# PRACTICE AP CHEMISTRY CUMLATIVE EXAM

Note: For all questions, assume that the temperature is 298 K, the pressure is 1.00 atmosphere, and solutions are aqueous unless otherwise specified.

Throughout the test the following symbols have the definitions specified unless otherwise noted.

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|---|---|
| T = temperature | M = molar |
| P = pressure | m = molal |
| V = volume | L, mL = liter(s), milliliter(s) |
| S = entropy | g = gram(s) |
| H = enthalpy | nm = nanometer(s) |
| G = free energy | atm = atmosphere(s) |
| R = molar gas constant | J, kJ = joule(s), kilojoule(s) |
| n = number of moles | V = volt(s) |
| mol = mole(s) | |

**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 and then fill in the corresponding oval on the answer sheet. A choice may be used once, more than once, or not at all in each set. ***Before turning in your answer sheet, count the number of questions that you have skipped and place that number next to your name ON YOUR ANSWER SHEET and circle it.***

Part A

**Questions 1-3** refer to the following orbital notations.

A) $Na^{+}$
B) $Mg^{2+}$
C) $Al^{3+}$
D) $C^{4+}$
E) $F^{-}$

1. Which has the largest radius?

2. Which has the smallest radius?

3. Which is isoelectronic with helium?

**Questions 4-7** refer to the following elements.

A) 0.1 M NaF
B) 0.1 M $CaCl_2$
C) 0.1 M $CH_3CH_2OH$
D) 0.1 M HCN
E) 0.1 M $C_6H_{12}O_6$

4. Which solution is the most acidic?

5. Which solution has the highest pH?

6. Which solution has the highest freezing point?

7. Which solution has the highest boiling point?

GO ON TO THE NEXT PAGE.

**Questions 7-9** refer to the following terms.

A) Cl
B) Ba
C) F
D) Ne
E) B

7. Has the largest first ionization energy.

8. Has the largest difference between the second and third ionization energy.

9. Has the smallest atomic radius.

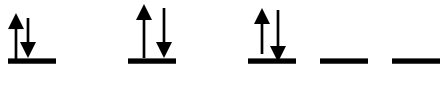
GO ON TO THE NEXT PAGE.

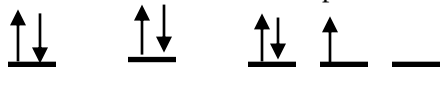
Part B

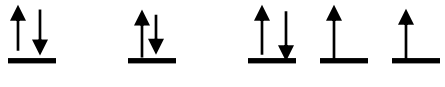
**Directions:** Each of the questions or incomplete statements below is followed by five suggested answers or completions. Select the one that is best in each case and then fill in the corresponding oval on the answer sheet.

10. Which of the following electron configurations is not following Hund's Rule, Heisenberg's Uncertainty Principle, and Pauli's Exclusion Principle?

(a) 


(b) 


(c) 


(d) 


11. What is(are) the correct method for separating a mixture?

I. Distillation
II. Chromatography
III. Filtration

A) I only
B) II only
C) I and III only
D) II and III only
E) I, II, and III

12. Hydrogen gas is collected over water at 24° C. The total pressure of the sample is 765 millimeters of mercury. At 24° C, the vapor pressure of water is 22 millimeters of mercury. What is the partial pressure of the hydrogen gas?

A) 22 mm Hg
B) 743 mm Hg
C) 765 mm Hg
D) 24 mm Hg
E) 787 mm Hg

13. Which of the following techniques is most appropriate for the recovery of solid NaCl from an aqueous solution of NaCl?

A) Paper chromatography
B) Filtration
C) Titration
D) Electrolysis
E) Evaporation to dryness

14. When a hydrate of $X_2CO_3$ (*MM* = 138) is heated until all the water is removed, it loses 49 percent of its mass. The formula of the hydrate is

A) $X_2CO_3 \cdot 9\ H_2O$
B) $X_2CO_3 \cdot 7\ H_2O$
C) $X_2CO_3 \cdot 5\ H_2O$
D) $X_2CO_3 \cdot 3\ H_2O$
E) $X_2CO_3 \cdot H_2O$

15. A compound is heated to produce a gas whose molecular weight is to be determined. The gas is collected by displacing water in a water-filled flask inverted in a trough of water. Which of the following is necessary to calculate the molecular weight of the gas, but does NOT need to be measured during the experiment?

A) Mass of the compound used in the experiment
B) Temperature of the water in the trough
C) Vapor pressure of the water
D) Barometric pressure
E) Volume of water displaced from the flask

GO ON TO THE NEXT PAGE.

16. $2\ H_2O(l) + 4\ MnO_4^-(aq) + 3\ ClO_2^-(aq) \rightarrow 4\ MnO_2(s) + 3\ ClO_4^-(aq) + 4\ OH^-(aq)$

According to the balanced equation above, how many moles of $ClO_2^-(aq)$ are needed to react completely with 10. mL of 0.40 *M* $KMnO_4$ solution?

A) 0.0030 mol
B) 0.0053 mol
C) 0.0075 mol
D) 0.013 mol
E) 0.030 mol

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17. A compound contains 5.4 mol of C, 9.0 mol of H, and 1.8 mol of O. What is the simplest formula of this compound?

A) CHO
B) $C_3H_5O$
C) $C_5H_9O_2$
D) $C_2H_4O$
E) $C_6H_{10}O_2$

18. The simplest formula for an oxide of element X (*MM* = 76.0) that is 24.0 percent oxygen by weight is

A) $X_2O$
B) XO
C) $XO_2$
D) $X_2O_3$
E) $X_2O_5$

19. A 2-L container will hold about 4 g of which of the following gases of 0ºC and 1 atm?

A) $SO_2$
B) $N_2$
C) $CO_2$
D) $C_4H_8$
E) $NH_3$

20. Which of the following represents the ground state electron configuration for the $Mn^{3+}$ ion? (Atomic number Mn = 25)

A) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^4$
B) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^5\ 4s^2$
C) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^2\ 4s^2$
D) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^8\ 4s^2$
E) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^3\ 4s^1$

21. Which of the following is a correct interpretation of the results of Rutherford's experiments in which gold atoms were bombarded with alpha particles?

A) Atoms have equal numbers of positive and negative charges.
B) Electrons in atoms are arranged in shells.
C) Neutrons are at the center of an atom.
D) Neutrons and protons in atoms have nearly equal mass.
E) The positive charge of an atom is concentrated in a small region.

22. Which of the following does NOT behave as an electrolyte when it is dissolved in water?

A) $CH_3OH$
B) $K_2CO_3$
C) $NH_4Br$
D) HI
E) Sodium acetate, $CH_3COONa$

23. A compound whose empirical formula is $C_2H_4O$ has a molar mass that lies between 100 and 150 g/mol. What is the molecular formula of the compound?

A) $C_2H_4O$
B) $C_4H_8O_2$
C) $C_6H_{12}O_3$
D) $C_6H_{12}O_2$
E) $C_6H_8O_3$

**STOP**
**END OF EXAM**

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