Name _____ Test 3 (12/9)
CHEM 0101 (Intro Chem) Fall 2009

1. Like gasoline, diesel fuel is a mixture of compounds. However, the energy released during the combustion of diesel fuel can be approximated using the equation below.

$C_{12}H_{24}(l) + 18\ O_2(g) \longrightarrow 12\ CO_2(g) + 12\ H_2O(g)$ $\Delta H \approx -5{,}600$ kJ/mol

a. (10 pts.) Determine the amount of energy released by burning 3500 g of diesel fuel.

b. (10 pts.) Determine the mass of CO_2 released during the reaction in part a.

2. (10 pts.) Determine the mass of CO_2 released when enough CH_4 is burned to release the same amount of energy as in part 1.a.

$CH_4(g) + 2\ O_2(g) \longrightarrow CO_2(g) + 2\ H_2O(g)$ $\Delta H = -802.3$ kJ/mol

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____

3. (10 pts.) Per joule of energy released, diesel fuel releases more CO_2 than gasoline. Explain how a vehicle powered by diesel fuel can still release less CO_2 than a similarly sized vehicle powered by gasoline.

4. (4 pts.) In lab, you compared the amount of energy released during the combustion of combustion of candle wax, wood, and methanol. Equations for the reaction are written below.

Combustion of candle wax

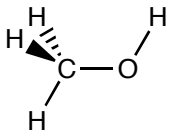
$$C_{25}H_{52}\ (g) + 38\ O_2\ (g) \longrightarrow 25\ CO_2\ (g) + 26\ H_2O\ (g)$$

*this equation is based on the untrue but not totally unreasonable premise that the candle is made from pure paraffin with the indicated formula

Combustion of methanol

$$CH_3OH\ (l) + O_2\ (g) \longrightarrow CO_2\ (g) + 2\ H_2O\ (g)$$

You discovered that per gram of fuel burned, the combustion of candle wax released more energy than the combustion of methanol. Considering that energy is released for every C to O bond and every H to O bond formed, explain why the combustion of CH_3OH (structure provided below) releases less energy.



methanol

5. (10 pts.) Briefly describe how a coal fired electric power plant generates electrical power.

6. In the sun, four protons (H^+) are fused together to form a helium ion ($^4He^{2+}$) and two positrons (β^+). Although this fusion reaction releases a lot of energy, and produces no radioactive byproducts, this reaction is too difficult to recreate on earth. Instead, some scientists work with the following reaction to generate energy from a fusion reaction.

$$^{2}_{1}H + {}^{3}_{1}H \longrightarrow {}^{4}_{2}He + {}^{1}_{0}n$$

a. (2 pts.) In this nuclear reaction, how many protons are on the reactant side of the arrow?

b. (2 pts.) How many protons are on the product side of the arrow?

c. (2 pts.) How many neutrons are on the reactant side of the arrow?

d. (2 pts.) How many neutrons are on the product side of the arrow (yes, $^{1}_{0}n$ is a neutron),

e. (2 pts.) Is this a balanced reaction?

f. (2 pts.) Is mass conserved in this reaction? That is, would the mass of the reactants be greater than the mass of the products, the same as the mass of the products, or less than the mass of the products.

7. (10 pts.) Briefly describe how the energy released by the fission of ^{235}U is converted to electrical energy.

8. (10 pts.) Are the metals oxidized or reduced in the following reactions.

a. $Pb^{2+}(aq) + H_2O(l) \longrightarrow PbO_2(s) + H_2(g)$

b. $2\ HgO(s) \longrightarrow 2\ Hg(l) + O_2(g)$

c. $2\ Na(s) + 2\ H_2O(l) \longrightarrow H_2(g) + 2\ NaOH(aq)$

9. (2 pts each) In a silver oxide battery (small watch batteries) the following reaction occurs.

$$Ag_2O(s) + Zn(s) \longrightarrow ZnO(s) + 2\ Ag(s)$$

a. Determine the charge of the Zn in the reactant.	b. Determine the charge of the Zn in the product.
c. Determine the charge of the Ag in the reactant.	d. Determine the charge of the Ag in the product.
e. Determine the charge of the O in the reactant.	f. Determine the charge of the O in the product.

g. Which atom(s) is/are gaining electrons?

h. Which atom(s) is/are losing electrons?

10. A reaction is drawn below.

$$4\ Na(s) + O_2(g) \longrightarrow 2\ Na_2O(s)$$

The charges for the atoms in the reaction written above are

	as a reactant	as a product
Na	**0**	in Na_2O **+1**
O	**0**	in Na_2O **–2**

a. (4 pts.) Consider the balanced chemical equation and determine the number of electrons that move during the reaction.

b. (2 pts.) Which atom(s) is/are losing electrons?

c. (2 pts.) Which atom(s) is/are gaining electrons?