1. The molecular formula of the hydride derived from the lowest oxidation state of the element M of atomic number 34 is,
(1) MH (2) MH_2 (3) MH_3 (3) MH_4 (5) MH_6

2. The atom X forms a cation of charge + 2 readily with dilute acid. The number of electrons in the last energy level of the cation is
(1) 2 (2) 8 (3) 14 (4) 18
(5) A definite statement cannot be made regarding this number.

3. 1 mol of a hydrocarbon on complete combustion gave 3 mol of water. 90 cm^3 of oxygen, measured at S.T.P., were required for the complete combusion of 20 cm^3 of the hydrocarbon measured at S.TP., The molecular formula of the hydrocarbon is
(1) C_2H_4 (2) C_2H_6 (3) C_3H_8 (4) C_3H_6 (5) C_3H_4

4. 40 ml of 0.010 mol l^{-1} HCl and 10 ml of 0.045 mol l^{-1} KOH were mixed together. The pOH of the resulting solution is.
(1) 1 (2) 2 (3) 3 (4) 4 (5) 5

5. When H_2S gas is passed over heated CuO,
(1) Cu, H_2O and S are obtained.
(2) CuS and H_2O are obtained.
(3) Cu, SO_2 and H_2O are obtained.
(3) CuS, H_2O and SO_2 are obtained.
(5) None of the above mixtures is obtained.

6. Rubies contain,
(1) Fe, Ti and Al. (2) Ti and Cr. (3) Al and Ti (4) Al and Cr. (5) Fe and Ti.

7. The oxidation number of phosphorus in the $P_2O_7^{4-}$ ion is,
(1) +10 (2) +5 (3) +4 (4) +3 (5) None of the above.

8. Which one of the following exhibits the strongest inter-molecular attractions?
(1) NH_3 (2) PH_3 (3) SiH_4 (4) GeH_4 (5) AsH_3

9. The $\frac{\text{charge}}{\text{mass}}$ ratio of the electron was experimentally determined accurately by
(1) Crookes. (2) Millikan (3) Geiger and Marsden (4) Thomson (5) Chadwick

10. $(CH_3)_3CCOOH$ (a) $ClCH_2COOH$ (b) $Cl_2CHCOOH$ (c) ICH_2COOH (d)
The acidic strength of the above acids decreases as follows.
(1) a>b>c>d (2) b>a>d>c (3) c>d>b>a (4) c>b>d>a (5) b>c>d>a

11. Which one of the following equations expresses Raoult's Law ?
(1) $\frac{P^\circ_A - P_A}{P^\circ_A} = 1 - x_A$ (2) $\frac{P^\circ_A - P_A}{P^\circ_A} = x_A$ (3) $\frac{P^\circ_A - P_A}{P_A} = x_B$ (4) $\frac{P^\circ_B - P_B}{P_B} = 1 - x_A$ (5) $\frac{P^\circ_A - P_B}{P^\circ_B} = x_A$

12. When 1 mol of 2 - pentene is subjected to ozonolysis under oxidative conditions,
(1) 2 mol propanoic acid are obtained.
(2) 2 mol ethanoic acid are obtained.
(3) 1 mol propanoic acid and 1 mol ethanal are obtained.
(4) 1 mol propanal and 1 mol ethanal are obtained.
(5) 1 mol prepanoic acid and 1 mol ethanoic acid are obtained.

13. The number of isomers with the molecular formula C_2F_2ClBr is
(1) 2 (2) 3 (3) 4 (4) 5 (5) none of the above.

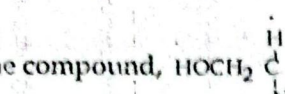
14. Two enthalpy changes are given below.
$C_6H_5C \equiv CH + 2H_2 \rightarrow C_6H_5CH_2CH_3$ $\Delta H^\circ = a$ kJ mol $^{-1}$
$C_6H_5CH = CH_2 + H_2 \rightarrow C_6H_5CH_2CH_3$ $\Delta H^\circ = b$ kJ mol $^{-1}$
The enthalpy change for the reaction $C_6H_5C \equiv CH + H_2 \rightarrow C_6H_5CH = CH_2$ is
(1) (a+b) kJ mol^{-1} (2) (a-2b) kJ mol^{-1} (3) (2a - b) kj mol^{-1} (4) (b-a) kJ mol^{-1} (5) (a - b) kJ mol^{-1}

15. H_2S and Br_2 react in aqueous solution and give
(1) HOBr and S. (2) HOBr and SO_2 (3) H_2SO_3 and HBr. (4) HBr and S. (5) H_2SO_4 and HBr.

16. Cl_2 and concentrated KOH react and give
(1) KCl and KOCl.
(2) KOCl and $KClO_4$
(3) $KClO_3$ and $KClO_4$
(4) KClO and $KClO_3$
(5) None of the above mixtures.

17. Which one of the following exhibits buffer action?
(1) An aqueous solution of NH_4Cl.
(2) An aqueous solution of CH_3COOK.
(3) A mixture of 10 ml of 1 mol l^{-1} $(NH_4)_2SO_4$ and 10 ml of 1 mol l^{-1} NaOH.
(4) A mixture of 10 ml of 1 mol l^{-1} $(NH_4)_2SO_4$ and 20 ml of 1 mol l^{-1} NaOH
(5) None of above shows buffer action.

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18. Consider the compound,  Which one of the statements concerning the above compound is true?
(1) It reacts with C_6H_5OH. (2) It reacts with $Sr(OH)_2$ (3) It reacts with $BaCl_2$.
(4) It reacts with CH_3OH. (5) It does not react with any of the above.

19. The anionic radius of the elements, oxygen, fluorine and sulfur decreases as follows.
(1) $O^{2-} > F^- > S^{2-}$ (2) $S^{2-} > O^{2-} > F^-$ (3) $S^{2-} > F^- > O^{2-}$ (4) $O^{2-} > S^{2-} > F^-$ (5) $F^- > S^{2-} > O^{2-}$

20. In which one of the following bonds is the covalent nature heghest?
(1) Si—Cl (2) P— Cl (3) S—Cl (4) P—F (5) Si — F

21. An organic compound A is more soluble in CCl_4 than in water, and the relevant distribution coefficient is 4. 1·000g of A was dissolved in 100 ml of water, and this aqueous solution was successively extracted three times using 100 ml portions of CCl_4 each time. The total mass of A extracted into CCl_4 is
(1) $^{3}/_{4}$g (2) $^{3}/_{5}$g (3) $^{63}/_{64}$ g (4) $^{124}/_{125}$ g (5) None of the above

22. Which one of the following could be used to distinguish between $C_6H_5CH_2I$ and C_6H_5I?
(1) Aqueous $Pb(NO_3)_2$ (2) CH_3COOH (3) Anhydrous $ZnCl_2$/ concentrated HCl.
(4) Phenolphthalein (5) None of the above can be used/

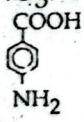
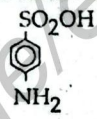
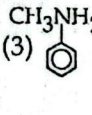
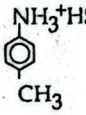
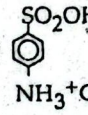
23. Which one of the following could be used to distinguish between $BrCH_2COC_6H_5$ and $(CH_3)_3CCOC_6H_5$?
(1) Brady's reagent (2) Tollen's reagent (3) Dilute HCl
(4) I_2/ NaOH (5) None of the above can be used.

24. Which one of the following indicators could be used for the titration of C_6H_5COOH with aqueous CH_3NH_2?
(1) Methyl Ornge. (2) Methyl Red (3) Phenolphthalein
(4) Litmus (5) None of the above can be used.

25. The weak acid H_2A ionizes in two stages as given below
$H_2A(aq) + H_2O(l) \rightleftharpoons H_3O^+(aq) + HA^-(aq)$; $Kc = K_1$
$HA^-(aq) + H_2O(l) \rightleftharpoons H_3O^+(aq) + A^{2-}(aq)$; $Kc = K_2$
The Kc for the equlibrium
$H_2A(aq) + 2H_2O(l) \rightleftharpoons 2H_3O^+(aq) + A^{2-}(aq)$ is
(1) $K_1 + K_2$ (2) $K_1 - K_2$ (3) K_2 / K_1 (4) K_1 / K_2 (5) $K_1 \times K_2$

26. Which one of the following cations is precipitated by aqueous ammonia in the presence of ammonium chloride?
(1) Ni^{2+} (2) Zn^{2+} (3) Mg^{2+} (4) Cr^{3+}
(5) None of the above is precipitated.

27. The inorganic compound Y, gave a colourless gas when treated with concentrated HNO_3. The Solution so obtained gave a precipitate with dilute H_2SO_4 Identfiy Y.
(1) $BaBr_2$ (2) $PbCO_3$ (3) $CoCO_3$ (4) $PbBr_2$ (5) NiS

28. The organic compound P, dissolves in water and it is strongly acidic. P gives a very unpleasant smell when heated with $CHCl_3$ and conecntrated KOH. An aqueous solution of P gives a precipitate with $SrCl_2$ and dilute HNO_3. Which one of the following could be P?
(1)  (2)  (3)  (4)  (5) 

29. Which one of the following isotopes is **not** radioactive?
(1) $^{32}_{16}P$ (2) $^{60}_{27}Co$ (3) $^{3}_{1}H$ (4) $^{24}_{11}Na$ (5) $^{18}_{8}O$

30. Which one of the following compounds does **not** dissolve in aqueous NaOH.?
(1) SnO. (2) pb $(OH)_2$ (3) Ag_2O (4) ZnO (5) As_2O_3

31. Which of the following statements / statement concerning H_2O are/ is true?
(a) It can act as an acid. (b) It can act as a base.
(c) It can act as a reducing agent. (d) All of the above statements are true.

32. Which of the following statements/statement concerning $C_6H5—\overset{O}{\overset{\|}{C}}—CH = CH_2$ are / is true ?
(a) It reacts with HCN (b) It reacts with HBr
(c) It exists as cis and trans isomers (d) It exists as optical isomers

33. Which of the following compounds / compound react/ reacts with dilute H_2SO_4?
(a) $C_6H_5CH_3$ (b) $C_6H_5CH_2CH_2F$ (c) $CH_3CH = CH_2$ (d) $CH_3C \equiv CH$

34. Which of the following statements / statement are / is true?
(a) The pH of pure water can be less than 7. (b) The pH of pure water can be greater than 7.
(c) The pH of an aqueous solution cannot be negative. (d) The pH of an aqueous solution cannot be greater than 14.

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35. Which of the following statements/sstatement concerning cinnamon oil are/ is true?
(a) It conta ns geraniol (b) It contains eugenol
(c) It contains cinnamaldehyde (c) It contains all of the above.

36. Which of the following statements / statement concerning the Si atom of the SiF_6^{2-} anion are? is true?
(a) It is octahedrally surrounded by F atoms (b) There are 6 electron in its valence shell
(c) There are 14 electrons in its valence shell (d) There are 12 electrons in its valence shell.

37. Which of the following statements / statement concerning N_2O_4 are / is true?
(a) It can act as an oxidizing agent (b) It is a neutral oxide
(c) It has a very dark colour (d) It can act as a reducing agent

38. Which of the following statements/ statement concerning catalyst are/is true?
(a) Some catalysts increase the equlibrium concentrations of the products of certain reactions.
(b) Some catalysts decrease the equlibrium concentrations of the products of certain reactions.
(c) The activation energies of certain reactions are decreased by some catalysts.
(d) The activation energies of certain reactions are increased by some catalysts.

39. Which of the following statements / statement concerning the electrochemical series and electrochemical cells are / is true ?
(a) The elements at the upper end of the electro-chemical series are obtained by the elcctrolysis of fused salts.
(b) Many elements at the lower end of the electro-chemical series are obtained by the electrolysis of fused salts.
(c) The ions pertaining to the upper end of the electrochemical series are strong oxidizing agents.
(d) The potential difference between the electrodes of an electrochemical cell changes with temperature.

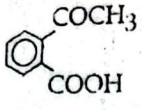
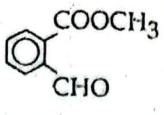
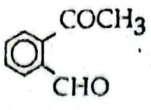
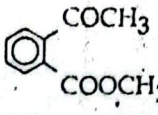
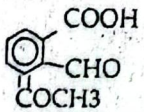
40. Which of the following statements/ statement concerning proteins and amino acids are/ is true?
(a) All proteins contain C, H and O.
(b) All proteins are formed by the polymerization of certain 2- aminocarboxylic acids.
(c) All 2-aminocarboxylic acids are optically active.
(d) All 2-aminocarboxylic acids are strong acids.

	First Statement	Second Statement
41.	The ionizing power of alpha particles iss greater than the ionizing power of beta particles.	The mass of the alpha particles is very much greater than the mass of the beta particles.
42.	When benzene is nitrated under vigorous conditions, 1, 3- dinitrobenzine is formed.	The - NO_2 group activates the 3-position of the benzene ring.
43.	The yield of the reaction, $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$ increases with pressure.	The equilibrium constant of this reaction increases with pressure.
44.	3- nitrobenzoic acid is more acidic than benzoic acid.	The nitro group exhibits a meta-derecting property.
45.	$(CH_3)_3$ CCHO does not undergo the Cannizzaro reaction	$(CH_3)_3CCHO$ in not an aromatic aldetyde.
46.	In the manufacture of NaOH, graphite cathodes are used.	Iron reacts with chlorine gas.
47.	Hydrogen cannot be reduced	Electrons are lost very readily from hydrogen atoms.
48.	The behaviour of real gases is described considerably well by the Van der Waals Equation.	The Van der Waals Equation includes corrections applicable for high pressures and low temperatures.
49.	The reaction between carboxylic acid and allcohols is catalysed by H_2SO_4	H_2SO_4 facilitates the formation of H_2O molecules from the acidic hydrogen of the RCOOH molecules and the —OH groups of the ROH molecules.
50.	Eppawala apatite cannot be directly used as a fertilizer for paddy cultivation.	Eppawala apatite contains phosphorus.

51. When nitrogen is present in an organic compound, a special procedure should be followed in testing for halogens in the Lassaigne extract with aqueous $AgNO_3$.
(1) because NO_3^- is present in the Lassaigen extract. (2) because NH_3 is present in the Lassaigen extract.
(3) because CN^- is present in the Lassaigen extract. (4) because the Lassigne extract is strongly alkaline.
(5) not because of any of the above reasons.

52. The organic compound, Q is insoluble in aqueous NaOH, and it gives an orange precipitate with Brady's reagent. Q reduces an ammoniacal sollution of $AgNO_3$. The organic product so obtained also gives an orange precipitate with Brady's reagent. Identify Q.

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

53. The volume of 1.0 g of a certain gas at 27°C and 1.23 atm is 5.0 l. The relative molecular mass of the gas is.
(1) 2.0. (2) 4.0. (3) 16.0. (4) 20.0 (5) 32.0.

54. A nuclear reaction is given below. $^{238}_{92}U + X \rightarrow {}^{243}_{97}Bk + {}^{4}_{2}He + 5\ {}^{1}_{0}N$ In this nuclear reaction, X is

(1) $^{10}_{5}B$ (2) $^{10}_{7}N$ (3) $^{14}_{7}N$ (4) $^{14}_{6}C$ (5) none of the above.

55. The chloride of an element contains 90.79% chlorine, The relative molecular mass of the chloride is approimately 120. Calculate the relative atomic mass of the element. (Cl = 35.5).
(1) 10 8. (2) 12.0. (3) 21.6. (4) 24.0 (5) 9.0.

56. An aqueous solution of NaCl was electrolysed using platinum electrodes for 10 minutes with a current of 3.0 A. The volume of hydrogen gas collected in this experiment was 207.0 ml, at S.T.P. The molar volume of hydrogen at S.T.P. is 22.4 . The Avogadro Constant is 6.022×10^{23} According to the above data, the charge on the electron is
(1) 1.602×10^{-19}C. (2) 1.608×10^{-19} C. (3) 1.612×10^{-19} C. (4) 1.617×10^{-19} C. (5) 1.622×10^{-19} C.

57. Which one of the following statements concerning the production of margarine is true?
(1) Glycerine is obtained as a by-product. (2) Iron oxide is used as a catalyst.
(3) Long-chain carboxylic acidss are obtained as by-products.
(4) aluminium powder is used as a catalyst.
(5) None, of the above statements is true.

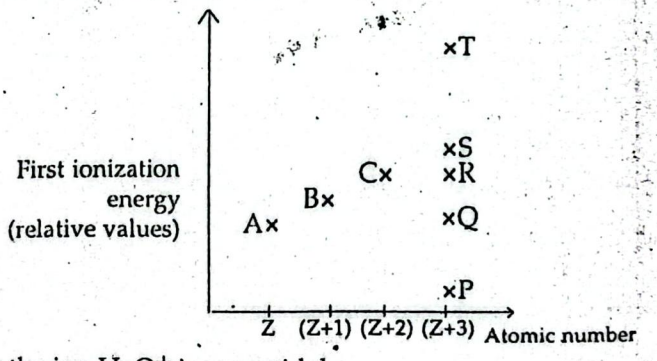
58. Which one of the following statements concerning the reaction between sulphur and concentrated nitric acid is true?
(1) SO_2, NO and H_2O are obtained as products. (2) SO_2, NO_2 and $H_2O$are obtained as products.
(3) H_2SO_4, NO_2 and H_2O are obtained as products. (4) H_2SO_4, N_2O and H_2O are obtained as products.
(5) SO_2, HNO_2 and H_2O are obtained as products.

59. When an aqueous solution of $(NH_4)_2SO_4$ is shaken with zinc powder,
(1) H_2 and N_2 are liberated. (2) SO_4^{2-} ions are reduced to SO_3^{2-} ions.
(3) H_2 and SO_2 are liberated. (4) H_2 and NH_3 are liberated.
(5) none of the above occurs.

60. Metals have a high electrical condutance
(1) because of ionic bonds (2) because of co-ordinate bonds.
(3) because of delocalized electrons. (4) because of ions of high mobility.
(5) not because of any of the above reasons.

PAPER - II (STRUCTURED ESSAY) (1990)

1. (a) The points A, B, and C in the above diagram corresond to the first ionization energies of the non-transition elements of atomic number Z, (Z+1) and (Z+2), respectively. Identify the point/points which might possibly be the first ionization energy of the non-transition element of atomic number (Z+3), out of the points P, Q, R, S and T, and indicate them in the space provided below. N. B. Marks will be deducted for the incorrect points indicated by you.



(b) Explain why the species BCl_2^+ is linear, whereas the ion H_3O^+ is pyramidal.

(c) Explain what is meant by 'Avogadro Constant'.

(d) 195 000 C were required for the complete electrolysis of 18.00 g of water. If the charge on the electron is 1.602×10^{-19} C, calculate the number of H_2O molecules in 18.00g of water, according to the above data. (H = 1.00; O = 16.00).

2. (a) Assume that the tri-valent metal M reacts with HNO_3 giving the nitrate of the metal, nitrogen dioxide and water only. Write the balanced chemical equation for this reaction.

(b) A mixture contains KNO_3 and $NaNO_3$ only. When 0.465 g of the mixture was subjected to thermal decomposition, the mass of the product remaining after the liberation of oxygen gas was 0.385 g. Calculate the mole percent of KNO_3 in the mixture. (K=39.0); Na=23.0; N=14.0; O=16.0).

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(c) Give one reaction in each case to illustrate the following:
(i) The reaction of sulphur as a reducing agent.
(ii) The reaction of Fe^{2+} as an oxidizing agent.
N. B. The balanced chemical equations for the reactions given by you, must be written.

(d) You are provided with an aqueous solution of Ag_2SO_4. Assume that you are required to show the presence of SO_4^{2-} ions in this solution. The one and only compound supplied to you for this purpose is $BaCl_2$. However, the elements normally provided in the laboratory, and also the ordinary equipment and facilities are made available to you. Explain briefly how you would show, under these conditions, the presence of SO_4^{2-} in the solution provided.

3. (a) The compound A contains 35.6% carbon, 3.4% hydrogen, 40.7% sulphur and oxygen only. If the relative molecular mass of A is approximately 200, determine its molecular formula. (C=12; H=1; S=32; O=16).

(b) The molecular formula of an organic compund B is C_5H_8O. If B is a ketone, which is not cyclic draw the structures of all the isomers of B.

(c) Indicate how the following conversions could be effected. The necessary reagents and reaction conditions should be clearly indicated at the appropriate places. **N.B. If the method of conversion proposed by you is unnecessarily long, you will not be awarded full marks.**

(i) $(CH_3)_2CHBr \rightarrow CH_2 = \underset{\displaystyle CH_3}{\overset{\displaystyle |}{C}} - COOH$

(ii) $CH_2 = CH_2 \rightarrow CH_3 - \underset{\displaystyle OH}{\overset{\displaystyle |}{CH}} - \underset{\displaystyle OH}{\overset{\displaystyle |}{CH}} - CHO$

(d) Indicate how you would chemically distinguish between the two compounds in each of the pairs given below.
(i) $CH_3CONHC_6H_5$ and $CH_3CH_2CONHCH_2C_6H_5$
(ii) $CH_3CH_2OCOC_6H_5$ and $CH_3CH_2CH_2OCOCH_2C_6H_5$

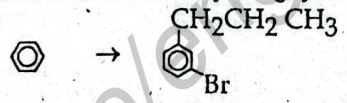
4. (a) (i) Draw the structural formula of the compound named below.
2 — chloro — 5 — iodo — 4 — nitrohexanoic acid.

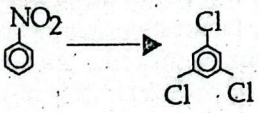
(ii) Name the compound having the following structure, in accordance with IUPAC nomenclature.
N. B. Disregard geometrical isomerism.

$$Br-CH_2-\underset{\displaystyle CH_3}{\overset{\displaystyle CH_3}{\overset{\displaystyle |}{\underset{\displaystyle |}{C}}}}-CF=CH-CHO$$

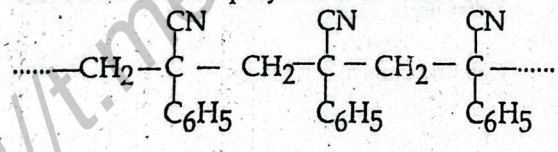
(b) Indicate clearly the mechanism pertaining to the addition of Br_2 to $CH_2=CH_2$ under polar condition.

(c) Indicate how the following conversions could be effected. The necessary reagents and reaction conditions should be clearly indicated at the appropriate places. **N. B. If the method of conversion suggested by you is unnecessarily long, you will not be awarded full marks.**

(i) 

(ii) 

(d) The structure of a polymer is as follows :



Draw the structure of the monomer.

PART B (ESSAY)

5. (a) Making use of the equation $PV = \frac{1}{3}mn\overline{c}^2$ pertaining to the kinetic molecular theory of an ideal gas, derive Avogadro's Law.

(b) 0.1 mol of a gas X is kept at 27°C in a vessel of volume 5.0 l. 0.2 g of hydrogen under a pressure of 1.0 atm and at a temperature of 127°C is introduced into the above vessel. Then the temperature of the vessel was reduced to 0°C. Assuming that X and H_2 do not react chemically and that X and H_2 behave as ideal gases, calculate the following. (H=1.0)
(i) The pressure inside the vessel before the introduction of the H_2 gas.
(ii) The total pressure inside the vessel after the introduction of the H_2 gas and the reduction of the temperature to 0°C.
(iii) The mole fraction of X in the vessel after the introduction of the H_2 gas and the reduction of the temperature to 47°C.
(iv) The mole fraction of H_2 in the vessel when the total pressured inside the vessel is doubled by compressing the mixture of gases in the vessel.

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(c) The molar volume of He at S.T.P. is 22.4 l, whereas the molar volume of CH_3Cl at S.T.P. is 21.9 l. How would you explain this difference?

(d) Explain how you would demonstrate the formation of strong hydrogen bonds by NH_3, with the aid of two appropriate graphs.

6. (a) Describe briefly how the distribution coefficient of ammonia between water and chloroform is determined.

(b) Consider the following equilibrium. $A_2(g) + 2B_2(g) \rightleftharpoons 2A_2B_4(g)$

The two gases A_2 and B_2 were mixed in the molar ratio of 1:2. This mixture reached equilibrium at a certain temperature and pressure. Then, 50% of A_2 remained unreacted in the equilibrium mixture, and the equilibrium pressure of the system was 100 atm.

Using the above data, calculate the Kp for this reaction

(c) Explain how you would show **qualitatively** that the reaction between Fe^{2+} ions and Ag^+ ions is a reversible one.

(d) You are provided with a solution of acid which is 0.5 mlo l^{-1} with respect to HCl and 0.25 mol l^{-1} with respect to H_2SO_4. You are also proveded with magnesium oxide. You are not permitted to use any other chemicals. However, you are permitted to use ordinary laboratory equipment, glassware and facilities. Describe clearly how you would show, under these conditions, that the molar ratio in the reaction between MgO and HCl is 1:2. (Mg = 24; 0 =16)

7. (a) (i) Explain the concept 'solubility product', taking As_2S_3 as the example.

(ii) MX_2 is a sparingly soluble ionic compound. M is divalent, while X is monovalent. At a certain temperature, the water solubility of MX_2 is 0.02 mol l^{-1}. How many moles of MX_2 would dissolve in 2.0 *l* of a 2.0 mol l^{-1} KX solution at the same temperature?

(b) (i) Explain the terms 'Lewis acid' and 'Lewis base', taking two examples in each case.

(ii) 49.95 ml of a 1.0 mol l^{-1} HCl solution and 50.05 ml of a 1.0 mol l^{-1} NaOH solution were mixed together, Calculate the pH of the resulting solution.
Kw at the relevant temperature = 1.0×10^{-14} mol^2 l^{-2}

(c) Explain how the compound $NaOCOCH_2CH_2CH_2COOH$ exhibits buffer action.

8. (a) (i) Name the factors that influence the rate of a chemical reaction.

(ii) Choossing two of these, suggest one simple experiment in each case to demonstrate the influence of each factor, separately.

(b) (i) According to the Colllsion Theory, what are the factors essential for the occurrece of a chemical reaction?

(ii) Explain what is meant by the 'Boltzmann Curve', and indicate briefly how certain important features pertaining to rates of chemical reactions could be understood by the use of those curves.

(c) Explain what is meant by the 'half-life of the $^{14}_{6}C$ isotope', and indicate briefly the principles of radiocarbon dating performed with the $^{14}_{6}C$ isotope.

9. (a) Write a brief description of the physico- chemical principles involved in the extraction of iron.

(b) Indicate how the follwoing conversions could be effected. **N.B. The necessary materials and reaction conditions should be clearly indicated at the appropriate places.** It is not necessary to write balanced chemical epuations for the reactions.

(i) $N_2 \rightarrow N_2O$. (ii) $KBr \rightarrow KHCO_3$

(c) How and under what conditions does NaOH react with the following? (i) Zn (ii) Cl_2

(d) You are supplied with a solid mixture containing Na_2CO_3, $(NH_4)_2CO_3$ and $BaCO_3$. As laboratory reagents you are supplied with only dilute H_2SO_4; even water is not supplied to you. Explain how you would show, under these conditions, that Na_2CO_3 is present in the mixture supplied to you.

10. (a) Write a brief description of the manufacture of sulphuric acid by the Contact process.

(b) How and under what conditions does H_2SO_4 react with the following?

(i) C. (ii) H_2S. (iii) HCOOH.

(c) You are supplied with a solid mixture containing NaCl, KCl, AgI and CuO. Propose a scheme of analysis for the determination of the percentages of NaCl, KCl and AgI in the mixture, by weight. **N.B. Practical details are not necessary.**

11. (a) Describe briefly how the nature of the bonding and acid- base nature vary in the series of hydrides NaH, SiH_4, PH_3, H_2S and HCl.

(b) Draw the structure of natural rubber. Explain how this structure is changed in the vulcanization of rubber.

(c) Draw the structure of graphite. Explain why graphite is a good conductor of electricity.

(d) Name the principal metal present in the following: (i) Rutile (ii) Corrundum

12. (a) Write a brief description of hardness of water and the removal of hardness.

(b) Explain how a system of industries can be built using coconut oil as a raw material and linking it with another industry.

(c) **"The excessive and unnecessary utilization of wood and fossil fuels is a grave crime committed against the future generation."**
Write a brief essay supporting this statement, from the point of view of chemistry.

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