1. The number of electrons in the last slub-energy level of the +3 cation formed by the element of atomic number 42 is
(1) 1 (2) 2 (3) 3 (4) 4 (5) 5

2. Which one of the following statements negarding phosphoruss is false?
(1) The compound PCl_3 exists. (2) The compound PCl_5 exists. (3) The compound P_2O_3 exists.
(4) The compound P_2H_5 exists. (5) The compound PO_4 does not exist.

3. The number of optically inactive alcohols of molecular formula $C_2H_{10}O$ and containing an aromatic ring is
(1) 3 (2) 4 (3) 6 (4) 7 (5) 8

4. 1 mol of a gas at 27°C, and under a certain pressure, is kept inside a vessel of variable volume. Another 1.5 mol of the same gas was introduced to the vessel and it was heated to a certain temperature, At this timperature, the pressure inside the vessel was double the initial pressure, the volume was also double the initial volume. If the gas behaves ideally, the new temperature is,
(1) 800°C (2) 527°C (3) 500°C (4) 480°C (5) 207°C

5. The chemical formula of cacsium periodate is
(1) $CSIO_4$ (2) $CsIO_3$ (3) $CsIO_4$ (4) $CsIO_4$ (5) $ScIO_4$

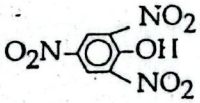
6. Which one of the following cannot be used directly to distinguissh between C_6H_5CHOH (CH$_3$) and $C_6H_5C(CH_3)_2OH$
(1) Acidified potassuim dichromate (2) Acidified ammonium chromate
(3) Phosphorus trichloride (4) Acidified sodium permanganate
(5) A mixture of concentrated hydrochloric acid and anydrous zinc chloride.

7. Which one of the following is present in apatite?
(1) $CaMg(PO_4)Cl$ (2) $Ca_5(PO_4)_3F$ (3) $CaH(PO_4)_3F$ (4) $Ca_2Mg(PO_4)_2$ (5) None of the above.

8. At a certain temperature the K_w of water is 1.0×10^{-12} mol^2 dm^6. The pH of an aqueous solution of 10^{-10} mol dm^{-3} CH_3COOH at the same temperature is approximately
(1) 10.1. (2) 10. (3) 9.9 (4) 7. (5) 6.

9. Assume that the divalent metal M reacts with nitric acid giving N_2O. Which of the following would be the M:HNO_3 molar ratio in the appropriate and balanced chemical equation for this reaction?
(1) 4:5 (2) 1:2 (3) 2:1 (4) 2:5 (5) none of the above.

10. The IUPAC name of $CH_3CH_2C(Cl)=C(Br)CH_2CHCOOH$ (CH$_2$CH$_2$CH$_3$) is
(1) 2-bromo-5chloro-4-propyl-4-hexenoic acid. (2) 2-bromo-5-chloro-4-propyl-4-heptenoic acid.
(3) 2-bromo-5-chloro-4-propyl-5-heptenoic acid. (4) 5-chloro-2- bromo-4-propyl-4-heptenoic acid.
(5) 5-chloro-2-bromo-4-propyl-5-heptenoic acid.

11.  F_3CCOOH  ClF_2CCOOH
The acidic nature of the above compounds increases as follows:
(1) a < c < b < d (2) a < d < c < b (3) c < a < b < d (4) a < c < d < b (5) c < a < d < b

12. Sulphur reacts with conecntrated nitric acid and gives the following:
(1) $SO_2+N_2O+H_2O$ (2) $H_2SO_4+NO_2+H_2O$ (3) $SO_2+H_2SO_4+N_2O_5+H_2O$
(4) $H_2SO_4+N_2O+H_2O$ (5) $SO_2+NO_2+N_2O+H_2O$

13. Chlorine reacts with hot concentrated potassium hydroxide and gives the following:
(1) $KCl+KClO+KClO_4+H_2O$ (2) $KCl+KClO+H_2O$
(3) $KCl+KClO_3+H_2O$ (4) $KCl+KClO_4+H_2O$ (5) $KClO_3+KClO_4+H_2O$

14. $Cr^{3+}(aq)+3e \rightarrow Cr(s) : E^{\ominus} = -0.74$ V $\quad X_2(l)+2e \rightarrow 2X^-(aq) : E^{\ominus} = +1.07$ V
$Cr(s) \mid Cr^{3+}$ (aq 1 mol dm^{-3}) $\mid X_2(l) \mid X^-$ (aq 1 mol dm^{-3}) In this electrochemical cell
(1) X^- is oxidized (2) Cr^{3+} is reduced (3) the e.m.f is + 0.33 V.
(4) the e.m.f. is +1.81 V. (5) the e.m.f. is – 1.81 V

15. The value of the equilibuitum constant, Kp of a given homogeneous gaseous chemical reaction
(1) depends on the pressure of the reactants. (2) depends on the partial pressures of the reactants.
(3) depends on the partial pressures of the produc (4) depends of the catalyst present on the system.
(5) does not depend on any of the above.

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16. Which one of the following statements concerning 'relative molecular mass' and 'vapour density' is true?
(1) In the case of a mono-atomic gas such as helium, the relative molecular mass is equal to its vapour density.
(2) the vapour density of a gas which behaves ideally is twice that of its relative molecular mass.
(3) The relative molecular mass of O_3 gas is three times its vapour density.
(4) The relative molecular mass of O_3 gas six times its vapour density.
(5) None of the above statements is true.

17. The mass of a $^{12}_{6}C$ atom is
(1) 19.93×10^{-24}g (2) 9.96×10^{-24}g (3) 1.66×10^{-24}g (4) 109.3×10^{-28}g (5) 9.107×10^{-28}g

18. CH_3CH_2Br (a) C_6H_5Br (b) $C_6H_5CH_2Br$ (c)
The case of hydrolysis of the above compounds increases as follows:
(1) a<b<c (2) a<c<b (3) b<a<c (3) b<c<a (5) c<b<a

19. The inorgnic compound *A* dissolved readily in water and also in dilute sulphuric acid without any chemical reaction. *A* imparted a green colour to the busen flame. When heated with concentrated nitric acid *A* gave a dark coloured gas. Which one of the following could be *A*?
(1) $BaBr_2$ (2) $Ba(NO_2)_2$ (3) CrI_3 (4) $Cu(NO_2)_2$ (5) $CuBr_2$

20. An organic compound was subjected to Lassigne fusion and was tested for nitrogen. In this test a black precxipitate was obtained on the addition of $FeSO_4$. Which one of the foollowing statements concerning the organic compound is most appropriate?
(1) The compound contains nitrogen. (2) The compound contain SO_4^{2-}.
(3) The compound contains sulphur and nitrogen. (4) The compound contains sulphur.
(5) The compound contains sulphur and phosphorus.

21. The organic compound *B* decolorizes bromine water.*B* answers the iodoform reaction. *B* can be oxidized readily, and it does not dissolve in aqueous NaOH. However, the oxidation product dissolves in aqucous NaOH. Which one of the following could be *B*?

(1) $CH_3CH_2CH=C(COCH_2CH_3)(CH_2OH)$
(2) $HO-C(=O)-CH=C(CH_2COCH_3)(CHO)$
(3) $CH_3CH=C(CH_2COCH_3)(CHO)$
(4) HO–C(=O)–C$_6$H$_3$(HO–C(CH$_3$)$_2$)–CH = CH$_2$
(5) H–C(=O)–C$_6$H$_3$(HO–C(CH$_3$)$_2$)–CH = CH$_2$

22. At a certain temperature the solubility of aluminium hydroxide in water is *x* mol dm^{-3}. The solubility product of aluminium hydroxide at this temperature is
(1) $27\,x^4$ mol^3 dm^{-9} (2) x^4 mol^4 dm^{-12} (3) $9x^3$ mol^3 dm^{-9}
(4) $27x^4$ mol^4 dm^{-12} (5) $27x^3$ mol^3 dm^{-9}

23. K_a of a weak mono-basic acid at 25°C is $1.0\text{X}10^{-6}$ mol dm^{-3}. What would be the pOH of a 1.0 mol dm^{-3} aqueous solution of this acid at 25°C? (N.B. $K_w = 10^{-14}$ mol^2 dm^{-6} at 25°C.)
(1) 3 (2) 6 (3) 8 (4) 10 (5) 11

24. the charge that can exist on a cathode ray particle was quantitatively determined by
(1) Moseley (2) Rutherford (3) Thomson (4) Marsden (5) none of the above

25. Which one of the following oxides is most strongly acidic in aqueous solution?
(1) N_2O_3 (2) P_2O_3 (3) P_2O_5 (4) Cl_2O_7 (5) Cl_2O

26. Which one of the following statements concerning mixtures consisting of C_2H_5Cl and C_2H_5Br is true/
(1) When the concentration of C_2H_5Cl is high, the mixture shows positive deviations from Raoult' Law.
(2) When the concentration of C_2H_3Br is high, the mixture shows positive deviarions from Raoult's Law.
(3) At a certain C_2H_5Cl concentration, the total vapour pressure of the mixture iss a maximum.
(4) At a certain C_2H_5Br concentration, the total vapour pressure of the mixture is a minimum.
(5) All of the above statements are incorrect.

27. For the purpose of distinguishing between $BrCH_2CH_2COBr$ and $BrCH_2COOH$
(1) phenolphthalein could be used. (2) methyl orange could be used.
(3) aqueous silver nitrate could be used. (4) all of the above could be used.
(5) none of the above could be used.

28. Which one of the following contains the highest percentage of aluminium?
(1) Rutile (2) Rubies (3) Clay (4) Aluminium carbonate (5) Granite

29. For the purpoe of showing the presence of sulphur in Seruwila iron ore
(1) a solution of sodium hydroxide could be used. (2) a solution of ammonia could be used.
(3) a solution of hydrochloric acid could be used. (4) all of the above cooud be used.
(5) none of the above could be used.

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

31. Which of the following statements / statement concerning alpha, beta and gamma rays are/ is correct?
(a) The path of alpha rays is changed by magnetic fields. (b) The path of beta rays i changed by electric fields.
(c) The ionizing power of gamma rays is very high. (d) The penetrating power of alpha rays is very high.

32. Which of the following reacts / react with phenol?
(a) Bromine (b) Aqueous KOH (c) Formaldehyde (d) Aqueous $KHCO_3$

33. A few drops of methyl orange indicator and magneium powder have been added to an aqueous solution of NH_4NO_3. Which of the following statements / statement concerning this system are/is true?
(a) Methyl orange turns red. (b) Methyl orange turns yellow.
(c) Hydrogen is liberated. (d) The NO_3^- anion is reduced to NH_3

34. On which of the following factors/.factor do/does the rate of a chemical reaction depend?
(a) The enthalpy of products (b) The enthalpy change in the reaction
(c) The activation inergy of the reaction. (d) the temperature

35. Which of the following are/is important in connection with the stability of the hypothetical compound, KF_2?
(a) The 1 st ionization energy of potassium (b) The 2nd ionization energy of potassioum
(c) The standard enthalpy of formation of CaF_2 (d) The lattice energy of KCl

36. Which of the following statements/ statement concerning hydrogen bonds are/is true?
(a) Hydrogen bonds may be formed by - NH_2 groups. (b) Hydrogen bonds may be formed by -SiH_2- groups.
(c) -CH_3 groups form strong hydrogen bonds. (d) Strong hydrogen bonds exist is liquid HF.

37. Which of the following statemints/ statement concerning ionization energies are/ iss true?
(a) The 2nd ionization energy of Sr is greater than the 1 st ionization energy of Rb.
(b) The firt ionization energies of the successive elements in the Fourth Period of the Periodic Table do not show the characteristic zig-zag variation.
(c) The first ionization energies of the successive elements in the Second Period of the Periodic Table do not show the characteristic zig-zag variation.
(d) The 5th ionization energy of nitrogen is greater than the 4th ionization energy of boron.

38. Which of the folllowing pertining to the mechanisms of certain organec reactions is/are true?
(a) $HNO_3 + H_2SO_4 + H_2O \rightarrow NO_2^+ 2H_3O^+ + SO_4^{2-}$
(b) In the conversion of methylbenzene to $C_6H_5CH_2Cl$ by Cl_2 gas, Cl^+ takes part in the reaction.
(c) $Br - \overset{\oplus}{C}H_2 - CH_2 \qquad : Cl^- - Br - CH_2 - CH_2 - Cl$
(d) $RCOOH + H_3O^+ \rightleftharpoons R - \overset{+O-H}{\underset{OH}{C}} + H_2O$

39. Which of the follewing is/ are closely connected with the manufacture of ammonia?
(a) Nitric acid (b) Environmental pollution (c) Explosives (d) Dolomite

40. Which of the following concerning the electrolysis of NaCl is/ are true?
(a) H_2 and Cl_2 can be obtained. (b) NaOH can be obtained
(c) Sodium metal cannot be obtained (d) A solution of NaOCl cannot be obtained.

	First Statement	Second Statement
41.	An aqueous solution containing Na_2CO_3 and $KHCO_3$ cannot show buffer action.	Both Na_2CO_3 and $KHCO_3$ show basic properties.
42.	The-F group linked to the benzene ring gives rise to ortho-para directing character.	The electronic effect  occurs.
43.	The realative molecular masses of proteins are very large.	In proteins a very large number of 2-amino carboxylic acid units are polymerized through -CO-NH- links.
44.	The brown colour of the equilibrium system $2NO_2 \rightleftharpoons N_2O_4$ .increases with pressure.	N_2O_4 is a dark brown compound.
45.	The manufacture of cement adverselly affects the environment.	Gases which are highly toxic to man are liberated in the manufacture of cement.
46.	N_2O_3 can act as an oxidixing agent	N_2O_3 decomposes readily into NO and NO_2
47.	In all catalytic processes adsorption is very important.	adsorbed molecules are highly reactive.
48.	Iron is a suitable metal for establish the Law of Multiple Proptions.	FeO and Fe_2O_3 can be readily obtained quantitatively from iron.

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49. Hydrogen and iodine are two elements suitable for conducting experiments for the pupose of estabishing Gay Lussac's Law.
Hydrogen and iodine combine to form hydrogen iodide.

50. $C_6H_5NH_2$ and $C_6H_5CH_2NH_2$ can be distinguished using ethanolic $CHCl_3$/ KOH
$C_6H_5NH_2$ is a premary aromatic amine.

51. Which one of the following concerning the increase in atomic radius is true?
(1) B<C<Be<Li (2) Na<Al<Si<Mg (3) Si<Al<Mg<K (4) Si<Al<K<Mg (5) None of the above is true

52 $O(g) + e \rightarrow O^-(g)$: $\Delta H^\ominus$ = -142 kJ mol^{-1}
$O(g) + 2e \rightarrow O^{2-}(g)$: $\Delta H^\ominus$ = +702 kJ mol^{-1}
The energy change that occurs when the gaseous ionic species O^- acquires an electron and becomes the gaseous ionic species O^{2-} is.
(1) +844 kJ mol^{-1} (2) -844 kJ mol^{-1} (3) +560 kJ mol^{-1} (4) -560 kJ mol^{-1} (5) +986 kJ mol^{-1}

53. It has become necessary to distinguish chemically between C_6H_5CHO and HCHO. Which one of the following courses of action is the most appropriate for this purpose?
(1) First, boiling with aqueous HCl, and then adding aqueous NaOH.
(2) First, boiling with aqueous KOH, and then adding aqueous H_2SO_4.
(3) Reacting with Brady's Reagent.
(4) Reacting with aqueous HI.
(5) Reacting with aqueous $LiHCO_3$

54. It has become necessary to synthesise C_6H_5D making use of C_6H_6 and D_2O. Which one of the following initial courses of reaction is the most appropriate for this purpose?
(1) C_6H_6 + concentrated HNO_3 (2) $C_6H_6 + D_2O$ + anhydrous $AlCl_3$
(3) $C_6H_6 + Br_2 + FeCl_3$ (4) $C_6H_6 + PCl_5 + D_2O$
(5) C_6H_6 + concentrated $HNO_3 + D_2O$

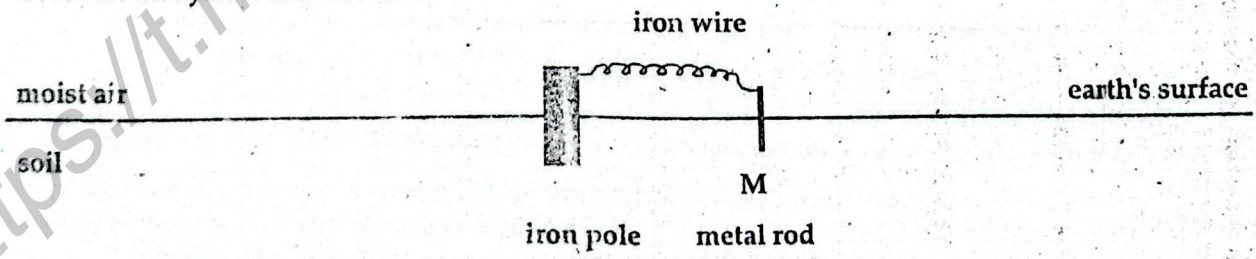
55. Consider the equilibrium, $A_2(g) + 2B_2(g) \rightleftharpoons AB_2(g); \Delta H < 0$
Which one of the following statements concerning this equilibrium is true?
(1) The equilibrium is shifted to the left by increasing the total pressure.
(2) The equilibrium is shifted to the right by decreasing $[A_2(g)]$
(3) The equlibrium is shifted to the right by increasing $[AB_2(g)]$
(4) The equilibrium is shifted to the left by increasing the temperature.
(5) The equilibrium is shifted to the left by decreasing the temperature.

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56. Which one of the following statements concerning the compound KO_2 is true?
(1) In this compound, the oxidation number of potassium is + 4
(2) In this compound the oxidation number of potassium is + 2.
(3) In this cmopiund, the oxidation number of oxygen is -2.
(4) In this compound, the oxidation number oxygen is -½
(5) All of the above statements are incorrect.

57. Which one of the following sstatements concerning a solution of diazonium chloride is incorrect?
(1) It reacts with warm water giving C_6H_5OH. (2) It reaccts with CuCl/concentrated HCl giving C_6H_5Cl
(3) It reacts with H_3PO_2 giving C_6H_6. (4) It reacts with aqueous H_2SO_4 giving $C_6H_5SO_2OH$.
(5) It reacts with CuCN/ KCN giving C_6H_5CN.

58. Consider the system shown below.



Which one of the following statements concerning the above system is most appropriate?
(1) When the metal M is Mg, iron corrodes very rapidly.
(2) When the metal M is Zn, iron corrodes rapidly.
(3) When the metal M is Sn, iron corrodes.
(4) When the metal M is Cu, the corrosion of iron is suppressed to a great extent.
(5) When the metal M is Ag, the corrosion of iron is completely stopped.

59. Which one of the following will react with aqueous H_2S?
(1) Aqueous HBr (2) Aqueous HI (3) Aqueous CH_3COOH
(4) Aqueous SO_2 (5) None of the above will react with aqueous H_2S.

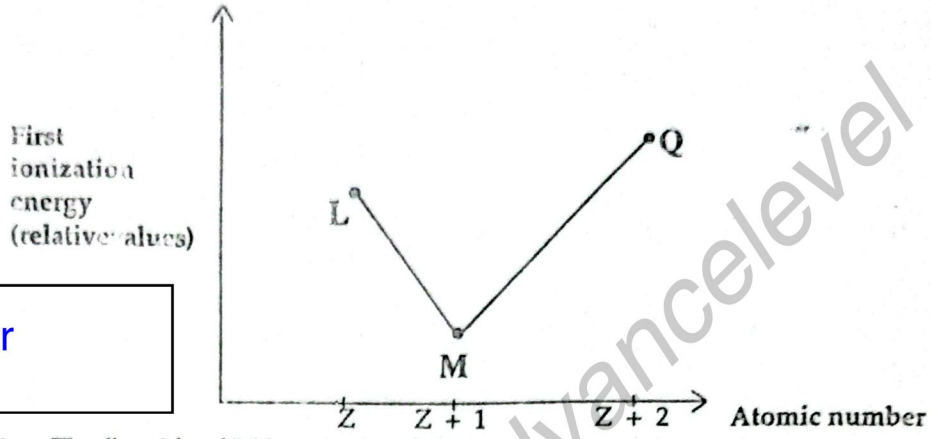
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(iv) Which one of the following is not closely connected with the manufacture of bleaching powder?
(1) the sea (2) Limestone (3) Degradation of the environment
(4) Water (5) Ammonia

PART A - ESSAY

1. (a) L,M, Q and R are four non-transition of atomic number, Z, (Z+1), (Z+2) and (Z+3), respectively. The variation of the first ionization energies of L,M and Q are graphically represented below.



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M shows amphoteric properties. The fluoride of M is an ionic solid.

(i) Write the chemical formula of the choloride of Q.

(ii) Write the electronic configuration of R in the usual form.

(b) Draw the **'dot-and diagram'** for the N_2F_2 molecule in which the two nitrogen atoms are identical.

N.B. (i) All the electrons in the valence shells of each of the atoms must be shown.

(ii) When a pair of electrons forming a bond is shown by a line, no marks will be awarded.

(c) Mention **two observations** which substantiate the view that electrons participate in the formation of chemical bonds.

(d) (i) A few drops of KCNS solution are added to a solution of $FeCl_3$. indicate the colour change that occurs.

(ii) Iron power is added to the mixture of solutions referred to in (i) above, and it is shaken well. If you are expecting a colour change in this case, indicate clearly the colour change that occurs. If you are not expecting a colour change in this case, indicate that fact clearly.

2. (a) Write the balanced ionic equation for the oxidation of oxalate ions ($C_2O_4^{2-}$) by chromate ions (CrO_4^{2-}) in acidic medium.

(b) An aqueous solution of the chloride of an element, X, was electrolysed. When a current of 2 A was passed throught the solution for a period of 900 s, 0.757 g of the element X was liberated. X forms a volatile hydride. The relative molecular mass of this hydride is approximately 125. Calclate the relative atomic of X. (F=96500 C)

(c) Give one example to illustrate each of the following:

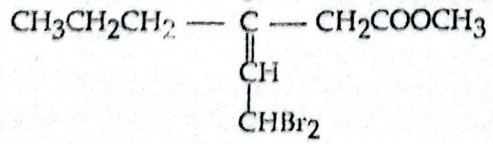
(i) The reaction of H_2S an oxidizing agent.

(ii) The reaction of NH_3 as an acid.

N.B. You should write balanced chemical equations for the reactions given by you.

3. (a) A is a compound of molecular formula RCOOH, where R contains carbon and hydrogen only. On complete combustion. A gave CO_2 and H_2O in the mass ratio 44:9. The relative molecular mass of A is approximately 100. Determine the molecular formula of A. (C=12;H=1;O=16)

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



N.B. Disregard geometrical isomerism.

(c) Indicate how the following conversions could be effected. The necessary reagents and reaction conditions should be indicated clearly at the appropriate places.

N.B. If the methods of conversion proposed by you are unnecessarily long, you will not be awared full marks.

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(i) $CH \equiv CH \rightarrow CH_3-\underset{\underset{Br}{|}}{\overset{\overset{H}{|}}{C}}-CH_2COOH$

(ii) $CH_3-\overset{\overset{CH}{|}}{C}H-COOC_2H_5 \rightarrow CH_3-\overset{\overset{OH}{|}}{C}(C_6H_5)_2$

4. (a) (i) Give the mechanism for the addition of Br_2 to C_2H_4.

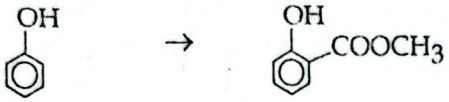
(ii) Accepting the mechanism for the above reaction, draw the structure of the product formed by the addition of ICl to $CH_3CH=CH_2$.

(b) (i) The molecular formula of the primary amine, B is $C_4H_{11}N$. Draw structure possible for B.

(ii) If B can be separated into optically active forms, draw the structure of the hydrochloride of B.

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

(i) 

(ii) 

PART B - ESSAY

5. (a) (i) Derive the equation PV=nRT, applicable for ideal gases.

(ii) A mixture of gases consisting of 4.0 g of hydrogen gas and a certain mass of helium is kept at a temperature of 273 °C under 2 atm pressure. Further 5.0 g of hydrogen are added to the mixture, and this new mixture is brought to s.t.p. Then the new volume was found to be twice the initial volume. Calculate the mass of helium present in the mixture. (The relative atomic masses of hydrogen and helium are 1.00 and 4.00 respectively.) **N.B. Assume that hydrogen and helium behave ideally.**

(b) You are supplied with a sample of propyne ($CH_3C \equiv CH$). Describe clearly how you would show experimentally that propyne does not behave as an ideal gas.

(c) The total vapour pressure of a solution containing 2 mol benzene and 3 mol toluene is 280 mm Hg, at a certain temperature, When another 1 mol of benzene is added to this mixture, the total vapour pressure of the resulting new solution, X, is 300 mm Hg. at the same temperature. Calculate the mole fraction of benzene in the vapour that is in equilibrium with the solution, X, at the same temperature, **N.B. Assume that benzene and toluene form ideal solutions.**

(d) Explain how you would experimentally show that there exists a dynamic equilibreum between lliquid iodomethane and its vapour.

6. (a) Describe briefly how you would experimentally determine the K_c for the esterification reaction that occurs between CH_3CH_2COOH and CH_3OH.

(b) The K_c for the equilibrium reaction. $A(aq) + B(aq) \rightleftharpoons C(aq) + D(aq)$
is 9.00 at room temperature. 2 mol of A and 2 mol of B were reacted together at room temperature and were allowed to reach equilibrium. Calculate the mole percentage of A remaining in the reaction mixture.

(c) (i) Explain what is meant by 'solubility product', taking Ag_2CrO_4 as the example.

(ii) At a certain temperature, the solubility product of Bi_2S_3 is 1.08×10^{-98} mol^5 dm^{-15} Calculate the mass of Bi_2S_3 dissolved at this temperature in 1000 dm^3 of water saturated with Bi_2S_3. (The relative atomic masses of Bi and S are 209 and 32, respectively.)

(iii) What do you propose as the most effective method for completely dissolving a considerable quantity of Bi_2S_3 and obtaining a solution containing Bi^{3+} ions? Explain why your proposed method would succeed?

7. (a) You are supplied with an aqueous solution containing K_2CO_3 and KOH. Explain how you would attempt to determine the concentration of CO_3^{2-} and the concentration of OH^- in the above solution.

(b) (i) Consider an aqueous solution containing ethanoic acid and sodium ethanoate. Derive the relationship that exists in this solution among the concentrations, $[H_3O^+]$,[acid] and [salt], and the dissociation constant, K_a of ethanoic acid. Using this rellationship show that the pH of the above solution is

$$pK_a + \log_{10}\frac{[salt]}{[acid]}, \quad (N.B.\ pK_a = -\log_{10} K_a)$$

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(ii) 101.0 cm^3 of a 0.1 mol dm^{-3} aqueouss solution of ethanoic acid and 1.0 cm^3 of a 0.1 mol dm^{-3} apueous solution of sodium hydroxide were mixed togerher. At a certain temperature, the hydrogen ion concentration of this mixture was 0.004 mol dm^{-3} Calculate the pK_a of ethanoic acid at this temperature.

(c) Proteins exhibit buffer action in aqueous medium. Explain how this action occurs.

8. (a) The standard enthalpy of formation of benzene cannot be experimentally determined by synthesising benzene directly from carbon and hydrogen. However, it can be indirectly determined experimentally Describe clearly and briefly how this could be done successfully.

(b) (i) What are the conditions that should be satisfied for the occurrence of a chemical reaction between gaseous molecules?

(ii) Explain as completely as you can, why the rate of a reaction is increased in the presence of catalysts

(c) Write brief descreptions of five of the applications of radioactive isotopes in medicine, agriculture and industry.

9. (a) How and under what conditions does carbon react with the following? **N.B. The relevant balanced chemical equations should be written.**
(i) H_2SO_4 (ii) HNO_3

(b) Indecate how the following conversions could be effected. **N.B The necessary reagents and reaction conditions should be stated clearly at the appropripate places. It is not necessary to write balanced chemical epuations.**

(i) Obtaining pure CuO starting with $CuFeS_2$

(ii) Obtaining N_2O_3. starting with HNO_3, Without using reducing agents.

(c) Show graphically, in the usual manner, how the boiling points of the hydrides of the non-transition elements of Group 6 of the periodic Table vary. Give reasons for that charasteristic variation.

10. (a) Comment briefly on the physico-chemical principles involved in the synthesis of ammonia by the Haber process. "**N.B It is sufficient to consider only four important aspects.**

(b) How and under what conditions does ammonia react with the following?
(i) AgBr (ii) CuO

(c) Give one characteristic property of each of the following: (i) diamond (ii) graphite. Explain those properties on the basis of the structures of these materials.

(d) (i) The monomeric hydrodcarbon of natural rubber can be obtained by subjecting rubber to thermal decomposition. Draw the structure of this hydrocarbon.

(ii) Explain the elasticity of rubber of the basis of the structure of rubber.

11. (a) Indicate the chemical reactions involved in the production of iron starting with the ore, 'haematite.' **N.B. You should give the necessary reaction conditions and the relevant balanced chemical equatlons.**

(b) (i) What are the methods of protection that could be used in the prevention of corrosion of iron?

(ii) Explain how the corrosion of iron is suppressed by those methods of protection.

(c) You are supplied with a sample of an allloy consisting of Al, Zn and Sn. propose a scheme of analysis for the determination of the percentages of the various elements present in this alloy.

12. (a) Explain how the environment is polluted by the combustion of petrolcum fuels. **N.B It is sufficient to consider six important aspects.**

(b) Explain the variation of acidic-basic properties of the oxides derved from the highest oxidation states of **Na, Mg. P.S and Cl.**

(c) You are supplied with an aqueous solution containing the ions, Cl^-, I^- and SO_4^{2-} Propose a scheme of analysis for the **quantitalive** determination of each of these ions.

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