Catholic University Institute of Buea (CUIB)
2020/2021 ACADEMIC YEAR
First Semester Examinations – February 2021

School	ENGINEERING	Department	CHEMICAL ENGINEERING		
Course Code	CME 101	Course Title	General Chemistry for Engineers		
Status	C	Credit Value	6		
Date	05/03/2021	Venue	Ngongi Hall, LH1	Time	10:30-12:30
Course Master		Mr Nkongho Epey Lewis			

Part A: Choose the correct answer and neatly mark the corresponding letter on the multiple choice section of your answer booklet with an X.

1. Which of the following statements is not a postulate of Dalton's atomic theory?
   A. Each element is characterized by the mass of its atoms.
   B. Atoms are composed of protons, neutrons, and electrons.
   C. Elements are composed of atoms.

2. How many electrons are in the ion P^{3-}?
   A. 12 B. 18 C.28 D.34
3. A sample of pure calcium fluoride with a mass 15.0 g contains 7.70 g of calcium. How much calcium is contained in 30.0 g of calcium fluoride?
   A. 1.71 g B. 7.70 g C. 15.0 g D. 15.4 G
4. Which of the following represents isotopes? I: $^{79}_{34}X$ II. $^{79}_{35}X$ III. $^{78}_{34}X$ IV: $^{81}_{36}X$
   A. I and II B. I and III C. I and IV D. III and IV
5. What is the mass of 8.50×10^{22} molecules of ammonia? (Avogadro # $=6.02 \times 10^{23}$; N= 14.007, H= 1.008)
   A. 0.00830g B. 0.417g C. 2. 40g D. 120 g
6. The greater the energy of a photon, the
   A. The longer the wave length and the higher the frequency
   B. The longer the wave length and the lower the frequency
   C. The shorter the wave length and the higher the frequency
   D. The shorter the wave length and the lower the frequency
7. The intensity of a beam of light is related to its
   A. Frequency B. relative number of photons C. speed D. wave length
8. The effective nuclear charge of an element with atomic number 18 is
   A. 6.05
   B. 6.50
   C. 5.55
   D. 6.75
9. What is the molar mass of $Ca_3(PO_4)_2$?
   A. 87.05 g B. 310.18 g C. 135.05 g D. 118.02 g E. 166.02 g

10. A sample of ammonia has a mass of 56.6 g. How many molecules are in this sample?
A. 3.32 molecules B. 17.03×10^{24} molecules C. 6.78×10^{23} molecules D. 2.00×10^{24} molecules
E. 1.78×10^{24} molecules

1. $aMnO_4^-(aq) + bH^+(aq)\ cFe^{2+}(aq) \longrightarrow dMn^{2+}(aq) + eFe^{3+}(aq) + fH_2O(l)$. ThE above equation is balanced when,
A. a = 1, b = 8, c =5, d =1, e =5, f = 4
B. a =1,b = 8, c = 5, d = 2, e = 3, f = 4
C. a = 2, b = 8, c = 5, d = 2, e = 2, e = 3, f = 4
D. a = 1, b = 8, c = 5, d = 2, e = 3, f = 5
E. None of the above

12. The oxidation half equation is $Fe^{2+}(aq) \longrightarrow Fe^{3+}(aq) + e$
A. TRUE
B. False
C. No way to tell
D. More information needed
E. Both c and d

13. The reduction half equation is $MnO_4^-(aq) + H^+(aq) \longrightarrow Mn^{2+}(aq) + H_2O$
A. True
B. False
C. No way to tell
D. More information needed
E.. Both C and D

14. The overall equation above is called
A. Precipitation reaction B. Redox reaction C. Acid-base reaction D. Spin-spin coupling reaction
E. No way to tell

15. The oxidation state of Mn in MnO^-_4 is
A. +1 B. +2 C. +7 D. +5 E. +4

16. Which response includes only the true startmemts concerning the characteristics of ionic compounds?
I. All atoms in the compounds share electrons
II. The compounds are gases of room temperature
III. The compounds have high melting points
IV. Many are soluble in polar solvents
V. Aqueous solutions of this compounds conduct electricity
A. I, II and IV B. I and V C. II and III D. IV and V E. III and IV

17. Which of the following formula is incorrect?
A. LI_3N B. Mg_2O C. KI D. NaBr E. SrS

18. Draw the Lewis dot formula of CO_2. The number of unshared pairs of electrons in the outer shell of the central atom is….

A. 1 B. 2 C. 3 D. 4 E. 0

19. Which molecule is incorrectly matched with molecular geometry?

Molecule	Molecular geometry
a) SeF_6	octahedral
b) CCl_4	tetrahedral
c) SO_3	pyramidal
d) SF_4	tetrahedral
e) SbH_3	pyramidal

20. Many simple molecules contain lone pairs of electrons which occupy hybrid orbitals of the central elements in a molecule. If an atom of the central element utilizes sp^3 hybrid orbital in a compound, which one of the following types of repulsions would be greater?

A. Boding pair-bonding pair
B. Bonding pair-lone pair
C. Lone pair-bonding pair
D. Lone pair-lone pair
E. Repulsion between all types of pairs of electrons are the same

21. Cortisone consists of molecules, each of which contains 21 atoms of carbon (plus other atoms). The mass percentage of carbon in cortisone is 69.98%. What is the molar mass of cortisone?

A. 176.5 g/mol B. 252.2 g/mol C.287.6 g/mol D. 312.8 g/mol E. 360.4 g/mol

22. A substance, A_2B has the composition by mass of 60% A and 40% B. What is the composition of AB_2 by mass?

A. 40%A, 60%B B. 50%A, 50%B C. 27%A, 73%B D. 33%A, 67%B E. none of these

23. The mass of one molecule of water is

A. 18.0 g B. 18.0 g/mol C. 18.0 g D. 18.0 amu E. Both B & D

24. A metal M forms an oxide M_2O_3, containing 68.4% metal by mass. Calculate the molar mass of the metal

A. 51.9g/mol
B. 106 g/mol
C.51.3 g/mol
D.45.6 g/mol
E.68.4 g/mol

25. From question 24 above we can say that O_2^+ is

A. Paramagnetic B. diamagnetic C. neutral D. no way to tell E. none of the above

6. The bond order for O_2^+ in question 24 above

is A. 3 B.2 C. 1 D. 2.5 E. 0

!7. Which of the following atoms has the longest diameter?

A) F B) Cl C) Br D) I

28. Which of the following elements has the greatest electronegativity?

A) Si B) P C) N D) O

29. The identity of an element is determined by....

A) Number of its protons B) Number of its neutrons C) Number of its electrons D) Its atomic mass.

30. Which element will have the higher electron affinity?

A) Chlorine B) Bromine C) Both A&B D) None

31. Carbon monoxide (CO) and carbon dioxide CO_2 is an illustration of Dalton's law of:

A) Definite proportions B) Multiple proportions C) Conservation of mass D) A &B E) A, B & C

32. Adipic acid contains 49.32% C, 43.84% O, 6.85% H by mass. What is the empirical formula?

A) $C_3H_5O_2$ B) $C_3H_3O_4$ C) C_2HO_3 D) $C_2H_5O_4$ E) C_3HO_3

33. Which compound contains the highest percent by mass hydrogen? [Cl=35.45, H=1.01, O=16.00, S=32.07, F=19.00]

A) HCl B) H_2O C) H_2SO_4 D) H_2S E) HF

34. Which of the following does not define solubility?

A. The concentration of solute in a saturated solution
B. The moles of solute dissolved in a given volume of solution
C. The maximum mass of solute that can dissolve in a given volume of solution
D. The minimum moles of solute needed to produce one litre of a saturated solution

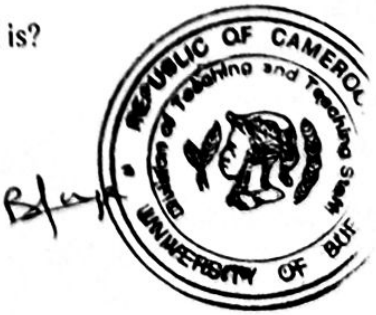
35. Which of the following is necessary to form a saturated solution at equilibrium?

A) Excess solute B) an ionic solute

C) Solute of low solubility D) ion product is less than K_{SP}

36. The pH at the equivalence point for a titration of a strong base with a strong acid is?

A) Acid B) 7 C) basic D) not determinable apriori



Electromagnetic radiation is a stream of particles called?

A) Electrons B) protons C) neutrons D) photons E) nucleons

38. When l = 2, we have

A) the 2s orbital B) the 2p orbital C) the 3d orbital D) the 4f orbital E) none of the above

39. In the following Schrodinger wave equation: $\nabla^2\Psi + (8\pi^2 m/h^2)(E - V)\Psi = 0$, ''V'' stands for the

A. potential energy of the electron
B. total energy of the electron
C. volume of the atom
D. velocity of the electron
E. velocity of the atom

40. An isotope with too many protons will decay:

A. proton emission
B. neutron emission
C. positron emission
D. beta emission
E. A &C

41. Calculate the pH of a 0.20 M CH_3COOH solution? Ka= 1.8×10^{-5}

A) 1.83 B) 3.44 C) 5.26 D) 2.7 E) none of the above

42. A buffer is at its best when pH equal?

A. 1.00
B. pKa ± 1.00
C. pKa
D. 7.00
E. A & C

43. What is the relationship between K_a and K_b at 25 °C for a conjugate acid-base pair?

A) $K_aK_b = 1.0 \times 10^{-14}$ B) $Ka/Kb = 1.0\ 10^{-14}$ C) $Ka/Kb = 1.0 \times 10^{-14}$ D) $Ka+Kb = 1.0 \times 10^{-14}$

44. Generally the solubility of

A) Solids decreases with increase in temperature B) Gases decrease with increase in temperature

C) Gases increase with increase in temperature D) Solids are not affected by changes in temperature

E) Gases are not affected by changes in temperature

45. What is the pOH of a 0.20 M solution of NaCN? The K_a of the HCN is 4.9×10^{-10} and K_b of CN⁻ is 2.0×10^{-5}

A) 2.70 B) 5.00 C) 7.00 D) 9.00 E) 11.30

46. Calculate the pH of a 0.100 M CH_3COONa solution. Ka for CH_3COOH is 1.8×10^{-5}

A. 2.87 B. 5.13 C. 8.87 D: 11.13 E. A&D

47. Which is the strongest acid among the following?

A) H_2SO_3 B) H_2SO_4 C) H_2SeO_3 D) H_2SeO_4

48. Which of the following molecules does not have a dipole moment?

A) HCl B) CO C) NCl_3 D) BCl_3 E) B & C

49. What volume of 0.500 M HNO_3 is needed to titrate 100 mL of 0.500 M $Ca(OH)_2$ to the equivalence point?

A) 12.5 mL B) 50.0 mL C) 100.0 mL D) 200 mL E) A & B

50. Indicate the major chemical species present in a solution of 0.10 M NH_3 and 0.10 M NH_4Cl.

A) NH_3, NH_4^+ B) NH_3, NH_4^+, Cl^- C) NH_3, NH_4^+, Cl^-, OH^- D) NH_3, NH_4^+, Cl^-, OH^-, H_2O

PART B

QUESTION ONE (10 Points)

Draw the molecular energy level diagram for N_2 **(3 pts)**

a) What is its bond order? **(2 pts)**
b) How many electrons are in the σ_{2p}*? **(1 pt)**
c) Comment on its stability. **(2 pts)**
d) Predict the magnetic property from your diagram **(2 pts)**

QUESTION TWO (10 Points)

a) Sketch the 1s, 2s and 2px atomic orbitals **(3 pts)**
b) State the four quantum numbers and give their significance. **(4 pts)**

QUESTION THREE (5 Points)

a) What is a buffer? **(2 pts)**
b) Given a solution of CH_3COOH and a solution of CH_3COONa, discuss the effect of a common ion on the ionization and acidity of a weak acid. Use chemical equations to illustrate your answer. **(3 pts)**