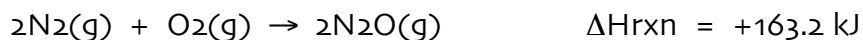# PRACTICE TEST/THERMOCHEMISTRY/AP CHEMISTRY

1.
  a) Calculate the amount of heat transferred when 10.00 g of N2O(g) is formed by the following reaction:

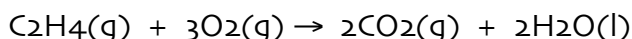$$2N_2(g) + O_2(g) \rightarrow 2N_2O(g) \qquad \Delta Hrxn = +163.2 \text{ kJ}$$

  b) Draw an energy diagram for this process.

2. Predict the value for $\Delta H°f$ for the following scenarios:

  a) $Br_2(g)$
  b) $Br_2(l)$
  c) $I_2(g)$
  d) $I_2(s)$

3. Calculate the $\Delta Hrxn$ for the following reaction:

$$C_2H_4(g) + 3O_2(g) \rightarrow 2CO_2(g) + 2H_2O(l)$$

$$\Delta H°f \quad C_2H_4(g) = 226.6 \text{ kJ/mol}$$
$$\Delta H°f \quad CO_2(g) = -393.5 \text{ kJ/mol}$$
$$\Delta H°f \quad H_2O(l) = -285.8 \text{ kJ/mol}$$

4. A 5.00 g sample of liquid water at 25.0°C is heated by the addition of 84.0 J of energy. The final temperature of the water is _____°C. The specific heat capacity of the liquid is 4.18 J/g°C.

  a) -21   b) 4.02   c) 25.2   d) 95.2   e) 29.0

5. THIS PROBLEM WAS TAKEN DIRECTLY FROM THE 1995 AP CHEM. EXAM.
   Propane is a hydrocarbon that is commonly used as a fuel for cooking.
   Propane's formula is C3H8.
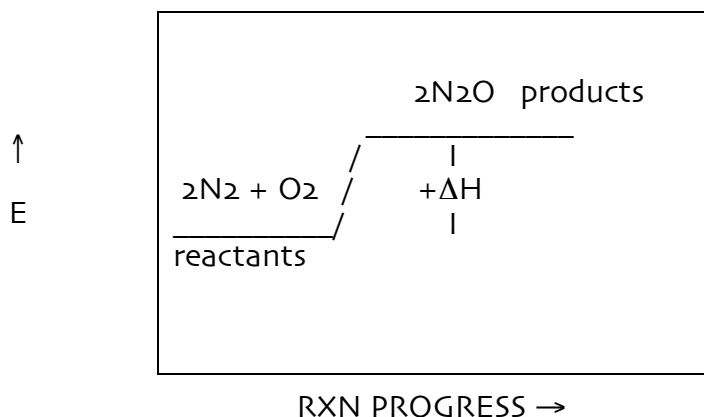
  a) Write a balanced equation for the complete combustion of propane gas.

  b) Calculate the volume of air at 30°C and 1.00 atm that is needed to burn completely 10.0 g of propane. Assume that air is 21.0% O2 by volume.

  c) The heat of combustion ($\Delta H°_{combustion}$) is -2,220.1 kJ/mol. Calculate the heat of formation, $\Delta H°_f$, of propane given that ΔH_f of H2O(l) is -285.3 kJ/mol and $\Delta H°_f$ of CO2(g) is -393.5 kJ/mol.

  d) Assuming that all of the heat evolved burning 10.0 g propane is transferred to 8.00 kg of water (specific heat = 4.184 J/g°C), calculate the increase in temperature of the water.

ANSWERS TO PRACTICE TEST:

1.
a) 10.00 g of N2O(g) X 1 mol N2O(g)/44.02 g X 163.2 kJ/2 moles N2O(g) = 18.54 kJ (endothermic)

b) ENERGY DIAGRAM:

```
                              2N2O   products
                              _____
 ↑                 /            |
            2N2 + O2  /         +ΔH
 E                  /           |
         _____ /           |
         reactants
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RXN PROGRESS →

2.
a) Br2(g) is > 0   This is because elemental Br2 is a liquid. Therefore, energy must be added (+) to the liquid in order for it to become a gas.

b) Br2(l) = 0   This is because it is in its pure elemental form.

c) I2(g) = > 0   This is because elemental I2 is a solid. Therefore, energy must be added (+) to the solid in order for it to become a gas.

d) I2(s) = 0   This is because it is in its pure elemental form.

3.
$\Delta H°rxn = \Sigma n\Delta H°f \text{ (products)} - \Sigma m\Delta H°f \text{ (reactants)}$

$\Delta H°rxn = \Sigma 2[(\Delta H°f \ CO_2(g)) + 2(\Delta H°f \ H_2O(l))] - [1(\Delta H°f \ C_2H_4(g)) + 3(\Delta H°f \ O_2(g))]$

$\Delta H°rxn = [2(-393.5 \text{ kJ/mol}) + 2(-285.3 \text{ kJ/mol})] - [1(226.6 \text{ kJ/mol}) + 3(0)]$

$\Delta H°rxn = (-787.0 \text{ kJ} + -570.6 \text{ kJ}) - (226.6 \text{ kJ/mol}) = -1584.2 \text{ kJ/mol of } C_2H_4 \text{ combusted}$
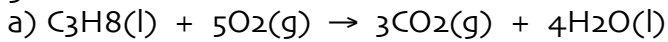
4.
The answer is E.

Work:

$q = (ms\Delta T)$ 84.0 J = $[(5.00 \text{ g})(4.184 \text{ J/g°C})(T_f - 25.0°C)]$

                     84.0 J = $(20.92 \text{ J/°C})(T_f - 25.0°C)$

                     84.0 J = $-20.92 \ T_f - 523 \text{ J}$

                     607 J = $-20.92 T_f$ $T_f = 29.0°C$

5.
a) $C_3H_8(l) + 5O_2(g) \rightarrow 3CO_2(g) + 4H_2O(l)$

b) we haven't done gas laws yet, but . . . .

10.0 g C_3H_8 X 1 mol C_3H_8/44.11 g C_3H_8 X 5 mol O_2/1 mol C_3H_8 = 1.13 moles O_2 =

moles pure O_2 needed.

Since the ideal gas law says, PV = nRT
(p=pressure in atm, V = volume in L, n = moles, R is a constant, and T = temperature in Kelvin)

So, V = nRT/P
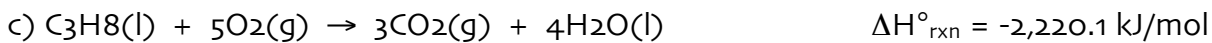
V of pure O_2 = 1.13 moles(0.0821Latm/molK)(303K)/1.00 atm = 28.1 Liters pure O_2

So, if O_2 is 21.0% of air . . . .

(X Liters of air)(.210) = 28.1   28.1/.210 = 134 Liters of air.

c) $C_3H_8(l) + 5O_2(g) \rightarrow 3CO_2(g) + 4H_2O(l)$ $\Delta H°_{rxn}$ = -2,220.1 kJ/mol

$\Delta H°_{rxn}$ = $\Sigma n\Delta H°f$ products - $\Sigma m\Delta H°f$ reactants

-2,220.1 kJ/mol = [3(-393.5 kJ) + 4(-285.3 kJ)] – [$\Delta H°f$ C_3H_8 + 5(0 kJ)]

-2,220.1 kJ/mol = [-1180.5 kJ + -1141.2 kJ] – $\Delta H°f$ C_3H_8

-2,220.1 kJ/mol = -2321.7 kJ – $\Delta H°f$ C_3H_8 $\rightarrow$ $\Delta H°f$ C_3H_8 = -101.6 kJ/mol

d)10.0 g C_3H_8 X 1 mol C_3H_8/44.11 g X -2220.1 kJ/1mol = -503.3 kJ

qrxn = -(qH2O + qcal) THERE IS NO CALORIMETER HEAT CAPACITY PROVIDED, SO OMIT THIS . .

qrxn = -(qH2O) $\rightarrow$ -503,000 J = -[(8.00 kg X 1000 g/kg)(4.184 J/g°C)(ΔT)

-503,000 J = -33472 J/°C ΔT $\rightarrow$ 15.0°C = ΔT