

الفقرة الأولى

Final Examination For 1st Year Students (General Chemistry 105C)

Q1. Shade the correct answer A ,B, C or D (One Mark each)

1. The carbocation with adjacent double bond is known as:
A) Stable carbocation B) allylic cation C) A and B D) None
2. The addition of HBr to 1,3-dienes is:
A) Electrophilic B) Nucleophilic C) Free radicals D) None
3. Curved headed arrow is used to indicate:
A) Homolytic bond fission B) Point of reactants to products
C) Reversible reactions D) None
4. Hydrogenation of 2-butyne in presence of lindler's catalyst consumed:
A) One mole of H₂ B) two moles of H₂
C) Three moles of H₂ D) None
5. Hydration of propene gave:
A) Propane B) propyne C) propanal D) None
6. CH₃CONH₂ is called:
A) Methylamine B) ethylamine C) urea D) None
7. CH₃SCH₃ is called:
A) Dimethylthiol B) dimethylsulphone C) dimethylsulphate D) None
8. Methylformate is the isomer of:
A) Formic acid B) formaldehyde C) formamide D) acetic acid
9. Many radicals are:
A) Stable B) unstable C) high reactive D) B and C
10. The correct order of increasing stability is:
A) ⁺CH₃, CH₃CH₂⁺, (CH₃)₂CH⁺, (CH₃)₃C⁺
B) (CH₃)₃C⁺, (CH₃)₂CH⁺, CH₃CH₂⁺, ⁺CH₃
C) CH₃CH₂⁺, ⁺CH₃, (CH₃)₂CH⁺, (CH₃)₃C⁺
D) (CH₃)₂CH⁺, (CH₃)₃C⁺, ⁺CH₃, CH₃CH₂⁺
11. Which alkenes don't have geometric isomerism:
A) 1-butene B) 2-butene C) 3-bromo-2-butene D) A and C
12. The order of increasing acidity of the following:
A) Propene, propyne, ethyne, ethene B) ethyne, propyne, ethene, propene
C) propene, ethene, propyne, ethyne D) None

Please turn over for the rest of questions

13. The correct order of increasing C-H bond length is:
 A) SP^3-H , SP^2-H , $SP-H$ B) SP^2-H , SP^3-H , $SP-H$
 C) SP^2-H , $SP-H$, SP^3-H D) None
14. The order of increasing angle between hybrid orbitals is:
 A) SP , SP^3 , SP^2 B) SP^2 , SP , SP^3 C) SP^3 , SP^2 , SP D) None
15. How many isomers obtained from mono bromination of methyl cyclopropane:
 A) 2 B) 3 C) 4 D) 5
16. The rate determining step in two steps reaction is:
 A) $E_a^1 < E_a^2$ B) exothermic, $+\Delta H$ C) endothermic, $-\Delta H$ D) None
17. Which carbon atom has the greatest % P character?
 A) Ethene B) ethyne C) ethane D) None
18. Electrophilic addition reaction of alkenes:
 A) Involve one endothermic step B) Involve two exothermic steps
 C) Involve formation of carbonium ion D) A and C
19. How many δ and π bonds in acetylene:
 A) 2 δ , 1 π B) 2 δ , 2 π C) 3 δ , 1 π D) None
20. How many 1° and 2° hydrogen's in 2,2-dimethylbutane:
 A) 12,2 B) 12,1 C) 11,2 D) 12,3
21. Propyne + H_3O^+ gave:
 A) Propanol B) propanal C) propane D) None
22. 2- Butene + O_3 (Zn/ H_2O) gave:
 A) Ethene B) 2-hydroxybutane C) butanol D) None
23. Propene + BH_3 (H_2O_2 / $NaOH$) gave:
 A) Propane B) 2-propanol C) propanal D) None
24. Propyne + $NaNH_2$ gave:
 A) Propene B) propane C) propylamine D) None
25. How many structure isomers are possible in compound C_4H_8 :
 A) 2 B) 3 C) 4 D) 5
26. $K_c = 0.040$ for the system below at $450^\circ C$:

$$PCl_{5(g)} \rightleftharpoons PCl_{3(g)} + Cl_{2(g)}$$
 K_p for this reaction at $450^\circ C$ equals ($R = 0.082 \text{ L atm mol}^{-1} \text{ K}^{-1}$)
 A) 0.40 B) 0.64 C) 2.37 D) 6.7×10^{-4}

27. The pH of a buffer solution prepared by dissolving 0.20 mole of cyanic acid (HCNO) and 0.80 mole of sodium cyanate (NaCNO) in water to make 1.0 liter of solution equals ($K_a = 2.0 \times 10^{-4}$)
 A) 0.97 B) 3.10 C) 4.40 D) 4.30
28. When NH_4Cl is added to NH_4OH solution, the dissociation of ammonium hydroxide is reduced. It is due to:
 A) Common ion effect B) Hydrolysis
 C) Oxidation D) Reduction
29. For PbCl_2 ($K_{sp} = 2.4 \times 10^{-4}$), will a precipitate of PbCl_2 form when 0.10 L of $3.0 \times 10^{-2} \text{ M}$ $\text{Pb}(\text{NO}_3)_2$ is added to 400 mL of $9.0 \times 10^{-2} \text{ M}$ NaCl ?
 A) Yes, because $Q > K_{sp}$ B) No, because $Q < K_{sp}$
 C) No, because $Q = K_{sp}$ D) Yes, because $Q < K_{sp}$
30. At a constant external pressure, adding helium gas to the equilibrium:

$$2\text{NO}_{(g)} + \text{O}_{2(g)} \rightleftharpoons 2\text{NO}_{2(g)}$$

 A) Shifts the equilibrium to the left B) Increases the K_p value
 C) Shifts the equilibrium to the right D) Has no effect
31. Which one of the following is not a conjugate acid–base pair?
 A) NH_3 and NH_4^+ B) NH_3 and NH_2^-
 C) HS^- and H_2S D) H_3O^+ and OH^-
32. Using molar concentrations (M), what is the unit of K_c for the reaction?

$$\text{CH}_3\text{OH}_{(g)} \rightleftharpoons \text{CO}_{(g)} + 2\text{H}_2_{(g)}$$

 A) M^{-2} B) M^{-1} C) M^2 D) M
33. What is the net ionic equation for the reaction that occurs when small amounts of hydrochloric acid are added to a HOCl/NaOCl buffer solution?
 A) $\text{H}^+ + \text{H}_2\text{O} \rightarrow \text{H}_3\text{O}^+$ B) $\text{H}^+ + \text{OCl}^- \rightarrow \text{HOCl}$
 C) $\text{HOCl} \rightarrow \text{H}^+ + \text{OCl}^-$ D) $\text{H}^+ + \text{HOCl} \rightarrow \text{H}_2\text{OCl}^+$
34. If K_{sp} for HgSO_4 is 6.4×10^{-5} , the solubility of this salt in mole per m^3 is:
 A) 8.0×10^{-3} B) 6.4×10^{-5} C) 8.0×10^{-6} D) None of these
35. When 0.15 g of a solute is dissolved in 15 g of solvent, the boiling point of the solution becomes 0.216°C higher than that of the pure solvent. Find the molecular weight of the substance, if molal elevation constant for the solvent is 2.16°C .
 A) 1000 B) 100 C) 1.01 D) 10.1

36. The pH value of NH_4NO_3 solution that is 0.071 mol/L equals:

(K_b for $\text{NH}_4\text{OH} = 1.8 \times 10^{-5}$ and $K_w = 1 \times 10^{-14}$)

- A) 5.2 B) 12.7 C) 7.0 D) 9.2

37. Which one of the following statements is correct?

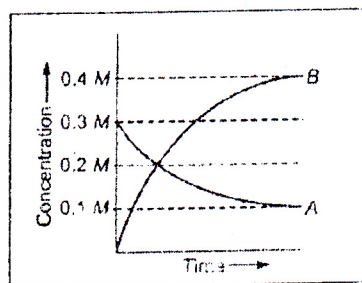
- A) K_c never has units.
B) K_c does not depend on temperature.
C) When K_c is very large, there are more products formed.
D) The value of K_c gives us the rate of reaction.

38. Which of the solution following pairs is not a buffer solution?

- A) $\text{NH}_4\text{OH} + \text{NH}_4\text{Cl}$ B) $\text{H}_3\text{BO}_3 + \text{Na}_2\text{B}_4\text{O}_7$
C) $\text{NH}_4\text{OH} + \text{Na}_2\text{CO}_3$ D) $\text{CH}_3\text{COOH} + \text{CH}_3\text{COONa}$

39. The figure shows the change in concentration of species A and B as a function of time. The equilibrium constant K_c for the reaction $A_{(g)} \rightleftharpoons 2B_{(g)}$ is:

- A) $K_c > 1$ B) $K_c < 1$
C) $K_c = 1$ D) data insufficient



40. The molar solubility of magnesium carbonate is 1.8×10^{-4} mol/L. What is K_{sp} for this compound?

- A) 1.8×10^{-4} B) 3.6×10^{-4} C) 1.3×10^{-7} D) 3.2×10^{-8}

Q2: Answer (T) for True sentences or (F) for False sentences: (One mark for each)

41. Pure liquids, solids, and solvents are not part of an equilibrium constant expression.
42. The decrease in boiling point is considered as a colligative property of a given solution compared to its pure solvent.
43. The reaction: $\text{H}_{2(g)} + \text{I}_{2(g)} \rightleftharpoons 2\text{HI}_{(g)}$ ($\Delta H = +53 \text{ kJ mol}^{-1}$) is not affected by a change in pressure because it is an endothermic reaction.
44. If $Q > K$ then the reverse reaction must occur to reach equilibrium.
45. The freezing point depression ΔT_f in dilute solutions is independent on the molal concentration m of the solute.
46. The K_{sp} values of the sulphides of the group II cations are lower than those of group IV.

Please turn over for the rest of questions

47. When a salt of weak acid and weak base is dissolved in water at 25 °C, the pH value of the resulting solution will always depend upon K_a and K_b values.
48. Boiling point elevation arises in systems where there is an equilibrium between a liquid solution phase and a second liquid phase?
49. The K_{sp} for silver(I) phosphate is 1.8×10^{-18} ; the silver ion concentration in a saturated solution of silver(I) phosphate equals $4.8 \times 10^{-5} M$.
50. The approximate pH of 0.71 M H_2SO_4 solution equals 0.15.

Good Luck

Examiners: *Prof. Hassan A.H. El-Sherief, Prof. Ali A. Abdel-Hafez Gomaa, Prof. Bahaa M. Abu-Zied, Dr. Mohamed I. Said*

Second Semester Examination
Subject: General Chemistry (C-100)
Students: First Level "Credit Hours System"

Part (I) (25 marks)

Q1: Answer the following: (14 Marks)

- 56 g of N_2 are mixed with 44 g of CO_2 and the pressure of the resulting mixture is 303 kPa. What is the partial pressure of N_2 in the mixture?
- What is the number of moles of hydrogen necessary to react completely with 1.0 L oxygen to give H_2O at 25 °C and 86.13 kPa?
- Calculate the ratio of rates of effusion of H_2 and O_2 , both at 0 °C and 1 atm pressure.
- Calculate the root mean square and the average kinetic energy of oxygen molecules at 18°C.
- Compute the weight mass of 6.00 L of ammonia gas, NH_3 at STP.
- Calculate the energy needed to convert 90 mL H_2O to vapor, the heat of vaporization of H_2O is 40.6 KJ/mol.

Q2: Answer the following: (5 Marks)

- The boiling point of water is 100 °C, whereas that of H_2S is – 42 °C. Explain?
- Which of the following substance would be expected to have the largest heat of vaporization and why?
(a) PH_3 (b) HBr (c) H_2S (d) H_2O

Q3: Write short notes on Two Only of the following: (6 Marks)

- Tyndall effect
- Brownian movement
- Peptization method for preparation of colloidal rotation

Part (II) (25 Marks)

Q4: Put (✓) for true sentences or (X) for false sentences: (7 Marks)

- The hybridization of C in $H_2C=CH_2$ molecule is sp^2 ()
- The emission spectra consist of a series of dark lines superimposed on the continuous spectrum of the light source. ()
- The splitting of a spectral line into several components in the presence of a static magnetic field is called Zeeman effect. ()
- The Lyman series of hydrogen spectrum appears in the visible region of light ()
- The B_2 molecule has diamagnetic properties. ()
- The repulsion between bonding electron pairs is greater than the repulsion between nonbonding pairs. ()
- The geometrical shape of HCN molecule is bent. ()
- In an antibonding molecular orbital, the nuclei are attracted to an accumulation of electron density outside the internuclear region. ()

Please turn over for the rest of question

Q5: Choose the correct answer (a), (b), (c) or (d): (8 Marks)

- i) The hybridization of **P** in **PCl₅** is
(a) sp^2 (b) sp^3 (c) sp^3d (d) sp^3d^2
- ii) Which of the following is the correct set of quantum numbers for the outermost electron of bromine (**Br**) atom?
(a) $n=3, \ell=0, m_\ell=0, m_s=+1/2$ (b) $n=3, \ell=1, m_\ell=-2, m_s=+1/2$
(c) $n=3, \ell=1, m_\ell=+2, m_s=+1/2$ (d) $n=3, \ell=1, m_\ell=+1, m_s=+1/2$
- iii) The total number of electron pairs on chlorine atom (**Cl**) in **ClF₃** molecule is
(a) 3 (b) 4 (c) 5 (d) 6
- iv) The bond order in **O₂⁺** molecule is
(a) 1 (b) 1.5 (c) 2 (d) 2.5
- v) The magnetic quantum number (**m_l**) describes the orbital's
(a) size (b) shape (c) energy (d) orientation in space
- vi) For the third line of Paschen series, n_2 is
(a) 4 (b) 5 (c) 6 (d) 7
- vii) The **NO₃⁻** ion has resonance structures.
(a) 0 (b) 2 (c) 3 (d) 4
- viii) The geometrical shape of **BrF₅** molecule is
(a) square pyramidal (b) trigonal bipyramidal (c) tetrahedral (d) octahedral
- ix) stated that no two electrons in the same atom can have the same set of 4 quantum numbers.
(a) Heisenberg (b) Pauli (c) Bohr (d) Planck

Q6: Answer Two Only of the following: (10 Marks)

- i) Write down Lewis structures for each of the following: **CO₃²⁻** and **SF₄**, assign the formal charge for each atom in both of them.
- ii) Using the molecular orbital theory, draw the energy level diagrams for **O₂⁻** and **C₂**. calculate the bond order and predict the magnetic properties for each of them.
- iii) Based on **VSEPR** theory, predict the electron domain geometries and the molecular shapes for **NH₃** and **BrF₅**

Constants: $R=0.0821 \text{ atm L mol}^{-1} \text{ K}^{-1}=8.314 \text{ J mol}^{-1} \text{ K}^{-1}=8.314 \text{ kPa L mol}^{-1} \text{ K}^{-1}$ and
 $1 \text{ atm}=101.325 \text{ kPa}=760 \text{ torr}=760 \text{ mm Hg}$.

Atomic weights: O=16, N=14 and H=1.

Atomic numbers: H=1, B=5, C=6, N=7, O=8, F=9, P=15, S=16, Cl=17, Br=35

Good Luck

Prof.Dr. Refaat M. Mahfouz and Dr. Soliman A. Soliman

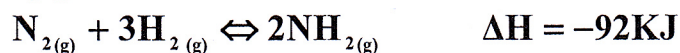


Final Examination For 1st Year Students (General Chemistry II, 105C,
Materials Science and Nanotechnology Group).

Section A (Analytical Chemistry)

Answer only five of the following: (25 Marks)

1. For the following gaseous reaction:

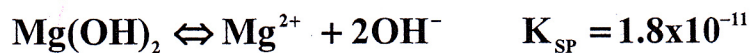


What is the effect of i) Addition of more nitrogen, ii) Lowering the temperature, and iii) Reducing the volume of the mixture to one-half of its original value.

2. Calculate the pH of a solution that is both 1M CH₃COOH and 1M CH₃COONa? ($K_a = 1.8 \times 10^{-5}$). What will be the pH after addition of HCl, which reacts with 2% of sodium acetate?
3. Calculate the solubility (in g/100mL) of Ag₂SO₄ in 1M aqueous Na₂SO₄ solution. ($K_{sp} = 1.4 \times 10^{-5}$) At 18°C. (Atomic weights: Ag = 107.9, S = 32 and O = 16).
4. For the system: $\text{A}_{(g)} + 2\text{B}_{(g)} \rightleftharpoons \text{C}_{(g)}$

The equilibrium concentrations are [A] = 0.06 mol/L, [B] = 0.12 mol/L, and [C] = 0.216 mol/L. Calculate the values of both K_c and K_p at 250 °C. ($R = 0.082 \text{ L atm mol}^{-1} \text{ K}^{-1}$)

5. What is the solubility of Mg(OH)₂ in a buffer solution having pH=9?



6. What is the pH of 5% (w/w) H₃PO₄ solution? ($d = 1.03 \text{ g/mL}$, $K_{a1} = 7.1 \times 10^{-3}$), [H = 1, P = 31, O = 16]

Please turn over for the rest of questions

Section B (Organic Chemistry)

Q1. Choice the correct answers for the following questions

(10 Points)

1. Which compound has a high boiling point?

- A) $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_3$ B) $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_3$ C) $\text{H}_3\text{C}-\overset{\text{CH}_3}{\underset{\text{H}}{\text{C}}}-\text{CH}_2\text{CH}_2\text{CH}_3$ D) $\text{H}_3\text{C}-\overset{\text{CH}_3}{\underset{\text{CH}_3}{\text{C}}}-\text{CH}_2\text{CH}_3$

2. Which of the following compounds is (S)-2-amino-2-methylbutanoic acid?

- A) $\text{H}_3\text{CH}_2\text{C}-\overset{\text{COOH}}{\underset{\text{CH}_3}{\text{C}}}-\text{NH}_2$ B) $\text{H}_3\text{CH}_2\text{C}-\overset{\text{CH}_3}{\underset{\text{NH}_2}{\text{C}}}-\text{COOH}$ C) $\text{H}_3\text{CH}_2\text{C}-\overset{\text{CH}_3}{\underset{\text{COOH}}{\text{C}}}-\text{NH}_2$ D) $\text{H}_3\text{CH}_2\text{C}-\overset{\text{NH}_2}{\underset{\text{COOH}}{\text{C}}}-\text{CH}_3$

3. $\text{C}_3\text{H}_8 + 5\text{O}_2 \longrightarrow \dots\dots\dots$

- A) $\text{CH}_3\text{CH}_2\text{COOH}$ B) CO_2 and H_2O C) CO and H_2O D) $\text{CH}_3\text{CH}_2\text{CHO}$ and H_2O

4. $\text{CH}_3\text{CH}_2\text{CH}_3 + \text{Br}_2 \xrightarrow{\text{Light}} \dots\dots\dots$

- A) $\text{CH}_3\overset{\text{Br}}{\text{CH}}\text{CH}_3$ B) $\text{CH}_3\text{CH}_2\text{CH}_2\text{Br}$ C) $\text{CH}_3\overset{\text{Br}}{\text{CH}}\text{CH}_2\text{Br}$ D) A and B

5. How many structural isomers are possible for a compound that has molecular formula C_5H_{12} ?

- A) 2 B) 3 C) 4 D) 5

6. The formal charge of carbon in CH_3F is

- A) +1 B) -1 C) +2 D) Zero

7. Which one of these compounds is more acidic?

- A) $\text{CH}_2=\text{CH}_2$ B) $\text{CH}_3-\text{C}\equiv\text{CH}$ C) $\text{CH}_3-\text{C}\equiv\text{C}-\text{CH}_3$ D) $\text{CH}_3\text{HC}=\text{CHCH}_3$

8. The most stable alkene is

- A) $\text{CH}_2=\text{CH}_2$ B) $(\text{CH}_3)_2\text{C}=\text{C}(\text{CH}_3)_2$ C) $\text{CH}_3\text{CH}=\text{CH}_2$ D) $\text{CH}_3\text{CH}=\text{CHCH}_3$

9. The most stable carbocation is

- A) CH_3^+ B) $(\text{CH}_3)_3\text{C}^+$ C) $(\text{CH}_3)_2\text{CH}^+$ D) CH_3CH_2^+

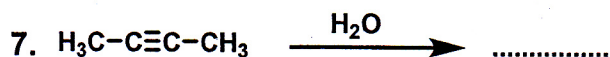
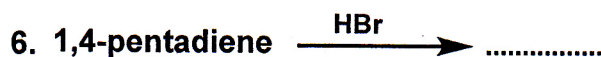
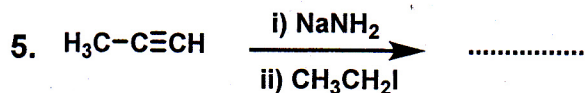
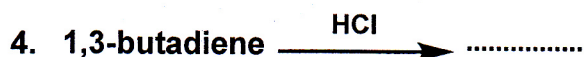
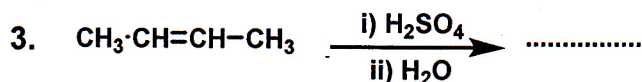
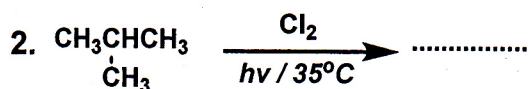
10. The bond length between the two carbon atoms in alkynes is

- A) 1.33\AA B) 1.09\AA C) 1.54\AA D) 1.20\AA

Please turn over for the rest of questions

Q2: Complete the following reactions:

(10 Points)



Q3: Write one method to prepare the following:

(3 Points)

1) Cyclohexene

2) 2-butyne

3) 2-bromopropane

Q4: Draw the structure of the following:

(2 Points)

1) Allyl bromide

2) 2,3-dichloropentane

3) *E*-2-bromo-3-chloro-2-butene

4) *cis*-1,2-

dichloroethene

Examiners: Ass. Prof. Mohamed I. Said, Dr. Abdelreheem A. Saddik

GOOD LUCK