

Name----- Lab. Section-----

Physical Constants

$R = 0.0821 \text{ L}\cdot\text{atm} / \text{mol}\cdot\text{K}$; $1 \text{ atm} = 760 \text{ Torr}$; $h = 6.626 \times 10^{-34} \text{ J}\cdot\text{s}$; $c = 3.00 \times 10^8 \text{ m/s}$

Multiple Choice Question--4 points each. Circle the correct choice.

1. How many *orbitals* are there in the $n = 3$ shell? a) 3 b) 6 c) 9 d) 12 e) none of the preceding choices

2. Which of the following is **not** a valid set of four quantum numbers to describe an electron in an atom?

a) 1, 0, 0, $+\frac{1}{2}$ b) 2, 1, 1, $+\frac{1}{2}$ c) 2, 0, 0, $-\frac{1}{2}$ d) 1, 1, 0, $+\frac{1}{2}$

3. Which pair of elements would you expect to exhibit the most similar physical and chemical properties?

a) As and Se b) Na and Cl c) As and Sb d) B and Be

4) The number of *unpaired* electrons in the ground state of an atom of Co is...

(A) one (B) three (C) five (D) seven (E) none of the preceding choices

5. Which of the following processes is exothermic? a) Ionization of a sodium atom b) Formation of gaseous chlorine atoms from $\text{Cl}_2(\text{g})$ c) Breaking apart of $\text{NaCl}(\text{s})$ into ions d) Addition of an electron to a chlorine atom

6. Which of the following bonds is the most polar? a) N-O b) O-F c) B-O d) S-O e) all are equally polar

7. At what temperature (**in** $^{\circ}\text{C}$) will 25.0 g of carbon dioxide (at 1.00 atm) occupy 21.5 L?

a) 188°C b) 461°C c) -263°C d) -270°C e) 113°C

8. How many times more rapidly will hydrogen (H_2) gas effuse through a pinhole than will deuterium (D_2) gas? Deuterium is an isotope of hydrogen with a *molecular* mass of 4.0 g/mole.

(A) $\sqrt{2}$ (B) 2 (C) $2\sqrt{2}$ (D) 4

9. Which of the following arrangements from lowest to highest in first ionization energies is correct ?

a) $\text{He} < \text{Li} < \text{Be} < \text{N} < \text{Ne}$ b) $\text{Li} < \text{Be} < \text{N} < \text{Ne} < \text{He}$ c) $\text{Be} < \text{Li} < \text{N} < \text{He} < \text{Ne}$ d) $\text{He} < \text{Ne} < \text{N} < \text{Be} < \text{Li}$

10. In which of the following compounds obeys the octet rule?

a) XeF_4 b) BF_3 c) ClO d) SO_2 e) none of the preceding choices

11. The bright spectral lines observed in the emission spectrum of a flame or gas discharge tube are due to

- a) the absorption of light at specific wavelengths
- b) the formation of an excited state of atoms
- c) the transition of an atom from an excited state to a lower energy state
- d) the change from anti-parallel to parallel electron spins in an atom

12. A one-liter container is filled with one mole of hydrogen at 25°C . A second one-liter container is filled with one mole of oxygen at 25°C . Comparing the pressure of the hydrogen to the oxygen, the ratio will be ...

a) 1:1 (b) 2:1 (c) 1:16 (d) 1:8

13. From Bond Dissociation Enthalpies: $\Delta H_{\text{D}}(\text{Cl}-\text{Cl}) = 243 \text{ kJ/mol}$; $\Delta H_{\text{D}}(\text{F}-\text{F}) = 159 \text{ kJ/mol}$; $\Delta H_{\text{D}}(\text{Cl}-\text{F}) = 255 \text{ kJ/mol}$; calculate the enthalpy, ΔH , for the chemical reaction: $\text{Cl}_2(\text{g}) + \text{F}_2(\text{g}) \rightarrow 2\text{ClF}(\text{g})$

(a) -147 kJ (b) -108 kJ (c) $+171 \text{ kJ}$ (d) $+912 \text{ kJ}$

14. Which molecule has the largest carbon-oxygen bond dissociation enthalpy?

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- (a) $\text{H}-\overset{\text{H}}{\text{C}}-\text{O}-\overset{\text{H}}{\text{C}}-\text{H}$ (b) $\text{O}=\text{C}=\text{O}$ (c) $:\text{C}\equiv\text{O}:$ (d) all are equal
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15. A certain gas has a density of 2.23 g/L at 0 °C and 760 mmHg. Its molar mass is...g/mol
(a) 5.00 (b) 50.0 (c) 49.0 (d) 51.0

16. Which molecule has two lone (unshared) pairs of electrons?

- (a) formaldehyde, CH_2O (b) cyanide ion, CN^- (c) H_2O (d) N_2 (e) all of the preceding

17. What is the formal charge of carbon in a molecule of carbon monoxide, $:\text{C}\equiv\text{O}:$?

- (a) 0 (b) +1 (c) -1 (d) +4 (e) -4

18. Which structure below has the shortest carbon-oxygen bonds?

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- (a) $\text{H}-\overset{\text{H}}{\text{C}}-\text{O}-\overset{\text{H}}{\text{C}}-\text{H}$ (b) $\text{O}=\text{C}=\text{O}$ (c) $:\text{C}\equiv\text{O}:$ (d) all are equal
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19. A gas sample occupies a volume of 16.4 L at 27 °C and 0.300 atm. How many moles of gas are present?
(A) 0.200 (B) 0.450 (C) 3.50 (D) 10.0

20. When 16 g of methane gas and 16g of oxygen are added to an empty container at 25 °C, the fraction of the pressure exerted by the oxygen is: {Molar Masses (CH_4 16. g/mol); (O_2 32. g/mol)}

- (A) 1/3 total pressure (B) 1/2 total pressure (C) 2/3 total pressure
(D) (1/3 total pressure)(273/298) (E) (2/3 total pressure)(273/298)

21. How many resonance structures that obey the octet rule exist for the carbonate ion, CO_3^{2-} ?

- (a) 1 (b) 2 (c) 3 (d) 4

22. A photon of light of wavelength 450 nm, when compared to a photon of light of wavelength 300 nm, has...

- (a) higher frequency (b) lower energy (c) a greater velocity (e) a shorter wavelength

23. The number of unpaired electrons in the Fe^{3+} ion is...(a) 1 (b) 2 (c) 3 (d) 4 (e) 5

24. According to Heisenberg's Uncertainty Principle, we can't simultaneously know both the _____ and the momentum of a small particle with 100% accuracy.

- (A) energy (B) momentum (C) bond length (D) spin (E) position

25. In which compound is the bonding primarily ionic? (A) KCl (B) OCl_2 (C) BCl_3 (D) SiCl_4