ADDIS ABABA CITY GOVERNMENT EDUCATION BUREAU

2013/2021 GRADE 12 CHEMISTRY MODEL EXAMINATIONS

TIME ALLOWED: 2:30 HOURS

Directions: -This examination paper has **10** pages including the answer sheet. In this examination, there are a total of **80** multiple choice questions. Each of the questions is followed by four possible alternatives. Choose the best answer and write the letter of your choice on the separate answer sheet provided. You will be allowed to work for 2:30 hours. Any form of cheating or an attempt to cheat in the examination hall will result in an automatic dismissal from the examination hall and cancellation of your score(s).

You may refer to the information given below when you work on some of the questions.

PHYSICAL CONSTANTS

Speed of light, $C = 3x10^{8}m/s$

Planck's constant, $h = 6.626x10^{-34}J/s$

Faradays constant, F = 96500 C/mol

Boiling point elevation constant, $kb = 0.5\ ^{o}C/m$

Boiling point of water at 1 atm = $100^{o}C$

Freezing point of water at 1 atm = $0^{o}C$

Mass of an electron = $9.11x10^{-31}$ Kg

Rydberg's constant, $R_H = 2.18 \times 10^{-18}J$

ATOMIC NUMBERS (Z) AND ATOMIC WEIGHTS (A)

Element	H	B	**C**	N	O	F	Na	Mg	Al	Si	P	S	Cl	K	Br	I	Cu
Z	1	5	6	7	8	9	11	12	13	14	15	16	17	19	35	53	29
A	1	11	12	14	16	19	23	24	27	28	31	32	35.5	39	80	127	63.5

1. A laboratory instructor has given a sample of ethanol to four students A, B, C and D. Each student was asked to measure the volume of a sample and recorded his/ her results. The true value is 8.72 ml. Their results for three trials are:

Trials	A	B	C	D
1	8.72ml	8.50ml	8.50ml	8.41ml
2	8.74ml	8.77ml	8.48ml	8.72ml
3	8.70ml	8.83ml	8.51ml	8.55ml

Which set of data is the most accurate?

A. A B. B C. C D. D

2. How many significant figures does the difference between 18.5626 and 8.06 have?

A. Three B. Four C. five D. Six

3. What is the temperature on the Kelvin scale corresponding to 104 ^{o}F?

A.169 B.377 C.313 D.210

4. Which of the following is NOT a chemistry laboratory safety rule?

A. Add water on concentrated acid C. never work alone in the laboratory

B. Do not suck solution in the pipette by mouth D. Tie back your long hair

5. Which one of the following is an extensive property?

A. melting point C. Color B. density D. Mass

6. Which of the following historical attributions is **INCORRECT**?

A. Thomsen - measured charge/ to mass ratio of electron C. De Broglie – measured radioactivity

B. Millikan - measured electron charge D. Einstein – explained photoelectric effect

7. Which of the following is the correct order of electromagnetic radiation with increasing frequency?

A. Radio Waves, Visible Light, IR Radiation, UV Radiation, X-Rays, γ –Rays

B. γ –Rays, Visible Light, IR Radiation, UV Radiation, X-Rays, Radio Waves

C. Radio Waves, UV Radiation, Visible Light, IR Radiation, X-Rays, γ –Rays

D. Radio Waves, Visible Light, X-Rays, IR Radiation, UV Radiation, γ –Rays

E. Radio Waves, IR Radiation, Visible Light, UV Radiation, X-Rays, γ –Rays

8. The wave number of an electromagnetic radiation is 1 x 10^{5}cm^{-1}. The frequency of the radiation would be

A.3 x 10^{8}s^{-1} B. 3 x 10^{6}s^{-1} C. 3 x 10^{10}s^{-1} D. 3 x 10^{15}s^{-1}

9. The work function of potassium is 3.313x 10^{-19}J.What is the maximum wave length in nm for which electron is ejected? A.200 B. 300 C. 500 D. 600

10. Which statement below is true with regard to Bohr's model of the atom?

A. The model accounted for the absorption spectra of atoms but not for the emission spectra.

B. The model could account for the emission spectrum of hydrogen and for the Rydberg equation.

C. The model was based on the wave properties of the electron.

D. The model was generally successful for all atoms to which it was applied.

11. An electron in a Bohr hydrogen atom has energy of -1.362×10^{-19} J. The value of n for this electron is———.

A. 5 B. 4 C. 3 D.2

12. "Equal energy of orbitals (degenerate orbitals) are each occupied by a single electron before the second electron of opposite spin enters the orbital". This principle is

A. Avogadro´s principle C. Pauli's´ exclusion principle

B. Aufbau principle D. Hund´s principle

13. The n=5 to n=3 transition in the Bohr hydrogen atom corresponds to the……of a photon with a wave length of…….nm.

A. absorption,657 B. absorption,1280 C. emission,657 D. emission,1282

14. Which one of the following represents an acceptable possible set of quantum numbers (in the order n, *l*, $m_{l,}$ $m_{s)}$ for an electron in an atom?

A. 2,0. 2, +1/2 B. 2,1, -1, -1/2 C. 2,0,1. -1/2 D. 2,1,0,0

15. How many electrons can be described by the following quantum numbers?

n = 3, l = 2, m_l = -1, m_s = +1/2

A. 1 B. 2 C. 4 D. 6

16. Among the following quantum numbers, one describes the orientation of orbitals in three-dimensional space about the nucleus.

A. Principal quantum number C. Magnetic quantum number

B. Azimuthal quantum number D. Spin quantum number

17. Which one of the following ions is arranged in the order of increasing ionic radius?

A. F^-,Na^+,N^{3-} B. Na^+, N^{3-}, F^- C. Na^+, F^-, N^{3-} D. N^{3-}, F^-, Na^+

18. Which of the following compounds contain ionic, covalent and coordinate covalent bond all in one?

A. NaCl B. Na_2CO_3 C. CH_3CO_2H D. NH_4Cl

19. Which of the following compounds would be expected to have the highest melting point?

A. MgF_2 B.$MgCl_2$ C. $MgBr_2$ D. MgI_2

20. The concept that electron pairs located in the valence shell of an atom bonded to other atoms tend to stay as far apart as possible so as to minimize repulsions between them is incorporated in the

A. Heisenberg uncertainty principle C. Molecular orbital theory

B. Valence **s**hell electron pair **r**epulsion theory D. Valence bond theory

21. All of these molecular shapes can be explained by **sp^3d** hybridization of electrons on the central atom **EXCEPT**

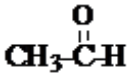
A. T-shape B. See-saw C. Trigonal planar D. Trigonal bipyramidal

22. From the following AF_n molecules which one has the smallest bond angle?

A. BF_3 B. CF_4 C. NF_3 D. OF_2

23. The hybridization of carbon atoms in C_2H_2,C_2H_4 and C_2H_6. respectively are

A. Sp2, Sp and sp3 B. Sp3, sp2 and sp C. Sp, sp2 and sp3 D. Sp3 , Sp and sp2

24. The C-to-C bond in ethanal molecule () is connected by the overlap of____&____ hybrid orbitals.

A. SP^3,SP^2 B. SP, SP C. P,SP

D. SP^3,SP^3

25. Which one of the following molecules has a dipole moment (is polar)?

A. CCl_4 B. PF_5 C. NCl_3 D. SO_3

26. According to Molecular orbital theory (MOT) theory, which species has the shortest bond length? A. O_2^{2-} B. O_2^{+} C. O_2 D. O_2^{-}

27. A (pi) bond is the result of the

A. Sidewise overlap of two parallel p orbitals C. Overlap of two s orbitals.

B. Overlap of two p orbitals along their axes. D. Overlap of an s and a p orbital

28. Consider the following reaction:

N_2 (g) + $3H_2$(g) ⟶ $2NH_3$ (g) If the rate of formation of NH_3 is 4.0 x 10^{-4} mol/s, then the rate of consumption of H_2 is

A.2.0 X 10^{-4} mol/s B. 4.0 X 10^{-4} mol/s C. 6.0 X 10^{-4} mol/s D. 1.2 X 10^{-3}

29. The reaction A + 2B → *products* was found to follow the rate law, rate = k $[A]^2[B]$. Predict by what factor the rate of reaction will increase when the concentration of A is doubled, the concentration of B is tripled, and the temperature remains constant.

A. 5 B. 6 C. 12 D.18

30. If the units in the rate in a given experiment are mol L^{-1} min^{-1} and the units of all concentrations are mol L^{-1}, then the units of the rate constant associated with the rate law: Rate= $k[A]^2[B]$

A. mol $L^{-}1$ min^{-1} B. L^2 mol^{-2} min^{-1} C. mol^2 L^{-2} min^{-1} D.mol^{-2} L^{-2} min^{-1}

31. The reaction 2 X + Y →3 Z was studied and the following data were obtained:

Experiment	X	Y	Rate (mol/L.sec)
1	3.0	1.5	1.8
2	1.5	3.0	0.45
3	1.5	1.5	0.45

What is the proper rate expression?

A. rate = $k[X][Y]$ C. rate = $k[Y]^2$

B. rate = $k[X]^2[Y]$ D. rate = $k[X]^2$

32. The proposed reaction mechanism between nitrogen monoxide and bromine is given below

$NO + Br_2 \rightleftharpoons NOBr_2$ Fast

$NOBr_2 + NO \rightarrow 2NOBr$ slow

Which of the following rate equations is consistent with the proposed mechanism?

A. Rate $= k[NO]^2$ C. Rate $= k[NO]^2[Br_2]$

B. Rate $= k[NO][Br_2]$ D. Rate $= k[NO][Br_2]^2$

33. For which one of the following reactions is K_P equal to Kc?

A. $4NH_3(g) + 5O_2(g) \rightarrow 4NO(g) + 6H_2O(g)$

B. $C(s) + CO_2(g) \rightarrow 2CO(g)$

C. $6CO_2(g) + 6H_2O(l) \rightarrow C_6H_{12}O_6(s) + 6O_2(g)$

D. $CaCO_3(s) \rightarrow CaO(s) + CO_2(g)$

34. A study of the system $4NH_3(g) + 4O_2(g) \rightarrow 2N_2O(g) + 6H_2O(g)$,was carried out. A system was prepared with $[NH_3]=[O_2]=3.60M$ as the only compounds initially. At equilibrium$[N_2O]$ is 0.60M. Calculate the equilibrium concentration of O_2

A.3.00M B.2.40M C.1.50M D.2.10M

35. Given the two reactions shown with their equilibrium constants

$PCl_3(g) + Cl_2(g) \rightarrow PCl_5(g)$ K1

$2NO(g) + Cl_2(g) \rightarrow 2NOCl(g)$ K2

What is the equilibrium constant for the reaction

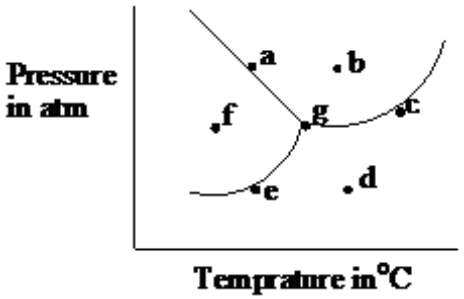
$PCl_5(g) + 2NO(g) \rightarrow PCl_3(g) + 2NOCl(g)$

A.K1/K2 B.K2/K1 C.K1K2 D.K2-K1

36. What are the number of components, phases and degree of freedom in a mixture of NaCl and water respectively?

A. 1,2,3 B. 3,1,2 C. 2,1,3 D. 3,2,1

37. Given the following phase diagram of pure water,



The solid, liquid and gas forms of water coexist at point _____.

A. c B. g C. a D. e

38. $SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$ $\Delta H = -197$ KJ/mol

According to the above information, what temperature and pressure conditions produce the greatest amount of SO_3?

A. Low Temperature and low Pressure C. High Temperature and high Pressure

B. Low Temperature and high Pressure D. High Temperature and low Pressure

39. Which of the following would react to form methyl ethanoate?

A. ethanol and methanoic acid C. Ethanol and ethanoic acid

B. methanol and Ethanoic acid D. Ethnol and propanoic oic acid

40. Commercially, liquid vegetable oils are converted to solid fats such as margarine by

A. Saponification B. Hydration C. Hydrogenation D. oxidation

41. The solubility of $K_2Cr_2O_7$ in water is 125 g/L at 20 ^{0}C. A solution is prepared at 20 ^{0}C that contains 6.0 grams of $K_2Cr_2O_7$ in 50 mL of water. This solution is

A. Diluted. B. Unsaturated. C. Supersaturated. D. Saturated

42. The concept of "like dissolves like " is illustrated by which of the following?

A. NaCl (s) is more soluble in CCl_4 than in water

B. $CuSO_4$(s) is more soluble in CCl_4 than in water

C. I_2(s) is more soluble in CCl_4 than in water

D. CCl_4 is soluble in water

43. When the molecular equation $CaCl_2$ (aq) + Na_2CO_3 (aq) $\longrightarrow$ $CaCO_3$ (s) + 2NaCl (aq) is written in terms of ionic equation , which one of the following pairs will be the spectator ions ?

A. Na^+ and Cl^- B. Ca^{2+} and Cl^- C. CO_3^{-2} and Cl^- D. Ca^{2+} and CO_3^{-2}

44. You have 100ml of a 0.5M HCl solution and you want to dilute it to exactly 0.1M.how much water should you add? A.400 B. 500 C.100 D.50

45. A concentration of 1000ppm is reported in a news article. This is the same concentration as---- A. 0.001% B. 0.01% C. 0.1% D. 1

46. 23g ethanol,(CH_3CH_2OH Mwt=46g/mol) is added to 500g of water. What is the molality of the resulting solution? A. 0.01m B. 0.1m C. 1.0m D. 10.0m

47. Which of the following liquid pairs shows a negative deviation from Raoult's law?

A. heptane and hexane C. carbontetra chloride and methanol

B. acetone and water D. hexane and ethanol

48. Commercial concentrated sulfuric acid(density=1.831g/cm3) is 94.0% H_2SO_4,by mass.What is the normality of H_2SO_4 solution?Molar mass of H_2SO_4 solution=98g/mol)

A.16.8M B. 28.2 C. 35N D. 40.4M

49. Which solution below has the highest concentration of hydroxide ion (OH^-) ?

A. pH = 7 B. pH = 12 C. pH = 10 D. pH = 4

50. Consider the following equilibrium: $HC_2O_4^- + HSO_4^-$ ⟷ $H_2C_2O_4 + SO_4^{2-}$

The order of Bronsted-Lowery acid base in the reaction respectively are

A. base, acid, acid, base C.base,acid base, acid

B . acid, base, acid, base D. acid, base, base, acid

51. Which of the following is the conjugate acid of the hydrogen phosphate ion, HPO_4^{2-}?

A. H_3PO_4 B. PO_4^{3-} C. $H_2PO_4^-$ D. HPO_4^{2-}

52. Three acids found in foods are lactic acid (in milk products), oxalic acid (in rhubarb), and malic acid (in apples). The pKa values are LA = 3.88, OA = 1.23, and MA = 3.40. Which list has these acids in order of decreasing acid strength?

A. LA > OA > MA C. OA > LA > MA

B. LA > MA > OA D. OA > MA > LA

53. A solution is prepared to be 0.10 *M* acetic acid, $HC_2H_3O_2$, and 0.20 *M* sodium acetate,$NaC_2H_3O_2$. What is the pH of this solution at 25^0C? *Ka* for acetic acid at 25^0C is 1.8×10^{-5}.(log2=0.3,log1.8=0.26)

A 5.04 B.4.07 C.6.5 D.8.07

54. What is the pH of a 0.01M base, B solution? Kb=1.6×10^{-9} ,log4=0.6)

hint $B + H_2O \leftrightarrow BH^+ + OH^-$

A. 8.6 B. 5.6 C. 4 D. 6

55. Which of the following titrations will have the highest pH at the equivalence point?

A. HCl with NH_3 B. CH_3COOH with KOH C. HCl with Na_2CO_3 D. HCl with NaOH

56. Which of the following salts are acidic?

I) $Al(NO_3)_3$ II) K_2CO_3 III) NaBr IV) CH_3COONa V) NH_4Cl

A. II, V B. I, V C. I, III,V D. I ,III,V

57. The pH when 25.0 mL of 0.5M NaOH solution have been added to 20.0 mL of 0.5 M acetic acid is(log5.5 = 0.74)

A. 2.57 B. 4.26 C. 4.47 D. 12.74

58. An indicator has an ionization constant that is equal to $1x10^{-5}$.If the molecular form of the indicators is yellow and its conjugate base is red. What is the color of the solution at pH=5?

A. Green B. Yellow C. Red D. Orange

59. Which one of the mixtures of the following pairs will not give a buffer solution?

A. CH_3COOH and CH_3COONa C. NH_3 and NH_4Cl

B. H_3PO_4 and KH_2PO_4 D. HNO_3 and $NaNO_3$

60. Which one of the following reactions is a redox reaction?

A. $Pb^{2+}(aq) + 2Cl^-(aq) \longrightarrow PbCl_2(s)$

B. $NaOH(aq) + HCl(aq) \longrightarrow NaCl(aq) + H_2O(l)$

C. $AgNO_3(aq) + HCl(aq) \longrightarrow AgCl(s) + HNO_3(aq)$

D. $2Al(s) + 3Cl_2(g) \longrightarrow 2AlCl_3(s)$

61. Balance the following equation, using the lowest possible whole number coefficients;

$Cu + HNO_3 \longrightarrow Cu(NO_{3)2} + NO_2 + H_2O$

The sum of the coefficients is: A. 21 B .12 C. 10 D .18

62. Chlorine has an oxidation number of +5 in:

A. NaClO B. $NaClO_2$ C. $NaClO_3$ D. $NaClO_4$

63. When the net ionic equations: $Fe^{2+} + Cr_2O_7^{2-} \rightarrow Cr^{3+} + Fe^{3+}$ is balanced by ion electro method in acidic medium , the coefficient of : Fe^{2+} , $Cr_2O_7^{2-}$, Cr^{3+} , Fe^{3+} become respectively:

A. 6, 1, 2, 6 B.3, 1, 2, 3 C.5, 1, 2, 5 D. 6, 1, 2, 7

64. During the electrolysis of concentrated aqueous solution of NaCl, what substance is formed at the cathode?

A. Chlorine B. Oxygen C. Hydrogen D. Sodium

65. How many grams of copper is produced when 20A of current is passed through copper(II) sulphate solution for 4 hrs.

A. 95gm B.186gm C. 47gm D. 85gm

66. Which one of the following is a **false** statement about salt bridge?

A. Salt bridge maintains electrical neutrality

B. When salt bridge is removed then the potential of the cell drops to zero.

C. Salt bridge increases the emf of the cell.

D. Salt electrochemical bridge connects two half cells

67. Consider an cell where the following reaction takes place:

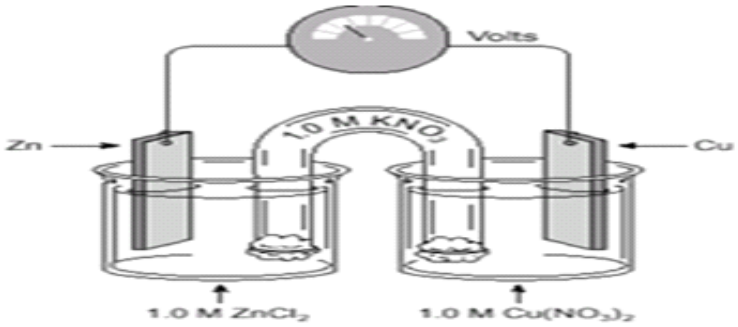
$3\ Sn^{2+}(aq) + 2\ Al(s) \longrightarrow 3\ Sn(s) + 2\ Al^{3+}(aq)$

Which of the following is the correct cell notation for this cell?

A. $Al \mid Al^{3+} \parallel Sn^{2+} \mid Sn$ C. $Al^{3+} \mid Al \parallel Sn \mid Sn^{2+}$

B. Sn | Sn^{2+} || Al^{3+}| Al D. Sn | Al^{3+} || Al | Sn^{2+}

68.



In the above electro chemical cell

A. The mass of the anode increases and the mass of the cathode increases
B. The mass of the anode decreases and the mass of the cathode decreases
C. The mass of the anode decreases and the mass of the cathode increases
D. The mass of the anode decreases and the mass of the cathode decreases

69. Electroplating is used to coat one metal with usually less reactive metal. If you want to plate out iron spoon with silver metal, then which of the following is TRUE?
A. The electrolyte must be contained silver ion
B. The iron spoon must be set at the anode
C. The silver metal must be the cathode
D. The material to be plated must be the anode

70. What is the most important type of solute – solvent interaction in a solution of KCl in H_2O?
A. Dipole – dipole B. London force C. Ion- dipole D. Hydrogen bonding

71. The four most abundant elements in the earth's crust in decreasing order of abundance are ;
A. Oxygen, Silicon ,Aluminium and Iron C. Aluminium ,Iron , Calcium and Magnesium
B. Iron, Aluminium, Silicon and Oxygen D. Silicon, Aluminium, Magnesium and Sodium

72. Which of the following **does not** add CO_2 to the atmosphere?
A. Burning of wood C. photosynthesis
B. Burning of kerosene D. use of motorcars

73. Which industrial chemicals **mismatched** with its manufacturing process
A. NH_3 - Haber process C. H_2SO_4-contact process
B. HNO_3 - Solvay process D. S- Frash process

74. Which of the following is a natural polymer?
A. PVC B. Polyethene C. Cellulose D.Teflon

75. Which one of the following is **NOT** a condensation polymer ?

A. Neoprene B. Polyamides C. Polyester D. Nylon

76. The monomer of neoprene is

A. Chloroprene B. Isoprene C. 2- methyl-1,3-butadiene D. Butadiene

77. Which of the following is the most abundant disaccharide carbohydrate?

A. Glucose B. Cellulose C. Maltose D. Sucrose

78. Given the following standard reduction potentials:

$Ag^{+}/Ag\ E^{0}=0.80V\ \ Cu^{2+}/Cu\ \ E^{0}=0.34V\ \ Cu(s) + 2Ag^{+} \longrightarrow Cu^{2+} + 2Ag(s)$

The cell potential at standard condition is……

A. -1.14V B. -0.46V C. 1.14V D. 0.46V

79. The dissociation constant of a weak acid is $1x10^{-4}$ in order to prepare a buffer solution with a PH = 5,the (salt)/(acid) ratio should be

A. 1: 10 B. 4: 5 C. 10: 1 D. 5: 4

80. What would be the boiling point of 2.00m solution of sucrose ($C_{12}H_{22}O_{11}$) in water at 1atm?

A.$101.5^{0}C$ B.$100.5^{0}C$ C.$101.0^{0}C$ D.$102.0^{0}C$

CHEMISTRY ANSWER SHEET

Student's Name _____Grade & Sec. _____Roll No._____

1.	**21.**	**41.**	**61.**
2.	**22.**	**42.**	**62.**
3.	**23.**	**43.**	**63.**
4.	**24.**	**44.**	**64.**
5.	**25.**	**45.**	**65.**
6.	**26.**	**46.**	**66.**
7.	**27.**	**47.**	**67.**
8.	**28.**	**48.**	**68.**
9.	**29.**	**49.**	**69.**
10.	**30.**	**50.**	**70.**
11.	**31.**	**51.**	**71.**
12.	**32.**	**52.**	**72.**
13.	**33.**	**53.**	**73.**
14.	**34.**	**54.**	**74.**
15.	**35.**	**55.**	**75.**
16.	**36.**	**56.**	**76.**
17.	**37.**	**57.**	**77.**
18.	**38.**	**58.**	**78.**
19.	**39.**	**59.**	**79.**
20.	**40.**	**60.**	**80.**