# Quiz 8 – Thermochemistry
AP Chemistry

This quiz must be completed and brought to my room <u>before</u> the start of first period on Tuesday. Failure to do so will incur a 25% penalty unless there is a legal reason.

You must <u>show all work</u> in order to receive credit.

1. **A 0.0500 L sample of 0.200 M aqueous hydrochloric acid is added to 0.0500 L of 0.200 M aqueous ammonia in a calorimeter whose heat capacity is 480 J/^{o}K. The temperature increase is 1.09^{o}K. Calculate DH^o in kJ/mole for the following reaction.**

$$HCl(aq) + NH_3(aq) → NH_4Cl(aq)$$
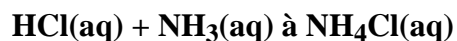
2. **Dimethylhydrazine, used as a rocket fuel. Given the enthalpies of formation, calculate the energy liberated when 10 g of dimethylhydrazine reacts.**
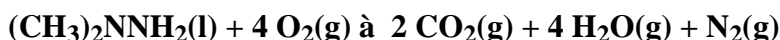   **(Atomic weights: C = 12.01, N = 14.01, H = 1.008, O = 16.00).**

$$(CH_3)_2NNH_2(l) + 4\,O_2(g) → 2\,CO_2(g) + 4\,H_2O(g) + N_2(g)$$
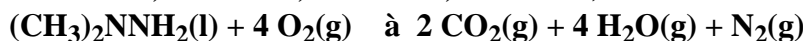
```
DHᵒ (CH₃)₂NNH₂ = +42.0 kJ/mole
DHᵒ H₂O(g) = -241.8 kJ/mole
DHᵒ CO₂(g) = -393.3 kJ/mole
```
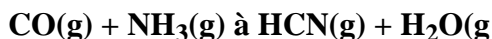
3. **Given the heat of reaction, DH^o = -1796.2 kJ, and the indicated heats of formation, determine the heat of formation of $(CH_3)_2NNH_2(l)$ in kJ.**

$$(CH_3)_2NNH_2(l) + 4\,O_2(g) → 2\,CO_2(g) + 4\,H_2O(g) + N_2(g)$$

```
DHᵒ_f CO₂(g) = -393.5 kJ
DHᵒ_f H₂O(g) = -241.8 kJ
```

4. **Calculate DH^o_f (kJ) for the following reaction from the listed standard enthalpies of formation:**

$$CO(g) + NH_3(g) → HCN(g) + H_2O(g$$
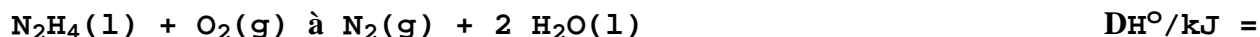
```
DHᵒ_f CO(g) = -110.5 kJ
DHᵒ_f NH₃(g) = -46.1 kJ
DHᵒ_f HCN(g) = +135.1 kJ
DHᵒ_f H₂O(g) = -241.8 kJ
```

5. **Given the following equations and DH^o values, determine the heat of reaction (kJ) at 298 K for the reaction:**

$$3\,N_2H_4(l) + 4\,ClF_3(g) → 3\,N_2(g) + 12\,HF(g) + 2\,Cl_2(g)$$

```
2 ClF₃(g) + 2 NH₃(g) → N₂(g) + 6 HF(g) + Cl₂(g)     DHᵒ/kJ = -1195.6
N₂H₄(l) + O₂(g) → N₂(g) + 2 H₂O(l)                          DHᵒ/kJ =
```
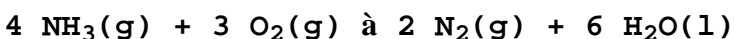
```
-622.4
4 NH₃(g) + 3 O₂(g) à 2 N₂(g) + 6 H₂O(l)                    DHᴼ/kJ =
-1530.6
```

6. **Given the following equations and DH⁰ values, determine the heat of reaction (kJ) at 298 K for the reaction:**

$$PCl_3(g) + Cl_2(g) \text{ à } PCl_5(g)$$

```
2 P(s) + 3 Cl₂(g) à 2 PCl₃(g)    DHᴼ/kJ = -542
2 P(s) + 5 Cl₂(g) à 2 PCl₅(g)    DHᴼ/kJ = -764
```
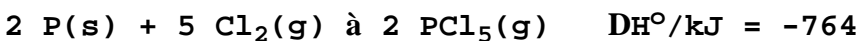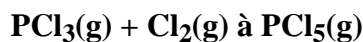
7. **4.90g of of ammonium iron (II)sulfate hexahydrate, $FeSO_4(NH_4)_2SO_4*6H_2O$, was dissolved in 200.mL of acidified water. 20.0mL of the solution reacted completely with 12.6mL of potassium manganate (VII) ($KMnO_4$) solution according to the balanced equation below. Calculate the concentration of the potassium manganate (VII) solution**

$$5Fe^{2+} + MnO_4^- + 8H^+ \text{ à } 5Fe^{3+} + Mn^{2+} + 4H_2O$$