Name: ____________________________ Date: ______________

1. A fixed quantity of gas absorbs 253 kJ of heat while doing 836 kJ of work. Calculate the overall change in the system's internal energy, ΔU.

A) - 583 kJ
B) + 583 kJ
C) + 1089 kJ
D) - 1089 kJ
E) + 2.12 x 10^5 kJ

2. Which of the following statements is FALSE for an endothermic reaction?

A) The enthalpy of the system decreases.
B) ΔH is positive.
C) Heat is transferred to the system.
D) The temperature of the surroundings decreases.
E) The enthalpy of the products is more than that of the reactants.

3. Given the following reactions:

$$C_6H_4(OH)_2(aq) \longrightarrow C_6H_4O_2(aq) + H_2(g) \qquad \Delta H = +177.4 \text{ kJ}$$

$$O_2(g) + 2H_2O(l) \longrightarrow 2H_2O_2(aq) \qquad \Delta H = +189.1 \text{ kJ}$$

$$H_2O(l) \longrightarrow H_2(g) + \frac{1}{2}O_2(g) \qquad \Delta H = +285.8 \text{ kJ}$$

Calculate □*H* for the reaction:

$$C_6H_4(OH)_2(aq) + H_2O_2(aq) \longrightarrow C_6H_4O_2(aq) + 2H_2O(l)$$

A) - 203.0 kJ
B) - 558.0 kJ
C) - 13.6 kJ
D) - 583.3 kJ
E) + 274.0 kJ

4. The equation for the standard formation for the hydrazine, N_2H_4, is

A) $N_2(g) + 2H_2(g) \rightarrow N_2H_4\ (g)$
B) $2NO_2\ (g) + 6\ H_2(g) \rightarrow N_2H_4\ (g) + 4\ H_2O\ (g)$
C) $2\ N_2H_4\ (g) \rightarrow 2\ NH_3(g) + H_2(g)$
D) $2N_2(g) + 4H_2(g) \rightarrow 2N_2H_4\ (g)$
E) $N_2(g) + 2H_2O\ (g) \rightarrow N_2H_4\ (g) + O_2(g)$

5. Consider the reaction:

$$2Na(s) + 2H_2O(l) \rightarrow 2NaOH(aq) + H_2(g)$$

When 2 moles of Na react with water at 25°C and 1 atm, the volume of H_2 formed is 24.5 L. Calculate the work done in joules when 0.34 g of Na reacts with water under the same conditions. (1 L·atm = 101.3 J)

A) - 18 J
B) - 36 J
C) -24 J
D) - 34 J
E) - 9.0 J

6. What is the ratio between energy for the $n = 1$ to $n = 2$ transition and the ionization energy of the hydrogen atom?

A) 3/4
B) 1/2
C) 1/9
D) 1/4
E) 1/8

7. Which one of the following statements is FALSE about the photoelectric effect?

A) The number of the electrons ejected is proportional to the frequency of the incident light.
B) The number of the electrons ejected is proportional to the intensity of the incident light.
C) The energy of the electrons ejected is proportional to the frequency of the incident light.
D) Electrons leave a metal when the energy of the incoming radiation exceeds the binding energy.
E) The more energetic the incident photons, the greater the kinetic energy of the ejected electrons.

8. Calculate the frequency of an emitted gamma photon having the energy of 3.14×10^{11} J/mol.

A) $7.87 \times 10^{20}\ s^{-1}$
B) $3.82 \times 10^{13}\ s^{-1}$
C) $5.21 \times 10^{13}\ s^{-1}$
D) $9.64 \times 10^{22}\ s^{-1}$
E) $4.22 \times 10^{22}\ s^{-1}$

9. How many unpaired electrons does a ground-state atom of chromium (Cr) have?

A) 6
B) 5
C) 4
D) 3
E) 7

10. Calculate the wavelength of a neutron that has a velocity of 100. cm/s. (The mass of a neutron = 1.675 □10^{-27} kg).

A) 396 nm
B) 5.05 nm
C) 663 nm
D) 1.98×10^{-9} m
E) 216 nm

11. Consider the element with the electron configuration [Xe] $4f^6\, 6s^2$. This element is

A) a lanthanide element.
B) a halogen.
C) a transition metal.
D) an alkali metal.
E) an actinide element.

12. Which one of the following statements is **TRUE**?

A) The electron affinity of bromine (Br) is greater than that of selenium (Se).
B) The first ionization energy of hydrogen (H) is greater than that of helium (He).
C) The first ionization energy of phosphorus (P) is less than that of sulfur (S).
D) **The fourth ionization energy of boron (B) is only slightly greater than the third ionization energy of the same element.**
E) The ionic radius of Fe^{2+} is smaller than that of Fe^{3+}.

13. The correct order of atomic radii of elements Cl, F, S and Ne is ....

A) S > Cl > F > Ne
B) Ne > F > Cl > S
C) F > Ne > S > Cl
D) S > Cl > F > Ne
E) Ne > S > Cl > F

Both A and D are correct answers

14. What is the correct electron configuration for the Te^{2-} ion?

A) [Kr] $5s^2 4d^{10} 5p^6$
B) [Kr] $5s^2 5d^{10} 5p^4$
C) [Kr] $5s^2 4d^{10} 5p^4$
D) [Kr] $5s^2 4f^{14}$
E) [Kr] $5s^2 5p^6$

15. Which one of the following sets of four quantum numbers that most likely represent the last electron of the Zn atom?

A) $n = 3, l = 2, m_l = 2, m_s = -\frac{1}{2}$
B) $n = 3, l = 1, m_l = 1, m_s = +\frac{1}{2}$
C) $n = 3, l = 3, m_l = 2, m_s = -\frac{1}{2}$
D) $n = 4, l = 2, m_l = 0, m_s = +\frac{1}{2}$
E) $n = 4, l = 3, m_l = 3, m_s = -\frac{1}{2}$

16. What is the magnitude of the partial negative and partial positive charges in the HI molecule?

Given:
$1\ D = 3.36 \times 10^{-30}$ C m;
$1\ e^- = 1.6022 \times 10^{-19}$ C;
1 angstrom = 1.0×10^{-10} m;
bond length HI = 1.61 angstroms;
Dipole Moment HI = 0.44 D

A) -0.057 and +0.057
B) -0.76 and +0.76
C) -1.2 and +1.2
D) -0.065 and +0.065
E) -0.86 and +0.86

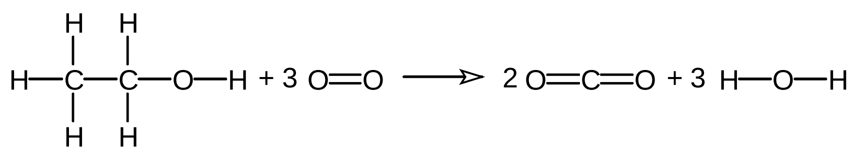
17. In which one of the following species is the central atom (the first atom in the formula shown by underline) likely to violate the octet rule?

A) $\underline{Xe}F_4$
B) $\underline{B}F_4^-$
C) $\underline{C}Cl_4$
D) $\underline{N}H_3$
E) $\underline{C}H_2Cl_2$

18. In the Lewis structure of the iodate ion, IO_3^-, that satisfies the octet rule, the formal charge on the central iodine atom is:

A) +2
B) +1
C) 0
D) -1
E) -2

19. Use bond energies to estimate the enthalpy change for the reaction of



C – H (413 kJ/mol) C = O (799 kJ/mol) O = O (495 kJ/mol)
C – C (347 kJ/mol) O – H (467 kJ/mol) C – O (358 kJ/mol)

A) -1276 kJ
B) -638 kJ
C) -946 kJ
D) -955 kJ
E) - 1465 kJ

20. Use the Born-Haber cycle to calculate the lattice energy of LiCl(s) given the following data:

Sublimation energy for Li:	Li (s) $\rightarrow$ Li (g)	$\Delta H°$ = 155.2 kJ/mol
First ionization energy for Li:	Li(g) $\rightarrow$ Li^+(g) + e^-	$\Delta H°$ = 520. kJ/mol
Bond energy (Cl-Cl):	Cl_2(g) $\rightarrow$ 2Cl(g)	$\Delta H°$ = 242.8 kJ/mol
Electron affinity for Cl:	Cl(g) + e^- $\rightarrow$ Cl^-(g)	$\Delta H°$ = -348 kJ/mol

Standard heat of formation for LiCl(s) Li(s) + $\frac{1}{2}$ Cl_2(g) $\rightarrow$ LiCl(s) $\Delta H°_f$ = -408.8 kJ/mol
Lattice energy for LiCl(s) LiCl(s) $\rightarrow$ Li^+(g) + Cl^-(g)

A) 857 kJ/mol
B) 40.0 kJ/mol
C) 736 kJ/mol
D) -40.0 kJ/mol
E) 1550 kJ/mol

Answer Key

1. A
2. A
3. A
4. A
5. A
6. A
7. A
8. A
9. A
10. A
11. A
12. A
13. A
14. A
15. A
16. A
17. A
18. A
19. A
20. A