Chemistry 211 Name: _____
Fall 2023 Please Print
Test 3

Multiple Choice: (4 points each. Put answers in left margin as capital letters.)
$h = 6.626 \times 10^{-34}$ J•s

1. Which of the following processes is endothermic?

   A) A ball rolling down a hill
   B) Boiling water
   C) A fire burning
   D) Iron rusting
   E) Steam condensing

2. What is ΔH for the net reaction below?

$N_{2\,(g)} + O_{2\,(g)} \longrightarrow 2\ NO_{(g)}$ ΔH = 180.5 kJ
$NO_{(g)} + \frac{1}{2}\ O_{2\,(g)} \longrightarrow NO_{2\,(g)}$ ΔH = -57.1 kJ
$N_{2\,(g)} + 2\ O_{2\,(g)} \rightarrow 2\ NO_{2\,(g)}$ ΔH = ?

   A) -123.4 kJ B) -66.3 kJ C) 66.3 kJ D) 123.4 kJ E) 132.6 kJ

3. Which of the following sets of quantum numbers is <u>not</u> permissible? ($n, \ell, m_\ell$)

   A) 2, 1, 1 B) 3, 3, 0 C) 4, 2, 1 D) 4, 1, -1 E) 5, 4, -1

4. An electron moves from the n = 1 level to the n = 2 level in hydrogen. Its energy changes by a factor of

   A) ¼ B) ½ C) $^3/_4$ D) 1 E) 2

5. Which of the following quantum numbers provides information about the energy of the electron in hydrogen?

   A) $\ell$ B) $m_\ell$ C) $m_s$ D) $n$ E) $E$

6. Which of the following species is isoelectronic to $As^{2-}$?

   A) Br B) $Br^{2+}$ C) $Ga^{-}$ D) Kr E) $Sb^{2-}$

7. What is the energy of one mole of photons of light with a wavelength of 437 nm?

   A) $5.86 \times 10^{-8}$ J
   B) $3.65 \times 10^{-3}$ kJ
   C) 274 kJ
   D) $2.11 \times 10^{3}$ kJ
   E) $8.77 \times 10^{5}$ kJ

8. Which atom is least electronegative?

   A) Al B) As C) I D) Li E) S

9. Which of the following is least likely to form an elemental ion (i.e. $X^{n+}$ or $X^{n-}$)?

   A) Cl B) Mg C) Na D) S E) Si

Discussion Questions: (You must show your work to receive credit.

1. Why is $\Delta H_f^o$ for $XeF_6$ is exothermic? [Hint: Writing the reaction should be helpful.] (5 points)

2. Write the formation reaction for ethanol, $C_2H_5OH_{(\ell)}$. (5 points)

3. Write out the electron configuration of the following and provide the number of unpaired electrons on each (10 points)

   Fe: $Sn^{2+}$:

4. Neon signs have a characteristic orange glow that results from passing an electrical current through the gas. The light is emitted because the neon atoms become excited and their return to the ground state results in light emission. (12 points)
   a) The wavelength of the emitted light is 585 nm. What is its frequency?
   b) Calculate the energy gap between the ground and excited state.
   c) What is the energy of 0.10 moles of these photons?

5. Draw the Lewis structures of $IF_3$ and $HBrO_2$. Which is the most electronegative element in each molecule? (12 points)

6. In the Bohr model of the ground state of hydrogen, the electron orbits the nucleus in a circle with a radius of 0.53 Å. Is this also true in the quantum-mechanical description of the hydrogen atom? Explain. (5 points)

7. Sketch the shape and orientation of the $p_x$ and $d_{xy}$ orbitals. (5 points)

8. For each of the following pairs, indicate which element has the larger atomic radius and provide your rationale: (10 points)

   a) S *vs*. Si

   b) N *vs*. P