CROSS RIVER UNIVERSITY OF TECHNOLOGY, CALABAR
DEPARTMENT OF PHYSICAL SCIENCES
FIRST SEMESTER EXAMINATIONS 2018/2019 SESSION
CHM 1101 – GENERAL CHEMISTRY 1

TIME: 2HRS

INSTRUCTION: Answer all questions in the space provided. All questions carry equal marks. Please write your **FULL NAMES,** Registration Numbers and Departments **VERY CLEARLY** on the space provided.

FULL NAME:…… **REG. NUMBER ……**

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1. Which kind of shapes are formed when an element has azimuthal quantum number of 2 and 3 _____
2. What is the electronic configuration of an atom that is in group 4 period 3? _____
3. Why do polar covalent compounds not conduct electricity? _____
4. Where in molecules are energy stored? _____
5. Which of the following compounds has higher boiling points?
   (a) NH_3 (b) CH_3COOH (c) Polymer (d) NaCl
6. Complete and balance the following equations showing the structure of the products.
   (a) $NH_3 + BF_3 \rightarrow$? _____ (b) $PCl_3 + O \rightarrow$? _____
7. The volume in space where there is a high probability of finding electron is _____
8. Elements that have both metallic and non-metallic properties is called _____
9. Which of the following has dative covalent bonds (a) CH_3CH_2OH (b) NH_4^+ (c) CH_4 (d) H^+ (e) OH^-
10. To study the rate of a reaction, it is necessary to: (a) identify the reactants (b) know the relative amount of reactants used (c) All of the above
11. A reaction in which all reactants are in the same phase is called (a) elementary (b) bimolecular (c) homogenous
12. The powers in the rate law are determined by (a) the physical state of the products and reactants (b) the coefficients in the balanced chemical equation (c) experiment
13. Reaction rate can change with (a) temperature (b) reactants concentration (c) all of the above
14. The rate constant for a reaction depends upon each of the following **EXCEPT** (a) solvent for solution (b) temperature (c) concentration of reactants
15. For first order reactions, the rate constant k, has the unit(s) (a) 1 mol^{-1} (b) time mol^{-1} (c) $time^{-1}$
16. The reaction A + B + C→ products is (a) unimolecular (b) tetramoleculars (c) trimolecular
17. For a reaction A → products, a graph of [A] versus time is found to be a straight line. What is the order of this reaction? (a) first order (b) second order (c) zero order
18. What is termolecular refers to? _____
19. The rate law relates the rate of a chemical reaction to: (a) the reaction mechanism (b) temperature (c) concentration of reactants

20. $CO(g) + NO_2(g) \rightarrow CO_2(g) + NO(g)$. Write the rate expression for the reaction _____

21. Which of the following statements is/are true regarding a 1.0M solution of a strong acid HA?
(a) $[A^-] > [H^+]$ (b) P^H is 0.00 (c) $[H^+] = 1.0M$ (d) [HA] = 1.0M

22. Classify each of the following species as a weak or strong base (a) LiOH (b) CN^- (c) H_2O (d) ClO^-_4 (e) NH_2^-

23. What are the names and formulae of the conjugate bases of the following acids?
(a) HNO_2 _____
(b) HCOOH _____

24. Give the conjugate acid of each of the following basses (a) HPO_4^{2-} _____
(b) $H_2PO_4^-$ _____

25. Define classical thermodynamics _____
_____

26. Mention two types of thermodynamic instruments (i) _____ (ii) _____

27. Write the equilibrium constant expression in terms of Kc and Kp for the reaction below:
$2NO(g) + Cl_2(g) \longleftrightarrow 2NOCl(g)$
_____

28. If the equilibrium constant for a reaction is large, what can be said about the reaction? (a) very little product is formed (b) very little reactant remains at equilibrium (c) the reaction goes to completion (d) large quantities of reactants remain at equilibrium

29. What effect does an increase in pressure have on each of the following system?
(a) $A(g) \longleftrightarrow 2B(s)$ _____
(b) $2A(l) \longleftrightarrow B(l)$ _____

30. Mention four thermodynamic state functions with their symbols
(i) _____ (ii) _____ (iii) _____
(iv) _____

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1. In electronic configuration of atom, why is 4s orbital filled before 3d orbital _____
2. Which group and period does the atom having electronic configuration $1s^2$, $2s^2$, $2p^6$, $3s^2$, $3p^2$ belong? _____ and _____
3. The kind of orbital that exist in an atom having principal quantum number of 3 is called _____
4. One of the following compounds is unlikely to form intermolecular hydrogen bond (a) NaOH (b) CH_3COOH (c) H_2O (d) C_2H_5OH
5. Identify the type of radicals found in the following compounds (a) $(NH_4)_2SO_4$ (b) $Pb(NO_3)_2$ _____
6. Complete and balance the following equation $Ba(NO_3)_2 + K_2SO_4 \rightarrow ?$ _____
7. Using ammonia molecule as an example show how dative bond could be formed with BF_3 _____
8. Why are ionic crystals bad conductors of electricity? _____
9. The type of reaction represented by the equation $2C_2H_5OH + 6O_2 \rightarrow 4CO_2 + 6H_2O$ is called _____
10. Complete and balance the following nuclear equations
    ${}_{12}Mg^{24} + {}_{1}H^{2} \rightarrow {}_{z}X^{A} + {}_{11}Na^{22}$ _____
11. Consider the reaction $NO_2 + CO \rightarrow NO + CO_2$. What is the overall order of the reaction? (a) 4 (b) 2 (c) 5 (d) 3
12. If the reaction $2A + 3D \rightarrow$ Products is the first order in A and second order in D, then the rate law will have the form (a) $K[A][D]^2$ (b) $K[A]^2[D]^2$ (c) $K[A]^2[D]^2$ (d) $K[A][D]$
13. In a lab, each of the following factors will vary to affect reaction rate **EXCEPT** (a) catalyst (b) concentration of reactants (c) oxygen availability (d) identity of reactants
14. Which of the following does not affect the rate of a chemical reaction (a) enthalpy of reaction (b) temperature (c) surface area (d) concentration of reactants
15. The rate of reaction at time t = 0 is called _____

16. _____ is an experimentally derived quantity that expresses rate of reaction as a function of concentration of species present in the entire reaction.
17. In the reaction $2A + B \rightarrow 2C + D$, $-\Delta C[A]/t$ is found to be $5.0 Mmin^{-1}$. What is the rate of change of B? (a) 2.5M/min (b) 10M/min (c) 5.0M/min (d) 25M/min
18. Which of the following rate law is third order overall? (a) Rate = $K[A]^3[B]^1$ (b) Rate = $K[A]^3[B]^3$ (c) Rate = $K[A][B]^3$ (d) Rate = $K[A]^5[B]^2$
19. Which of the following salts will be alkaline on hydrolysis (a) Na_2CO_3 (b) $NaHCO_3$ (c) $NaSO_4$ (d) $NaHSO_4$
20. Which of the following salts is soluble in water (a) AgCl (b) $NaNO_3$ (c) $BaCl_2$ (d) $CaSO_4$
21. Sodium tetraoxosulphate (vi) is said to be an (a) acidic salt (b) basic salt (c) neutral salt (d) complex salt
22. _____ is a conjugate acid for H_2O
23. _____ is the conjugate base for HCl
24. Arrange the following compounds in the order of increasing acidity; NH_3, HCl, HI and CH_4
25. Which of the following element has the highest electronegativity (a) oxygen (b) sodium (c) fluorine (d) chloride
26. Which of the following elements has the lowest ionization energy (a) oxygen (b) sodium (c) carbon (d) nitrogen
27. _____ mathematical expression relates pH to pKa of an acidic compound.
28. Which of the following reagents can oxidize H_2O to $O_2(g)$ under standard state conditions? (a) $H^+(aq)$ (b) $Cl^{-1}(aq)$ (c) $Cu^{2+}(aq)$ (d) $MnO^{-4}(aq)$
29. Which species in each pair is a better reducing agent under standard state conditions? (a) Na or Li (b) H_2 or I_2 (c) Fe^{2+} or Ag (d) Br- or Co^{2+}
30. The mathematical relation for the first law of thermodynamics is (a) $\Delta E = q-w$ (b) $\Delta E = O$ for cyclic process (c) $\Delta E = q$ for an Isochoric process (d) All of the above
31. For an adiabatic process, according to the first law of thermodynamics (a) $\Delta E = -w$ (b) $\Delta E = w$ (c) $\Delta E = q-w$ (d) none of the above
32. Which of the following is not an intensive property? (a) pressure (b) concentration (c) density (d) volume
33. What is a half-cell reaction? _____

    _____
34. State the principle of operation of the galvanic cell _____

    _____
35. Why does gold not tarnish in air? _____

    _____
36. A nuclear reaction in which a heavy nucleus is split into two or more simpler nuclei is called

    _____
37. Moving down a group, owing to the increase in the number of electron shells, the atomic size

_____

38. Provide the respective conjugate acid and conjugate base for NH_3 and HNO_3

_____

39. What is the product of the reaction $ALCl_3 + NH_3 \rightarrow$ _____
40. Which is a stronger acid? (a) one with an acid dissociation constant of $2.6x10^{-5}$ (b) one with an acid dissociation constant of $1.8x10^{-4}$
41. Arrange the following acids in the order of decreasing $CH_3CHClOH$, CH_3CHFOH, CH_3CHIOH and $CH_3CHBrOH$ _____
42. Provide a mathematical expression that relates pka to pH _____
43. _____ equation indicates Ohm's law in electrolytic cell.
44. Oxidation usually takes place at the _____
45. In a typical cell notation, the double slash represents _____
46. Write a cell reaction for the notation. $Zn(s)/Zn^{2+}(aq)//Cu^{2+}(aq)/Cu(s)$ _____

_____

47. Calculate the molar conductivity of calcium hydroxide given that molar conductivities of calcium and hydroxide ions are 25.5 and 40.2ɔcm^3/mol.

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1. Whose principles states that two electrons in an atom cannot have all four set of quantum numbers the same _____
2. What are radicals? Give 3 examples of it _____
   _____
3. The concept whereby physical properties of elements in a group vary gradually and regularly is called _____
4. The role of azimuthal quantum number in an atom is _____
5. Which of the following compounds have dative bonds? (a) HCl (b) NH_3 (c) NH_4^+ (d) CH_3CH_2OH (e) CH_4
6. Ionic crystals are bad conductors of electricity because? _____
   _____
7. Polar covalent compounds do not conduct electricity because? _____
   _____
8. What is the weight of CO_2 that can be obtained by complete combustion of 36g of CO?
   _____
9. How many molecules of $K_2Cr_2O_7$ are there in 50g of the sample? _____
   _____
10. Explain why hydrogen exist as H_2 but Helium does not exist as He_2 _____
    _____
    _____
11. Show how an atom that has 4 electrons in the valence shell will combine with a mono-valent atom.
    _____
12. The kind of bond likely to be formed in each of the following compounds are (a) $MgCl_2$ _____ (b) NH_3 _____ (c) molecules of palm oil _____ (d) NH_4^+ _____
13. Two ions Cl^- and Na^+ are said to be isoelectronic with atom A and B respectively. What is the meaning of the statement? _____
14. Non polar liquids are volatile because? _____
    _____

15. By means of structural diagram show how the following compounds will form molecular association and co-association (a) CH_3COOH (b) H_2O (c) NH_3 (d) HF. State which is the strongest and why?

_____

16. Meteorologist use the first law of thermodynamics in its adiabatic form (i.e. Q=0). Using statement of the first law, argue why the temperature in a rising cloud falls as it goes to higher altitudes. (a) the temperature falls because we are away from the warm surface of the earth (b) the temperature falls because the internal energy of the cloud decreases due to reduced pull of gravity (c) the temperature falls because the air pressure decreases with altitude and the cloud expand (d) the temperature falls because the pressure decreases with altitude and the cloud contracts

17. Any thermodynamic process which produces or consumes energy in an open or closed systems may be of two types namely
    i. _____
    ii. _____

18. Any experimental quantity that has exact differentials is called (a) thermodynamic system (b) thermodynamic variables (c) thermodynamic quantity (d) all of the above

19. Thermodynamic properties can be defined as _____

_____

20. For the reaction 2A + 3B + C → products, the rate equation is: (a) Rate = $K[A]^2$ (b) Rate = $K[A][B][C]$ (c) Rate = $K[A]^2[B]^3[C]$ (d) Rate = $K[B]^3[C]$ (e) insufficient information to fix the rate equation.

21. From the data generated from the gas phase decomposition of hydrogen Iodide, determine the order of the reaction in Hl.

t/hours	0	2.0	4.0	6.0
[Hl]/m	1.00	0.50	0.33	0.25

    (a) one and half (b) zero (c) first (d) second

22. Hydrogen peroxide (H_2O_2) in basic solution oxidizes iodide ion (I-) to iodine (I2) in a two-step reaction. Write equation of reaction to show the mechanism indicating the slow and fast steps.
    i. _____
    ii. _____

23. Write the equation for overall reaction in Q7 above _____

_____

24. Thermodynamic reactions are relatively rare because they _____

_____

25. If the rate of a reaction quadruples when the conception doubles, the reaction is known as

_____

26. Which of the following methods can be used for determining the order of a chemical reaction? (a) differential methods (b) integration method (c) fractional change method (d) finding a rate expression which fits observed data over a wide range of condition (e) all of the above

27. Under what condition does the isothermal expansion of a gas become a free expansion process? (a) at constant temperature (b) at constant temperature and pressure (c) when the gas expands against a vacuum (d) when the gas expands against an external pressure
28. Arrange the following elements in increasing order of electronegativity; Na, Li, Cl, K, Br, I and F _____
29. Generally, ionization energy increases from left to right across a period. However, aluminum has a lower ionization energy than magnesium. This is because _____ _____
30. Lawrencium (Lr) is an element with atomic number 103. How many protons and neutrons does it have? _____
31. Two atoms have the electronic configuration $1s^2$, $2s^2$, $2p^6$ and $1s^2$, $2s^2$, $2p^6$, $3s^1$. The first ionization of one is 2080KJ/mol and that of the other is 494KJ/mol. Match each ionization energy with the given electronic figuration _____ _____
32. One of the basis of their positions in the periodic table, which of the following atom has the highest atomic radius (a) Na (b) Mg (c) Al (d) Si
33. The existence of neutrons was proved by _____ in the year _____
34. An element Z has the electronic configuration $1s^2$, $2s^2$, $2p^6$ $3s^2$, $3p^6$, $4s^1$ what is the electronic configuration of the cation _____
35. Across a period, atomic radii decreases. This is due to _____ _____
36. Write the electronic configuration of the smallest halogen _____
37. According to Aufbau principle, electrons will enter the possible orbital in the order of descending energy. True/False
38. Balance the nuclear reaction $_{12}Mg^{24} + {}_1H^2 \rightarrow {}_zX^A + {}_{11}Na^{22}$ _____