AP CHEMISTRY
CHAPTER 5
MULTIPLE CHOICE
No calculator

(Questions 1-16) Choose the letter of the statement that best answers the question or completes the statement.

Questions 1-4 refer to the following orbital diagrams

- A. 1s ↑ 2s ↑↓
- B. 1s ↑↓ 2s ↑ Li
- C. [Kr] 5s ↑↓ 4d ↑ ↑ ___ ___ ___
- D. [Ne] 3s ↑↓ 3p ↑ ↑ ↑ P
- E. 1s ↑↓ 2s ↑↓ 2p ↑↓ ↑↓ ↑↓

E 1. The least reactive element is represented by:

C 2. The transition element is represented by:

B 3. The most chemically reactive element is represented by:

A 4. The element in an excited state is represented by:

B 5. The ground-state configuration of Fe^{2+} is which of the following?
- A. $1s^2 2s^2 2p^6 3s^2 3p^6 3d^5 4s^1$
- (B) $1s^2 2s^2 2p^6 3s^2 3d^6$
- C. $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{56} 4s^2$
- D. $1s^2 2s^2 2p^6 3s^2 3p^6 3d^8 4s^2$
- E. $1s^2 2s^2 2p^6 3s^2 3p^6 3d^4 4s^2$

$1s^2 2s^2 2p^6 3s^2 3p^6 3d^6$

E 6. Which of the following contains only atoms that are diamagnetic in their ground state? No unpaired e^-
- A. Kr, Ca, and P
- B. Cl, Mg, and Cd
- C. Ar, K, and Ba
- D. He, Sr, and C
- E. Ne, Be, and Zn

X 7. A valence electron from an arsenic atom might have an electron with the following set of quantum numbers in the ground state?
- A. $n = 4; \ell = 1, m_l = 0; m_s = +\frac{1}{2}$
- B. $n = 4; \ell = 1, m_l = 2; m_s = -\frac{1}{2}$
- C. $n = 3; \ell = 1, m_l = 0; m_s = +\frac{1}{2}$
- D. $n = 5; \ell = 1, m_l = -1; m_s = -\frac{1}{2}$
- E. $n = 4; \ell = 2, m_l = +1; m_s = +\frac{1}{2}$

(Use the following ground-state electron configurations for questions 8-11):

A. $1s^2 1p^6 2s^2 2p^3$
B. $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^1$ ✓
C. $1s^2 2s^2 2p^6 3s^2 3p^6 3d^3$ → Lost 4s
D. $1s^2 2s^2 2p^5$
E. $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6$

D 8. The electron configuration of a halogen is:

B 9. This is a possible configuration for a transition metal atom.

A 10. This electron configuration is not possible. No 1p

C 11. This is a possible configuration of a transition metal ion.

(The following answers are to be used for questions 12-15):

A. Pauli exclusion principle
B. electron shielding
C. the wave properties of matter
D. Heisenberg uncertainty principle
E. Hund's rule

D 12. The exact position of an electron is not known.

E 13. Oxygen atoms, in their ground state, are paramagnetic.

A 14. An atomic orbital can hold no more than two electrons.

____ 15. The reason the 4s orbital fills before the 3d. = Aufbau

X 16. In the ground state the highest-energy electron of a rubidium atom might have which of the following sets of quantum numbers?

A. $n = 5; \ell = 0, m_l = 1; m_s = +\frac{1}{2}$
B. $n = 5; \ell = 1, m_l = 1; m_s = +\frac{1}{2}$
C. $n = 4; \ell = 0, m_l = 0; m_s = +\frac{1}{2}$
D. $n = 5; \ell = 0, m_l = 0; m_s = +\frac{1}{2}$
E. $n = 6; \ell = 0, m_l = 0; m_s = +\frac{1}{2}$

A.P. Chemistry

Chapter 7 Practice Questions

Answer the following questions.

1. The bond energy of fluorine is 159 kJ/mol.

    i. Determine the energy, in J, of a photon of light needed to break a F–F bond.
    ii. Determine the frequency of this photon in s^{-1}.
    iii. Determine the wavelength of this photon in nanometers.

2. Determine the wavelength, in m, of an alpha particle traveling at 5.2×10^7 m/s. An alpha particle has a mass of 6.6×10^{-24} g. (Use DeBroglie's wavelength equation.)

3. Barium imparts a characteristic green color to a flame. The wavelength of this light is 551 nm. Determine the energy involved in kJ/mol.

4. The average atomic mass of naturally occurring neon is 20.18 amu. There are two common isotopes of naturally occurring neon as indicated in the table below.

Isotope	Mass (amu)
Ne-20	19.99
Ne-22	21.99

    a. Using the information above, calculate the percent abundance of each isotope.

    b. Calculate the number of Ne-22 atoms in a 12.55 g sample of naturally occurring neon.

5. A major line in the emission spectrum of neon corresponds to a frequency of $4.34 \times 10^{14}\ s^{-1}$.

   a. Calculate the wavelength, in nanometers, of light that corresponds to this line.

6. In the upper atmosphere, ozone molecules decompose as they absorb ultraviolet (UV) radiation, as shown by the equation below. Ozone serves to block harmful ultraviolet radiation that comes from the sun.

$$O_3(g) \xrightarrow{UV} O_2(g) + O(g)$$

A molecule of $O_3(g)$ absorbs a photon with a frequency of $1.00 \times 10^{15}\ s^{-1}$.

   a. How much energy, in joules, does the $O_3(g)$ molecule absorb per photon?

   b. The minimum energy needed to break an oxygen-oxygen bond in ozone is 387 kJ mol^{-1}. Does a photon with a frequency of $1.00 \times 10^{15}\ s^{-1}$ have enough energy to break this bond? Support your answer with a calculation.

FR

1. $\frac{159\,kJ}{1\,mol} \times \frac{1000\,J}{1\,kJ} \times \frac{1\,mol}{6.02\times10^{23}} = 2.64\times10^{-19}\,J$

$E = h\nu$

$2.64\times10^{-19}\,J = (6.63\times10^{-34}\,J{\cdot}s)\,\nu$

$\nu = 3.98\times10^{14}\,/s$

$\lambda = \frac{3.00\times10^{8}\,m/s}{3.98\times10^{14}\,/s} = 7.53\times10^{-7}\,m \times \frac{1\times10^{9}\,nm}{1\,m} = 753\,nm$

2. $\lambda = \frac{h}{mv}$ $\quad \lambda = \frac{6.63\times10^{-34}\,J{\cdot}s}{(6.6\times10^{-27}\,kg)(5.2\times10^{7}\,m/s)}$

$= 1.9\times10^{-15}\,m$

3. 551 nm $\quad E = \frac{hc}{\lambda} = \frac{(6.63\times10^{-34}\,J{\cdot}s)(3.00\times10^{8}\,m/s)}{5.51\times10^{-7}\,m}$

$= 3.61\times10^{-19}$

$\frac{3.61\times10^{-19}\,J}{1\,photon} \times \frac{1\,kJ}{1000\,J} \times \frac{6.02\times10^{23}}{mol} = 217\,kJ/mol$

4.

$20.18 = (x)(19.99) + (1-x)(21.99)$

$20.18 = 19.99x + 21.99 - 21.99x$

$20.18 = -2x + 21.99$

$2x = 1.81$

$x = .905$

90.5% 19.99

9.5% 21.99

$12.55\,g \times \frac{1\,mol}{20.18} \times \frac{6.02\times10^{23}\,atoms}{1\,mol} = 3.74\times10^{23}$ atoms

$(.095)(3.74\times10^{23}) = 3.56\times10^{22}$

5. $\lambda = \frac{c}{\nu}$ $\lambda = \frac{3.00\times10^{8}\,m/s}{4.34\times10^{14}\,s^{-1}} = 6.91\times10^{-7}\,m$

$6.91\times10^{-7}\,m \times \frac{1\times10^{9}\,nm}{1\,m} = 691\,nm$

6. $E = h\nu$ $E = (6.63\times10^{-34}\,J\cdot s)(1.00\times10^{15}\,s^{-1})$

$= 6.63\times10^{-19}\,J$ / photon

$6.63\times10^{-19}\,J \times \frac{1\,kJ}{1000\,J} \times \frac{6.02\times10^{23}\,phot}{1\,mol} = 399\,kJ/mol$

Yes