CLEP Chemistry
Practice Test

Time—90 Minutes 80 Questions	For each question below, choose the best answer from the choices given.

Part A

Directions: Each set of lettered choices below refers to the numbered questions or statements immediately following it. Select the one lettered choice that best answers each question or best fits each statement. A choice may be used once, more than once, or not at all in each set.

1. Forms ions with +1 charge in solution.

(A) Na
(B) Zn
(C) Hg
(D) N
(E) He

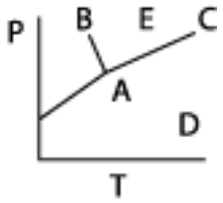
2. Exists as a liquid in its elemental form.

(A) Na
(B) Zn
(C) Hg
(D) N
(E) He

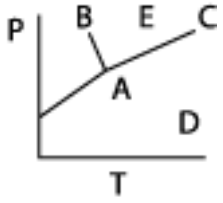
3. Forms a compound having the formula XH_3 (where X is an element).

(A) Na
(B) Zn
(C) Hg
(D) N
(E) He

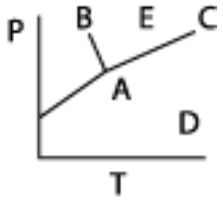
4. Which point is the critical point?



5. At which point can all three phases exist simultaneously?



6. At which point can only the liquid phase exist?



7. The product of this reaction is an insoluble precipitate.

(A) HI(*aq*) + NaOH(*aq*)
(B) $H_2O(l)$ + HOCl(*aq*)
(C) K(*s*) + $H_2O(aq)$
(D) Xe(*g*) + $H_2(g)$
(E) Zn(*s*) + $CuSO_4(aq)$

8. This reaction produces an acidic solution.

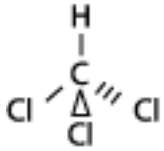
(A) HI(*aq*) + NaOH(*aq*)
(B) $H_2O(l)$ + HOCl(*aq*)
(C) K(*s*) + $H_2O(aq)$
(D) Xe(*g*) + $H_2(g)$
(E) Zn(*s*) + $CuSO_4(aq)$

9. No product is expected from this reaction.

(A) HI(*aq*) + NaOH(*aq*)
(B) $H_2O(l)$ + HOCl(*aq*)
(C) K(*s*) + $H_2O(aq)$
(D) Xe(*g*) + $H_2(g)$
(E) Zn(*s*) + $CuSO_4(aq)$

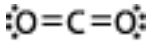
10. What is the geometry of $CHCl_3$?

(A) Linear
(B) Tetrahedral
(C) Octahedral
(D) Trigonal-pyramidal
(E) Trigonal-bipyramidal



11. What is the geometry of CO_2?

(A) Linear
(B) Tetrahedral
(C) Octahedral
(D) Trigonal-pyramidal
(E) Trigonal-bipyramidal

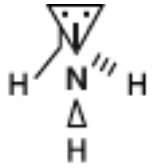


12. What is the geometry of PF_5?

(A) Linear
(B) Tetrahedral
(C) Octahedral
(D) Trigonal-pyramidal
(E) Trigonal-bipyramidal

13. What is the geometry of NH_3?

(A) Linear
(B) Tetrahedral
(C) Octahedral
(D) Trigonal-pyramidal
(E) Trigonal-bipyramidal



14. What is the geometry of SF_6?

(A) Linear
(B) Tetrahedral
(C) Octahedral
(D) Trigonal-pyramidal
(E) Trigonal-bipyramidal

15. What type of reaction is HCl (*aq*) + NaOH (*aq*) ⟶ ?

(A) Acid-base reaction
(B) Nuclear reaction
(C) Combustion reaction
(D) Precipitation reaction
(E) No reaction

16. What type of reaction is $CH_3CH_2OH + O_2 \rightarrow$?

(A) Acid-base reaction
(B) Nuclear reaction
(C) Combustion reaction
(D) Precipitation reaction
(E) No reaction

17. What type of reaction is $^6Li + {}^2H \rightarrow$?

(A) Acid-base reaction
(B) Nuclear reaction
(C) Combustion reaction
(D) Precipitation reaction
(E) No reaction

18. What type of reaction is $Pb(NO_3)_2$ (*aq*) + 2NaI (*aq*) ⟶ ?

(A) Acid-base reaction
(B) Nuclear reaction
(C) Combustion reaction
(D) Precipitation reaction
(E) No reaction

19. Has the highest boiling point.

(A) H_2O
(B) H_2S
(C) H_2Se
(D) H_2Te
(E) HCl

20. Has the highest molecular weight.

(A) H_2O
(B) H_2S
(C) H_2Se
(D) H_2Te
(E) HCl

21. Exists as a liquid at STP.

(A) H_2O
(B) H_2S
(C) H_2Se
(D) H_2Te
(E) HCl

Part B

Directions: Each of the questions or incomplete statements below is followed by five suggested answers or completions. Select the one that is best in each case.

Questions 22-24

$2A + B \rightarrow C$

The experimental rate law for the hypothetical exothermic reaction above at 25°C is:

$Rate = k[A]^2[B]$

22. What is the overall order of the above reaction?

(A) 0
(B) 1
(C) 2
(D) 3
(E) 4

23. According to the rate law of the reaction, doubling the concentration of reactant A has what effect on the reaction at 25°C?

(A) The rate of reaction is twice as fast.
(B) The rate of reaction is twice as slow.
(C) The rate of reaction is four times as fast.
(D) The rate of reaction is four times as slow.
(E) The rate of reaction is not affected.

24. Running the reaction at 50°C, results in which of the follow?

(A) The reaction shifts to the right.
(B) The reaction shifts to the left.
(C) The rate of reaction is twice as fast.
(D) The rate of reaction is twice as slow.
(E) No change is observed.

25. The most probable oxidation number for the element with atomic number 20 is

(A) -2
(B) -6
(C) +2
(D) +4
(E) +10

26. Which of the following is most likely to be found in nature in gaseous form?

(A) Li
(B) P
(C) V
(D) Al
(E) N

27. $1s^2 2s^2 2p^6 3s^2 3p^5$

Atoms of element X have the electronic configuration shown above. The compound most likely formed with calcium, Ca, is

(A) CaX
(B) Ca_2X
(C) CaX_2
(D) Ca_2X_2
(E) Ca_2X_3

28. $CH_3 — O — CH_3$

The organic molecule represented above is an example of a(n)

(A) ester.
(B) carboxylic acid.
(C) ether.
(D) alcohol.
(E) amine.

29. One of the outermost electrons in a tin atom in the ground state can be described by which of the following sets of four quantum numbers (n, l, m_l, m_s)?

(A) $6, 0, +1, +\frac{1}{2}$

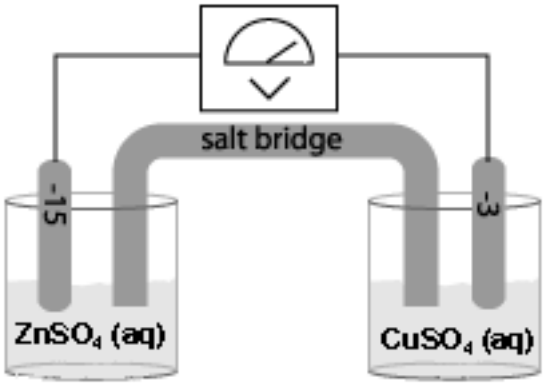
(B) $6, 1, -1, +\frac{1}{2}$

(C) $6, 1, 2, +\frac{1}{2}$

(D) $6, 2, 1, +\frac{1}{2}$

(E) $6, 3, 2, +\frac{1}{2}$

Questions 30-32



Given two solutions $ZnSO_4$ (1M) and $CuSO_4$ (1M) in an electrochemical cell, as shown above, answer questions 30-32.

30. What reaction takes place at the anode?

(A) $Zn \rightarrow Zn^{2+} + e^-$
(B) $Zn^{2+} + 2e^- \rightarrow Zn$
(C) $Cu \rightarrow Cu^{2+} + 2e^-$
(D) $Cu^{2+} + 2e^- \rightarrow Cu$
(E) None of the above

31. Given the following standard reduction potentials, what is the standard emf of the electrochemical cell at 25°C?

$Cu^{2+} + 2e^- \rightarrow Cu \quad E^o = 0.34$ V

$Zn^{2+} + 2e^- \rightarrow Zn \quad E^o = -0.76$ V

(A) +1.1 V
(B) +0.42 V
(C) -0.42 V
(D) -1.1 V
(E) None of the above

32. The salt bridge in the cell does which of the following?

(A) The salt bridge is where reduction takes place.
(B) The salt bridge is where oxidation takes place.
(C) The salt bridge allows neutral ions to interact with ions in solution.
(D) The salt bridge allows the two solutions to mix.
(E) The salt bridge allows positive and negative ions to flow freely.

33. Which of the following represents the structure of an alkali metal?

(A) $^{19}X_9$
(B) $^{11}X_5$
(C) $^{24}X_{12}$
(D) $^{40}X_{20}$
(E) $^{40}X_{19}$

34. How many liters of N_2 can be produced from the decomposition of 2 moles of NH_3 at standard temperature and pressure?

(A) 11.2 L
(B) 22.4 L
(C) 44.8 L
(D) 67.2 L
(E) 89.6 L

35. Which of the following is not a homogeneous mixture?

(A) Air
(B) Sugar in water
(C) Salt in water
(D) Oil in water
(E) Acetone in water

36. $H_2(g) + O(g) \leftrightarrow H_2O(g)$

In this reversible exothermic reaction, which factor will shift the equilibrium to the reactants?

(A) Adding H_2O
(B) Adding H_2
(C) Removing O
(D) Adding a catalyst
(E) Cooling

37. Water is placed in a freezer. What is the effect on its energy content and entropy content?

	Energy	Entropy
(A)	Increase	Increase
(B)	Increase	Decrease
(C)	Decrease	Increase
(D)	Decrease	Decrease
(E)	No change	Decrease

38. Considering the following unbalanced equation how many moles of H_2O are formed from three moles of oxygen?

$$H_2S + O_2 \rightarrow SO_2 + H_2O$$

(A) 1
(B) $\frac{3}{2}$
(C) 2
(D) $\frac{5}{2}$
(E) 3

39. Complete ionization of a sodium sulfate molecule yields

(A) Na^+, SO_4^{2-}
(B) $2Na^+$, SO_4^{2-}
(C) Na^+, $2SO_4^{2-}$
(D) $2Na^+$, $2SO_4^{2-}$
(E) $2Na^+$, $3SO_4^{2-}$

40. $H_2S(aq) + MnO_4^-(aq) \rightarrow S(s) + MnO_2(s) + H_2O(l) + OH^-(aq)$

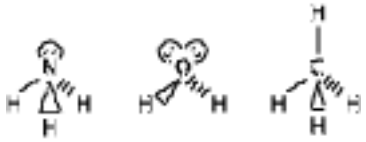
Balancing this equation yields the following coefficients from left to right:

(A) 2, 1, 2, 1, 1, 1
(B) 1, 3, 1, 2, 2, 1
(C) 2, 3, 2, 3, 1, 2
(D) 3, 2, 2, 3, 2, 3
(E) 3, 2, 3, 2, 2, 2

41. The volume in liters of a 0.2M solution of NaOH needed to neutralize 2 liters of a 0.03M solution of HCl is

(A) 0.3 L
(B) 0.03 L
(C) 0.1 L
(D) 0.01 L
(E) 0.2 L

42.



For the molecules above, the resultant dipole moments are oriented (from left to right):

(A) ↑, o, ↓
(B) ↑, →, ↓
(C) ↓, ↓, o
(D) ↑, ↑, o
(E) o, →, ↑

43. How many unpaired electrons does the ground state of manganese have?

(A) 2
(B) 3
(C) 4
(D) 5
(E) 6

44. Arrange the following gaseous ions in order of increasing atomic radius.

(A) Li^+, Be^{2+}, B^{3+}, Na^+
(B) B^{3+}, Be^{2+}, Na^+, Li^+
(C) Na^+, Li^+, Be^{2+}, B^{3+}
(D) Na^+, B^{3+}, $Be2^+$, Li^+
(E) B^{3+}, Be^{2+}, Li^+, Na^+

45. Which of the following methods is best for separating a one liter sample of two miscible liquids with a boiling point difference of approximately 65°C?

(A) Fractional Distillation
(B) Chromatography
(C) Distillation
(D) Filtration
(E) Extraction

46. In the following reaction,

$$H_2O + SO_3^{2-} + 2Fe^{3+} \rightarrow SO_4^{2-} + 2Fe^{2+} + 2H^+$$

the oxidation numbers for S and Fe before and after the reaction, respectively, go from

(A) +4, +3 to +6, +2
(B) +3, +3 to +8, +2
(C) +6, +3 to +8, +2
(D) +6, +2 to +8, +3
(E) +4, +3, to +8, +2

47. Given the following reversible reaction,

$$2NiS(s) + 3O_2(g) \leftrightarrow 2NiO(s) + 2SO_2(g)$$

how does one express the equilibrium constant, K?

(A) $\left(\frac{2[SO_2]}{3[O_2]}\right)$

(B) $\frac{2[NiO]*2[SO_2]}{2[NiS]*3[O_2]}$

(C) $\left(\frac{[NiO]^2*2[SO_2]^2}{[NiS]^2*[O_2]^3}\right)$

(D) $\left(\frac{[NiS]^2*[O_2]^3}{[NiO]^2*[SO_2]^2}\right)$

(E) $\left(\frac{[SO_2]^2}{[O_2]^3}\right)$

48. Which of the following is most soluble in water?

(A) Methane
(B) Hydrochloric acid
(C) Toluene
(D) Octanol
(E) Ethyl ether

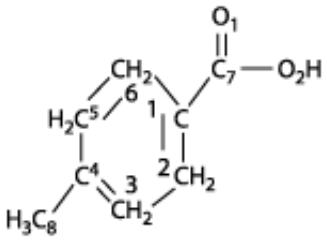
49. Which one of the following solutions would have the lowest freezing point?

(A) 1 molal HCl
(B) 2 molal HCl
(C) 3 molal HCl
(D) 1 molal H_3PO_4
(E) 2 molal H_3PO_4

50. How many moles of water are produced from the complete combustion of three moles of methane (CH_4)?

(A) 10
(B) 8
(C) 6
(D) 4
(E) 2

Questions 51-52



51. What is the hybridization state for C_8?

(A) *sp*
(B) sp^2
(C) sp^3
(D) sp^4
(E) sp^3d

52. Which atom has *sp* hybridization?

(A) C_1
(B) C_7
(C) O_1
(D) O_2
(E) None of the above

53. What is the value of "y" in the following nuclear reaction?

$$^{235}U_{92} \rightarrow {}^{y}Th_{90} + {}^{4}He_{2}$$

(A) 231
(B) 233
(C) 235
(D) 237
(E) 239

54. Which of the following elements is the most electronegative?

(A) Be
(B) B
(C) C
(D) N
(E) O

55. The third law of thermodynamics, also known as the law of entropy states

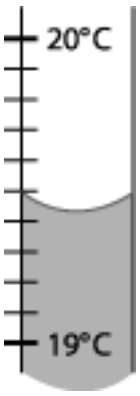
(A) energy is neither created nor destroyed.
(B) systems tend to increase in disorder.
(C) systems prefer to exist in their lowest energy state.
(D) systems prefer to exist in their highest energy state.
(E) systems tend to decrease in disorder.

56. Determine ΔH (in kJ) for the reaction $H_2O + Cl_2 \rightarrow 1/2O_2 + 2HCl$, given the following information.

(i) $H_2O \rightarrow H_2 + 1/2O_2$ $\quad \Delta H = +286$ kJ
(ii) $H_2 + Cl_2 \rightarrow 2HCl$ $\quad \Delta H = -185$ kJ

(A) +84 kJ
(B) +101 kJ
(C) +391 kJ
(D) -391 kJ
(E) -101 kJ

57.



The thermometer reads

(A) 19.6°C
(B) 19.50°C
(C) 19.5°C
(D) 19.4°C
(E) 19.40°C

58. Which of the following has the largest bond energy?

(A) F-F
(B) C=C
(C) I-I
(D) N≡N
(E) O=O

59. What is the density of hydrogen gas at 25°C and 4 atm pressure? ($R = 0.082\ L * atm * mol^{-1} * K^{-1}$)

(A) 0.002 g/L
(B) 0.08 g/L
(C) 0.33 g/L
(D) 1.38 g/L
(E) 2.98 g/L

60. A chlorine-37 nucleus contains how many protons and how many neutrons?

	Protons	Neutrons
(A)	17	37
(B)	17	20
(C)	37	20
(D)	37	17
(E)	20	17

61. Which of the following has the lowest ionization energy?

(A) Li
(B) Na
(C) K
(D) F
(E) Ne

62. The spontaneous exothermic reaction, $PCl_5(l) + Cl_2(g) \rightarrow PCl_5(s)$, has what signs for ΔG, ΔH, and ΔS?

	ΔG	ΔH	ΔS
(A)	+	+	-
(B)	-	+	-
(C)	-	-	-
(D)	-	-	+
(E)	+	-	+

63. Which of the following are allotropes?

(A) NH_3, NH_4^+
(B) H_2O, H_2S
(C) $C_{(graphite)}$, $C_{(diamond)}$
(D) He, Ne
(E) N_2, O_2

64. How does one express 300 in scientific notation with three significant figures?

(A) 300
(B) 30×10^1
(C) 3.0×10^2
(D) 3.00×10^2
(E) 0.300×10^3

65. An atom has an atomic number of 15 and an atomic mass of 31. Which of the following is false?

(A) The atom has 31 neutrons.
(B) The atom has 15 electrons.
(C) The atom has 15 protons.
(D) The atom has 16 neutrons.
(E) The atom has more neutrons than protons.

66. The pOH of a 1.0 M solution of HBr is:

(A) 1
(B) 4
(C) 7
(D) 10
(E) 14

67. $PCl_5(g) \leftrightarrow PCl_3(g) + Cl_2(g)$

In this reversible endothermic reaction, which factor will result in more product formation?

(A) Removing PCl_5
(B) Adding Cl_2
(C) Removing PCl_3 as it is formed
(D) Increasing the pressure
(E) Cooling the reactant

68. The splitting of a heavy nucleus into nuclei of lighter elements and releasing considerable amounts of energy is

(A) natural decay
(B) chain reaction
(C) atomic fusion
(D) atomic fission
(E) radioactivity

69. In a laboratory, a gas is heated to 128°F. What is the corresponding temperature in Kelvin?

(A) 395 K
(B) 326 K
(C) 312 K
(D) 128 K
(E) 53 K

70. Which of the following molecules is classified as an organic molecule?

(A) NH_3
(B) CH_2NH_2
(C) LiH
(D) H_2
(E) $Mg(OH)_2$

71. Which of the followings has an affect on the value of the equilibrium constant?

(A) Addition of a catalyst
(B) Increasing the volume
(C) Introducing a solid to the reaction
(D) Changing the temperature
(E) Doubling the pressure

72. When Berrylium-9 collides with an alpha particle, a neutron and which of the following elements is produced?

(A) $^{14}N_7$
(B) $^{13}C_6$
(C) $^{12}C_6$
(D) $^{14}N_6$
(E) $^{13}N_7$

73. How many atoms are in 9g of H_2O?

(A) 3.01×10^{23}
(B) 6.02×10^{23}
(C) 12.04×10^{23}
(D) 3.01×10^{13}
(E) 1.6×10^{24}

74. If there are 12.04×10^{23} atoms of $H_2(g)$, how many liters of H_2 are there at STP?

(A) 5.6 L
(B) 11.2 L
(C) 22.4 L
(D) 33.6 L
(E) 44.8 L

75. Colligative properties of solutions apply to which of the following?

(A) Determination of the heat of reaction
(B) Determination of empirical formula
(C) Determination of ionization energy
(D) Determination of molecular weight
(E) Determination of boiling point

76. Determine the oxidation state of Si in H_2SiF_6.

(A) -4
(B) -2
(C) +2
(D) +4
(E) +6

77. For the following reaction at equilibrium,

$$NH_4Cl(s) \leftrightarrow NH_3(g) + HCl(g)$$

the partial pressure of NH_3 is 1.2 atm and the partial pressure of HCl is 2.0 atm. What is the value of K_p?

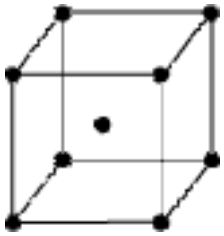
(A) 0.6
(B) 0.8
(C) 1.7
(D) 2.4
(E) 3.2

78. Which of the following has an atomic number of 12 and has 2 electrons in its valence shell?

(A) Be
(B) Mg
(C) C
(D) Na
(E) F

79. Vanadium crystalizes in a body-centered cubic latice, like the one shown below. How many Vanadium atoms are present in a unit cell?

(A) 2
(B) 3
(C) 5
(D) 8
(E) 9



80. A common rule when preparing acidic solutions is to always add acid to water. Which of the following is not a reason for this rule?

(A) Mixing strong acids with water produces a large amount of heat.
(B) Mixing strong acids with water causes rapid cooling.
(C) Adding water to acid could result in splashing concentrated acid.
(D) Adding acid to water initially produces a very dilute solution.
(E) There is no reason to add acid to water instead of adding water to acid.