G.C.E. (A/L) Examination
2011 August
Chemistry I / Two hours

Instructions

- *This paper consists of 08 pages (Periodic Table is provided)*
- *Answer all the questions*
- *Use of calculators is not allowed.*
- ***Write your Index Number** in the space provided in the answer sheet*
- *Follow the instructions given on the back of the answer sheet carefully*
- *In each of the questions 1 to 50, pick one of the alternatives from (1), (2), (3), (4), (5) which is correct or **most appropriate** and **mark your response on the answer sheet with a cross (x) in accordance with the instructions given on the back of the answer sheet.***

Universal gas constant $R = 8.314\ JK^{-1}\ mol^{-1}$
Avogadro Constant $N_A = 6.022 \times 10^{23}\ mol^{-1}$

1. The 3d block element that shows the highest electrical conduction is,
(1) Mn (2) Co (3) Ni
(4) Cu (5) Ti

2. The **increasing** order of atomic radii of the elements C, P, S, As and Se is,
(1) C < P < S < As < Se
(2) C < P < S < Se < As
(3) C < S < P < As < Se
(4) C < S < Se < P < As
(5) C < S < P < Se < As

3. The correct structure of propynal is,
(1) CH ≡ CCHO (2) CH_2 = CHCHO (3) CH_3CH_2CHO
(4) CH CCH$_2$OH (5) CH_2 = $CHCH_2OH$

4. A colourless solid X liberates a brown gas on heating with dil. HCl, and a colourless alkaline gas on heating with NaOH. The solid X is,
(1) NH_4NO_2 (2) NH_4NO_3 (3) NH_4Cl
(4) NaBr (5) $NaNO_3$

5. The energy of one mole of photons with wave- length 305 nm is, (Planck constant = 6.62×10^{-34} Js, speed of light = 3.00×10^8 ms^{-1})
(1) 256 kJ (2) 302 kJ (3) 392 kJ
(4) 452 kJ (5) 512 kJ

6. The number of subshells (sub energy levels), orbitals and the maximum number of electrons that could be present in the main energy level described by the principal quantum number, n = 3 are respectively,
(1) 9, 3 and 8 (2) 3, 9 and 18 (3) 3, 6 and 32
(4) 2, 9 and 18 (5) 3, 4 and 18

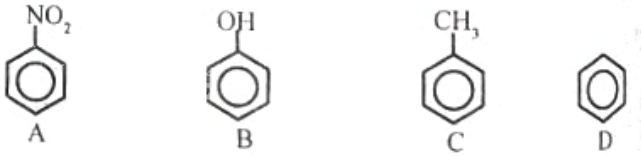
7. Which of the following statements is **incorrect** with regard to the arrangement of electrons among main energy levels and orbitals?
(1) When orbitals of equal energy are available, they first fill singly (one electron in each orbital), with electron spins parallel.
(2) No two electrons in an atom can have the same four quantum numbers.
(3) Electrons occupy orbitals in such a way as to minimize the energy of the atom.
(4) The maximum number of electrons in a main energy level described by the principal quantum number, n, is equal to $2n^2$
(5) The energy of an atom is minimized by filling completely the principal energy levels in succession.

8. The mass of a sample containing only $SrCO_3$ and $BaCO_3$ is 0.800 g. When the sample is dissolved in excess dilute acid, the volume of CO_2 gas liberated at standard temperature and pressure is 0.112 dm^3. The mass percentage of $SrCO_3$ in the sample is, (C = 12, O = 16, Sr = 88, Ba = 137)
(1) 30 (2) 56 (3) 70
(4) 80 (5) 84

9. Which one of the following statements is **not** true with regard to 3d block elements of the periodic table?
(1) The highest oxidation state of each of the elements Sc, Ti, V, Cr and Mn is equal to the number of the group the element belongs to.
(2) The highest oxidation state of each of the elements Fe, Co, Ni, Cu and Zn is less than the number of the group the element belongs to.
(3) All cations of the elements have vacant 4s orbitals and all valence electrons occupy 3d orbitals.
(4) Ions such as MnO_4^-, $Cr_2O_7^{2-}$ and CrO_4^{2-} in which elements are in their highest oxidation states tend to be good reducing agents, whereas ions such as Ni^{2+} and Zn^{2+} are good oxidizing agents.
(5) Zn has the lowest melting point of the 3d block elements.

10. The enthalpy change of which of the following chemical reactions corresponds to the standard enthalpy of formation of CaO(s)?
(1) $Ca^{2+}(g) + O^{2-}(g)$ g $\rightarrow$ CaO(s)
(2) Ca(g) + ½ O_2(g) g $\rightarrow$ CaO(s)
(3) Ca(s) + O(g) $\rightarrow$ CaO(s)
(4) 2Ca(s) + O_2(g) $\rightarrow$ 2 CaO(s)
(5) Ca(s) + ½O_2(g) $\rightarrow$ CaO(s)

11. The **increasing** order of the rate at which the following compounds undergo nitration is,



A B C D

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

12. The **increasing** order of the pH of the aqueous solutions (a) to (d) are,
(a) 0.1 mol dm^{-3} NH_4Cl
(b) 0.5mol dm^{-3} NH_4Cl
(c) 0.1mol dm^{-3} CH_3COONa
(d) 0.5mol dm^{-3} CH_3COONa

(1) b < a < c < d (2) a < b < d < c
(3) a < b < c < d (4) b < a < d < c
(5) d < c < b < a

13. Which of the following represents a correct step of the mechanism of the reaction between propene and HBr?

(1) $CH_3CH_2\overset{\curvearrowright}{CH_2} + Br^- \longrightarrow CH_3\underset{Br}{CH}CH_3$

(2) $CH_3\overset{\curvearrowright}{CH} = CH_2 + H\overset{\curvearrowleft}{-}Br \longrightarrow CH_3\overset{+}{C}HCH_3 + Br^-$

(3) $CH_3\underset{Br}{\overset{\curvearrowright}{C}}HCH_2 + H\overset{\curvearrowleft}{-}Br \longrightarrow CH_3\underset{Br}{CH}CH_3$

(4) $CH_3\overset{\curvearrowright}{C}HCH_3 + Br^- \longrightarrow CH_3\underset{Br}{CH}CH_3$

(5) $CH_3\overset{\curvearrowright}{CH} = CH_2 \longrightarrow CH_3\overset{+}{C}H - \bar{C}H_2$

14. Equal volumes of HNO_3 of pH = 2.0 and of HCl of pH = 1.0 were mixed. The pH of the mixture is,
(1) 1.0 (2) 1.3 (3) 1.5 (4) 2.0 (5) 3.0

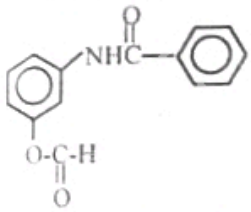
15. $CH_3CH_2CH_2CH_3$ (A) $CH_3CH_2CH_2OH$ (B)

CH_3CH_2CHO (C) CH_3COOH (D)

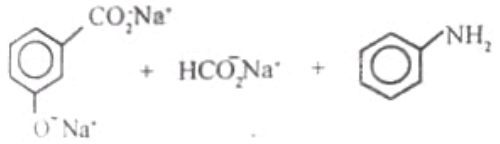
The increasing order of the boiling points of the above compounds is,
(1) A<B<C<D (2) A<C<B<D
(3) A<C<D<B (4) C<A<D<B
(5) C<B<D<A

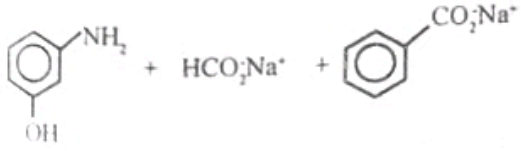
16. The percentage ionization of an aqueous solution of 0.10 mol dm^{-3} HCOOH at 25°C is,
(K_a of HCOOH at 25°C = 1.7×10^{-4} mol dm^{-3})
(1) 0.4 (2) 2 (3) 4 (4) 10 (5) 40

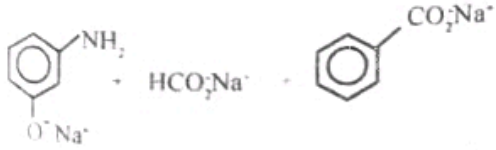
17. The compound given below was heated with excess aq. NaOH

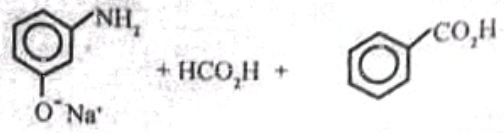


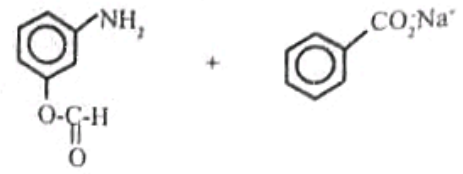
The products formed from this reaction are,

(1) 

(2) 

(3) 

(4) 

(5) 

18. The IUPAC name of $[Co(OH)(NH_3)_4(H_2O)]^{2+}$ is,
(1) tetraamminehydroxoaquacobalt (III) ion
(2) hydroxoaquatetraamminecobalt (III) ion
(3) tetraammineaquahydroxocobalt (II) ion
(4) tetraammineaquahydroxocobalt (III) ion
(5) hydroxotetraammineaquacobalt (III) ion

19. The element **X** forms the stable $X^{3+}(aq)$ ion with five unpaired electrons in aqueous solution. An atom of element **X** has four unpaired electrons in its ground state. The element **X** is,
(1) Fe (2) Cr (3) Sc (4) Co (5) Al

20. The reagent/ reagents which **cannot** be used to distinguish between KBr and KI is/are,
(1) aqueous $Pb(NO_3)_2$ (2) conc. H_2SO_4
(3) I_2/CCl_4 (4) Br_2/CCl_4
(5) aqueous $AgNO_3$ and conc. NH_3

21. The products obtained when sulphur reacts with conc. HNO_3 are,
(1) H_2SO_4, NO and H_2O (2) SO_2, NO_2 and H_2O
(3) H_2S, NO_2 and H_2O (4) SO_2, NO and H_2O
(5) SO_2, SO_3, NO_2 and H_2O

22. At a certain temperature, the value of the equilibrium constant K_c for the following reaction is

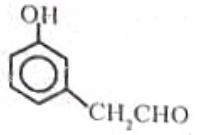
$$H_2(g) + CO_2(g) \rightleftharpoons H_2O(g) + CO(g)$$

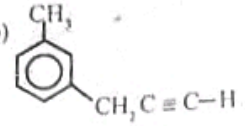
When 0.90 mol of $H_2(g)$ and 0.90 mol of $CO_2(g)$ are introduced to a 5.0 dm^3 vessel, the concentration CO(g) at equilibrium at the same temperature is,
(1) 0.12 mol dm^{-3} (2) 0.24 mol dm^{-3}
(3) 0.36 mol dm^{-3} (4) 0.60 mol dm^{-3}
(5) 1.2 mol dm^{-3}

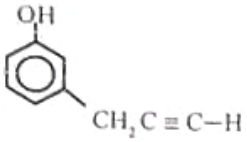
23. Compound **A** decolourizes alkaline $KMnO_4$ solution. Consider the following statements regarding
(a) It may contain a doulble bond
(b) It may contain a triple bond
(c) It may be an aldehyde
(d) It may be a ketone

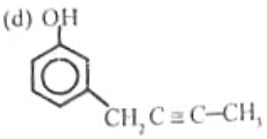
The correct statement/s regarding the compound **A** is/are
(1) (a) only (2) (a) and (b) only
(3) (a) and (c) only (4) (a), (b) and (c) only
(5) (a), (b) and (d) only

24. Consider the following compounds

(a) 

(b) 

(c) 

(d) 

Which of the aobve compound show/s all the following observations?

- Decolourizes bromine water.
- Liberates H_2 when reacted with sodium
- A white precipitate is formed when reacted with ammoniacal silver nitrate.

(1) (a) only (2) (c) only
(3) (b) and (c) only (4) (a), (b) and (c) only
(5) (b), (c) and (d) only

25. The two pure liquids **A** and **B** that form ideal solutions when mixed in all proportions, exist in equilibrium with their vapours in a closed vessel. At a certain temperature, the mole fractions of **A** and **B** in liquid phase are x_A and x_B respectively and the partial vapour pressures of **A** and **B** in the vapour that is in equilibrium with the liquid are P_A and P_B rspectively. The vapour pressures of pure **A** and pure **B** at that temperature are P_A^0 and respectively. The mole fraction of **A** in the vapour phase is.

(1) $\frac{P_A^0 - P_A}{P_A^0}$ (2) $\frac{P_B^0 - P_B}{P_B^0}$ (3) $\frac{P_A^0 x_A}{x_A + x_B}$

(4) $\frac{P_A^0 x_A}{P_A^0 x_A + P_B^0 x_B}$ (5) $\frac{P_B^0 x_B}{P_A + P_B}$

26. Consider the following statements regarding the kinetics of a chemical reaction.

(a) The unit of rate is mol dm^{-3} and it is independent of the overall order of the reaction.
(b) Increase in temperature decreases the rate of an exothermic reaction.
(c) Increase in concentration of reactants does not affect the overall order of a reaction.

Which of the above statements is/are true?

(1) (a) only (2) (b) only (3) (c) only
(4) (b) and (c) only (5) All (a), (b)and (c)

27. Which of the following statements is correct with regard to the chemistry of the metallic elements group1 and 2?

(1) Group 1 elements react less vigorously with water, when going down the group.
(2) Group 2 carbonates become less stable to heat, when going down the group.
(3) The hydroxides, sulphates and carbonates of Group 2 elements become more soluble in water going down the group.
(4) All elements in Group 2 form covalent hydrides.
(5) Except for Li_2CO_3, all carbonates of Group 1 are stable to heat.

- Questions **28** and **29** are based on solutions **A**,**B**,**C** and **D** given below.

A : Solution prepared by dissolving 10.2 g of pure potassium hydrogen phthalate (molar mass =204 g mol^{-1}) which is a weak monobasic acid in water, and then diluting up to 1.00 dm^3

B : Solution prepared by dissolving 2.0 g of NaOH (molar mass of pure NaOH = 40 g mol^{-1}), containing an inert compound in water, and then diluting up to 1.00dm^3

C : Conc. HCl (molar mass = 36.5 mol^{-1}) solution of density 1.2 g cm^{-3} and of strength 36.5% (w/w)

D : Solution prepared by diluting 10.0 cm^3 of solution **C** up to 1.00 dm^3.

28. A sample of 25.00 cm^3 of solution **B** requires 22.00 cm^3 of solution **A** for complete reaction. The purity of NaOH used to prepare solution **B** is,

(1) 76% (2) 88% (3) 91% (4) 94% (5) 97%

29. Volume of solution **B** required to react completely with 12.50cm^3 of solution **D** is,

(1)17.10 cm^3 (2) 26.40 cm^3 (3) 30.00 cm^3
(4) 33.60 cm^3 (5) 34.10 cm^3

30. V_2O_5 dissolves in conc. H_2SO_4 to form a yellow coloured oxocation which turns blue when treated with a mild reducing agent such as Na_2SO_3. The yellow solution when treated with Zn pieces undergoes a number of colour changes to finally give a light purple solution. The vanadium species responsible for the yellow, blue and light purple colours are respectively,

(1) VO_2^+, V^{3+} and V^{2+} (2) VO^{2+}, V^{3+} and V^{2+}
(3) VO_2^+, VO^{2+} and V^{2+} (4) VO_2^+, VO^{2+} and V^{3+}
(5) VO_2^+, VO^{2+} and VO

- For each of the questions **31** to **40**, one ore more responses out of the four responses (a), (b), (c) and (d) given 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 correct.

Summary of above Instructions

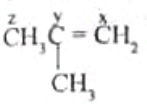
(1)	(2)	(3)	(4)	(5)
Only (a) and (b) are correct.	Only (b) and (c) are correct.	Only (c) and (d) are correct.	Only (d) and (a) are correct.	**Any other** number or combination of responses is correct.

31. Which of the following statements is/are true regarding the equilibrium given below?

$2H_2O(l) \rightleftharpoons H_3O^+(aq) + OH^-(aq)$

(a) $[H_3O^+(aq)][OH^-(aq)] > 1.00 \times 10^{-14} mol^2\ dm^{-6}$ at temperatures above 25°C.
(b) It exists in any aqueous weak acid solution.
(c) It is an exothermic reaction.
(d) $[H_3O^+(aq)] = [OH^-(aq)]$ for any aqueous system.

32. The correct statement/s regarding the structure of the following compound is/are,



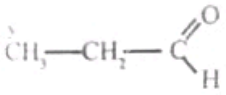
(a) Carbon atoms labelled **x,y** and **z** lie on one straight line.
(b) The angle between C-H bonds on the carbon atom labelled as x is 160°.
(c) All four carbon atoms lie on one plane.
(d) The distance between carbon atoms labelled x and y is less than the distance between carbon atoms labelled **y** and **z**.

33. The correct statement/s with regard to extraction/ production of elements / compounds is/are,
(a) $CaCl_2$ is used to lower the temperature required to bring NaCl to the molten state, during the extraction of Na metal.
(b) Purification of bauxite is the first step in the extraction of Al metal.
(c) Ammonia and carbon monoxide are used as raw materials in the production of urea.
(d) SO_2 and H_2 gases are used in the production of sulphur from H_2S present in natural gas.

34. Which of the following statements is/are true regarding natural rubber?
(a) SO_2 and CO_2 gases are evolved when tyres made of natural rubber are burnt in air.
(b) Natural rubber is a polymer of propene.
(c) Natural rubber has double bonds with trans configuration.
(d) Vulcanization of natural rubber introduces cross linking between carbon chains.

35. By which of the following processes is/are H_2 released at the cathode?
(a) Electrolysis of an aqueous $CuSO_4$ solution using copper electrodes.
(b) Electrolysis of an aqueous $CuSO_4$ solution using platinum electrodes.
(c) Electrolysis of water using carbon electrodes.
(d) Electrolysis of an aqueous NaCl solution using carbon electrodes.

36. The correct statement/s regarding the following compound is/ are



(a) It undergoes an electrophilic addition reaction with HCN.
(b) The hydrogen atoms attached to carbon atom labelled **y** exhibit acidic character.
(c) It reacts with $NaBH_4$ to form an alcohol.
(d) It undergoes oxidation when reacted with $[Ag(NH_3)_2]^+ OH^-$ to form a carboxylic acid.

37. Which of the following statements is/are true regarding polyvinylchloride (PVC)?
(a) It is a synthetic polymer that can be softened by heating.
(b) It does not contain double bonds.
(c) It is formed by addition polymerization of CHCl=CHCl.
(d) it possesses weak intermolecular attractive forces between polymer chains

38. Which of the following is/are **not** an assumption/ assumptions of the molecular kinetic theory of gases?
(a) Gaseous molecules are very small and hence their masses can be neglected in calculations.
(a) Gaseous molecules are very small and hence their volumes can be neglected in calculations.
(c) Collisions among gaseous molecules are perfectly elastic.
(d) At a given temperature the kinetic energies of all gaseous molecules are the same.

39. Which of the following statements is/are true regarding Rutherford's gold foil experiment?
(a) All the positive charges reside in a small region referred to as the nucleus.
(b) The atom has a large empty space in which electrons move around the nucleus.
(c) Thompson's model of the atom was proved acceptable.
(d) Electrons travel in fixed orbitals.

40. Which of the following steps raise/ raises the pH of an aqueous solution at constant temperature by 2 units?
(a) Decreasing the existing concentration of H^+ in solution 200 times.
(b) Decreasing the existing concentration of H^+ in solution by 2.0 mol dm^{-3}.
(c) Decreasing the existing concentration of H^+ in solution 100 times.
(d) Decreasing the existing concentration of H^+ in solution by 0.01 mol dm^{-3}.

- 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 and mark appropriately on your answer sheet.

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

First Statement	Second Statement
41. The pH of a dibasic acid in which the first ionization constant is K_1, is higher than the pH of a monobasic acid of the same concentration and the same ionization constant (K_1).	The acid strength of a substance depends only on the number of ionizable hydrogen atoms present in its molecule.
42. **LiI** has more covalent character than **LiF**.	When the cation is small and /or has a high charge, it has a high polarization power.
43. Diazonium salts of aromatic amines react with water to form phenols.	Diazonium salts can act as nucleophilic reagents.
44. As long as the temperature is maintained constant, the equilibrium constant of a chemical equilibrium system does not change by the addition of a catalyst.	A catalyst decreases the activation energy of both the forward reaction and the backward reaction by the same fraction.
45. Phenol readily reacts with bromine water giving a white precipitate.	Bromine adds to compounds containing double bonds.
46. CO_2 does not contribute to acid rain.	Carbonic acid is formed when CO_2 dissolves in water.
47. In a chemical reaction, all molecules with energy greater than the activation energy form products.	In all chemical reactions, the reactants must go through a state having energy greater than the energy of reactants.
48. The concentration of **Fe(III)** in an aqueous solution can be determined using salicylic acid.	The intensity of the colour of the complex formed by **Fe(III)** with salicylic acid, depends on the concentration of the complex.
49. The boiling point of CO_2 is higher than the boiling point of formaldehyde.	Intermolecular attractive forces between CO_2 molecules are stronger than intermolecular attractive forces between formaldehyde molecules.
50. The amount of dissolved oxygen is not a measure of water pollution.	Concentration of oxygen in polluted water depends only on the temperature of the water/ air system.