

## Answer on Question # 55533 - Chemistry - General chemistry

### Question:

1. Given the data.  $\text{N}_2(\text{g}) + \text{O}_2(\text{g}) = 2 \text{NO}(\text{g}) \Delta H = +180.7 \text{ kJ}$ ;  $2 \text{NO}(\text{g}) + \text{O}_2(\text{g}) = 2 \text{NO}_2(\text{g}) \Delta H = -113.1 \text{ kJ}$ ;  $2 \text{N}_2\text{O}(\text{g}) = 2 \text{N}_2(\text{g}) + \text{O}_2(\text{g}) \Delta H = -163.2 \text{ kJ}$ ; Use Hess's Law to calculate  $\Delta H$  for the reaction

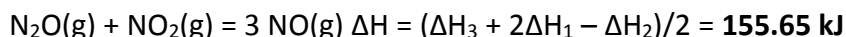
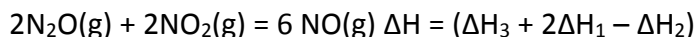
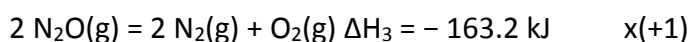
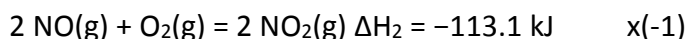
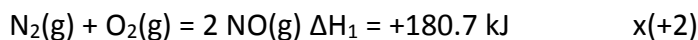
$\text{N}_2\text{O}(\text{g}) + \text{NO}_2(\text{g}) = 3 \text{NO}(\text{g})$ ; Show your work.

2. Calcium carbide ( $\text{CaC}_2$ ) reacts with water to form acetylene ( $\text{C}_2\text{H}_2$ ) and  $\text{Ca}(\text{OH})_2$ . From the following enthalpy of reaction data and data in Appendix C in textbook, calculate  $\Delta H_f^\circ$  for  $\text{CaC}_2(\text{s})$ :  
 $\text{CaC}_2(\text{s}) + 2 \text{H}_2\text{O}(\text{l}) = \text{Ca}(\text{OH})_2(\text{s}) + \text{C}_2\text{H}_2(\text{g}) \Delta H = -127.2 \text{ kJ}$

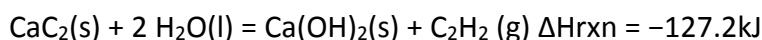
3. Using average bond enthalpies, predict which of the following reactions will be most exothermic: a)  $\text{C}(\text{g}) + 2 \text{F}_2(\text{g}) = \text{CF}_4(\text{g})$  b)  $\text{CO}(\text{g}) + 3 \text{F}_2(\text{g}) = \text{CF}_4(\text{g}) + \text{OF}_2(\text{g})$  c)  $\text{CO}_2(\text{g}) + 4 \text{F}_2(\text{g}) = \text{CF}_4(\text{g}) + 2 \text{OF}_2(\text{g})$

### Solution

1)



2)



$$\Delta H_{\text{rxn}} = \Delta H_f^\circ(\text{C}_2\text{H}_2) + \Delta H_f^\circ(\text{Ca}(\text{OH})_2) - 2\Delta H_f^\circ(\text{H}_2\text{O}) - \Delta H_f^\circ(\text{CaC}_2);$$

$$\Delta H_f^\circ(\text{CaC}_2) = \Delta H_f^\circ(\text{C}_2\text{H}_2) + \Delta H_f^\circ(\text{Ca}(\text{OH})_2) - 2\Delta H_f^\circ(\text{H}_2\text{O}) - \Delta H_{\text{rxn}}$$

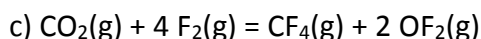
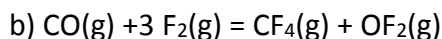
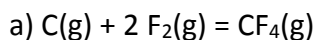
$$\Delta H_f^\circ(\text{C}_2\text{H}_2) = 227.4 \text{ kJ/mol}$$

$$\Delta H_f^\circ(\text{Ca}(\text{OH})_2) = -985.2 \text{ kJ/mol}$$

$$\Delta H_f^\circ(\text{H}_2\text{O}) = -285.8 \text{ kJ/mol}$$

$$\Delta H_f^\circ(\text{CaC}_2) = 227.4 - 985.2 + 2 \times 285.8 + 127.2 = \mathbf{-59.0 \text{ kJ/mol}}$$

3)



C-F bond enthalpy 440 kJ/mol

C=O bond enthalpy in carbon dioxide 805 kJ/mol

C=O bond enthalpy in carbon monoxide 1077 kJ/mol

O-F bond enthalpy 184 kJ/mol

F-F bond enthalpy 153 kJ/mol

a)  $\Delta H_{\text{rxn}} = 2 \times 153 - 4 \times 440 = -1454 \text{ kJ}$  – **the most exothermic**

b)  $\Delta H_{\text{rxn}} = 1077 + 3 \times 152 - 2 \times 184 - 4 \times 440 = -595 \text{ kJ}$

c)  $\Delta H_{\text{rxn}} = 805 \times 2 + 4 \times 153 - 4 \times 440 - 2 \times 2 \times 184 = -274 \text{ kJ}$

**Answer: 1) 155.65 kJ; 2) -59.0 kJ/mol; 3) a)**