ (4) $\frac{P^o_A - P_A}{P^o_A} = X_A$

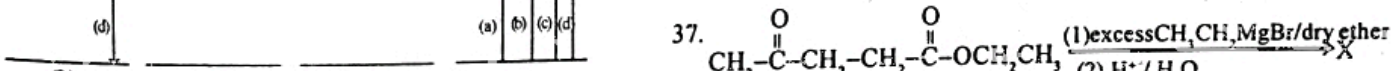
(5) $\frac{P^o_B - P_B}{P^o_B} = 1 - X_A$

35. A salt containing only one type of an anion, gives a colourless gas when reacted with dil. HCl. This gas decolourizes a piece of filter paper dipped in acidified $KMnO_4$. Which one of the following could not be the anion?

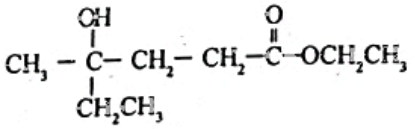
(1) SO_3^{2-} (2) SO_4^{2-} (3) HSO_3^- (4) S^{2-} (5) $S_2O_3^{2-}$

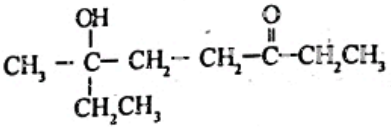
36. A well water sample was found to contain Ca^{2+}, NO_3^-, HCO_3^- and Cl^- ions. A 25.0 cm^3 portion of the water sample was titrated with 0.010 mol dm^{-3} H_2SO_4 using methyl orange as the indicator. The colour of the solution changed from yellow to pink when the burette reading was 5.00 cm^3.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

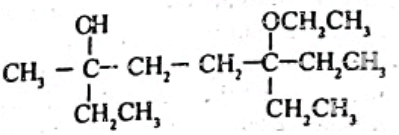
(1) 200 (2) 100 (3) 75 (4) 50 (5) 25

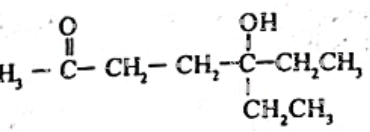
37. 

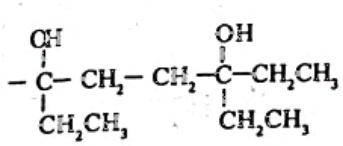
The structure of X in the reaction given above is,

(1) 

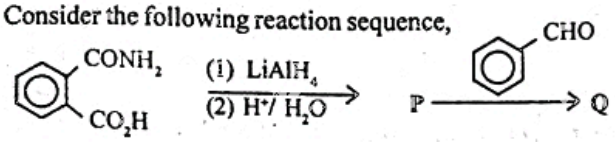
(2) 

(3) 

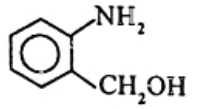
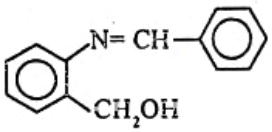
(4) 

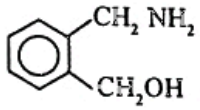
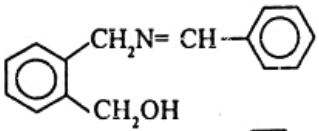
(5) 

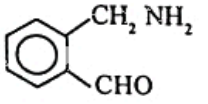
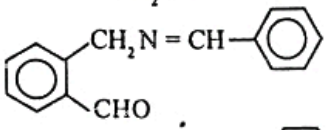
38. Consider the following reaction sequence,

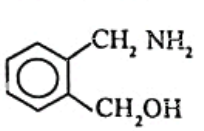
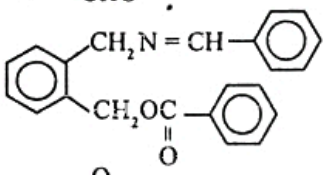


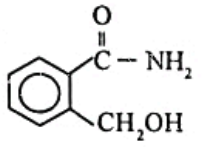
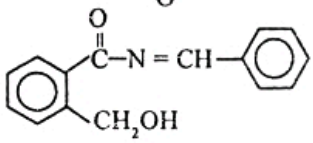
P and Q respectively are,

(1)  and 

(2)  and 

(3)  and 

(4)  and 

(5)  and 

○ Questions 39 and 40 are based on the following experiment :

A series of solutions of different concentrations of a substance, S, was prepared in water. Each solution was then thoroughly shaken with chloroform and allowed to reach equilibrium. Substance S is more soluble in chloroform than in water, and it does not undergo any chemical reaction with water or chloroform.

39. For each of the above equilibria, the concentration of S in the organic phase (Y - axis) versus the concentration of S in the aqueous phase (X - axis)was plotted in order to investigate the distribution of S between two phases.
Which of the following statements is true regarding the above graph?
(1) The graph is not a straight line.
(2) The slope of the graph is temperature dependent.
(3) The slope of the graph increases with increasing the concentrations of S in the aqueous phase.
(4) The slope of the graph decreases when the volume of the aqueous layer is decreased.
(5) The graph does not go through the origin.

40. The partition coefficent of S between the two phases is P and P>1. In any of the above equilibria the volumes of aqueous and chloroform phases used are V_{aq} and V_{or} respectively, and the masses of S initially present (before equilibration) in aqueous phase and that remained after equilibration in aqueous phase are m and x respectively. Which one of the following expressions represents x correctly?

$\frac{V_{or}}{V_{aq}}$

(1) $\frac{mPV_{or}V_{aq}}{PV_{or}+V_{aq}}$ (2) $\frac{mV_{aq}}{PV_{or}+V_{aq}}$ (3) $\frac{PV_{or}+V_{aq}}{mV_{aq}}$

(4) $\frac{V_{aq}}{PV_{or}+V_{aq}}$ (5) $\frac{mV_{or}}{PV_{or}+V_{aq}}$

○ **Instructions for questions No. 41 to 50.**
For each of the questions 41 to 50, four responses (a), (b), (c) and (d) are given; out of which, one or more 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.

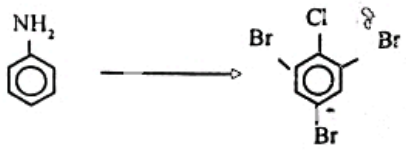
Summary of above Instructions

(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.

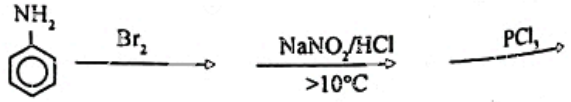
41. Which of the following statements regarding a catalyst is/are valid?
(a) It changes the enthalpy of a chemical reaction.
(b) It decreases the activation energy of a chemical reaction.
(c) It is not consumed during a chemical reaction.
(d) It increases both the rates of forward and reverse reactions of a chemical reaction at equilibrium by the same factor.

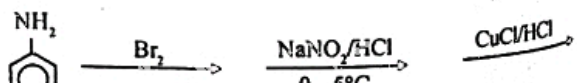
42. Which of the following statements is/are true regarding electronegativity of elements?
(a) Electronegativity is defined as the tendency of an atom to attract electrons to itself.
(b) Electronegativity values of the elements within a group increases in going down the group.
(c) Electronegativity of atoms with nearly filled outer most shell of electrons generally has higher values than those with sparsely filled outer most shell of electrons.
(d) The ionic character of a covalent bond increases when the difference between the Electronegativities of the two atoms forming the bond increases.

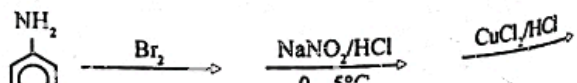
43. Which of the following statements is/are true regarding polymers?
(a) Phenol-formaldehyde is a thermosetting polymer.
(b) $CH_2=CH_2$ undergoes addition polymerization to form polyethylene (polythene).
(c) In natural rubber, there are two carbon-carbon double bonds in each repeating unit.
(d) Polystyrene decolourizes bromine water.

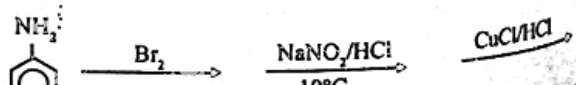
44. 

The conversion gives above could be done by.

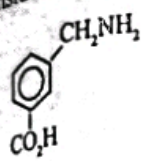
(a) 

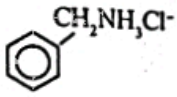
(b) 

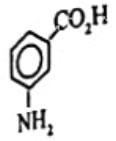
(c) 

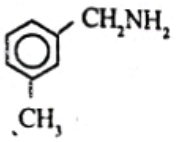
(d) 

45. Consider the following compounds

(a) 

(b) 

(c) 

(d) 

What compounds show all of the following observations?

(i) Liberates CO_2 with Na_2CO_3 solution.

(ii) Liberates a gas with $NaNO_2$ and dil. HCl at 25°C.

(iii) Gives a green coloured solution, when the solution from test (ii) above is warmed with a small amount of $K_2Cr_2O_7$.

46. Corrosion of an underground iron pipeline can be prevented by welding a metal M to the pipeline. Which of the following state ments is/are true regarding this process?

(a) The metal M can be Mg.

(b) The metal M undergoes oxidation.

(c) The matal M can be Cu.

(d) An anodic reaction can occur on the surface of the pipeline.

47. At 300 K, a closed, rigid vessel contains equal masses of He and Ne gases. Which of the following statements is/are true regarding this system? (He = 4, Ne = 20)

(a) $\frac{\text{Number of moles of He}}{\text{Number of moles of Ne}} = 5$

(b) The partial pressures of the two gases are equal.

(c) $\frac{\text{Density of He}}{\text{Density of Ne}} = \frac{\text{atomic mass of He}}{\text{atomic mass of Ne}}$

(d) $\frac{\text{Mean kinetic energy of a He atom}}{\text{Mean kinetic energy of a Ne atom}} = \frac{\text{atomic mass of He}}{\text{atomic mass of Ne}}$

48. Which of the following statements is/are correct relevant to the extraction of essential oils by steam distillation?

(a) The essential oil must be completely miscible with water.

(b) The essential oil should have a boiling point lower than that of water.

(c) The essential oil must be immiscible in water.

(d) The mixture will boil at a temperature lower than 100°C at atmospheric pressure.

49. Which of the following statements is/are correct regarding $FeSO_4.7H_2O$?

(a) It is used as a primary standard in volumetric analysis.

(b) Cystals of $FeSO_4.7H_2O$ turns brown on exposure to air.

(c) It gives a blus precipitate with $K_3[Fe(CN)_6]$

(d) Its aqueous solution reacts with KI to give iodine.

50. Which of the following statements is/are true regarding positive rays which have been detected during experiments with dis charge tubes in determining atomic structure?

(a) They are found toghether with cathode rays and responsible for the glow observed in the region behind a perforated cathode.

(b) They are formed by loss of electrons from atoms or molecules.

(c) They consist of particles whose mass is independent of the residual gas.

(d) They are not affected by electric and magnetic fields.

Instruction for questions 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 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	Diamond is an allotrope of carbon which does not conduct electricity.	Diamond has a giant structure where each carbon atom is covalently bonded to four other carbon atoms.
52	Addition of a few drops of H_2SO_4 increases the electrical conductance of water.	Benzene has six π electrons which due to cyclic conjugation gives benzene a high stability.
53	The first ionization energy of oxygen is lower than that of nitrogen.	Less energy required to form $O^{2-}(g)$ from O(g) than N^{3-} (g) from N(g).
54	The equilibrium constant, Kp of the reaction $2A(l) + 3B(g) \rightleftharpoons C(s) + 2D(g)$ is directly proportional to the concentration of **D**.	At constant temperature and volume the pressure of an ideal gas is directly proportional to its concentration.
55	The standard enthalpy of formation of any compound is equal to the standard enthalpy of combustion of that compound.	The standard enthalpy of formation of any element at its most stable state is zero.
56	HF(aq) is a stronger acid than other hydrogen halides.	The H-F bond is weaker than the other hydrogen halogen bonds.
57	Boiling point of butane is higher than that of acetone.	Only σ bonds are present in butane while σ bonds and one π bond are present in acetone.
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.
59	$Ca(OCl)_2$ is an oxidizing agent present as a constituent in bleaching powder and is used as a disinfectant.	All bleaching agents possess oxidizing properties.
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.