Chemistry 3A – Fall 2025 **Version B**

Sections 43957-43958

Midterm Examination #2

Select the **BEST** response for the question. Point values: multiple choice 3 pt; true/false 1 pt

1. A lab report had just had a number "10.0" with no units written for this quantity. It was supposed to be the **mass** of sulfur used in the experiment. What units should the number have had?

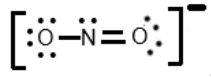
   a) g b) mol c) g/mol d) (number of) molecules e) mol/g

2. Which of the following represents a change in enthalpy in a substance that is being is being boiled?

   a) ΔH_{vap} b) ΔH_{sub} c) ΔH_{fus} d) ΔH_{melt}

3. Which of these types of matter will have a definite volume and a definite shape?

   a) gas b) liquid c) solid d) London Dispersion Force e) choices (a) and (b))

The Lewis structure is shown for NO_2^- ion  . Next three questions relate to it.

4. What are the total number of valence electrons for the molecule?

   a) 6 b) 10 c) 12 d) 18 e) 24

5. Each atom in the molecule should have an octet of electrons. How many electrons is that?

   a) 2 b) 4 e) 8 d) 10 e) 12

6. Which of the following statements is FALSE about the Lewis structure

   a) There are a total of 3 bonding pairs of electrons in the molecule
   b) The molecule has a net charge of -1
   c) The central atom nitrogen has no nonbonding (lone) pairs of electrons
   d) One of the oxygen atoms has three nonbonding (lone) pairs of electrons

7. Assume specific heat capacity of cadmium (Cd) is 0.250 J/(g °C). A 10.0 g piece of cadmium metal is heated from 20°C to 50°C. How many joules of heat energy were transferred to the metal?

   a) 400 J b) 225 J c) 75.0 J d) 0.635 J

8. What is the best choice for what is TRUE about the characteristics of a Type II ion?

   a) it is a positively charged metal cation
   b) it is an element that can ionize to more than one charge state (for example, it can be +1, +2, +3, and even -1, -2, etc)
   c) the element's name in a compound requires the use of a roman numeral (the Stock system)
   d) all the above

9. Carbon and hydrogen have very little difference in their electronegativity values. What kind of chemical bond are they likely to form in any molecule?

   a) ionic b) metallic c) (nonpolar) covalent d) polar covalent

10. In drawing a Lewis structure for the carbonate $(NO_3)^-$ ion, you have placed the octet around the three oxygen (O) atoms, but you see the central carbon (N) atom has only six electrons (3 bonding pairs) to the oxygen atoms. You have no electrons remaining to add in your inventory. What step do you need to do?

a) Nothing: your Lewis structure is ready and complete
b) Add a hydrogen atom to the molecule
c) A lone pair from one of the oxygen (O) atoms will have to be used to create a double bond with the central nitrogen (N)
d) Use Avogadro's Number at an earlier step
e) The noble gas argon (Ar) must provide a single electron to complete this structure

11. What is the molar mass of $MgSO_4 \cdot 7\ H_2O$?

a) 120.38 g/mol b) 126.112 g/mol c) 246.5 g/mol d) 18.016 g/mol

12. What is the mass percentage of water in the hydrate $MgSO_4 \cdot 7\ H_2O$?

a) 0% b) 49.84% c) 51.16% d) 100%

13. What class of (crystalline) solid does extensively hydrogen-bonded H_2O as ice as well as carbon dioxide (CO_2) as dry ice, and also diatomic element molecule iodine (I_2) form?

a) ionic b) covalent network c) metallic d) molecular

14. Ammonia ($:NH_3$) is a molecule with three terminal H atoms and a nonbonding (lone) pair of electrons on the central N atom. What is its molecular geometry?

a) bent b) trigonal planar c) trigonal pyramidal d) tetrahedral

15. Water is at 1°C. What is its temperature on the Kelvin scale?

a) 0 K b) 100 K c) 274 K d) 298 K

16. When atoms like cesium and fluorine have the largest differences in electronegativity, what kind of bond will they form?

a) ionic b) metallic c) covalent d) polar covalent e) covalent-ionic

17. How many moles of a compound is there if the number of molecules or atoms or particles of that compound is two (2) times Avogadro's Number?

a) 1 mol b) 2 mol c) 10 mol d) 20 mol e) 100 mol

18. Of the following intermolecular forces dipole-dipole (D-D), hydrogen bonding (H-B), London Dispersion Forces (LDF), which choice shows the order of strength of interaction?
(LDF > H-B means LDF is stronger than H-B)

a) LDF > H-B > D-D b) H-B > D-D > LDF c) H-B > LDF > D-D d) D-D > H-B > LDF

19. What procedure is done in a laboratory if the goal is to get the **empirical formula** of an unknown compound?

a) checking viscosity b) elemental analysis c) boiling point determination
d) heating curve analysis e) cooling curve analysis

20. What is the correct name for **Fe_2O_3**, noting that Fe is a Type II metal cation?

a) tin(IV) sulfide b) iron(I) oxide c) iron(III) oxide d) iron oxide

21. Which molecular formula correctly shows the compound **dinitrogen tetrachloride**?

a) NCl b) N_2Cl_2 c) N_4Cl_2 d) N_2Cl_4

22. What kind of **intermolecular force** is an electrostatic interaction in which the molecules have a structure giving them a permanent partial positive charge (δ+) on one end or side and a partial negative charge (δ-) on another end or side?

a) hydrogen bonding b) London dispersion forces c) covalent-ionic
d) dipole-dipole interaction e) enthalpy of covalency

23. There are 6.022×10^{23} atoms of element calcium (Ca). How many grams of calcium are there?

a) 6.022×10^{23} g b) 6.65 g c) 40.08 g d) 241.3 g

24. Which of these elements is a Group 2 element?

a) Na b) Ca c) Mg d) both (b) and (c) e) all elements (a), (b), (c) are Group 2

25. What characteristics are true about the H_2O molecule?

a) Its central oxygen atom has three nonbonding (lone) pairs of electrons
b) The difference in electronegativity between O and H atoms enables hydrogen bonding
c) Its molecular geometry is described as trigonal planar
d) It has no molecular polarity (no dipole moment)

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26. Beryllium has a molar mass of 9.012 g/mol

a) true b) false

27. There are more molecules in 0.50 mol of CO_2 than in 0.50 mol of SO_2

a) true b) false

28. A **formula unit** is a dimension of **mass** and its units are in grams (g)

a) true b) false

29. 1 mol of sodium and 1 mole of potassium are equal numbers of Na and K atoms

a) true b) false

30. Kinetic energy is an energy determined by motion or velocity of a mass

a) true b) false

31. Nonbonding (lone) pairs of electrons affecting molecular geometry is explained by Valence Shell Electron Pair Repulsion (VSEPR) theory

a) true b) false

32. The burning of gasoline is an endothermic process

a) true b) false

33. 2.0 moles of H_2 molecules is 6.022×10^{23} molecules of H_2

a) true b) false

34. London Dispersion Forces describe a temporary, instantaneous induced dipole as intermolecular force

a) true b) false

35. Cesium chloride is an ionic compound with the formula Cs_2Cl

a) true b) false