

NATIONAL EDUCATIONAL ASSESMENT AND EXAMINATIONS AGENCY (NEAEA)
ETHIOPIAN UNIVERSITY ENTRANCE EXAMINATION (EUEE)
CHEMISTRY EXAMINATION 2009

BOOKLET CODE: 00

NUMBER OF ITEMS:

SUBJECT CODE: 00

TIME ALLOWED: 00

DIRECTIONS: Each of the following questions is followed by four possible alternatives.

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

PHYSICAL CONSTANTS:

Gas constant, $R = 8.314 \text{ J mol}^{-1} \text{ K}^{-1} = 0.0821 \text{ L - atm mol}^{-1}$

Avogadro's number = $6.023 \times 10^{23} \text{ mol}^{-1}$

Plank's constant, $h = 6.626 \times 10^{-34} \text{ Js}^{-1}$

Energy, $1 \text{ eV} = 1.602 \times 10^{-19} \text{ J}$

Speed of light, $c = 2.9979 \times 10^{10} \text{ ms}^{-1}$

Faraday's constant (F) = $96500 \text{ C mol}^{-1} \text{ e}$

Charge of 1 mole of electrons = $96500 \text{ C} = 1F$

SI Units and Conversation Factors

1 ton = 907.185 kg

1 metric ton = 1000 kg

1 Å = 10^{-10} m

1 L-atm = 101.3 J

Coulombs = amperes x seconds

ATOMIC NUMBERS (Z) AND ATOMIC WEIGHTS (A)

Element	H	He	Li	B	C	N	O	F	Ne	Na	Mg	P	S	Cl	Ca	Cr	Mn	Fe
Z	1	2	3	5	6	7	8	9	10	11	12	15	16	17	20	24	25	26
A	1.0	4.1	6.9	10.8	12.0	14.0	16.0	19.0	20.2	22.98	24.31	30.97	32.1	35.5	40.1	52.0	54.9	55.9

Element	Co	Ni	Cu	Zn	Ag	Cd	Pt	Au	Hg
Z	27	28	29	30	47	48	78	79	80
A	58.9	58.7	63.5	65.4	107.9	112.4	195.08	197.0	200.6

1. Which of the following covalent bonds is the most polar?

- A. H - F
 B. H - C
 C. H - H
 D. H - N

2. The force that hold different atoms or ions together are called?

- A. Electric forces

- B. Physical bonds
- C. Chemical bond
- D. Atomic forces

3. How many electrons are shared between two atoms in a double bond?

- A. 2
- B. 3
- C. 4
- D. 6

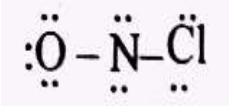
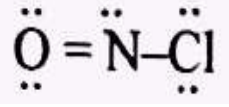
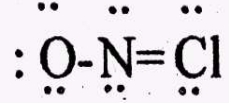
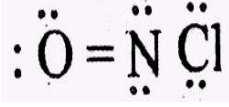
4. Which of the following is the correct Lewis structure for oxygen atom?

- A. Three lone- pairs of valence electrons
- B. One lone- pair of valence electrons and one bonding site.
- C. Two lone- pairs of valence electrons and one bonding site.
- D. Two lone- pairs of valence electrons and two bonding sites.

5. What is the chemical formula of the compound formed by aluminium (III) and sulphate ion, SO_4^{2-} ?

- A. AlSO_4
- B. Al_2SO_4
- C. $\text{Al}_2(\text{SO}_4)_3$
- D. $\text{Al}(\text{SO}_4)_3$

6. Which of the following is the most reasonable valence- bond structure of the nitrosyl chloride (NOCl)?

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

7. What is the ground state electronic configuration of Cu^{2+} ?

- A. $[\text{Ar}] 4s^1 3d^8$
- B. $[\text{Ar}] 4s^2 3d^7$
- C. $[\text{Ar}] 4s^1 3d^{10}$
- D. $[\text{Ar}] 3d^9$

8. Which of the following is the correct order for electrons filling in orbitals?

- A. 3s, 3p, 4s, 3d
- B. 2p, 3s, 3p, 3d
- C. 3p, 4s, 3d, 5s
- D. 4s, 3d, 4p, 4d

9. The normal human eye responds to visible light of wavelength ranging from about 390nm to 710nm. What is the frequency range of the human eye?

- A. $7.7 \times 10^{14} \text{s}^{-1}$ to $4.2 \times 10^{14} \text{s}^{-1}$
- B. $4.2 \times 10^{14} \text{s}^{-1}$ to $7.7 \times 10^{14} \text{s}^{-1}$
- C. $1.3 \times 10^{15} \text{s}^{-1}$ to $2.4 \times 10^{15} \text{s}^{-1}$
- D. $2.4 \times 10^{15} \text{s}^{-1}$ to $1.3 \times 10^{15} \text{s}^{-1}$

10. How many different types of orbitals are there in the third energy level?

- A. 2
- B. 3
- C. 6
- D. 7

11. The Heisenberg uncertainty principle states that

- A. Two atoms of the same element must have the same number of protons.
- B. No two electrons in the same atom can have the same set of four quantum numbers.
- C. It is impossible to determine both position and momentum of an electron simultaneously.
- D. Electrons of atoms in ground state enter energetically equivalent set of orbitals singly before they pair any orbitals of the set.

12. Which of the following transitions will have minimum wavelength?

- A. $n_4 \rightarrow n_1$
- B. $n_2 \rightarrow n_1$
- C. $n_4 \rightarrow n_2$
- D. $n_3 \rightarrow n_1$

13. What is the energy associated with one photon of a microwave radiation having a frequency of $2.45 \times 10^9 \text{s}^{-1}$?

- A. $1.62 \times 10^{24} \text{J}$
- B. $2.45 \times 10^9 \text{J}$
- C. $2.45 \times 10^{-9} \text{J}$
- D. $1.62 \times 10^{-24} \text{J}$

14. What is the frequency of a radiation (in Hz) from an atom if its wavelength is $1.0 \times 10^{-9} \text{nm}$?

- A. 3.3×10^{-27}
- B. 3.0×10^{17}
- C. 3.0×10^8
- D. 3.0×10^{26}

15. Which of the following particle was discovered by the cathode rays experiment?

- A. Electron
- B. Neutron
- C. Nucleus
- D. Proton

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

- A. You should tie back loose hair.
- B. You should never add acid to water.
- C. Do not suck solution in the pipette by mouth.

- D. When lighting a Bunsen Burner, you should light the match stick before turning on the gas.

17. Which of the following are the correct steps of the Scientific Method?

- A. Observation- Hypothesis- Experimentation- Formulation of Laws- Theories.
 B. Observation- Formulation of Laws- Experimentation- Hypothesis- Theories
 C. Observation- Experimentation- Hypothesis- Formulation of Laws- Theories
 D. Observation- Experimentation- Formulation of Laws- Hypothesis- Theories

18. Which of the following is the correct relationship between picometer (PM) and nanometer (nm)?

- A. 1Pm = 10nm
 B. 1pm = 100nm
 C. 1nm = 10pm
 D. 1nm = 1000pm

19. How many significant figures has the sum of 2.453, 4.6 and 8.14?

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

20. Which one of the following measurements has the greatest number of significant figures?

- A. 0.00046
 B. 0.0046
 C. 460
 D. 4.6×10^6

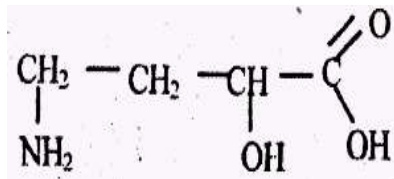
21. Which of the following methods is used to convert oils into fats?

- A. Esterification reaction using strong bases like NaOH or KOH
 B. Saponification reaction using strong bases like NaOH or KOH
 C. Hydrolysis reaction in the presence of water and a catalyst
 D. Hydrogenation reaction at high temperature and in the presence of a catalyst

22. The solubility of compounds containing the carboxylic acid group can be increased by reaction with

- A. Sulphuric acid
 B. Sodium hydroxide
 C. Water
 D. Benzoic acid

23. What is the IUPAC name for the following molecule?



- A. γ - amino - α - hydroxybutyric acid
 B. 4 - amino - 2 - hydroxybutanoic acid
 C. 1 - amino - 3 - hydroxybutanoic acid
 D. α - amino - γ - hydroxybutyric acid

24. What products will be formed when a carboxylic acid reacts with an alcohol?

- A. Ketone and water
- B. Amide and water
- C. Acid chloride and water
- D. Ester and water

25. Consider the reaction

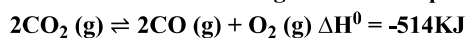


What is the equilibrium constant expression if the initial concentration of AB_3 is 0.1M and the equilibrium concentration of A is expressed by x?

(Assume the initial concentrations of A and B are both zero.)

- A. $\frac{x-3x}{0.1-x}$
- B. $\frac{x.3}{(0.1-3x)^3}$
- C. $\frac{x-x^3}{(0.1-3x)^3}$
- D. $\frac{x(3x)^3}{0.1-x}$

26. Consider the following reaction at equilibrium.



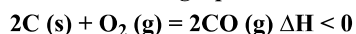
What does Le Chatelier's principle predict when the temperature for the reaction is increased?

- A. The value of the equilibrium constant will increase.
- B. The value of the equilibrium constant will decrease.
- C. The partial pressure of $O_2(g)$ at equilibrium will increase.
- D. The partial pressure of $CO_2(g)$ at equilibrium will increase.

27. For one component system, when would the degree of freedom becomes one?

- A. When only one phase is present.
- B. When two phases are present at equilibrium.
- C. When three phases are present at equilibrium.
- D. At all times.

Use the following equilibrium reaction for questions 29



29. For the reaction: $2C(s) + O_2(g) = 2CO(g)$ $\Delta H < 0$ if the reaction is at equilibrium with excess C (s) remaining, what change will increase the quantity of CO (g) for the reaction at equilibrium?

- 1) Adding C (s)
- 2) Decreasing the temperature
- 3) Increasing the pressure

- A. Only 1
- B. Only 2
- C. 1 and 2
- D. 2 and 3

30. Which one of the following is correct when a reaction reaches equilibrium?

- A. The reaction rate for the forward direction is decreased to zero.
- B. The rate of the forward and reverse reaction becomes equal.
- C. The rate of the reverse reaction is reached a maximum.
- D. The amounts of reactants and products becomes equal.

31. A possible mechanism for the reaction, $A + 2B \rightarrow AB_2$ is

Step: $A + B \rightarrow AB$ Slow

Step: $AB + B \rightarrow AB_2$ Fast

Overall: $A + 2B \rightarrow AB_2$

According to the mechanism, what will be the rate law?

- A. Rate = $K[A][B]$
- B. Rate = $K[B]^2$
- C. Rate = $K[A][B]^2$
- D. Rate = $K[A]$

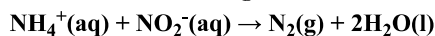
32. The initial rate of a reaction $A + B \rightarrow$ products was measured for several different starting concentrations of A and B, with the following results.

Exp	[A]	[B]	Initial rate of formation of C M/s
1	0.04	0.04	9.6×10^{-6}
2	0.08	0.04	1.92×10^{-5}
3	0.02	0.02	9.6×10^{-6}

What is the initial rate of reaction when $[A]_0 = 0.12M$ and $[B]_0 = 0.015M$?

- A. $0.006Ms^{-1}$
- B. $0.006M^{-2}s^{-1}$
- C. $1.08 \times 10^{-5}Ms^{-1}$
- D. $1.08 \times 10^{-4}Ms^{-1}$

33. Given the following data for the reaction:



Experiment	$[NH_4^+]$	$[NO_2^-]$	Rate
1	0.010M	0.020M	0.020M/s
2	0.015M	0.020M	0.03M/s
3	0.010M	0.010M	0.005M/s

What will be the rate law for the given reaction?

- A. Rate = $K[NH_4^+][NO_2^-]$
- B. Rate = $K[NH_4^+]^2[NO_2^-]$
- C. Rate = $K[NH_4^+][NO_2^-]^2$
- D. Rate = $K[NH_4^+][NO_2^-]^2$

34. The rate of a reaction increases with increasing the concentration of reactant molecules, because

- A. The average kinetic energy of the molecules increases.
- B. The frequency of molecular collisions increase.
- C. The order of the reaction increases
- D. The activation energy increases.

35. Consider the following reactions:



At a certain temperature, the rate of decomposition of $\text{N}_2\text{O}_5(\text{g})$ is $2.5 \times 10^6 \text{ mol/s}$. What will be the rate of formation of NO_2 ?

- A. $1.0 \times 10^{-5} \text{ mol/s}$
- B. $2.5 \times 10^{-6} \text{ mol/s}$
- C. $1.3 \times 10^{-6} \text{ mol/s}$
- D. $5.0 \times 10^{-6} \text{ mol/s}$

36. Which of the following refer to a reaction that is NOT dependent on the concentration of a reactant?

- A. Second order reaction
- B. First order reaction
- C. Zero order reaction
- D. Third order reaction

37. What is (are) the F-S-F bond angle(s) in SF_6 ?

- A. 109.5°
- B. 120°
- C. 90° and 120°
- D. 90° and 180°

38. What is the bond order of a superoxide anion, with the chemical formula O_2^- ?

- A. 3
- B. 2.5
- C. 2
- D. 1.5

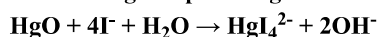
39. What kind of hybrid orbitals are utilized by the carbon atom in CF_4 molecules?

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

40. Which of the following molecule is INCORRECTLY matched with the electronic geometry of the central atom?

- A. CF_4 : tetrahedral
- B. H_2O : tetrahedral
- C. CF_4 : Pyramidal
- D. BeBr_2 : linear

41. A 0.217g sample of HgO reacts with excess iodide ions according to the reaction:



How many ml, of 0.1M HCl is required to reach equilibrium point during the titration of the solution?

- A. 1.0
- B. 10
- C. 20
- D. 50

42. Which statement about indicators is always correct?

- A. The mid-point of the PH rage of an indicator is 7.0
- B. The PH rage is greater with higher PKa values.
- C. The colour red indicates an acidic solution.
- D. The PKa values of the indicator is within its PH range.

43. To a 50.0ml of a buffer solution that is 0.25M in HF and 0.10M in NaF, if 5.0ml of 0.050M NaOH is added, what is the final PH of this buffer solution? Given the $pK_{aHF} = 3.17$

- A. 2.77
- B. 2.8
- C. 2.74
- D. 3.17

44. The suppression of ionization of a weak acid or a weak base by adding one of its own ions is known as:

- A. Buffer effect
- B. Ionization effect
- C. Common ion effect
- D. Association effect

45. Nitrous acid, HNO_2 is 0.37% ionized in 3.0M solution. What is the K_a for this acid?

- A. $\frac{3.0(0.0037)^2}{99.63}$
- B. $\frac{(0.0037)^2}{0.9963}$
- C. $\frac{3.0(0.0037)^2}{0.9963}$
- D. $\frac{0.9963}{(0.0037)^2}$

46. Among the following acids, which has the lowest PK_a value?

- A. CH_3CH_2COOH
- B. $HCOOH$
- C. $(CH_3)_2CHCOOH$
- D. CH_3COOH

47. Which one of the following is a Lewis acid?

- A. NH_3
- B. CCl_4
- C. $AlCl_3$
- D. $LiCl$

48. Which of the following is the conjugate acid of the HS^- ion?

- A. H_2S^-
- B. S_2^-
- C. S^-

D. H²S

49. What will be the ration of the boiling point elevation of a 0.1M solution of sucrose, sodium sulphate and potassium bromide?

A. 1 : 3 : 1

B. 1 : 1 : 2

C. 1: 3 : 2

D. 1 : 2 : 2

50. When the molecular equation: $\text{CaCl}_2(\text{aq}) + \text{Na}_2\text{CO}_3(\text{aq}) \rightarrow \text{CaCO}_3(\text{s}) + 2\text{NaCl}(\text{aq})$

Is written in terms of ionic equation, which one of the following pairs will be the spectator ions?

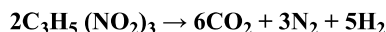
A. Na⁺ and Cl⁻

B. Ca²⁺ and Cl⁻

C. Na₃²⁻ and Cl⁻

D. Ca²⁺ and CO₃²⁻

51. If 0.454kg of nitroglycerin explodes according to the following reaction:



What is the total volume of gases in dm³ produced at STP?

A. 44.8

B. 163

C. 397.7

D. 650

52. How many grams of methanol would have to be added to water to prepare 150ml of solution which is 2.0M methanol?

A. 2.4

B. 9.6

C. 9.6 x 10³

D. 4.3 x 10²

53. A certain 500g toothpaste sample has 0.2g of fluoride. What is the concentration of the fluoride in ppm?

A. 200

B. 250

C. 400

D. 1000

54. What will be the normality of a 2.3M sulphuric acid solution?

A. 0.23N

B. 0.46N

C. 2.3N

D. 4.6N

55. The solubility of NaCl in water at 20⁰C is 36g in 100g of water. A solution that contains 18g of NaCl in 50g of water at 20⁰C is

A. Saturated

B. Unsaturated

C. Supersaturated

D. Dilute

56. Which of the following will increase the rate at which a solid dissolves in a liquid?

- A. Supersaturating the solution
- B. Grinding the solid into smaller pieces
- C. Lowering the temperature of the solvent
- D. Placing the solution in opaque container

57. Which of the following pairs of substances are miscible?

- A. Water and gasoline
- B. Water and oxygen
- C. Water and salt
- D. Water and ethanol

58. Which of the following types of solution are possible?

1. Solid dissolved in a liquid

2. Gas dissolved in a gas

3. Gas dissolved in a liquid

4. Solid dissolved in a solid

- A. 1 and 2
- B. 1, 2, 3 and 4
- C. 1, 2 and 4
- D. 1

59. The chemical makeup of oil is esters of glycerol with three

- A. Identical saturated fatty acids.
- B. Predominantly saturated fatty acids.
- C. Predominantly unsaturated fatty acids.
- D. Identical unsaturated fatty acids.

60. Which of the following general class of organic molecules do triglycerides belong to?

- A. Ketones
- B. Carboxylic acids
- C. Esters
- D. Ethers

61. What type of polymerization occurs when amino acids react to form peptides and proteins?

- A. Addition polymerization
- B. Condensation polymerization
- C. Substitution polymerization
- D. Hydration polymerization

62. Which of the following is the most abundant polysaccharide?

- A. Amylose
- B. Cellulose
- C. Starch
- D. Sucrose

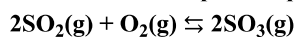
63. What is the other name for polymethyl methacrylate (PMMA)?

- A. Perspex
- B. Teflon
- C. Bakelite
- D. Nylon- 6

64. What is the monomer of polyvinyl chloride (PVC)?

- A. Chloroethane
- B. Ethylene dichloride
- C. Chloroform
- D. Ethyl chloride

65. The second step in the production of sulphuric acid is given by the reaction:



Which conditions would increase the yield of this reaction?

- A. High temperature and low pressure
- B. Low temperature and high pressure
- C. High temperature and high pressure
- D. Low temperature and low pressure

66. Which of the following reactions is used in the production of industrially important chemical?

- A. $\text{H}_2\text{S}_2\text{O}_7(\text{l}) + \text{H}_2\text{O}(\text{l}) \rightarrow 2\text{H}_2\text{SO}_4(\text{aq})$
- B. $3\text{NO}_3(\text{g}) + \text{H}_2\text{O}(\text{l}) \rightarrow 2\text{HNO}_3(\text{aq}) + \text{NO}_2(\text{g})$
- C. $(\text{NH}_4)_2\text{HPO}_4(\text{s}) + \text{NH}_3(\text{g}) \rightarrow \text{NH}_4\text{H}_2\text{PO}_4(\text{s})$
- D. $2\text{Cr}(\text{s}) + \text{Al}_2\text{O}_3(\text{s}) \rightarrow \text{Cr}_2\text{O}_3(\text{s}) + 2\text{Al}(\text{s})$

67. Which one of the following metal is used for galvanization of iron sheets?

- A. Nickel
- B. Zinc
- C. Chromium
- D. Aluminium

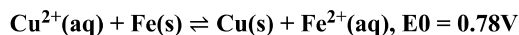
68. In what way is the phosphorous cycle differs from the carbon and nitrogen cycle?

- A. Phosphorus is more abundant than carbon and nitrogen
- B. Phosphorus is less important than carbon and nitrogen
- C. Phosphorus, once used by an organism does not cycle back to the environment
- D. The reservoirs for phosphorus exists in mineral form in rocks than in the atmosphere

69. Which one of the following is needed for photosynthesis?

- A. Carbon dioxide
- B. Nitrogen
- C. Oxygen
- D. Phosphorus

70. Consider the reaction:



What is the value of E when $[\text{Cu}^{2+}]$ is equal to 0.040M and $[\text{Fe}^{2+}]$ is equal to 0.40M?

- A. 0.72V
- B. 0.75V

- C. 0.81V
- D. 0.84V

71. For the electrochemical cell represented by:



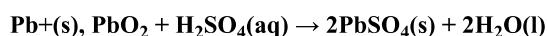
The standard reduction potentials for Cu^{2+}/Cu and Zn^{2+}/Zn are +0.34 and -0.76V, respectively, what will be the cell reaction that occurs spontaneously and its cell voltage?

- A. $\text{Cu} + \text{Zn}^{2+} = \text{Cu}^{2+} + \text{Zn}$ $E^0(\text{V}) = 1.10$
- B. $\text{Zn} + \text{Cu}^{2+} = \text{Zn}^{2+} + \text{Cu}$ $E^0(\text{V}) = 0.42$
- C. $\text{Cu}^{2+} + \text{Zn}^{2+} = \text{Zn} + \text{Cu}$ $E^0(\text{V}) = 0.42$
- D. $\text{Cu}^{2+} + \text{Zn} = \text{Cu} + \text{Zn}^{2+}$ $E^0(\text{V}) = 1.10$

72. What product(s) is /are formed during the electrolysis of a concentrated aqueous solution of sodium chloride?

- A. $\text{Cl}_2(\text{g})$
- B. $\text{Cl}_2(\text{g})$ and $\text{H}_2(\text{g})$
- C. $\text{NaOH}(\text{aq})$ and $\text{Cl}_2(\text{g})$
- D. $\text{Cl}_2(\text{g})$, $\text{H}_2(\text{g})$ and $\text{NaOH}(\text{aq})$

73. In the reaction:



Which substance behaves as the oxidizing agent?

- A. Pb
- B. PbSO_4
- C. PbO_2
- D. H_2SO_4

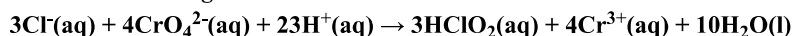
74. What mass of magnesium (Mg) is produced in the electrolysis of molten MgCl_2 , if a current of 7.50×10^2 A is passed through the molten salt for 1.00 hour?

- A. 3.4×10^2 g
- B. 9.92×10^2 g
- C. 1.7×10^2 g
- D. 4.96×10^2 g

75. Devices in which oxidation- reduction reaction is induced by an electric current are called

- A. Galvanic cells
- B. Electrolytic cells
- C. Voltaic cells
- D. Electromotive cells

76. In the following reaction:



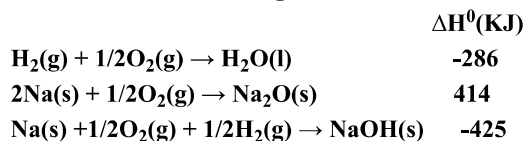
What is the behaviour $\text{Cl}^-(\text{aq})$?

- A. An acid
- B. A base
- C. An oxidizing agent
- D. A reducing agent

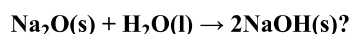
77. The KP for the reaction: $2\text{SO}_3(\text{g}) \rightleftharpoons 2\text{SO}_2(\text{g}) + \text{O}_2(\text{g})$ is 0.26 at $1,000^\circ\text{C}$ and 40.8 at $1,300^\circ\text{C}$, which of the following combinations of ΔH and ΔS are most plausible for the reaction at these temperatures?

- | | ΔH | ΔS |
|--------------------------|------------------|------------------|
| <input type="radio"/> A. | >0 | <0 |
| <input type="radio"/> B. | >0 | >0 |
| <input type="radio"/> C. | <0 | >0 |
| <input type="radio"/> D. | <0 | <0 |

78. Based on the following information



What will be the standard enthalpy changes for the reaction?



- A. -978KJ
 B. -722KJ
 C. -150KJ
 D. +275KJ

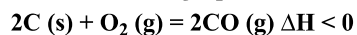
79. At what condition(s) is the equation, $\Delta\text{H} = \Delta\text{U} + \text{P}\Delta\text{V}$, applicable?

- A. For constant pressure and temperature processes
 B. Only for constant pressure processes
 C. Only for constant temperature processes
 D. Only for constant volume processes

80. What is a thermodynamic system that exchanges both energy and matter with the surroundings?

- A. Adiabatic
 B. Closed
 C. Isolated
 D. Open

Use the following equilibrium reaction for questions 81



81. What is the equilibrium expression? (M)

- A. $K = \frac{2[\text{CO}]}{2[\text{C}] + [\text{O}_2]}$
 B. $K = \frac{[\text{CO}]^2}{[\text{C}]^2[\text{O}_2]} h$
 C. $K = \frac{2[\text{CO}]}{[\text{O}_2]}$
 D. $K = \frac{[\text{CO}]^2}{[\text{O}_2]}$

Submit

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Source: Ethiopian National Examinations Agency