G.C.E. (A/L) Examination
2000 August
Chemistry I / Two hours

Enter your Index Number in the space provided on the answer sheet. Use of calculators is not allowed.

You should attempt all the questions in this paper. For each questions there are five responses of which only one is correct. When you have selected the response which you consider to be the best answer to a question, mark your response on the answer sheet in accordance with the instructions given therein.

Universal gas constant. $R = 8.314\ JK^{-1}\ mol^{-1}$

1. The element having chemical properties most similar to Zn is
(1) Ca (2) Sr (3) pb (4) Mg (5) Cd

2. The element which is not a member of the d-block in the periodic table is
(1) Cu (2) Mn (3) Fe (4) Se (5) Zn

3. At a temperature of 300 K and under a pressure of 1 atmosphere, which is the gas that is most likely to have a density nearest to that of N_2?
(relative atomic masses : H = 1; C = 12; N = 14; O = 16; F = 19)
(1) O_2 (2) NO (3) CO_2 (4) CH_3F (5) C_2H_4

4. Which of the following is a thermosetting polymer?
(1) Polystyrene (2) Polyvinyl chloride
(3) Polyethylene (4) Urea-formaldehyde
(5) Natural rubber

5. The element most likely to form a diatomic molecule in the gaseous state is
(1) Ne (2) Zn (3) Na (4) Ca (5) Ar

6. The valencies of an element, whose outer electronic configuration is of the form $ns^2\ np^3$, are most likely to be
(1) 2 and 4 (2) 2 and 5 (3) 1 and 5 (4) 3 and 5
(5) 4 and 5

7. An organic compound containing C, H and O only, has 29.6% oxygen by mass. Its relative molecular mass is 270. How many oxygen atoms are present in a molecule of this organic compound?
(relative atomic masses : H = 1; C = 12; O = 16)
(1) 1 (2) 2 (3) 3 (4) 4 (5) 5

8. The standard enthalpy values, ΔH°_D, for the step-wise dissociation of gaseous methane at a given temperature are given below :

$CH_4(g) \rightarrow CH_3(g) + H(g)$ $\quad \Delta H^\circ_{D_1} = +426\ kJ\ mol^{-1}$
$CH_3(g) \rightarrow CH_2(g) + H(g)$ $\quad \Delta H^\circ_{D_2} = +436\ kJ\ mol^{-1}$
$CH_2(g) \rightarrow CH(g) + H(g)$ $\quad \Delta H^\circ_{D_3} = +455\ kJ\ mol^{-1}$
$CH(g) \rightarrow C(g) + H(g)$ $\quad \Delta H^\circ_{D_4} = +347\ kJ\ mol^{-1}$

The value of the mean standard bond dissociation enthalpy for the C-H bond in $CH_4(g)$, in units of kJ mol^{-1} is
(1) + 416 (2) + 208 (3) + 862
(4) + 426 (5) - 416

9. How many moles of hydrogen atoms are present in 0.10 kg of a solution of ethanol in water containing 10% by mass of ethanol (C_2H_5OH)? (relative atomic masses : H = 1 ; C = 12; O = 16)
(1) 1.3 (2) 10.0 (3) 11.3 (4) 5.2 (5) 5.7

10. Calculate the mass of $Ca_3(PO_4)_2$ required to produce 100 g of $Ca(H_2PO_4)_2$ according to the equation
$Ca_3(PO_4)_2 + 4H_3PO_4 \rightarrow 3Ca(H_2PO_4)_2$
(relative atomic masses : H = 1 ; O = 16; P = 31; Ca = 40)
(1) 22g (2) 44g (3) 75g (4) 132g (5) 226g

11. 100.0cm^3 of a 0.050 mol dm^{-3} NaOH solution and 50.0cm^3 of a 0.020 mol dm^{-3} H_2SO_4 solution were mixed and the total volume of the mixture made up to 250.0 cm^3 with distilled water. The concentration of OH^- ions in the resultant solution is
(1) 0.012 mol dm^{-3} (2) 0.016 mol dm^{-3}
(3) 0.020 mol dm^{-3} (4) 0.120 mol dm^{-3}
(5) 0.012 mol cm^{-3}

12. An HCl solution contains 36.5% by mass of HCl. The density of the solution is 1.15 g cm^{-3}. What is the concentration of HCl in the solution, in units of mol dm^{-3}?
(relative atomic masses : H = 1 ; Cl = 35.5)
(1) 0.869 (2) 1.15 (3) 11.5 (4) 115 (5) 8.69

13. Which of the following aqueous solutions will have the highest pH value?
(1) 0.100 mol dm^{-3} NH_4Cl (2) 0.001 mol dm^{-3} CH_3COOH
(3) 0.010 mol dm^{-3} NaOH (4) 0.010 mol dm^{-3} NH_4OH
(5) 0.006 mol dm^{-3} $Ca(OH)_2$

14. $2A + B \rightarrow 2D$ is a single step reaction. For given concentrations of A and B, the rate of the reaction is equal to R. When the concentrations of A and B are doubled, the rate of the reaction may be given by
(1) 2R (2) 4R (3) 8R (4) $4R^2$ (5) R^2

15. A solution was prepared by mixing 100 cm^3 of a 0.1 mol dm^{-3} NH_4OH solution with 100 cm^3 of a 0.1 mol dm^{-3} NH_4Cl solution. The result of adding a further 10 cm^3 of water to the solution is to
(1) decrease the pH of the solution considerably.
(2) increase the pH of the solution considerably.
(3) maintain pH of the solution unchanged at 7.
(4) decrease the concentration of the solution keeping the pH approximately constant.
(5) affect neither the pH nor the concentration of the solution.

16. Which one of the following solutions shows the largest change in pH, on addition of 1 cm^3 of 0.1 mol dm^{-3} HCl?
(1) 24 cm^3 of 0.1 mol dm^{-3} HCl
(2) 24 cm^3 of 0.1 mol dm^{-3} NaOH
(3) 24 cm^3 of pure water
(4) 24 cm^3 of a solution containing a mixture of 0.05 mol dm^{-3} CH_3COONa and 0.05 mol dm-3 CH_3COOH
(5) 24 cm^3 of 0.1 mol dm^{-3} CH_3COONa

17. Which of the following substances is used for the industrial conversion of apatite phosphate fertiliser?
(1) NaOH (2) NH_4OH (3) H_2SO_4 (4) $Ca(OH)_2$ (5) NaCl

18. Ilmenite is a mineral sand found in pulmuddai the eastern coast of Sri Lanka. Which of the following elements is predominantly present in Ilmenite?
(1) Calcium (2) Sodium (3) Thorium
(4) Titanium (5) Zirconium

19. Which of the following shows the highest second ionization energy?
(1) Na (2) Mg (3) Al (4) Si (5) Ar

20. The best method to detect chloride ions in water is to
(1) add $AgNO_3$ solution.
(2) add dilute HNO_3 and $AgNO_3$ solutions.
(3) add NH_4OH and $AgNO_3$ solutions.
(4) add dilute HCl and $AgNO_3$ solutions.
(5) add dilute H_2SO_4 and $AgNO_3$ solutions.

21. Which of the following gives a solution with a colour nearest to that produced when excess NH_4OH is added to an aqueous solution of $CuSO_4$?
(1) excess dilute HCl is added to a solution of $NiCl_2$
(2) NH_4CNS is added to a solution of $FeCl_3$.
(3) concentrated HCl is added to a concentrated solution of $CuSO_4$.
(4) excess NaOH is added to a solution of $K_2Cr_2O_7$.
(5) excess concentrated HCl is added to a concentrated solution of $CoCl_2$

22. In the titration of 25.0cm³ portions of NaOH solution with HCl solution, which of the following activities is the most essential?
(1) Washing the pipette out with HCl solution
(2) Washing the titration flask with NaOH solution.
(3) Measuring the temperatures of the titrating solutions
(4) Filling the burette up to the zero mark with HCl solution.
(5) Rinsing the inside of the burette with the HCl solution.

23. In the reaction,
$2NO_2(g) + H_2O(l) \rightarrow HNO_3(aq) + HNO_2(aq)$
(1) nitrogen undergoes oxidation only.
(2) nitrogen undergoes reduction only.
(3) nitrogen undergoes both oxidation and reduction.
(4) there is no change in the oxidation state of nitrogen.
(5) water acts both as an oxidising agent and as a reducing agent.

24. Which one of the following is the correct order for the H^+ (aq) concentrations of 0.1 mol dm^{-3} aqueous solutions of halogen acids?
(1) HF < HCl < HBr < HI (2) HF < HCl < HBr = HI
(3) HF < HCl = HBr = HI (4) HF = HCl = HBr = HI
(5) HF = HCl < HBr < HI

25. An alkyl bromide L when reacted with hot alcoholic KOH gave a compound M.M, when reacted with HBr gave N which is an isomer of L. The compound N when reacted with aqueous KOH gave a tertiary alcohol. Which one of the following compounds is most likely to be L?

(1) $CH_3CH_2CH_2CH_2Br$ (2) $CH_3CH_2\underset{\displaystyle CH_3}{\underset{|}{C}}H - Br$

(3) $CH_3 - \underset{\displaystyle CH_3}{\underset{|}{C}}H - CH_2Br$ (4) $CH_3 - \underset{\displaystyle CH_2Br}{\underset{|}{C}} - CH_2CH_3$ (with CH_3)

(5) $CH_3 - \underset{\displaystyle CH_3}{\underset{|}{C}} - CH_2Br$ (with CH_3)

26. Consider the three carbonium ions, a, b, and c.

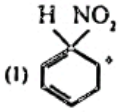
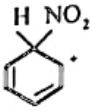
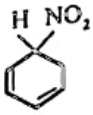
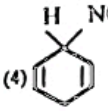
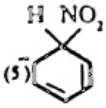
a: $CH_3\overset{+}{C}H_2$

b: $CH_3 - \underset{\displaystyle H}{\underset{|}{\overset{\displaystyle CH_3}{\overset{|}{C^+}}}}$

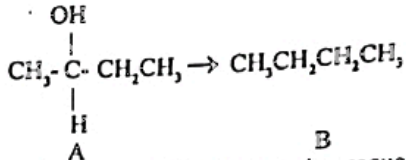
c: $CH_3 - \underset{\displaystyle CH_3}{\underset{|}{\overset{\displaystyle CH_3}{\overset{|}{C^+}}}}$

The order of stability for the ions is
(1) $c > b > a$ (2) $a > b > c$
(3) $b > c > a$ (4) $c > a > b$
(5) $b > a > c$

27. When benzene is nitrated with a mixture of concentrated HNO_3 and concentrated H_2SO_4, which of the following species is formed as an intermediate?

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

28. In order to bring about the conversion,



which of the following reaction sequences would be the most appropriate?

1. $A \xrightarrow[2.\ H_2\ /\ pd]{1.\ K_2Cr_2O_7\ /H^+} B$

2. $A \xrightarrow[2.\ Zn\ (Hg)\ /\ HCl]{1.\ K_2Cr_2O_7\ /\ H^+} B$

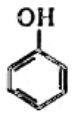
3. $A \xrightarrow[2.\ LiAlH_4]{1.\ K_2Cr_2O_7\ /\ H^+} B$

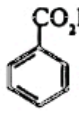
4. $A \xrightarrow[2.\ LiAlH_4]{1.\text{dehydration with conc.}H_2SO_4} B$

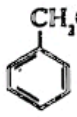
5. $A \xrightarrow[2.\ LiAlH_4]{1.\ \text{Esterification with } CH_3CO_2H/\ H^+} B$

29. Which of the following steps does not take place during the free radical reaction of Cl_2 with methane in the presence of light?
(1) $Cl_2 \rightarrow \overset{\circ}{C}l + \overset{\circ}{C}l$ (2) $\overset{\circ}{C}H_3 + \overset{\circ}{C}l \rightarrow CH_3Cl$
(3) $\overset{\circ}{C}H_3 + Cl_2 \rightarrow CH_3Cl + \overset{\circ}{C}l$ (4) $CH_4 \rightarrow \overset{\circ}{C}H_3 + \overset{\circ}{H}$
(5) $CH_4 + \overset{\circ}{C}l \rightarrow \overset{\circ}{C}H_3 + HCl$

30. Consider the compounds A, B and C.

A: 

B: 

C: 

Which of the following statements is true?
(1) Addition of aqueous NaOH will convert only A and B to their sodium salts.
(2) Addition of aqueous NaOH will convert only B and C to their sodium salts.
(3) Addition of aqueous NaOH will convert A , B and C to their sodium salts.
(4) Addition of aqueous Na_2CO_3 will convert only A and B to their sodium salts.
(5) Addition of aqueous Na_2CO_3 will convert A , B and C to their sodium salts.

○ **Instructions for question No. 31 to 40**

For each of the questions 31 to 40 four responses (a), (b), (c) and (d) are given. One or more of these is/are correct. Select the correct response/responses. In accordance with the instructions given on your answer sheet, mark

(1) if only (a) and (b) are correct
(2) if only (b) and (c) are correct
(3) if only (c) and (d) are correct
(4) if only (d) and (a) are correct
(5) if any other number or combination of responses is / are correct.

Summary of Instructions				
(1)	(2)	(3)	(4)	(5)
Only (a) and (b) correct.	Only (b) and (c) correct.	Only (c) and (d) correct.	Only (d) and (a) correct.	any other number or combination of responses correct.

31. Which of the following statements / statement concerning electrons are / is true?
(a) Electrons tend to move in a curved path in a magnetic field.
(b) Electrons have both particle and wave properties.
(c) Electrons cannot be added to or removed from an atom.
(d) The speed of electrons is equal to the speed of light.

32. Which of the following statements / statement concerning atomic orbitals are / is true?
(a) On overlap of two p -orbitals, a π- bond is always formed.
(b) On overlap of an s-orbital and a p-orbital, a σ- bond or a π- bond can be formed.
(c) On overlap of two s - orbitals, a σ- bond is always formed.
(d) s and p - orbitals taking part in hybridization should belong to the same atom.

33. Which of the following compounds/compound give/gives an acidic gas when warmed with dilute H_2SO_4 and a basic gas when warmed with dilute NaOH?
(a) $Pb(NO_3)_2$ (b) $(NH_4)_2CO_3$ (c) NH_4NO_3 (d) $(NH_4)_2SO_4$

34. The aim of the Lassaigne (sodium) fusion test is to convert the elements in an organic compound to water soluble anions. Which of the following anions/anion may be formed from the constituent elements in this test?
(a) P^{3-} (b) ClO^- (c) CN^- (d) S^{2-}

35. Which of the following statements/statement concerning methylamine and aniline are / is true?
(a) Methylamine has a higher K_b value than aniline because methylamine is a stronger base than aniline.
(b) Aniline is a stronger base than methylamine because the lone pair of electrons on the nitrogen atom overlaps with π-electrons of the phenyl group in aniline.
(c) Aniline is a stronger base than methylamine because methylamine is a primary amine while aniline is a secondary amine.
(d) Methylamine and aniline can both act as nucleophiles due to the presence of a lone pair of electrons on the N atom.

36. Which of the following processes/ process are / is endothermic?
(a) $Na^+(g) + Cl^-(g) \rightarrow Na^+Cl^-(s)$
(b) $Cl(g) + e \rightarrow Cl^-(g)$
(c) $Na(g) \rightarrow Na^+(g) + e$
(d) $Cl_2(g) \rightarrow 2\,Cl(g)$

37. One mole of CH_3COOH is added to 1 dm^3 of pure water. Which of the following statements/statement are/is true?
(a) The pH of the solution is > 7.
(b) The concentration of H^+ ions in the solution is > the concentration of OH^- ions in the solution.
(c) The concentration of H^+ ions in the solution is approximately 1 mol dm^{-3}
(d) CH_3COOH does not completely dissociate in the aqueous solution.

38. Which of the following statement / statements pertaining to the composition of a solution prepared by dissolving 18 g of glucose in 180 g of water at 277 K is /are true? (molar masses of glucose and water are 180 and 18 g mol^{-1}, respectively; Density of water at 277 K is 1.0 g cm^{-3}.)
(a) The concentration of glucose in the solution is 0.55 mol dm^{-3}.
(b) The mass fraction of glucose in the solution is 0.10.
(c) The molality of glucose in the solution is 0.10 mol kg^{-1}
(d) The mole fraction of glucose in the solution is $\frac{1}{101}$

39. Which of the following reactions/ reaction are/is involved in the usual method for the determination of dissolved oxygen in water?
(a) Reaction of Mn(II) with oxygen in alkaline medium.
(b) Reaction of I^- with oxygen in alkaline medium.
(c) Reaction of Mn (II) with oxygen in acidic medium.
(d) Reaction of I_2 with $S_2O_3^{2-}$ in either neutral or slightly acidic medium.

40. Which of the following statements/statement are /is true regarding Ca^{2+} (Z = 20) and Zn^{2+} (Z = 30) ions?
(a) Both ions have 6 electrons each in the outermost p-subshell.
(b) Both ions have 18 electrons each in the outermost shell.
(c) Ca^{2+} ion has 8 electrons in the outermost shell and Zn^{2+} ion has 18 electrons in the outermost shell.
(d) Both ions have 8 electrons each in the outermost shell.

○ **Instruction for question No. 41 to 50**

In Questions No. 41 to 50, two statements are given in respect of each question. From the Table given below, select the response out of the responses (1), (2), (3), (4) and (5) that best fits the two statements given for each of the questions and mark appropriately on your answer sheet.

First Statement	Second Statement	Response
True	True, and correctly explains the first statement.	(1)
True	True, but does not explain the first statement correctly.	(2)
True	False	(3)
False	True	(4)
False	False	(5)

	First Statement	Second Statement
41	The standard enthalpy of formation of any substance, ΔH°_f, is taken as equal to the standard enthalpy of that substance at the same temperature.	The enthalpy values of all elements under standard conditions are taken as zero.
42	Chemical and physical properties of isotopes are similar.	Isotopes have the same number of protons but a different number of neutrons.
43	Heating acetaldehyde with Tollens reagent produces a silver mirror.	Acetaldehyde undergoes self-condensation in a basic medium.

44	In the absence of sunlight, benzene very readily undergoes electrophilic addition with Br_2.	The π- electron system of benzene is stabilised by resonance.
45	An aqueous solution of NH_4Cl is weakly acidic.	NH_4Cl undergoes partial ionisation in an aqueous solution.
46	A homogeneous solution when heated from 10°C to 185°C underwent a rise of temperature equivalent to 448.15 K.	To convert a temperature from the Centigrade scale to the Kelvin scale, 273.15 should be added to the temperature expressed in °C.
47	The rate of the reaction between SO_2 (g) and O_2(g) can be increased by introducing NO(g) into the reaction mixture.	The mechanism of the reaction between SO_2(g) and O_2(g) is modified in the presence of NO(g).
48	The radius of the H atom is equal to the radius of the He^+ ion	The H atom and the He^+ ion have one electron each.
49	The pH of saturated solutions of the metal hydroxides of group II elements (Mg to Ba) increases down the group.	The solubility of group II metal hydroxides increases down the group.
50	When NH_4Cl and NH_4OH are added to an aqueous solution containing Mg (II) ions, no precipitate is obtained.	$Mg(OH)_2$ is soluble in NH_4OH.

51. On mixing the compounds A, B and C separately with bromine water, the following observations were recorded :

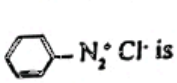
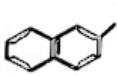
A decolorised bromine water and formed a white precipitate.
B neither decolorised bromine water nor formed a precipitate.
C decolorised bromine water without forming a precipitate.

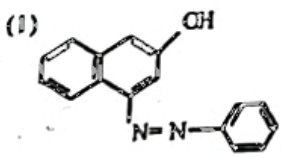
Which of the following groups of compounds is in agreement with the above observations?

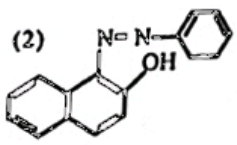
(1)	A = 2 - butene	B = benzene	C = phenol
(2)	A = 2 - butene	B = benzene	C = aniline
(3)	A = phenol	B = benzene	C = 2- butene
(4)	A = benzene	B = 2 -butene	C = aniline
(5)	A = phenol	B = aniline	C = 2- butene

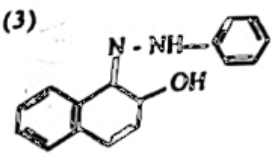
52. On heating the product obtained from the reaction of an organic compound X with excess ammonia, Y was obtained. The compound Y when heated with P_2O_5 formed an alkyl cyanide. which of the following is likely to be X?

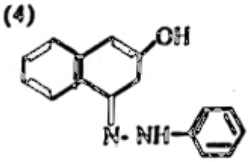
(1) CH_3CH_2COOH (2) $CH_3CH_2CH_2Cl$ (3) $CH_3CH_2CH_2OH$
(4) $CH_3CH_2CH_2NH_2$ (5) CH_3CH_2CHO

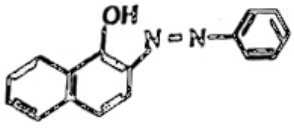
53. When  is reacted with  in an alkaline medium, the product obtained is

(1) 

(2) 

(3) 

(4) 

(5) 

54. Which of the following solutions would be expected to obey Raoult's Law most closely?
(D = deuterium)

(1) benzene in toluene (2) benzene in phenol
(3) ethanol in water (4) DCl in H_2O
(5) D_2O in H_2O

55. 250 cm³ of oxygen was collected by the downward displacement of water at a temperature of 25° C and a pressure of 750 mm Hg. If the oxygen thus collected is dried at a temperature of 25° C and 750 mm Hg pressure, what volume will it occupy? (Saturated vapour pressure of water at 25° C = 50 mm Hg)

(1) 233 cm³ (2) 244 cm³ (3) 250 cm³
(4) 255 cm³ (5) 266 cm³

56. The value of the pH of 1×10^{-8} mol dm^{-3} solution of HNO_3 in water is approximately

(1) 8.0 (2) 7.1 (3) 7.0 (4) 6.9 (5) 6.0

57. Given below are the pH ranges for the colour change interval of five indicators. Which of these indicators is the most suitable for the titration of 25.0 cm³ of 1×10^{-3} mol dm^{-3} solution of NaOH with 1×10^{-3} mol dm^{-3} solution of HCl?

Indicator	pH range
(1) Methyl orange	2.9 - 4.6
(2) Congo red	3.0 - 5.0
(3) Bromothymol blue	6.0 - 7.6
(4) Phenolphthalein	8.3 - 10.0
(5) Thymolphthalein	9.3 - 10.5

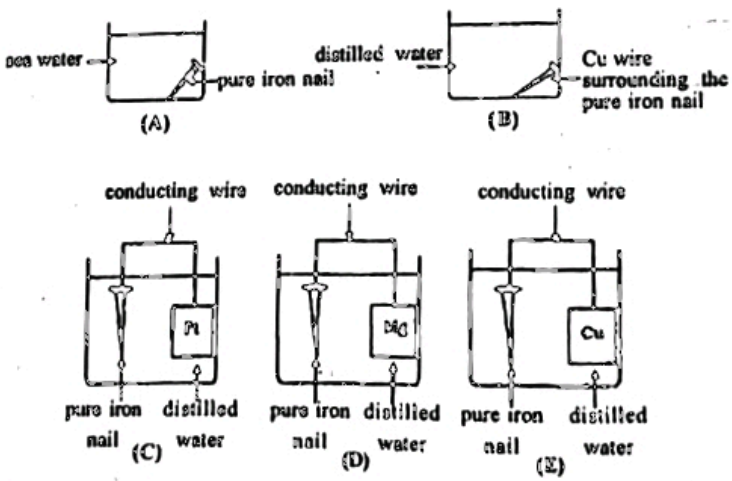
58. When a pure Mg ribbon is immersed in a dilute solution containing $CuSO_4$ and $ZnSO_4$, the most likely observation is that

(1) the colour of the solution increases.
(2) the colour of the solution remains unchanged.
(3) Cu is deposited on the surface of Mg.
(4) Zn is deposited on the surface of Mg.
(5) both Cu and Zn are deposited simultaneously on the surface of Mg.

59. The radius of the Br^- ion is 1.95 Å. The inter-ionic distances of KBr(s) and KCl(s) are 3.28 Å and 3.14 Å respectively. The radius of the Cl^- ion is

(1) 2.09 Å (2) 1.95 Å (3) 1.90 Å (4) 1.84 Å (5) 1.81 Å

60. For a study of corrosion of Fe, the following experimental set-ups were prepared by a student in the laboratory :



In which of the above set-ups will the iron nail not show any sign of corrosion?

(1) A (2) B (3) C (4) D (5) E