1. The maximum valency of the element of atomic number 32 is
(1) 2 (2) 4 (3) 5 (4) 6 (5) 7

2. In which one of the following is the first ionization energy highest?
(1) Be (2) Mg (3) F (4) Ne (5) He

3. Consider the equilibrium, $2NOCl(g) \rightleftharpoons 2NO(g) + Cl_2(g)$, Which one of the following concerning this equilibrium is true?
(1) $K_c = \frac{[NO]\times[Cl_2]}{[NOCl]}$ (2) $K_c = \frac{[NO]\times[Cl_2]^2}{[NOCl]}$ (3) $K_c = \frac{[NO]^2\times[Cl_2]}{[NOCl]^2}$
(4) $K_c = \frac{[2NO]\times[Cl_2]}{[2NOCl]}$ (5) Since this is a gaseous system, there is no Kc value for this system.

4. Sodium metal reacts with ammonia gas under certain conditions and gives hydrogen gas and sodamide. $NaNH_2$, only. How much of molecular hydrogen will be given by 23g of sodium in this reaction? (H=1 ; Na = 23; N = 14)
(1) 1 g (2) 0.5 g (3) 2 g (4) 23 g
(5) Since the balanced chemical equation relevant to this reaction is not given, a definite answer cannot be given for this question.

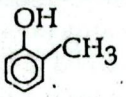
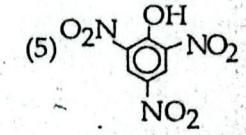
5. The number of optically inactive compounds with moecular formula $C_4H_{10}O$ is,
(1) 3 (2) 4 (3) 6 (4) 7 (5) 8

6. Which one of the following catalysts is used in the industrial conversion of ammonia to nitric oxide by oxidation with air?
(1) Ag (2) Al (3) Cr_2O_3 (4) Fe_2O_3 (5) None of the above is used

7. Which one of the following statements concerning the various types of cinnamon oil is false?
(1) They contain eugenol (2) They contain cinnamaldehyde
(3) They may contain camphor (4) They contain geraniol
(5) In one type of cinnamon oil, the camphor percentage is very high

8. The two miscible solvents A and B form ideal solutions. At a certain temperature, the vapour pressures of the pure solvents are, respectively, 60 mm Hg and 120 mm Hg. At the same temperature, what would be the total vapour pressure of a solution in which the A : B mole ratio is 1 : 3 ?
(1) 75 mm Hg (2) 90 mm Hg (3) 100 mm Hg (4) 105 mm Hg (5) The correct answer is not given.

9. The nucleus formed by the emission of first, one alpha particle, and then, two beta particles from the $^{238}_{92}U$ nucleus is,
(1) $^{234}_{92}U$ (2) $^{234}_{90}Ac$ (3) $^{234}_{92}Pa$ (4) $^{234}_{92}Th$ (5) None of the above.

10. Which one of the following will not tend to react with bromine water ?
(1) $CH_2 = CHCH_3$ (2) $CH_3CH = CHCH_3$ (3)  (4)  (5) 

11. Cl_2 reacts with aqueous NaOH, and gives
(1) a mixture of $NaClO_3$ and $NaClO_4$ (2) a mixture of NaClO and $NaClO_3$
(3) a mixture of NaClO and $NaClO_4$ (4) a mixture of NaClO and NaCl (5) none of the above mixtures.

12. A solution of concentration 10^{-9} mol dm^{-3} with respect to HCl is made with pure water. The pH of this solution is
(1) 9 (2) 8 (3) 7.5 (4) 7 (5) 0

13. Which one of the following methods could be used to distinguish between $C_6H_5NH_2$ and $C_6H_5NHCH_3$?
(1) Heating with $KMnO_4$ and concentrated H_2SO_4 (2) Heating with $K_2Cr_2O_7$ and concentrated H_2SO_4
(3) Heating with $CHCl_3$ and alcoholic KOH (4) Adding bromine water
(5) None of the above can be used

14. Which one of the following reagents could be used to distinguish chemically between CH_3CH_2CHO and HCHO?
(1) Ammoniacal silver nitrate (2) Brady's reagent (3) Fehling's solution
(4) Aqueous potassium hydroxide (5) None of the above can be used.

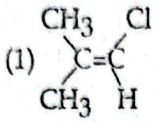
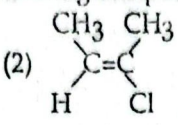
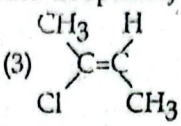
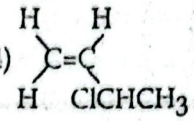
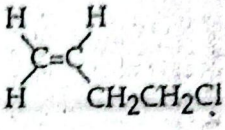
15. The concentration of an aqueous solution of a weak mono-basic acid is 0.1 mol l^{-1}. The pH of this solution is 3. The dissociation constant of the acid is
(1) 10^{-1} mol l^{-1} (2) 10^{-2} mol l^{-1} (3) 10^{-3} mol l^{-1} (4) 10^{-4} mol l^{-1} (5) 10^{-5} mol l^{-1}

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16. At a given temperature, a catalyst
(1) increases the rate of the forward reaction only.
(2) decreases the rate of the reverse reaction only.
(3) changes the activation energies of the forward reaction and the reverse reaction.
(4) increases the heat of reaction of an exothermic reaction.
(5) increases the heat of reaction of an endothermic reaction.

17. Which one of the following compounds exists in optically active forms?

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

18. Which one of the following statements concerning H_2SO_4 is true ?
(1) It oxidizes sulphur.
(2) Concentrated H_2SO_4 reacts with sulphur and gives SO_3.
(3) It oxidizes carbon to CO.
(4) It does not react with carbon.
(5) All of the above statements are incorrect.

19. Consider the following reaction. $A(g) + B(g) \rightleftharpoons C(g) + D(g)$; $\Delta H = +100\ kJ\ mol^{-1}$
Which one of the following will increase the yield of D in this reaction ?
(1) Increasing the total pressure of the system.
(2) Decreasing the total pressure of the system.
(3) Decreasing the temperature of the system.
(4) Removing B from the system.
(5) None of the above will increase the yield of D.

20. Which one of the following is most suitable for use in experimentally establishing the Law of Multiple Proportions through the preparation of sulphides ?
(1) Al (2) Ag (3) Mg (4) Sn (5) Zn

21. Which one of the following statements is true for alcohols, in general ?
(1) Alcohols react with PI_3. (2) Alcohols react with Br_2 (3) Alcohols react with I_2/NaOH.
(4) Alcohols react with CsOH. (5) All of the above statements are true.

22. "One volume of nitrogen and three volumes of hydrogen combine to give two volumes of ammonia" Which one of the following is most closely connected with the above statement?
(1) Boyle's Law. (2) Avogadro's Law (3) Gay Lussac's Law.
(4) Equilibrium Law. (5) Combined Gas Law.

23. The shape of the cationic species PCl_4^+ is
(1) planar. (2) trigonal pyramidal. (3) trigonal bipyramidal.
(4) tetrahedral. (5) none of the above.

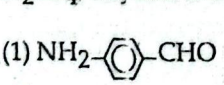
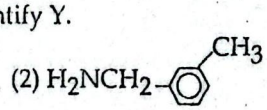
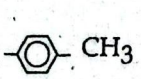
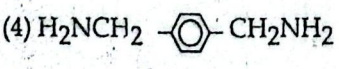
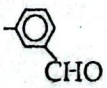
24. The inorganic compound, P gave a colourless gas and a colourless solution with dilute HCl. The gas turned acidified K_2CrO_4 green. The solution gave a precipitate with dilute H_2SO_4. Which of the following could be P?
(1) $Sr(NO_2)_2$ (2) MgS_2O_3 (3) SrS (4) $Ba(NO_2)_2$ (5) NH_4HS

25. The relationship between the relative molecular mass, M, of a gas and the vapour density, D, of a gas is
(1) M = D (2) M/2 = D (3) M = D/2 (4) M = 16 D
(5) Since no reference is made to the temperature and pressure of the gas, a definite answer cannot be given for this question.

26. Which one of the following is not essential for the production of steel ?
(1) O_2 (2) $CaCO_3$ (3) C (4) $CaSiO_3$
(5) All of the above are essential for the production of steel.

27. 100 cm^3 of a 0.250 mol dm^{-3} barium nitrate solution and 200 cm^3 of a 0.100 mol dm^{-3} sodium nitrate solution are mixed together. The NO_3^- concentration of the solution so formed is
(1) 0.175 mol dm^{-3} (2) 0.150 mol dm^{-3} (3) 0.233 mol dm^{-3} (4) 0.117 mol dm^{-3} (5) none of the above.

28. The organic compound X, when reacted with $NaNO_2$ and dilute HCl gives N_2 gas. However, a phenol is not formed in this reaction. When the organic product formed in this reaction is oxidized under vigorous conditions, the organic compound, Y is obtained. When Y is reacted with $HOCH_2CH_2OH$ in the presence of H_2SO_4, terylene is not obtained. Identify Y.

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

29. Which one of the following will give is precipitate with aqueous $BaCl_2$?
(1) Aqueous NH_4I (2) CO_2 dissolved in water (3) Aqueous $(NH_4)_2CrO_4$
(4) Bromine water (5) None of the about will give a precipitate.

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30. Which one of following exhibits the weakest inter-molecular attractions ?
(1) NH_3 (2) HI (3) CH_3Cl (4) CH_4 (5) H_2S

31. Which of the following statements/statement concerning a reaction in a state of equilibrium are/is true ?
(a) Kp of the reaction changes with the pressure,
(b) Kc of the reaction changes with the pressure.
(c) Kc of the reaction depends on the temperature.
(d) The activation energy of the reaction does not depend on the pressure

32. Arrack contains about 30% ethanol, by weight. Arrack and water are mixed in ratio 1 : 2, by volume. Which of the following statements / statement concerning this mixture are/is true ?
(a) At a given temperature, the total vapour pressure of the mixture is higher than the vapour pressure of water at the same temperature.
(b) Drinking this mixture is harmful for the body.
(c) The mole fraction of H_2O in the mixture is greater than the mole fraction of H_2O in water.
(d) The mole fraction of C_2H_5OH in arrack is less than the mole fraction of C_2H_5OH in the mixture.

33. Which of the compounds / compound represented below give/gives a precipitate with aqueous $AgNO_3$?
(a) $C_6H_5NH_3I$ (b) C_2H_5Br (c) C_6H_5COBr (d) Cl_3CCOCl

34. Which of the following reagents / reagent could be used to convert nitrobenzene to aniline ?
(a) Sn and HCl (b) Fe and dilute H_2SO_4 (c) Ag and HCl (d) Hg and H_2SO_4

35. Which of the following statements / statement are/is true ?
(a) In a strong magnetic field, beta rays are attracted towards the N magnetic pole.
(b) In a strong magnetic field, beta rays are attracted towards the S magnetic pole.
(c) In an electric field, alpha rays are repelled by the positively charged plate.
(d) In an electric field, gamma rays are not attracted towards the negatively charged plate.

36. The isotopes of a given element
(a) have the same number of neutrons. (b) have the same number of protons.
(c) have the same number of electrons. (d) have the same number of nucleons.

37. Which of the following is/are useful in the industrial production of urea ?
(a) Air (b) Hydrogen (c) Hydrocarbons (d) Water

38. Which of the following is/are capable of causing damage to the environment ?
(a) SO_2 (b) Cl_2 (c) $^{3}_{1}H$ (Tritium) (d) CO_2

39. Which of the following statements/statement concerning the electrochemical cell,
$Zn(s) \mid Zn^{2+}(aq) \mid Cu^{2+}(aq) \mid Cu(s)$ are/is true ?
(a) When an electric current is obtained from this cell, copper metal forms $Cu^{2+}(aq)$ cations.
(b) When an electric current is obtained from this cell, zinc cations are converted to zinc metal.
(c) The e.m.f. of this cell depends on the zinc ion concentration.
(d) The e.m.f. of this cell depends on the temperature.

40. Which of the following statements/statement concerning rusting of iron are/is true ?
(a) When $(NH_4)_2SO_4$ is dissolved in the water, rusting is increased.
(b) When Cl_2 is dissolved in the water, rusting is increased.
(c) When NaCl is dissolved in the water, rusting is decreased.
(d) When NH_3 is dissolved in the water, rusting is increased.

	First Statement	Second Statement
41.	The melting point of diamond is very high.	The bonds in diamond are covalent.
42.	Aniline undergoes bromination more easily than benzene.	The - NH_2 group activates the benzene ring.
43.	Hydrogen astatide (HAt) does not act as a reducing agent.	In HAt, astatine is in an oxidized state.
44.	An aqueous solution of $(NH_4)_2CO_3$ can exhibit buffer action to some extent.	In aqueous solution, HCO_3^- exhibits strong basic properties.
45.	Zinc reacts with aqueous HCl and with aqueous NaOH, and gives hydrogen gas.	Zinc is an electropositive element.
46.	The behaviour of real gases does not conform to the equation $(P + \frac{n^2a}{V^2}) \times V = nRT$	In this equation, there is no correction for the volume of the molecules.

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47. Nitric acid cannot act as a base. — Nitric acid is derived from N_2O_5

48. The 3rd Period of the long form of the Periodic Table contains 18 elements. — The 3rd quantum level may contain a maximum of 18 electrons.

49. There are no indicators suitable for use in titrating aqueous KOH with aqueous CH_3CH_2COOH. — CH_3CH_2COOK undergoes hydrolysis in aqueous solution.

50. When benzaldehyde is boiled with aqueous NaOH, sodium benzoate is formed. — In this reaction, NaOH acts as an oxidizing agent.

51. Which one of the following could be used to obtain $C_6H_5CH_2CH_2CH_3$ from $C_6H_5COCH_2CH_3$?
(1) Tin and concentrated HCl
(2) Iron and dilute H_2SO_4
(3) Zinc amalgam and concentrated HCl
(4) $SnCl_2$ and concentrated HCl
(5) Tin and concentrated H_2SO_4

52. When a saturated aqueous solution of H_2S is kept exposed to the air in one corner of the laboratory, the bad smell of H_2S spreads throughout the entire laboratory. This observation
(1) agrees with hydrogen sulphide being continuous.
(2) agrees with water being non-continuous.
(3) agrees with aqueous solutions being non-continuous.
(4) agrees with gases being non-continuous.
(5) agrees with both hydrogen sulphide and water being continuous.

53. The reaction between CaH_2 and D_2O gives
(1) H_2 (2) D_2 (3) H_2 and D_2 (4) $Ca(OD)_2$ (5) $Ca(OH)_2$ and $Ca(OD)_2$

54. When NH_3 gas is passed over heated MgO,
(1) N_2 is obtained.
(2) N_2O is obtained.
(3) Mg_3N_2 is obtained.
(4) $Mg(NO_2)_2$ is obtained.
(5) none of the above is obtained.

55. When $CH_3\underset{\displaystyle OH}{\underset{|}{C}}HCH_3$ vapour is passed over heated copper
(1) $CH_3CH_2CH_3$ is obtained.
(2) $CH_3CH{=}CH_2$ is obtained.
(3) $CH_3C{\equiv}CH$ is obtained.
(4) $CH_3\overset{\displaystyle O}{\overset{\|}{C}}CH_3$ is obtained.
(5) CH_3CH_2CHO is obtained.

56. Which one of the following methods could be used to manufacture bleaching powder ?
(1) Passing Cl_2 gas over CaO
(2) Reacting CaO with HOCl
(3) Passing Cl_2 gas over $CaCO_3$
(4) Passing HCl gas over heated slaked-lime
(5) None of the above methods could be used to manufacture bleaching powder.

57. It has become necessary to synthesise $C_6H_5\overset{\displaystyle CH_3}{\overset{|}{C}}\overset{\displaystyle CH_3}{COOH}$ using $C_6H_5\overset{\displaystyle CH_3}{\overset{|}{C}}\overset{\displaystyle CH_3}{-OH}$. The most suitable initial step for this conversion is
(1) reacting the above alcohol with concentrated HNO_3
(2) reacting the above alcohol with concentrated HNO_3 and concentrated H_2SO_4.
(3) reacting the above alcohol with concentrated HCl and anhydrous $ZnCl_2$.
(4) reacting the above alcohol with CH_3MgBr.
(5) reacting the above alcohol with HCHO.

58. An alkene when subjected to ozonolysis under oxidative conditions, gave methanoic acid and pentan-2-one in the mole ratio of 1 : 1. The alkene is
(1) $CH_3CH_2CH_2\overset{\displaystyle CH_3}{\overset{|}{C}}{=}CH_2$
(2) $CH_3CH_2\overset{\displaystyle CH_2CH_3}{\overset{|}{C}}{=}CH_2$
(3) $CH_3CH_2CH_2\overset{\displaystyle CH_3}{\overset{|}{C}}{=}CHCH_3$
(4) $(CH_3)_2CHCH_2\overset{\displaystyle CH_3}{\overset{|}{C}}{=}CH_2$
(5) $(CH_3)_2CHCH_2\overset{\displaystyle CH_3}{\overset{|}{C}}{=}CHCH_3$

59. The chemical equivalent of a certain metal was determined by two methods. The values so obtained were 9 and 27. The relative atomic mass of the metal.
(1) could be 126
(2) could be 117
(3) could be 90
(4) could be 81
(5) could not be any of the above

60. Which one of the following is most consistent with the accepted mechanism of esterification?
(1) $CH_3COOH + CH_3CH_2{}^{18}OH \rightleftharpoons CH_3COOCH_2CH_3 + H_2{}^{18}O$
(2) $CH_3COOH + CH_3CH_2{}^{18}OH \overset{H^+}{\rightleftharpoons} CH_3COOCH_2CH_3 + H_2{}^{18}O$
(3) $CH_3COOH + CH_3CH_2{}^{18}OH \xrightarrow{H^+} CH_3OOCH_2CH_3 + H_2{}^{18}O$
(4) $CH_3COOH + CH_3CH_2{}^{18}OH \overset{H^+}{\rightleftharpoons} CH_3CO{}^{18}OCH_2CH_3 + H_2O$
(5) $CH_3COOH + CH_3CH_2{}^{18}OH \rightleftharpoons CH_3C{}^{18}OOCH_2CH_3 + H_2O$

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PART A - STRACTURED ESSAY

1. (a) Write the electronic configuration of the element of atomic number 43, in the usual form $1s^2 2s^2$.... etc.

   (b) (i) What is the highest oxidation number of the element of atomic number 49?

   (ii) What is the lowest oxidation number of the elemnet of atomic number 49?

   (c) The arrangment of atoms in the moloucle C_2N_5 is of the form, NCCN. Draw the **'dot-and-cross diagram'** for this molecule.

   (d) Even though the relative molecutar mass of H_2S is about twice the relative molecular mass of H_2O, the boling point of H_2O is very much higher than the boiling point of H_2S. Explain this fact as completely as you can.

2 (a) (i) Give one chemical reaction to illustrate the action of $Zn(OH)_2$ as an acid. **N.B. The balanced cheinical equation should be written.**

   (ii) Write the balanced Chemical equation portaining to the reduction process that occurs when MnO_4^- ions are allowed to interact with electrons in acidic medium. (That is, write the ion-electron half-reaction for this reduction)

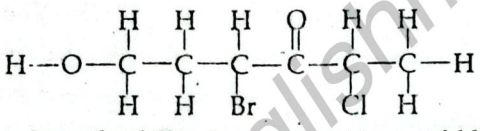
   (b) The trivalent metal M reacts with dilute HNO_3 and gives NH_3. This NH_3 reacts with the excess of HNO_3 present in the reaction mixture and forms NH_4NO_3. Assuming that the other prodacts of he reaction are the nitrate of the metal and water only, write the balanced chemical equation for this reaction.

   (c) A mixture of NaBr and KBr was quantitatively analysed by dissolving in water, adding dilute HNO_3 and aqueous $AgNO_3$. 0.325 g of the mixture gave 0.564 g of AgBr. Calculate the **mole per cent** of KBr present in the mixture. (Na = 23; K = 39; Br = 80; Ag = 108)

3. (a) An organic compound contains 60.8% carbon, 35.4% nitrogen and hydrogen only. If the relative molecular mass of the compound is about 170, determine the molecular formula of the compound. (H = 1; C = 12; N = 14)

   (b) (i) The molecular formula of the compound X is $C_8H_{11}N$ it contains the benzen nucleus, and it is not a primary amine . Draw all the structures possible for X.

   (ii) Name the compound with the following structure, according to **IUPAC** nomenclature.



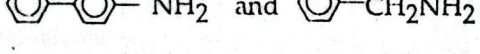
   (c) Indicate how the following conversions could be effected. The necessary reagents and reaction conditions must be given clearly at the appropriate places.
   N.B. If the methods of conversion provided by you are unnecessaraily long you will not be awarded full marks.

   (i) $CH_3CH = CH_2 \rightarrow (CH_3)_2CHCOOH$

   (ii) $C_2H_2 \rightarrow CH_3-CH(Br)-CH_2-CH(OH)-C\equiv N$

4. (a) Indicate how you would distinguish **chemically** between the two compounds in each of the following pairs.

   (i) CH_3CHO and $(CH_3)_3CCHO$

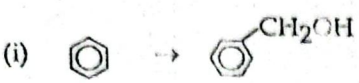
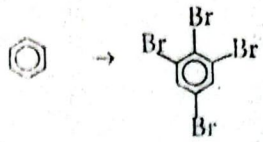
   (ii)  and

   (b) (i) Indicate the mechanism of the addition reaction between $CH_3CH = CHCH_3$ and Br_2 under polar conditions.

   (ii) Propose a method for the establishment of the correctness of the mechanism of the above reaction.

   (c) Indiente how the following conversions could be effected. The necessary reagents and reaction conditions must be given clearly at the appropriate place.
   N.B. If the methods of conversion proposed by you are unnecessarily long, you will not be awarded full marks.

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(i)  (ii) 

5. (a) Explain qualitatively four principal differences between gases and solids on the basis of the motion and arrangement of molecules.

(b) (i) Write the two mathematical expressions for Raoult's Law pertaining to the liquid A of a binary system consisting of two miscible liquids, A and B

(ii) At a certain temperature, the vapour pressure of pure A is twice the vapour pressure of pure B. The mole ratio A : B in a binary solution which behaves ideally is 1 : 1. Calculate the ratio,

$$\frac{\text{total vapour pressure of the solution}}{\text{vapour pressure of pure A}}$$

at the same temperature. **(Assume that the solution and the vapours are in equillbrium.)**

(c) (i) The following equilibrium reaction is used at high temperatures for the industrial production of hydrogen. $CO(g) + H_2O(g) \rightleftharpoons CO_2(g) + H_2(g)$
Assume that the above reaction was started with equi-molar quantities of carbon monoxide and steam.

In the above equilibrium mixture at 500 °C and under a certain pressure, the carbon monoxide concentration was 0.134 mol l^{-1}, while the partial pressure of carbon monoxide was 16.88 atm. Calculate Kp for this equilibrium at 500 °C.

(ii) If the total pressure of the above system is increased three-fold at 500°C, what would be the partial pressure of hydrogen in the equilibrium mixture ? **N.B. Assume that all the gases referred to above, behave ideally.**

6. (a) Explain the following observations:

(i) The standard enthalpy change that occurs in the neutralization of 1 mole of aqueous HCl with 1 mole of aqueous NaOH is approximately equal to the standard enthalpy change that occurs in the neutralization of 1 mole of aqueous NHO_3 with 1 mole of aqueous KOH.

(ii) The standard enthalpy change that occurs in the neutralization of 1 mole of aqueous CH_3COOH with 1 mole of aqueous NaOH is considerably less than the standard enthalpy change that occurs in the neutralization of 1 mole of aqueous HCl with 1 mole of aqueous NaOH.

(b) You are supplied with a sample of solid $PbCl_2$. Describe briefly how you would attempt to determine the solubility product of $PbCl_2$ at 25°C. **Clue : $PbCl_2$ is somewhat soluble in hot water.**

(c) (i) Derive the relationship that exists among the dissociation constant of a weak mono-basic acid (Ka) the degree of dissociation (α) and the concentration of the solution (C),

(ii) Calculate the OH^- concentration at 25°C in an aqueous solution of HCOOH of concentration 0.05 mol dm^{-3} **(HCOOH is a weak mono-basic acid.)**
Ka of HCOOH at 25°C = 1.8×10^{-4} mol dm^{-3}
Kw at 25°C = 1.0×10^{-14} mol^2 dm^{-6}

7. (a) The compound, BX_2 decomposes in aqueous solution as follows: $2BX_2(aq) \rightarrow B_2(g) + 2X_2(g)$ The relationship between the time required to liberate 1.0 ml of the above mixture of gases (t) and the concentration of $BX_2(aq)$ was studied at 25°C under 1 atm pressure. The data obtained from this study are given below.

$BX_2(aq)$ concentration, mol l^{-1}	time, t s
0.070	62
0.050	122

Calculate the time required for the liberation of 1.0 ml of the mixture of gases, under the same conditions as above, when the $BX_2(aq)$ concentration is 0.045 mol l^{-1}

(b) Explain why the rate of a chemical reaction increases considerably, when the temperature increases even only slightly.

(c) (i) Discuss briefly the principles pertaining to the production of energy by nuclear fission.

(ii) State four difficulties in employing nuclear fission as a solution to the 'Oil Crisis' in Sri Lanka.

8. (a) Describe briefly a method for experimentally establishing Hess's Law using solid sodium hydroxide and hydrochloric acid.

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(b) Calculate the mean C—H bond dissociation energy using the following data.
Standard enthalpy of CH_4 = − 75 kJ mol^{-1}
Heat of atomization of graphite = + 720 kJ mol^{-1}
Bond dissociation energy of H_2 = + 430 kJ mol^{-1}

(c) (i) A certain electrochemical cell is represented below,
Al(s) | Al^{3+}(aq) | Hg^{2+}(aq) | Hg(l) ; E = + 2.5 V
Write the relevant cell reaction.

(ii) Discuss the occurrence of metals and their extraction in relation to the electrochemical series. **N.B. It is sufficient to discuss five relevant points.**

PART C - ESSAY

9. (a) Indicate clearly and separately whether the hydroxide, the sulphate and the phosphate of the elements, potassium, magnesium and barium are precipitated or not from aqueous solution when the relevant aqueous cations and aqueous anions are allowed to interact. **N.B. You should indicate separately 9 responses in respect of 9 interactions.**

(b) Indicate how the following conversions could be effected. N.B. The reactants and reaction conditions should be given at the appropriate places. It is not necessary to write balanced chemical equations.
(i) $CaCO_3.MgCO_3$ (dolomite) → pure Mg (ii) HCl → $KClO_3$

(c) You are supplied with an aqueous solution containing OH^- and CO_3^{2-} ions. You are not supplied with acid base indicators. However, you are supplied with other common laboratory chemicals. You are not permitted to use electrical instruments such as pH meters. Explain how you would show, under these conditions, the presence of OH^- ions in the solution provided.

10. (a) Explain how it could be demonstrated that the electronegative character of elements increases with increase in atomic number across a period of non-transition elements, by considering the appropriate oxides of Na, Al, P and Cl.

(b) Write balanced chemical equations for the following reactions:
(i) The reaction between concentrated H_2SO_4 and S.
(ii) The reaction between aqueous H_3AsO_4 and H_2S.

(c) (i) Write **five** oxidation numbers exhibited by nitrogen, and **indicate clearly one chemical formula as a representative example for each of those oxidation numbers. N.B. The sign of each oxidation number should also be indicated clearly.**

(ii) You are provided with a chemical fertilizer consisting of ammonium phosphate, ammonium sulphate and potassium chloride. Indicate briefly how you would attempt to determine the percentage of nitrogen present in this mixture. **N.B. Experimental details are not necessary.**
Clue: When an aqueous solution of ammonia is boiled, NH_3 is expelled readily.

11. (a) Write a brief description of the physico-chemical principles involved in the method of manufacture of caustic soda that was employed at Paranthan.
N.B. It is sufficient to consider only five of the most important aspects.

(b) Indicate four uses of the by-products that can be obtained from the manufacture of caustic soda.

(c) (i) Write the names of two ores containing iron.

(ii) Write a short description of the environmental pollution that can be caused by the production of iron. **N.B. It is sufficient to present your views concerning four of the important pollutants.**

12. (a) Discuss briefly the physico-chemical principles involved in the **Haber Process** employed for the industrial production of ammonia. **N.B. It is sufficient to consider five of the most important aspects.**

(b) (i) What is meant by, **'temporary hardness of water'?**

(ii) Explain **three** methods available for the removal of temporary hardness of water.

(c) (i) Draw the structure of natural rubber.

(ii) Propose a method for the determination of the percentage of sulphur in a sample of vulcanized rubber. **N.B. Practical details are not necessary. Clue : Certain sulphates are insoluble in water**

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