1. The chemical formula of sodium aluminate is
(1) $NaAlO_3$ (2) NaAlO (3) $NaAlO_2$ (4) Na_2AlO_3 (5) none of the above.

2. The number of electrons in the last sub-energy level of an atom of the element of atomic number 40 is
(1) 12 (2) 10 (3) 4 (4) 2 (5) none of the above.

3. An oxide formed by a certain element contains 50% oxygen, by mass. The element
(1) can be N. (2) can be S. (3) can be Al. (4) can be C (5) Cannot be any of the above.

4. The number of possible structures in respect of the molecular formula C_7H_9N, containing the benzene nucleus, is
(1) 3 (2) 4 (3) 5 (4) 6 (5) 7

5. The relative molecular mass of a gaseous compound is 48. If the molar volume of the compound at s.t.p. is 20.4, *l* what is the volume of 9.6 g of the compound at 5°C under 24 atm?
(1) 190. 1 ml (2) 173.1 ml (3) 166.9 ml (4) 183. 3 ml
(5)A definite value cannot be indicated for this volume.

6. The chemical formula of Seruwila iron ore is
(1) Cu_2FeS_2 (2) $CuFe_2S_2$ (3) CuS. FeS (4) $CuFeS_3$ (5) Cu_2FeS_3

7. Which one of the following statements concerning a beam of electrons is true?
(1) It is attracted towards the cathode (2) It is attracted towards an N- magnetic pole
(3) It is attracted towards an S - magnetic pole. (4) It is deflected away from the anode.
(5) All of the above statements are false.

8. The mole fraction of the solute of a binary system consisting of two volatile components is
(1) $\frac{P°_{solute} - P_{solute}}{P°_{solvent}}$ (2) $\frac{P°_{solvent} - P_{solvent}}{P_{solvent}}$ (3) $\frac{P°_{solvent} - P_{solute}}{P°_{solvent}}$
(4) $\frac{P°_{solvent} - P_{solvent}}{P°_{solvent}}$ (5) None of the above.

9. Which one of the following statements concerning $CH_3CH = CHCH_2COCH_2CH_2OH$ is false?
(1) It decolorizes bromine water. (2) It changes the colour of a solution of alkaline $KMnO_4$
(3) HCN adds onto it. (4) It answers the iodoform reaction.
(5) It gives a precipitate with Brady's reagent.

10. Which one of the following when added to bromine water will enhance its colour?
(1) Aqueous SO_2 (2) Aqueous Hl. (3) Aqueous NH_3 (4) Aqueous H_2S (5) Solid BaO.

11. Which one of the following can be used to distinguish between $CH_3CH(OH)CH(CH_3)_2$ and $(CH_3)CHOH$?
(1) Concentrated HCl (2) Anhydrous $ZnCl_2$/ concentrated HCl. (3) PI_3
(4) I_2 / NaOH (5) None of the above can be used.

12. Which one of the following is not closely connected with the 'Contact Process'?
(1) SO_2 (2) SO_3 (3) CO_2 (4) V_2O_5 (5) H_2O.

13. 25 ml of a 0.04 mol dm^{-3} hydrochloric acid soution and 25 ml of a 0.02 mol dm^{-3} sulphuric acid solution were mixed together. Assuming that these two acid solutions are completely dissociated, calculate the pH of the above mixture.
(1) 1.52 (2) 1.5 (3) 1.45 (4)1.4 (5) 1.3

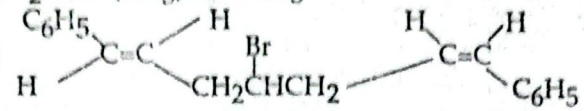
14. Eppawala apatite contains
(1) Ti (2) Al (3) Mg (4) F (5) none of the above

15. CH_3NH_2 (a) $(CH_3)_2NH$ (b) $C_6H_5NH_2$ (c) $C_6H_5NHCH_3$ (d)
The basic strength of the above compounds increases in the following order:
(1) d<c<a<b (2) c<d<a<b (3) c<d<b<a
(4) a<d<c<b (5) The correct order is not given above.

16. The $^{234}_{88}Pa$ nucleus first emits a beta particle, and then emits three alpha particles. Form this nuclear proce
(1) $^{222}_{88}Rn$ is formed (2) $^{222}_{92}Rn$ is formed (3) $^{222}_{92}Ra$ is formed (4) $^{222}_{86}Rn$ is formed (5) $^{222}_{86}U$ is formed

17. The e/m value for the electron was experimentally determined accurately by
(1) Millikan. (2) Crookes (3) Rutherford (4) Marsden (5) none of the above

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18. Which one of the following compounds does not show Optical activity?
(1) H_2NCH_2COOH (2) $H_2NCH(CH_3)COOCH_3$
(3) $CH_3CH(OH)COOH$
(5) All of the above are optically active. (4) 

19. The number of straight-chain structures corresponding to the molecular formula $C_3H_4P_2$ is
(1) 2 (2) 3 (3) 4 (4) 5 (5) none of the above.

20. Which one of the following statements concerning a catalyst is most appropriate?
(1) Increases the activation energy of the forward reaction.
(2) Increases the activation energy of the reverse reaction.
(3) Deereases the activation energy of the forward reaction.
(4) Decreases the enthalpy change in an exothermic reaction.
(5) None of the above statements is appropriate.

21. Which one of the following statements concerning the nitrogen family of elements is **false**?
(1) The acidic strength of the oxides derived from the highest oxidation state decreases from N to Bi.
(2) The basic strength of the hydrides increases from N to Bi.
(3) The non-metallic properties decrease from N to Bi.
(4) The metallic properties increase from N to Bi.
(5) The sulphides of As, Sb and Bi are insoluble in dilute HCl.

22. Which one of the following equations concerning the equilibrium, $2H_2(g) + 2X(g) \rightleftharpoons X_2H_4(g)$ is true?

(1) $Kp = \dfrac{PX_2H_4(g)}{P^2H_2(g) \times PX(g)}$ (2) $Kp = \dfrac{P^2X_2H_4(g)}{P^2H_2(g) \times P^2X(g)}$ (3) $Kc = \dfrac{[X_2H_4(g)]^2}{[H_2(g)]^2 \times [X(g)]^2}$

(4) $Kc = \dfrac{[X_2H_4(g)]}{[2X(g)]^2 \times [2H_2(g)]^2}$ (5) $Kc = \dfrac{[X_2H_4(g)]}{[H_2(g)]^2 \times [X(g)]^2}$

23. Assume that magnesium metal reacts with excess H_2S gas forming H_2 gas and solid $Mg(SH)_2$ quantitatively. What would be the mass of molecular hydrogen that would be formed from 24 g of magnesium metal in this reaction? (H=1: Mg = 24)
(1) 4 g (2) 2g (3) 1g (4) 12 g (5) 24g.

24. Which one of the following statements concerning the cell, $Cd(s)\left|Cd^{2+}(aq)\right\|Ag^{-}(aq)\left|Ag(s)\right.$ is **false**?
(1) The cadmium ion concentration influences the e.m.f.. of this cell.
(2) The silver ion concentration influences the e.m.f.. of this cell.
(3) In this cell reaction, Cd (s) and Ag+(aq) interact in unequal mole proportions.
(4) In this cell reaction, Cd(s) and Ag(s) interact respectively in the mole proportion of 2 : 1
(5) Temperature influences the e.m.f. of this cell.

25. Which one of following statements concerning acid-base indicators and simple titrations is true?
(1) Methyl orange cannot be used in the titration between NaOH and HNO_3.
(2) phenolphthalein cannot be used in the titration between KOH and HCl.
(3) Methyl orange can be used in determining the amount of Na_2CO_3 present in a mixture of Na_2CO_3 and $NaHCO_3$.
(4) Phenolphthalein can be used in determining the amount of Na_2CO_3 present in a mixture of Na_2CO_3 and $NaHCO_3$.
(5) All of the above statements are incorrect.

26. The inorganic compound, X is insoluble in water. X dissolves in dilute HNO_3 and gives an orange coloured solution. This solution gives a green colour in the flame test. When H_2S gas is passed through this solution, it turns green. Which one of the following could be X?
(1) $CuCrO_4$ (2) $PbCrO_4$ (3) $Ba(MnO_4)_2$ (4) $BaCrO_4$ (5) BaI_2

27. The organic compound, Y dissolves readily in dilute sodium hydroxide. Y gives an orange precipitate with Brady's reagent, Further, it gives a light yellow precipitate when warmed with I_2/NaOH, Which one of the following could be Y?
(1) $CH_3\underset{OH}{\underset{|}{C}}HCH_2CH_2CH_2CHO$. (2) $CH_3COCH_2CH_2COOH$ (3) $(CH_3)_2\underset{OH}{\underset{|}{C}}CH_2COCOOH$.
(4) $CH_3CH_2COCH_2\underset{I}{\underset{|}{C}}HCOOH$. (5) Y cannot be any of the above.

28. It has become necessary to synthesise $C_6H_5COC_6H_5$, starting with benzene. Which one of the following is most suitable as the first step for this synthesis?
(1) Reacting benzene with concentrated HNO_3
(2) Reacting benzene with a mixture of concentrated HNO_3 / concentrated H_2SO_4
(3) Reacting benzene with Br_2
(4) Reacting benzene with Cl_2 / anhydrous $AlCl_3$
(5) Reacting benzene with C_6H_5Br / anhydrous $FeBr_3$

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29. It has become necessary to perpare $Pb(NO_2)_2$ starting from a sample of nitric acid provided to you. Which one of the following courses of action is the most suitable first step for this preparation ?
(1) Reacting the nitric acid sample with $PbCO_3$.
(2) Diluting the nitric acid sample and reacting with copper turnings.
(3) Reacting a part of the nitric acid sample with aqueous NaOH.
(4) Concentrating a part of the nitric acid sample and reacting with sulphur.
(5) Reacting a part of the nitric acid with $PbSO_4$.

30. The IUPAC name of $CH_3C(Br) = C(CH_2CH_2CH_3)CH_2COOH$ is

(1) 5 — bromo — 4 — propyl — 4 — pentenoic acid.
(2) 5 — bromo — 4 — propyl — 4 — hexenoic acid.
(3) 4 — bromoethyl — 4 — heptenoic acid.
(4) 4 — bromoethyl — hept — 4 — enoic acid.
(5) 4 — propyl — 5 — bromo — 4 — pentenoic acid.

31. Which of the following is/ are connected with the term 'molecule'?
(a) Gay Lussac's Law (b) The term 'atom' (c) Dulong and petit's Law (d) Faraday's Laws

32. When H_2S gas is passed through a neutral aqueous solution which is 0.05 mol dm^{-3} with respect to Pb^{2+}, and 0.10 mol dm^{-3} with respect to Ni^{2+}, both PbS and NiS are precipitated. When H_2S gas is passed through an acidified solution containing Pb^{2+} and Ni^{2+}, only PbS is precipitated. Which of the following is/ are substantiated by the above observations?
(a) The solubility product of PbS is smaller that the solubility product of NiS.
(b) In neutral aqueous solution, the solubility product of PbS is equal to the solubility product of NiS.
(c) The concept of solubility product does not apply to the above neutral aqueous solution.
(d) The concept of solubility product does not apply to the above acidified solution.

33. Which of the following statements/ statement concerning $(CH_3)_3CCl$ and $C_6H_5CH_2Cl$ are / is true?
(a) Both of these compounds give a white precipitate with aqueous $AgNO_3$
(b) Only $C_6H_5CH_2Cl$ will give a precipitate with $AgNO_3$ acidified with HNO_3
(c) Only $(CH_3)_3CCl$ will give a precipitate with $AgNO_3$ acidified with HNO_3
(d) Both of these compounds increase the electrical conductance of water considerably.

34. Which of the followings courses/ course of action can be adopted in order to distinguish between $C_6H_5COOC_6H_5$ and $CH_3CH_2COOCH(CH_3)C_6H_5$?
(a) Subject to alkaline hydrolysis, and then add a diazonium salt solution.
(b) Subject to acid hydrolysis, and then add bromine water.
(c) Test with Br_2/ aqueous NaOH.
(d) Test with ammoniacal silver nitrate.

35. Which of the following statements/ statement conerning halogens are/ is true?
(a) All the halogens can exist in positive oxidation states.
(b) All the halogens are electronegative .
(c) All the halogens are diatomic.
(d) All the halogens react with hydrogen gas explosively.

36. Which of the following react/ reacts with aqueous KOH?
(a)Fe (b) Mg (c) Al (d) Si

37. Which of the following are/ is closely connected with cinnamon oil?
(a) Camphor (b) Steam distillation. (c) Crystallization. (D) Geraniol.

38. Zinc granules are placed in an aqueous solution of ammonium iodide, shaken well, and kept aside. Which of the following statements/ statement concerning the aqueous solution so produced are/ is true ?
(a) Blue litmus is turned red. (b) Red litmus is turned blue/
(c) Starch solution is turned deep blue. (d) Light red litmus is turned dark red.

39. Which of the following react/ reacts with SO_2?
(a) Aqueous hydrogen iodide. (b) Apueous iodine
(c) Aqueous potassium carbonate. (e) Dilute sulphuric acid.

40. Which of the following statements / statement are / is true?
(a) For a reaction to occur between gas molecules, the pressure should always be high.
(b) For a reaction to occur between gas molecules, the gas molecules should always collide.
(c) For a reaction to occur between gas molecules, the temperature should always be higher than room temperature.
(d) For a reaction to occur between gas molecules, a catalyst is always necessary.

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	First Statement	Second Statement
41.	Bromobenzene undergoes nitration more easily than benzene.	The - Br group activates the benzene ring.
42.	An aqueous solution of methylammonium benzoate can show buffer action.	Benzoic acid is a weak acid.
43.	When the temperature increases, the rate of a reaction also increases.	Kp and K_c of a reaction depend on temperature.
44.	Bleaching powder acts as a germicide.	Bleaching powder is on oxidizing agent.
45.	A mixture consisting of C_6H_6 and $C_6H_5CH_3$ shows deviations form Raoults Law.	The - CH_3 group repels electrons.
46.	C_2H_5MgBr reacts with ethanoic acid.	C_2H_5MgBr adds across the C = O group in ethanoic acid.
47.	H_3O^+ is planar.	There are three O - H bonds in H_3O^+
48.	The rusting of iron is suppressed by NH_3 gas.	NH_3 gas cannot act as an acid.
49.	H_2Se cannot act as an oxidizing agent.	In H_2Se, selenium exists in the highest oxidation state.
50.	The reaction of styrene with aqueous H_2SO_4 give an optically active compound.	Styrene does not show cis-trans isomerism.

51. Which one of the following can be used to distinguish between $Mg(NO_3)_2$ and $(NO_3)_2$?
(1) Aqueous Na_2CO_3 (2) Aqueous $NaHCO_3$ (3) Aqueous NH_3
(4) Aqueous KI. (5) None of the above can be used.

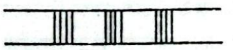
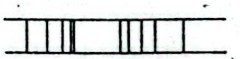
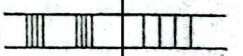
52. Which one of the following cannot be used to distinguish between KBr and KI?
(1) Aqueous $AgNO_3$/ dilute HNO_3 (2) Aqueous $Pb(NO_3)_2$ (3) Concentrated H_2SO_4.
(4) Concentrated HNO_3 (5) CCl_4

53. Which one of the following cannot be used to convert ethanol to ethanal?
(1) Reacting with $K_2Cr_2O_7$ and dilute H_2SO_4 (2) Reacting with K_2CrO_4 and dilute H_2SO_4
(3) Passing ethanol vapour over heated copper. (4) Passing ethanol vapour over heated calcium.
(5) Passing ethanol vapour over heated silver.

54. Which one of the following is most closely connected with the basis of steam distillation?
(1) Boyle's Law. (2) Charle's Law (3) Dalton's Law of partial pressures. (4) Raoult's Law.
(5) None of the above is closely connected with the basis of steam distillation.

55. Which one of the following statements concerning ionization energies is true?
(1) The first ionization energy of oxygen is greater than the first ionization energy of nitrogen.
(2) The second ionization energy of beryllium is greater than the second ionization energy of lithium.
(3) The first ionization energy of aluminium is less than the first ionization energy of magnesium.
(4) All of the above statements are true.
(5) All of the above statements are incorrect.

56. Which one of the following patterns of lines is most closely connected with the pattern of lines of the atomic spectrum of hydrogen?

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

(5) None of the above patterns of lines is closely connected with the pattern of lines of the atomic spectrum of hydrogen.

57. It has become necessary to synthesise $(CH_3)_2CHBr$, starting from $CH_3CH_2CH_2OH$. Which one of the following courses of action is most suitable as the first step for this synthesis?
(1) Reacting $CH_3CH_2CH_2OH$ with concentrated HCl
(2) Reacting $CH_3CH_2CH_2OH$ with concentrated HCl / anhydrous $ZnCl_2$.
(3) Reacting $CH_3CH_2CH_2OH$ with concentrated H_2SO_4
(4) Reacting $CH_3CH_2CH_2OH$ with phosphorus tribromide
(5) Reacting $CH_3CH_2CH_2OH$ with bromine.

58. In the series of elements, Li, Be, B, C, N, O and F, the highest valency
(1) decreases from Li to F. (2) increases from Li to F. (3) is a maximum at C.
(4) is a maximum at N. (5) is a maximum at O.

59. The easiest method to show the presence of nitrogen in $H_2NCO-C_6H_4-SO_2OH$ is
(1) boiling with dilute H_2SO_4.
(2) boiling with dilute NaOH.
(3) performing Lassaigne Fusion, and then showing the presence of CN^-
(4) reacting with concentrated HCl.
(5) reacting with concentrated HNO_3.

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59. It has been ...

60. Which one of the following is most relevant in connection with the addition reaction that occurs between C_2H_4 and Br_2?

(1) $H_2C=CH_2 + Br^- \longrightarrow H_2C-CH_2-Br$

(2) $H_2C=CH_2 + Br^+ \longrightarrow H_2C^+-CH_2-Br$

(3) $H_2C=CH_2 \quad Br^{+\delta}-Br^{-\delta} \longrightarrow H_2C^+-CH_2-Br + :Br^-$

(4) $H_2C=CH_2 \quad Br^{-\delta}-Br^{+\delta} \longrightarrow H_2C-CH_2-Br + Br^+$

(5) $H_2C=CH_2 \quad Br^+ + Br^- \longrightarrow H_2C-CH_2^+-Br$

PART A STRUCTURED ESSAY

1. (a) (i) Write the electronic configuration of the element of atomic number 48 in the usual form, $1s^2 2s^2$ ..... etc

(ii) The atomic number of the element, X is 51. What is the lowest oxidation nymber expected from X

N.B. If the oxidation number given by you has a sign, that too should be clearly indicated.

(b) Give briefly **two items of evidence** for the non-continuous nature of matter.

(c) The element. Y forms a compound of molecular formula $H_4Y_2O_7$. In this compound, the two Y atoms are identical. Suggest a structural formula for the molecule, $H_4Y_2O_7$.

2. (a) (i) Define **'relative molecular mass'.**

(ii) Write the chemical formulae of the compounds given below, in the appropriate cages.

magnesium phospate	
ferric thiosulphate	

(b) An alloy contains magnesium, aluminium and copper. A sample of the alloy of mass 0.600 g was fi treated with dilute NaOH. The volume of hydrogen gas so obtained was 336 cm^3 at s.t.p. The metall residue remaining after this reaction was then treated with dilute HCl. The volume of hydrogen gas obtained was 112 cm^3 at s.t.p. Calculate the percentage of magnesium and the percentage of aluminu by mass, present in the alloy. The molar olume of hydrogen at s.t.p. is 22.4 dm^3. (Mg=24; Al=27)

(c) You are provided with an aqueous solution containing ferric ions and permanganate ions. Indic briefly how you would attempt to determine the concentration of ferric ions and the concentration permanganate ions present in this solution. **N.B. Experimental details are not necessary.**

3. (a) An organic compound contains 31.4% carbon, 1.3% hydrogen, 18.3% nitrogen and oxygen only. relative molecular mass of the compound is approximately 250. Determine the molecular formula of compound. (H=1; C=12; N=14; O=16)

(b) The molecular formula of the compound, A is C_3H_6O. A does **not** contain tne enol gr

(ie. the $>C=C<_{OH}$ group.) A is not a cylic compound. **Draw all the srtructures** possible for A

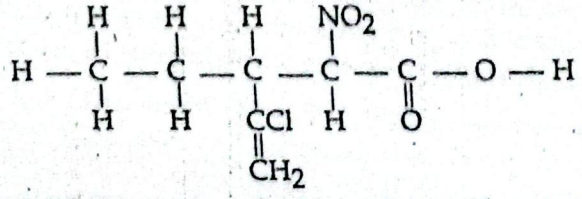
(c) Indicate how the following conversions could be effdcted. The neccessary reagents and reaction co tions should be given at the appropriate places. N.B. If the methods of conversion suggested by you unnecessarily long, you will not be awarded the maximum marks.

(i) $C_2H_4 \longrightarrow CH_3CH(OH)COOCH_2CH_3$

(ii) Using $CH_3CH_2CONH_2$ as the only organic compound,

$CH_3CH_2CONH_2 \longrightarrow CH_3CH_2CH_2NHCH_2CH_2CH_3$

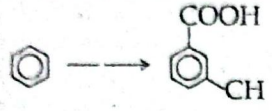
4. (a) Name the following compound according to IUPAC nomenelature:

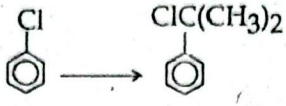


(b) When $C_6H_5COCH_3$ is treated with a mixture of concentrated HNO_3 and concentrated H_2S(3-nitro derivative is formed. Considering the mechanism of this reaction, explain the above obser

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(c) Indicate how the following conversions could be effdcted. The necessary reagents and reaction conditions should be given at the approprite places. N.B. If the methods of conversion given by you are unnecessarily long you will not be awarde maximum marks.

(i) 

(ii) 

PART B - ESSAY

5. (a) Assuming the equation $PV = \frac{1}{3} mN\bar{c}^2$, derive Avogadro's Law.

(b) A vessel of volume V contains 3.20 g of oxygen under 1.12 atm at 0°C. This vessel was connected to another vessel of volume V which has been completely cvacuated. Thereafter, the two vessels were heated to 17°C, and a gas X was introduced into the system until the pressure was 1.00 atm at the same temperature, The mass of X required for this purpose was 3.00 g. If oxygen and X behave as ideal gases under these conditions, calculate the relative molecular mass of X. (O=16)
N.B. Assume that the volume of the vessels do not change with temperature, and that there is no reaction between X and oxygen.

(c) (i) You are supplied with the organic solvent A. Describe briefly how you would determine the distribution coefficient of iodine between water and A.

(ii) An organic compound is more soluble in benzene than in water. The distribution coefficient of the organic compound between benzene and water is 4. The concentration of an aqueous solution of the organic compound is 10.00 gl^{-1} 100 ml of this solution was extracted for the first time with 100 nil of benzene. 50 ml of the resulting aqueous solution was extracted for the second time with anotl er 50 ml of benzene. 25 ml of the aqueuss solution resulting after the second extraction was extracted for the third time with another 25 ml of benzene. Calculate the amount of the organic compound remaining in this 25 ml of the aqueous solution after the third extraction.

6. (a) (i) Describe briefly an experiment suitable for demonstrating that the surface area of zinc metal influences the rate of the reaction between zinc metal and aqueous sodium hydroxide.

(ii) Describe briefly an experiment suitable for demonstrating that temperature influences the rate of the reaction between $MnO4^-$ and $C_2O_4^{2-}$ ions in acidic medium.

(b) The rate of the reaction, $2B(aq) + 3C(aq) \rightarrow D(s) + E(aq) + F(aq)$

was investigated by measuring the time required for the formation of a small and constant quantity of D(s). The data obtained from this study carried out at constant temperature, using a solution containing B and a solution containing C, are given below.

solution containing B, ml	solution containing C, ml	water, ml	time, s
15.0	25.0	10.0	18.0
20.0	25.0	5.0	10.1
25.0	8.0	17.0	7.6
25.0	2.0	23.0	30.0

The rate law pertaining to this reaction can be written as follows: Rate α $[B(aq)]^x \times [C(aq)]^y$
Using the above data, calculate x and y.

(c) Explain how you would show that the reaction between $SO_3^{2-}(aq)$ and $I_2(aq)$ can be reversed.
N.B. Experimental details are not necessary.

7. (a) Derive the relationship between the Kp and Kc of the reaction,

$$aA(g) + bB(g) \rightleftharpoons yY(g) + zZ(g).$$

(b) Consider the equilibrium, $R_2Q_4(g) \rightleftharpoons 2RQ(g) + Q_2(g)$. Pure R_2Q_4 gas exit in a closed vessel at 27°C under 4 atm. When a certain catalyst was introduced into the system, the aboye equilibrium was attained. At 27°C the pressure of the system in equilibrium was 6 atm. Calculate the Kp and Kc for this system at 27°C. **N.B. Assume that nothing escapes out of the vessel when the catalyst is introduced into the vessel.**

(c) 50.05 cm^3 0.1 mol dm^{-3} aqueous NaOH and 49.95 cm^3 of 0.1 mol dm^{-3} aqueous HCl are mixed together at 25°C. Calculate the pH of this mixture at 25°C. Kw at 25°C = 1.0×10^{-14} mol^2 dm^{-6}

(d) Considering the simple theory of acid-base indicators, explain what is meant by, **'the pH range of an indicator'**

8. (a) Comment on **four** important characteristic properties of catalysts.

(b) (i) Explain what is meant by **'natural radioactivity'**

(ii) Explain the basis of radiocarbon dating.

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(c) (i) Give the Born-Haber Cycle necessary for the examination of the stability of the hypothetical compound, KF_2

(ii) In this Born-Haber Cycle, what would you use in place of the lattice energy of KF_2?

PART C - ESSAY

9. (a) How and under what conditions do the following react with air and water?
(i) Sodium (ii) Magnesium

(b) Indicate how the following conversions could be effected. **N.B. The necessary reagents and reaction conditions should be given at the appropriate places. It is not necessary to write balanced chemical equations.**

(i) Using $KCl.MgCl_2.6H_2O$ as the only potassium-containing compound,

$KCl.MgCl_2.6H_2O \rightarrow$ Pure potassium

(ii) Using H_2SO_4 as the only sulphur - containing compound,

$H_2SO_4 \rightarrow$ Pure $BaSO_3$

(c) You are supplied with an aqueous solution containing potassium sulphate and potassium phosphate. Explain how you would attempt to determine the sulphate ion and phosphate ion concentrations in this solution.

10. (a) Describe briefly the chemistry relevant to the industrial conversion of ammonia to nitric acid.

(b) Indicate how a compound having nitrogen in the + 2 oxidation state can be obtained using nitric acid. **N.B. Balanced chemical equation/ equations for the relevant reaction / reactions should be given.**

(c) Describe briefly the experiment involving ammonia which is being used in the laboratory to determine the percentage of oxygen in air, by volume.

11. (a) Write a brief description of the physico-chemical principles involved in the **'Ammonia - Soda process.'**

(b) Write a brief description of the environmental pollution that can be caused by a caustic soda factory. **N.B. It is sufficient to consider four important relevant points.**

(c) Explain how you would experimentally demonstrate that bromine is intermediate between chlorine and iodine, in terms of electronegative character.

12. (a) Write a brief description of the manufacture of bleaching powder, starting from limestone.

(b) (i) Write brief descriptions of how clay is formed and its composition.

(ii) You are supplied with two samples of soil. Explain how you would identify the sample containing more of iron.

(c) In the vulcanization of a kind of rubber employed for a special purpose, $CaCO_3$ has been used in addition to sulphur. Indicate briefly how you would attempt to determine the percentage of $CaCO_3$ in a sample of this rubber. **N.B. Experimental details are not necessary.**

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