

Multiple Choice Questions (160 Points) There is *only* one best answer for each question. Good luck!

1. Atomic number describes the number of _____ in an atom.
 - a. protons
 - b. neutrons
 - c. electrons
 - d. a and b
 - e. all of the above

2. Which of the following symbols represents an alpha particle?
 - a. ${}^4_2\text{He}$
 - b. ${}^2_4\text{He}$
 - c. ${}^0_{+1}\text{e}$
 - d. ${}^0_{-1}\text{e}$
 - e. ${}^1_0\text{n}$

3. The most penetrating type of radiation is a(n)
 - a. alpha particle
 - b. beta particle
 - c. gamma ray
 - d. positron
 - e. cathode ray

4. If plutonium-244 decays by successive α , β , β , α emissions, what nucleus is produced?
 - a. ${}^{236}_{88}\text{Ra}$
 - b. ${}^{236}_{89}\text{Ac}$
 - c. ${}^{236}_{90}\text{Th}$
 - d. ${}^{240}_{90}\text{Th}$
 - e. ${}^{236}_{92}\text{U}$

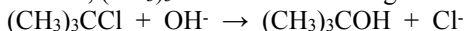
5. If Ag-106 decays by electron capture, what is the product?
 - a. ${}^{105}_{46}\text{Pd}$
 - b. ${}^{106}_{46}\text{Pd}$
 - c. ${}^{105}_{47}\text{Ag}$
 - d. ${}^{106}_{48}\text{Cd}$
 - e. ${}^{107}_{47}\text{Ag}$

6. By what (single step) process does polonium-211 decay to lead-207?
- α particle emission
 - β particle emission
 - positron emission
 - electron capture
 - neutron capture
7. The decay of radioactive elements is a first-order process. The half-life of carbon-14 is 5730 years. How many years will it take for 5.0 g of carbon-14 to decay to 1.0 mg?
- 5730 years
 - 17,200 years
 - 24,900 years
 - 57,300 years
 - 70,400 years
8. Given the initial rate data for the reaction $A + B \rightarrow C$, determine the rate expression for the reaction.

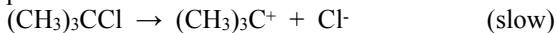
<u>[A], M</u>	<u>[B], M</u>	<u>$\Delta[C]/\Delta t$ (initial) M/s</u>
0.334	0.134	4.11×10^{-9}
0.334	0.187	8.00×10^{-9}
0.668	0.134	4.11×10^{-9}

- $\frac{\Delta[C]}{\Delta t} = 2.75 \times 10^{-7} \text{ M}^{-2}\text{s}^{-1}[\text{A}]^2[\text{B}]$
 - $\frac{\Delta[C]}{\Delta t} = 3.07 \times 10^{-8} \text{ s}^{-1}[\text{B}]$
 - $\frac{\Delta[C]}{\Delta t} = 2.29 \times 10^{-7} \text{ M}^{-1}\text{s}^{-1}[\text{B}]^2$
 - $\frac{\Delta[C]}{\Delta t} = 6.85 \times 10^{-7} \text{ M}^{-2}\text{s}^{-1}[\text{A}][\text{B}]^2$
 - $\frac{\Delta[C]}{\Delta t} = 1.23 \times 10^{-8} \text{ s}^{-1}[\text{A}]$
9. For a zero order reaction, which of the following (if plotted versus time) should give a straight line?
- $\ln [\text{A}]$
 - $\ln k$
 - $\ln [1/\text{A}]$
 - $1/[\text{A}]$
 - $[\text{A}]$

10. In basic solution, $(\text{CH}_3)_3\text{CCl}$ reacts according to the equation:



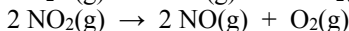
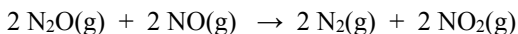
The accepted mechanism for the reaction is



What is a rate law that is consistent with the mechanism for this reaction?

- rate = $k[(\text{CH}_3)_3\text{CCl}]$
- rate = $k[(\text{CH}_3)_3\text{CCl}][\text{OH}^-]$
- rate = $k[(\text{CH}_3)_3\text{C}^+][\text{OH}^-]$
- rate = $k[(\text{CH}_3)_3\text{CCl}][\text{OH}^-]/[\text{Cl}^-]$
- rate = $k[(\text{CH}_3)_3\text{CCl}][\text{OH}^-]/[\text{Cl}^-]$

11. The elementary steps for the catalyzed decomposition of dinitrogen monoxide are shown below.



Which of the following statement(s) is/are CORRECT?

- The overall balanced reaction is $2 \text{N}_2\text{O}(\text{g}) \rightarrow 2 \text{N}_2(\text{g}) + \text{O}_2(\text{g})$.
- $\text{NO}(\text{g})$ is a catalyst for the reaction.
- $\text{N}_2(\text{g})$ is a reaction intermediate.

- 1 only
- 2 only
- 3 only
- 1 and 2
- 1, 2, and 3

12. What is the half-life for a first-order reaction with a rate constant of 0.291 s^{-1} ?

- 0.420 s
- 1.93 s
- 2.38 s
- 6.87 s
- 13.1 s

13. The effect of adding a catalyst to a reaction is to

- increase the number of collisions between reactants
- increase the energy of the products
- increase the equilibrium constant of a reaction
- lower the activation energy of a reaction
- decrease the enthalpy change of a reaction

14. Which of the following elements is most likely to form compounds with an expanded valence shell?

- P
- Ne
- F
- Li
- N

15. Which of the following combinations is most likely to produce an ionic bond?

- Cl and Br
- P and S
- N and O
- B and O
- Li and F

16. Which of the following aqueous solutions would have the highest vapor pressure at 25 °C?
- pure water
 - 1 m glucose ($C_6H_{12}O_6$)
 - 1 m $NaNO_3$
 - 1 m $MgCl_2$
 - 1 M $(NH_4)_2SO_4$
17. What is the formal charge on each atom in a hypobromite ion, OBr^{-1} ?
- O = -2, Br = -1
 - O = -2, Br = +1
 - O = -1, Br = +1
 - O = -1, Br = 0
 - O = 0, Br = -1
18. Use VSEPR theory to predict the molecular geometry of HCN.
- bent
 - linear
 - trigonal planar
 - tetrahedral
 - octahedral
19. How many sigma (σ) bonds and pi (π) bonds are in acetylene, C_2H_2 ?
- one σ , one π
 - two σ , two π
 - three σ , one π
 - three σ , two π
 - four σ , one π
20. One product of the combustion of ethylene, C_2H_4 , is carbon dioxide. What change in hybridization of the carbon occurs in this reaction?
- sp^3 to sp^2
 - sp^2 to sp
 - sp^3 to sp^3d
 - sp^2 to sp^3d^2
 - sp^2 to sp
21. Use molecular orbital theory to predict which ion is paramagnetic.
- C_2^{2-}
 - O_2^{2-}
 - O_2^{2+}
 - N_2^{2-}
 - B_2^{2-}
22. Which of the following molecules may be a cycloalkane?
- C_3H_8
 - C_4H_6
 - C_5H_{12}
 - C_6H_{12}
 - C_7H_{16}

23. The empirical formula of a certain hydrocarbon is CH_2 . When 0.120 mole of the hydrocarbon is completely combusted with excess oxygen, 17.7 L CO_2 gas is produced at 27°C and 1.00 atm. What is the molecular formula of the hydrocarbon?
- C_2H_2
 - C_2H_4
 - C_3H_6
 - C_5H_{10}
 - C_6H_{12}
24. An unknown gaseous hydrocarbon contains 85.63 % C. Its density is 0.426 g/L at 0.465 atm and 373 K. What is the molecular formula of the gas?
- C_2H_4
 - C_3H_6
 - C_4H_8
 - C_5H_{10}
 - C_6H_{12}
25. What intermolecular force or bond is primarily responsible for the solubility of H_2S in water?
- ion-dipole force
 - dipole-dipole force
 - ionic bonding
 - covalent bonding
 - hydrogen bonding
26. What is the solute mole fraction of 1.98 m $\text{Fe}(\text{NO}_3)_3(\text{aq})$? The molar mass of $\text{Fe}(\text{NO}_3)_3$ is 241.9 g/mol and the molar mass of water is 18.02 g/mol.
- 0.0345
 - 0.0641
 - 0.324
 - 0.479
 - 0.863
27. Concentrated hydrofluoric acid is 28.9 M and has a density of 1.18 g/mL. What is the weight percent of concentrated HF?
- 24.5%
 - 49.0%
 - 51.0%
 - 68.2%
 - 75.5%
28. The Henry's law constant for N_2 in water at 37°C is 8.2×10^{-7} M/mm Hg. What is the equilibrium concentration of N_2 in water when the partial pressure of N_2 is 634 mm Hg?
- 1.3×10^{-9} M
 - 5.2×10^{-4} M
 - 1.9×10^{-2} M
 - 1.9×10^3 M
 - 7.7×10^8 M
29. Which of the following species will have a Lewis structure most like that of a sulfate ion, SO_4^{2-} ? Assume that the Lewis structure has no double bonds.
- NH_3
 - CBr_4
 - SO_3
 - H_2CO
 - H_2O

30. Use Lewis structures to predict the bond order for a nitrogen-oxygen bond in the nitrite ion, NO_2^{1-} .

- a. $1/2$
- b. 1
- c. $4/3$
- d. $3/2$
- e. 3

31. For $\text{NH}_4\text{NO}_3(\text{aq})$, the solvent is

- a. NH_4NO_3
- b. NH_4^+
- c. NO_3^{1-}
- d. water
- e. Duff beer

32. Determine which of the following species is paramagnetic.

- a. NO^{+1}
- b. CO
- c. CN^{-1}
- d. OF^{-1}
- e. NO