NATIONAL EDUCATIONAL ASSESMENT AND EXAMINATIONS AGENCY (NEAEA)
ETHIOPIAN UNIVERSITY ENTRANCE EXAMINATION (EUEE)
CHEMISTRY EXAMINTION 2005

BOOKLET CODE: 00
NUMBER OF ITEMS:

SUBJECT CODE: 00
TIME ALLOWED: 00

PHYSICAL CONSTANTS

a) Mass of electron = 9.11 x 10^{-31}kg

b) Gas constant, R= 8.314Jmol^{-1}K^{-1} = 0.0821L atm mol^{-1}K^{-1}

c) Avogadro's number = 6.023 x 10^{23}mol^{-1}

d) Plank's constant, h = 6.626 x 10^{-34}J s/photon

e) Faraday's constant, F = 9.65 x 10^{4}Cmol^{-1}

f) Rydberg's constant, R_H = 109,678cm^{-1}

g) Velocity of light, c = 3 x 10^{8}ms^{-1}

ATOMIC NUMBERS (Z) AND ATOMIC WEIGHTS (A)

Element	H	He	Li	Be	B	C	N	O	F
Z	1	2	3	4	5	6	7	8	9
A	1.0	4.0	6.9	9.01	10.8	12.0	14.0	16.0	19.0

Element	Ne	Na	Mg	Al	P	S	Cl	Ar	K
Z	10	11	12	13	15	16	17	18	19
A	20.2	23.0	24.3	26.98	31.0	32.1	35.5	39.95	39.09

Element	Ca	Mn	Fe	Cu	Zn	Br	Kr	I
Z	20	25	26	29	30	35	36	80
A	40.08	54.9	55.9	63.55	65.38	79.90	83.80	200.6

1. Which of the following is NOT a basic SI unit?

- ◯ A. Candela
- ◯ B. Gram
- ◯ C. Mole
- ◯ D. Second

2. Which of the following statements is TRUE?

- A. Ultraviolet light has longer wavelength than visible light.
- B. The energy of radiation decreases as the wavelength decreases.
- C. The frequency of radiation increases as the wavelength decreases.
- D. Wave number of an electromagnetic radiation increases as wavelength increases.

3. Which of the following ionic compounds is formed from the reaction between magnesium and nitrogen?

- A. MgN_2
- B. Mg_2N_2
- C. Mg_3N_2
- D. Mg_2N_3

4. Which of the following molecules represents a non-polar covalent bond?

- A. B-Cl
- B. C-Cl
- C. Cl-Cl
- D. Mg-Cl

5. Which of the following groups in the periodic table has paramagnetic atoms?

- A. Group zero
- B. Group IIA
- C. Group IIB
- D. Group IVA

6. How many types of cubic unit cells are known?

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

7. What is the process that converts liquid vegetable oils to solid fats?

- A. Hydration
- B. Hydrogenation
- C. Hydrolysis
- D. Saponification

8. What would be the solubility of $HOCH_2(CH_2)6CH_2OH$ compared to $CH_3(CH_2)6CH_2OH$?

- A. Less soluble in water
- B. More soluble in water
- C. The same solubility in water.
- D. More soluble in a non-polar solvent such as dichloroethane.

9. Which of the following gases is manufactured using the Haber process?

- A. Ammonia
- B. Nitric oxide
- C. Nitrogen
- D. Nitrogen dioxide

10. Which one of the mixture of the following pairs will NOT give a buffer solution?

- A. HCN and NaCN
- B. NH_3 and NH_4Cl
- C. H_3PO_4 and KH_2PO_4
- D. HNO_3 and $NaNO_3$

11. Which one of the following is TRUE for salts formed from strong acids and strong bases?

- A. No hydrolysis takes place.
- B. Produces ions that are proton donors.
- C. Produces ions which are proton acceptors.
- D. Depends on the pKa and pKb of the parent acids and bases, respectively.

12. Which of the following metals is NOT obtained by commercial electrolytic process?

- A. Ag
- B. Al
- C. Cu
- D. Na

13. Which of the following metals has the highest electrical and thermal conductivities?

- A. Ag
- B. Co
- C. Cu
- D. Ni

14. Enthalpy is defined as the heat content of the system at constant:

- A. Heat
- B. Moles
- C. Pressure
- D. Volume

15. Which of the following elements is the second most abundant element in the earth's crust?

- A. Aluminium
- B. Iron
- C. Oxygen
- D. Silicon

16. Which of the following plant nutrient will be produced as a result of nitrogen fixation?

- A. Carbohydrate
- B. Cellulose
- C. Mineral
- D. Protein

17. What is the number of significant figures in 0.0030050?

- A. 4
- B. 5
- C. 7
- D. 8

18. Which of the following properties of a substance does NOT represent an intensive physical property?

- A. Boiling point
- B. Colour
- C. Density
- D. Volume

19. What is the mass of one molecule of water?

- A. 3.0×10^{-23}g
- B. 1.8×10^{-23}g
- C. 0.0003g
- D. 18.0g

20. Which of the following quantum number (s) is (are) related to the size and energy of an electron in a hydrogen atom?

- A. n
- B. n,l
- C. n,l,m
- D. n,l,m,s

21. An electron has a spin quantum number, s = +1/2 and a magnetic quantum number, m_1 = +1. In which of the following orbital will it NOT be present?

- A. S-orbital
- B. P-orbital
- C. d-orbital
- D. f-orbital

22. Which of the following molecules has a trigonal bi pyramidal structure?

- A. PCl_5
- B. IF_5

- C. ICl_4^-
- D. BrF_5

23. Which of the following represents the general configuration of the transition elements?

- A. ns^2np^6
- B. ns(n-1)d
- C. ns(n-2)f
- D. $ns^2np^6(n-1)d^{10}$

24. The total number of electrons participating in the bond formation of carbonate anion, CO_3^{2-} in the molecule of carbonic acid are:

- A. 16
- B. 10
- C. 8
- D. 5

25. Which of the following crystals possess high electrical and thermal conductivities?

- A. Ionic crystals
- B. Metallic crystals
- C. Molecular crystals
- D. Covalent network crystals

26. What is the valid rate expression for the following reaction? $2NO + 2H_2 \rightarrow N_2 + 2H_2O$

- A. 1/2 ?($\Delta[H_2]$)/Δt
- B. -1/2 ?($\Delta[H_2O]$)/Δt
- C. -1/2 ?($\Delta[NO]$)/Δt
- D. ($\Delta[N_2]$)/Δt

27. Which of the following statements is TRUE about equilibrium reaction?

- A. No more reactants are transformed into products.
- B. There are equal amounts of reactants and products.
- C. The rate constant for the forward reactions equals that of the reverse reaction.
- D. The rate for the forward reactions equals that of the reverse reactions.

28. Three gases are in equilibrium in a closed chamber sealed with a piston. The following equilibrium is established:

$2NH_3$ (g) ⇋ N_2 (g) + $3H_2$ (g)

What will happen if the piston is pushed into the chamber?

- A. The mole fraction of N_2 increases.
- B. The mole of N_2 decreases.
- C. The mole fraction of N_2 remains the same.
- D. The mole fraction of N_2 increases and then decreases.

29. Which of the following reactions will produce an akyl carboxylic acid?

- A. Heating a methyl ketone with acid and iodine.
- B. Reacting an alkyl halide with hydrogen gas and platinum.
- C. Reacting an alcohol with ozone.
- D. Oxidation of a primary alcohol with hot permanganate or chromate.

30. Which of the following statements is NOT TRUE?

- A. Naturally derived soaps consists of a soluble salt of a long chain fatty acid.
- B. Triacylglycerols are esters of glycerol and long chain carboxylic acids.
- C. Long chain carboxylic acids are also known as fatty acids.
- D. The major acidic component of vinegar is formic acid.

31. What is the name of triacylglycerol(triglycerides) that is solid at room temperature?

- A. Lecithin
- B. Fat
- C. Wax
- D. Oil

32. Which of the following is the most important type of solute-solvent interaction in a solution of n- butanol in water?

- A. Dispersion
- B. Ion-dipole
- C. Dipole-dipole
- D. Hydrogen bonding

33. What is the product of the hydrolysis of easters in the presence of a mineral acid catalyst?

- A. Alcohol
- B. Carbon dioxide
- C. Ether
- D. Ketones

34. To which organic functional group does the following molecular representation, i.e, R_1R_2CHCOH belong? (R_1 and R_2 represent different alkyl chains)

- A. Amides
- B. Aldehyde
- C. Ethers
- D. Organic acid

35. What is the quantity of water, in mL, required to prepare 0.5 M of HCl from a concentrated solution of 3.5M in 50 mL is?

- A. 50mL
- B. 100mL

C. 300mL

D. 350mL

36. What is the equivalent weight of HNO_3, as an oxidizing agent, in the following balanced reaction?
$3Fe^{2+} + 4H^+ + +NO^-_3 \rightarrow 3Fe^{3+} + NO + 2H_2O$

A. 10.5

B. 15.75

C. 21.00

D. 31.50

37. Given the following equilibria and equilibrium constant:
(I) $HC_2H_3O_2 + H_2O \rightleftarrows H_3O^+ + C_2H_3O_2^-$; $K_a = 1.80 \text{ X } 10^{-5}$
(II) $H_2CO_3 + H_2O \rightleftarrows H_3O^+ + HCO^-_3$; $K_a = 4.20 \text{ x } 10^{-7}$
(III) $NH_4^+ + H_2O \rightleftarrows H_3O^+ + NH_3$; $K_a = 5.6 \text{ x } 10^{-10}$
(IV) $HCOOH + H_2O \rightleftarrows H_3O^+ + COOH^-$; $K_a = 1.80 \text{ x } 10^{-4}$
What is the strength of the acids in DECREASING order?

A. I, IV, II and III

B. II, III, IV and I

C. III, II, I and IV

D. IV, I, II and III

38. Given the reaction:
$H_2PO_4^- + H_2O \rightarrow H_3O^+ + HPO_4^{2-}$
Which of the following represents a conjugate acid base pair?

A. $H_2PO_4^-$ and H_2O

B. $H_2PO_4^-$ and HPO_4^{2-}

C. $H_2PO_4^-$ and H_3O^+

D. H_2O and $H_2PO_4^{2-}$

39. Which of the following statements is TRUE about colligative properties?

A. Both vapour pressure and freezing point increase when a non-volatile solute is added to a solvent.

B. Both freezing point and boiling point increase when a non-volatile solute is added to a solvent.

C. Both vapour pressure and boiling point decrease when a non-volatile solute is added to a solvent.

D. Colligative properties depend only upon the number of solute particles in a solution and not upon their identity.

40. What is the pH of 0.005 M solution of $Ca(OH)_2$?

A. 2.3

B. 10

C. 12

D. 14

41. The indicator Bromthymol Blue (HBb) is a weak acid with $K_a = 1.0 \times 10^{-7}$ ionizes as follows:
$HBb(aq, yellow) \rightleftharpoons H^+(aq, colorless) + ln^-(aq, blue)$
Which way will the equilibrium shift when NaOH is added and what will the colour of the NaOH solution be containing this indicator?

- A. Equilibrium will shift to the right and the colour of NaOH solution will turn green.
- B. Equilibrium will shift to the right and the colour of NaOH solution will turn blue.
- C. Equilibrium will shift to the left and the colour of NaOH solution will turn yellow.
- D. Equilibrium will shift to the left and the colour of NaOH solution will turn blue.

42. How many kilo joules of heat are absorbed when 20 g of NaCl(s) is decomposed in to Na(s) and $Cl_2(g)$ at constant pressure according to the following reaction?

$$2Na(s) + Cl_2(g) \rightarrow 2NaCl(s) \qquad \Delta H = -821.8kl$$

- A. -281.0
- B. -140.5
- C. +140.5
- D. +281.0

43. In the electroplating of nickel from a solution containing Ni^{2+} ion, what will be the weight of the metal deposited on the cathode by a current of 8 A flowing for 500 minutes?

- A. 73g
- B. 103g
- C. 117.4g
- D. 145g

44. A 1M solution of $Cu(NO_3)_2$ is placed in a beaker with a strip of Cu metal. A 1M of $SnSO_4$ is placed in a second beaker with a strip of Sn metal. The two beakers are then connected by a salt bridge and the two metal electrodes are connected by wires to a voltmeter. Which of the following electrodes serves as the anode and which electrode gains mass?
Given that $E^0Cu^{2+}/Cu = 0.34V$ and $E^0Sn^{2+}/Sn = 0.14V$

- A. Anode, Sn, Sn electrode gains mass.
- B. Anode, Sn, Cu electrode gains mass.
- C. Anode, Cu, Sn electrode gains mass.
- D. Anode, Cu, Cu electrode gains mass.

45. Which of the following metal alloys does NOT contain tin?

- A. Brass
- B. Bronze
- C. Pewter
- D. Plumber's solde

46. What structural feature is usually needed to present in order for an addition polymer to be produced?

- A. A carbon-carbon sigma bond.
- B. A carbon-oxygen pi bond.

- C. A carbon-oxygen sigma bond.
- D. A carbon-carbon pi bond.

47. What are the raw materials required to synthesize nylon 6, 6, a specific king of nylon?

- A. Diacids
- B. Diamines
- C. Diacids and diamines
- D. Polyethylene

48. Which of the following substances are added to natural rubber to toughen it?

- A. Calcium
- B. Carbon
- C. Nitrogen
- D. Sulphur

49. What is the quantity of heat required to raise the temperature of 80g of ethanol from 25^0C to 75^0C? (specific heat of ethanol = $2.46Jg^{-1}K^{-1}$)

- A. 2.46kJ
- B. 4.0kJ
- C. 9.84kJ
- D. 18.68kJ

50. Consider the following gaseous reaction at 250C:
$CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(g)$ $\Delta H = -802kJ$
Which energy change would occur if 3.2 moles of CH_4 is completely combusted?

- A. 2.57×10^3kJ will be released.
- B. 2.57×10^2kJ will be absorbed.
- C. 6.43×10^3kJ will be released.
- D. 6.43×10^3kJ will be absorbed.

51. What is the number of chloride ions (Cl^-) present in 1.0×10^{-5} mol of $AlCl_3$?

- A. 1.80×10^9
- B. 6.02×10^{18}
- C. 6.02×10^{23}
- D. 6.02×10^{28}

52. Which of the following is the most important ingredients used for production of DAP fertilizer?

- A. Ammonia and phosphoric acid.
- B. Nitric acid, urea and phosphoric acid.
- C. Phosphoric acid, urea and ammonia.
- D. Sulphuric acid, ammonia and urea.

53. Which of the following bio molecules forms a zwitterions at higher or lower PH?

- A. Cellulose
- B. Glucose
- C. Protein
- D. Starch

54. Which of the following form of synthetic rubbers can be vulcanized to greatly enhance its mechanical strength?

- A. Neoprene
- B. Isoprene
- C. Styrene-butadiene rubber
- D. Butyl rubber

55. What is the range in the number of carbon atom of the monosaccharides that are found in nature?

- A. 3 to 7
- B. 4 to 10
- C. 4 to 12
- D. 5 to 12

56. What are the two principal polysaccharide forms of starch?

- A. Aldohexose and ketopentose.
- B. Amylose and amylopectin
- C. Maltose and cellobiose
- D. Sucrose and lactose.

57. What is the Kelvin scale (K) corresponding to the temperature readings when the degree Celsius (^{0}C) is identical to the degree Fahrenheit (^{0}F)?

- A. 0 k
- B. 37 k
- C. 233 k
- D. 273 k

58. What is the wavelength associated with an electron of mass, m = 9.11 x 10^{-28}g, travelling at 40% of the velocity of light?

- A. 6.06 x 10^{-15}m
- B. 2.42 x 10^{-15}
- C. 6.06 x 10^{-12}m
- D. 2.42 x 10^{-11}m

59. The quantum numbers listed below are meant for four different electrons in an atom:

I. n = 4, 1 = 0, m_1 = 0, m_s = + 1/2

II. n =3, 1 = 1, m_1 = 1, m_s = + 1/2

III. n = 4, 1 = 2, m_1 = 0, m_s = + 1/2

IV. n = 4, 1 = 1, m_1 = 0, m_s = -1/2

When these sets of quantum numbers are arranged in order of increasing energy, one may get:

- A. I < II < III< IV
- B. I < III < II < IV
- C. ⍰II < I < IV < III
- D. IV < III < II < I

60. Which of the following hybrid orbitals is favouring the formation of trigonal bipyramidal?

- A. sp^3d
- B. sp^3
- C. sp^3d^2
- D. sp^3d^3

61. Which one of the following molecules/molecular ions is paramagnetic according to the molecular orbital theory?

- A. O_2^{2-}
- B. O_2
- C. F_2
- D. O_2^{2+}

62. For the reaction: 2A + B → C the following experimental results were obtained:

Experiment	[A]	[B]	Rate (mol L^{-1} S^{-1})
1	0.50	0.50	0.300
2	0.50	0.25	0.075
3	0.25	0.25	0.075

What is the value of the rate constant?

- A. 0.6 mol L^{-1} S^{-1}
- B. 0.6 L^{-1} S^{-1}
- C. 1.2 L^{-1} S^{-1}
- D. 2.4 mol^{-1} S^{-1}

63. Increase in temperature of rate of a given reaction is due to the increase in the:

- A. Extent of molecular dissociation.
- B. Activation energy of the reaction.
- C. Frequency of collision of the reaction species.
- D. Numerical value of the rate constant of the reaction.

64. If a piece of aluminium (Al) foil measuring 24 cm by 31 cm has a mass of 10.35 g, (density of Al = 2.70 gcm^{-3}). What is the thickness of the foil in millimetres?

- A. 5.15×10^{-3}
- B. 5.15×10^{-2}
- C. 3.833
- D. 744

65. What sizes of particles and velocities can one consider quantum effect?

- A. Pericles with very large mass and large velocities.
- B. Particles with large mass and small velocities.
- C. Particles with very small mass and large velocities.
- D. Particles with small mass and small velocities.

66. Which of the following molecules has a dipole moment?

- A. XeF_4
- B. H_2S
- C. SO_3
- D. CH_4

67. The reaction for the formation of nitrosyl chloride
$2NO(g) + Cl_2(g) \rightleftharpoons 2NOCl(g)$ was studied at 25^0C. the value of K_p for this reaction at 25^0C is 1.9×10^3 atm^{-1}. What is the value of K at 25^0C?

- A. 1.9×10^{-3} L/mol
- B. 3.8×10^{-3} L/mol
- C. 4.6×10^{4} L/mol
- D. 4.6×10^{5} L/mol

68. Which of the following reactions will convert carboxylic acids to primary amines?

- A. Decarboxylation with HBr and peroxide, then reaction of the alkyl bromide with ammonia.
- B. Reduction of the acid to the alcohol with NaOH/ formaldehyde then reaction with ammonium chloride and heat.
- C. A two-step conversion, first to the amide with ammonia and heat, and then by reduction with lithium aluminium hydride or hydrogen plus catalyst.
- D. Lactase fermentation in the presence of ammonia atmosphere

69. A solution was prepared by adding 48g of methanol (CH_3OH) in to 81g of water (H_2O). What is the mole fraction of methanol in this solution?

- A. 0.25
- B. 0.75
- C. 1.5
- D. 4.5

70. A solution was prepared by dissolving 3.75 g of pure hydrocarbon in 95.0g of cyclohexane. The boiling point of pure cyclohexane was observed to be 80.70^0C and that of the solution was 81.45^0C. What is the approximate molecular weight of the hydrocarbon? (K_b for cyclohexane = 2.79^0C/m)

- A. 71.0g/mol
- B. 105g/mol
- C. 147g/mol
- D. 312g/mol

71. A 50mL solution of H_2SO_4 of 0.205 M is titrated with NaOH solution of unknown concentration. The endpoint against phenolphthalenin indicator was signalled when 41.0ml of NaOH was added. What is the concentration of NaOH solution?

- A. 0.10M
- B. 0.25M
- C. 0.4M
- D. 0.50M

72. To 0.2 M solution of a weak monoprotic acid, HA, enough quantity of its sodium salt, NaA, was dissolved to give a concentration of 0.2 M of the salt. What will be the acid concentration, $[H_3O^+]$, in the final solutions? (K_a of HA = 1.80×10^{-5})

- A. 3.60×10^{-6}M
- B. 1.00×10^{-5}M
- C. 1.80×10^{-5}M
- D. 1.90×10^{-3}M

73. Gaseous petrol in a combustion system has done 375kJ of work during its expansion in the piston. Simultaneously, it absorbed 586 kJ of heat from the engine. What is the internal energy change during the process?

- A. +211kJ
- B. +961kJ
- C. -211kJ
- D. -961kJ

74. Which of the following reactions is expected to have negative value of entropy change (ΔS)?

- A. $C_6H_6(s) + 6O_2(g) \rightarrow 6CO_2(g) + 6H_2O(l)$
- B. $CaCO_3(s) \rightarrow CaO(s) + CO_2(g)$
- C. $N_2O_4(g) + Cl(g) \rightarrow 2NOCl(g) + O_2(g)$
- D. $2SO_2(g) + O_2(g) \rightarrow 2SO_3(g)$

75. Consider the following unbalanced redox reaction in acidic solution:
$MnO_4^- + Fe^{2+} \rightarrow Mn^{2+} + Fe^{3+}$ what is the change in oxidation state for both the substances oxidized and reduced, and the coefficients of Fe^{2+} and Mn^{2+}, respectively after balancing?

- A. 2 and 7, and 2 and 5
- B. 3 and 2, and 5 and 1

- C. 1 and 5, and 5 and 1
- D. 2 and 5, and 5 and 2

76. How many mL conc. HNO_3 and how many mL of water are required to prepare 500mL of 0.1M HNO_3 from a conc. 13M HNO_3?

- A. 1mL HNO_3 and 496.15 mL H_2O.
- B. 3mL HNO_3 and 500mL H_2O.
- C. 3.85 mL HNO_3 and 500mL H_2O.
- D. 3.85 mL HNO_3 and 496.15 mL H_2O.

77. What is the pH of an aqueous solution prepared to contain 1.3 x 10^{-3}M sodium nitrite ($NaNO_2$) if the acid dissociation equilibrium constant, K_a for nitrous acid (HNO_2) is 5.1 x 10^{-4}?
Kw = 1.0 x 10^{-14}

- A. 3.1
- B. 5.1
- C. 6.0
- D. 7.3

78. What reactions occur at the anode and cathode when an aqueous solution of Na_2SO_4 is electrolyzed?
E^0 red
I. $S_2O_8^{2-} + 2e^- \rightarrow 2SO_4^{2-}$ 2.01V
II. $O_2 + 4H^+ + 4e^- \rightarrow 2H_2O$ 1.23V
III. $2H_2O + 2e^- \rightarrow H_2 + 2OH^-$ -0.83V
IV. $Na^+ + e^- \rightarrow Na$ -2.71V

- A. H_2 at cathode and O_2 at anode.
- B. Na at cathode and $S_2O_8^{2-}$ at anode.
- C. H_2 at cathode and S_2O_82- at anode.
- D. Na at cathode and O_2 at anode.

79. Which synthetic polymer is produced from caprolactam?

- A. Nylon -6
- B. Nylon 6, 10
- C. Teflon
- D. Terylene

80. For the following hypothetical equation, in aqueous solution, what is the correct representation of the cell notation?
$A(s) + B^{2+}(aq)$ _ $A^{2+}(aq) + B(s)$

- A. $A(s)|A^{2+}(aq)||B^{2+}(aq)|B(s)$
- B. $B^{2+}(aq)|B(s)||A^{2+}(aq)|A(s)$
- C. $A^{2+}(aq)(s)|A(s)||B(s)|B^{2+}(aq)$
- D. $B(s)|B^{2+}(aq)||A^{2+}(aq)|A(s)$

Submit