Name_____

_____1. When ΔH° is negative at constant pressure for a given chemical or physical process, it indicates that A) the process is endothermic B) work is being done on the system C) work is being done by the system D) heat is flowing into the system E) the process releases energy in the form of heat

_____2. ΔH° for the reaction $2\ HCl(g) + I_2(s) \rightarrow 2\ HI(g) + Cl_2(g)$ is
A) –66.4 kJ B) +66.4 kJ C) 118.2 kJ D) 236.4 kJ E) –236.4 kJ

_____5. $C(s) + O_2(g) \rightarrow CO_2(g)$ $\Delta H = -393.5$ kJ

$2C(s) + O_2(g) \rightarrow 2\ CO(g)$ $\Delta H = -221.1$ kJ

The heats of combustion of graphite to CO_2 and CO are given above. What is the standard enthalpy change for the reaction $CO(g) + \frac{1}{2}\ O_2 \rightarrow CO_2(g)$?

A) –283.0 kJ B) –627.1 kJ C) –172.4 kJ D) + 172.4 kJ E) + 627. 1 kJ

_____8. Given: $NO(g) + \frac{1}{2}\ O_2(g) \rightarrow NO_2(g)$ $\Delta H^\circ = -59$ kJ
$NO_2(g) + 2\ H_2(g) \rightarrow 2\ H_2O(g) + \frac{1}{2}\ N_2(g)$ $\Delta H^\circ = -519$ kJ
$H_2(g) + \frac{1}{2}\ O_2(g) \rightarrow H_2O(g)$ $\Delta H^\circ = -243$ kJ

What is the heat of formation, ΔH°_f of NO(g) ?
A) + 92 kJ/mol B) +335 kJ/mol C) –820 kJ/mol D) –1063 kJ/mol

_____9. For which chemical equation will the heat of reaction, ΔH°, correspond to the molar heat of formation of liquid water?
A) $H_2(g) + \frac{1}{2}\ O_2(g) \rightarrow H_2O(\ell)$ B) $H(g) + H(g) + O(g) \rightarrow H_2O(\ell)$
C) $2\ H_2(g) + \frac{1}{2}\ O_2(g) \rightarrow 2\ H_2O(\ell)$ D) $H^+(aq) + OH^-(aq) \rightarrow H_2O(\ell)$

_____15. How much heat is needed to raise the temperature of 1.00 mole of water from 10.0°C to 50.0° C? A) 167 J B) 3.01 kJ C) 9.29 J D) 3760 J E) 40.0 kJ

18 to 20. Indicate whether each of the following values is positive (+) negative (–) or zero. (0)

_____18. ΔH of formation of $Br_2(\ell)$

_____19. ΔH of formation of $Cl_2(\ell)$

_____20. The charge on the nucleus of a chloride ion

_____21. The Rutherford Gold Leaf experiment established that
A) atoms contain three different subatomic particles
B) atoms are mostly empty space
C) variations in atomic mass are caused by different numbers of neutrons
D) the energy of an electron is quantized
E) electrons have a negative charge

_____22. Which metal has the smallest **second** ionization energy?
A) Be B) Na C) Mg D) Ca E) K

_____23. In which compound are the two ions (positive and negative) isoelectronic?
A) MgF_2 B) KBr C) NaCl D) LiF E) RbCl

_____25. How many unpaired electrons are there on an Ni^{3+} ion?
A) 0 B) 2 C) 3 D) 5 E) 7

_____26. In a hydrogen atom, which of the following electron drops would produce the highest frequency of light? A) from n=6 to n=3 B) from n=2 to n=1
C) from n=4 to n=2 D) from n=6 to n=5 D) from n=7 to n=3

_____27. The total number of electron orbitals available in the fourth principal energy level is A) 4 B) 16 C) 9 D) 18 E) 32

_____28. In the Stern-Gerlach experiment, silver atoms were shot through a powerful magnetic field. The stream of atoms divided into two separate paths. This division would **not** be observed with atoms of A) Cu B) Cr C) Mg D) K E) Al

Base your answers on the following elements in the ground state:
A) $^{31}_{15}P$ B) $^{32}_{16}S$ C) $^{35}_{17}Cl$ D) $^{7}_{3}Li$ E) $^{19}_{9}F$

_____29. Has the lowest first ionization energy

_____30. Has only three electrons in the 3 p energy level

_____31 Has a higher ionization energy than the element on either side of it in the same period of the periodic table
_____32. Of the above, has the smallest atomic radius.

_____33. Has the highest **second** ionization energy.

_____34. The Pauli exclusion principle states that A) the velocity of all electromagnetic radiation equals the speed of light B) all particles with mass also have a wave length
C) the velocity of an electron and its exact position cannot be known at the same instant
D) each electron in an atom has its own unique set of four quantum numbers
E) as many electrons as possible remain unpaired within one atomic subshell

PROBLEMS: (8 points each, except for problem II, which is 10 points)

I. A 0.110 gram sample of propane, C_3H_8 (MM = 44.1) is burned in excess oxygen to produce H2O (ℓ) and CO2(g)

A. Write the balanced equation for the reaction.

B. The combustion of the 0.110 grams of C_3H_8 produces enough heat to change the temperature of 232.2 grams of water from 25.00℃ to 30.75 C.

1. How much heat was produced in the combustion of the 0.110 grams ?

2. What is the value of ΔH° of the reaction in part A, in kJ per mole of propane? (the heat of combustion of propane)

C. Based on your answer to B part 2, and the data on the thermo table, what is the heat of formation, ΔH_f, of propane gas, in kJ/mol ?

(If you were unable to answer part B, use – 2200 kJ as the heat of combustion)

II. The combustion of ethane, C_2H_6 is the subject of this problem:

$$2\ C_2H_6(g) + 7\ O_2(g) \rightarrow 4\ CO_{2(g)} + 6\ H_2O(l)$$

A. Find ΔH for this reaction, as written.

B. How much heat is produced in the combustion of 10.00 gram of ethane?

III. Explain each of the following observations using principles of atomic structure and/or bonding.

(a) Potassium has a lower first-ionization energy than lithium.
(b) The ionic radius of N^{3-} is larger than that of O^{2-}.
(c) A calcium atom is larger than a zinc atom.
(d) Boron has a lower first-ionization energy than beryllium.

V. Provide the electron configurations of each of the following atoms and/or ions. You may NOT use condensed configurations.

A. Mn B. Ga^{3+} C. Ti^{2+} D. As^{3-}