4] a

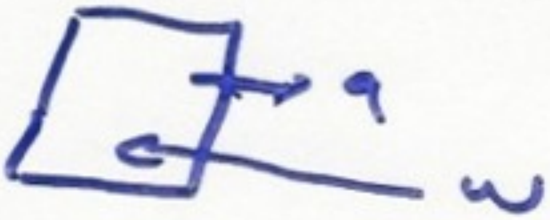
iii

Endothermic

b. $\Delta E < 0$

$\Delta E = q + w$

c. i



ii

$\Delta E > 0$

all

iii

5] a. Distance traveled is not a state function. The pathway matter.

b. Over all change in elevation is a state function. Pathway independent

8 a. work is done on the gas during compression.

$$\Delta E = \underset{(+)}{w} + q \qquad w = -P\underset{(-)}{\Delta V}$$

$$w = (+)$$

b. $$\underset{(+)}{\Delta E} = \underset{(+)}{w} + \underset{(+)}{q}$$

19 a. The system is what we study

b. A closed system is one where no heat or material is exchanged with the surroundugs.

c. universe = system + Surrounding

31 a. A state function is pathway independent.

b. change in temperature is pathway independent. Work is pathway dependent.

c. change in volume only depends on the initial state and the final state.

39 $C_2H_2OH + 3O_2 \rightarrow$

$\Delta H = -1235\ kJ$

$3H_2O + 2CO_2$

43

$2Mg + O_2 \rightarrow 2MgO$

$\Delta H^\circ = -1204\ kJ$

a. Exothermic rxn $(-\Delta H^\circ)$

$\boxed{43}$ b. $2Mg + O_2 \rightarrow 2MgO$

$\Delta H° = -1204\ kJ$

$$3.55g\ Mg \times \frac{1 mol\ Mg}{24.3g} \times \frac{-1204\ kJ}{2 mol\ Mg} =$$

-87.9 kJ released

c.

$$-234\ kJ \times \frac{2 mol\ MgO}{-1204\ kJ} \times \frac{40.3\ g}{1 mol\ MgO} =$$

15.7g MgO

d. $2MgO \rightarrow 2Mg + O_2$

$\Delta H° = +1204\ kJ$

$$40.3g\ MgO \times \frac{1 mol\ MgO}{40.3g} \times \frac{1204\ kJ}{2 mol\ MgO} =$$

602 kJ

absorbed

$\boxed{45}$ $Ag^+ + Cl^- \rightarrow AgCl_{(s)}$

$\Delta H^\circ = -65.5\ kJ$

a. $0.450\ mol\ AgCl_{(s)} \times \frac{-65.5\ kJ}{1\ mol\ AgCl}$

$= -29.5\ kJ$

b. $9.00\ g\ AgCl_{(s)} \times \frac{1\ mol\ AgCl}{143.3\ g} \times \frac{-65.5\ kJ}{1\ mol\ AgCl}$

$= -4.11\ kJ$

c. $AgCl_{(s)} \Rightarrow Ag^+_{(aq)} + Cl^-_{(aq)}$

$\Delta H^\circ = 65.5\ kJ$

$9.25 \times 10^{-4}\ mol\ AgCl \times \frac{65.5\ kJ}{1\ mol\ AgCl}$

$= 0.0606\ kJ$

$\boxed{47}$ $CH_3OH + \frac{3}{2}O_2 \rightarrow$

$CO_2 + 2H_2O(l)$

$\Delta H = -726.5\ kJ$

a. $CO_2 + 2H_2O \rightarrow CH_3OH + \frac{3}{2}O_2$

$\Delta H = +726.5\ kJ$

b. $2CH_3OH + 3O_2 \rightarrow 2CO_2 + 4H_2O_{(l)}$

$\Delta H = 2(-726.5\ kJ)$

c. The forward reaction is exothermic. A release of heat implies a lowering of potential energy (a more stable state)

d. $H_2O_{(l)} \rightarrow H_2O_{(g)}$ $\Delta H(+)$

The overall reaction would be more endothermic.

$\boxed{53}$ $\boxed{q = mc\Delta T}$

a. $= (80.0\,g\ C_8H_{18})\left(\frac{2.22\,J}{g\ ^\circ C}\right)(25^\circ c - 10^\circ c)$

$= 2.66 \times 10^3\,J \times \frac{1\,kJ}{1000\,J} = 2.66\,kJ$

b. $\frac{2.22\,J}{g\ K} \times \frac{114\,g}{1\,mol\ C_8H_{18}} = \frac{253.58\,J}{mol\ K}$

$H_2O = \frac{75.2\,J}{mol\ K}$

more heat required to raise the temperature of octane.

55 $NaOH_{(s)} \rightarrow Na^+ + OH^-$

6.5g

$$\boxed{q = mc\Delta T}$$

$$q_p = (106.5g\ H_2O)\left(\frac{4.18\ J}{g\ C^\circ}\right)(37.8^\circ - 21.6^\circ C)$$

$$q_p = 7218.7 J \times \frac{1 kJ}{1000 J} = 7.22 kJ$$

$$\frac{7.22\ kJ}{6.5g\ NaOH} \times \frac{40g}{1mol\ NaOH} = \frac{-44.4}{1mol}$$

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57 $C_6H_4O_2 + 7O_2 \rightarrow 6CO_2 + 4H_2O$

2.2g $\boxed{q_P = C\Delta T}$

$$= \left(\frac{7.854 kJ}{^\circ C}\right)(30.57^\circ C - 23.44^\circ C)$$

$$= -56 kJ$$

$$\frac{-56 kJ}{2.2g} \times \frac{108g}{1mol\ C_6H_4O_2} = \frac{2754 kJ}{mol}$$

$\boxed{63}$ $P_4O_6 \rightarrow P_4 + 3O_2$ $+1640.1\,kJ$

$P_4 + 5O_2 \rightarrow P_4O_{10}$ $-2940.1\,kJ$

$P_4O_6 + 2O_2 \rightarrow P_4O_{10}$

$\Delta H = -1300\,kJ$

$\boxed{65}$ $C_2H_4 \rightarrow 2H_2 + 2C$ $-52.3\,kJ$

$2C + 4F_2 \rightarrow 2CF_4$ $2(-680\,kJ)$

$2H_2 + 2F_2 \rightarrow 4HF$ $2(-537\,kJ)$

$C_2H_4 + 6F_2 \rightarrow 2CF_4 + 4HF$

$\Delta H = -2.49 \times 10^3\,kJ$

$\boxed{66}$ $N_2 + O_2 \rightarrow 2NO \quad +180.7\,kJ$

$$\frac{2}{2}NO_2 \rightarrow \frac{2}{2}NO + \frac{1}{2}O_2 + \frac{113.1\,kJ}{2}$$

$$\frac{2}{2}N_2O \rightarrow \frac{2}{2}N_2 + \frac{1}{2}O_2 - \frac{163.2\,kJ}{2}$$

$$N_2O + NO_2 \rightarrow 3NO$$

$\Delta H = 155.65\,kJ$

$\boxed{67}$ standard conditions

$P = 1\,atm \quad T = 298\,K$

ΔH_f° : the enthalpy change that occurs when 1 mol of a compound is formed from its elements at standard conditions

68 a. Standard enthalpies of formation allow us to calculate heats of reaction or heats of formation with out having to measure them.

b. ΔH_f° of a element in its stable form is considered to zero.

c. $$12C_{(s)} + 12H_{2(g)} + \frac{11}{2}O_2 \rightarrow C_{12}H_{22}O_{11}$$

$\boxed{69}$ a. $\frac{1}{2}N_2 + O_2 \rightarrow NO_{2(g)}$

$\Delta H^\circ_f = 33.84\ kJ$

b. $S + \frac{3}{2}O_2 \rightarrow SO_{3(g)}$

$\Delta H^\circ_f = -395.2\ kJ$

c. $Na + \frac{1}{2}Br_2 \rightarrow NaBr_{(s)}$

$\Delta H^\circ_f = -361.4\ kJ$

$\boxed{71}$ $2Al + Fe_2O_3 \rightarrow Al_2O_3 + 2Fe$

$\Delta H^\circ_{rxn} = \Delta H^\circ_{prod.} - \Delta H^\circ_{react.}$

$= [-1669.8\ kJ + 2(0)] -$

$[-822.16\ kJ - 2(0)]$

$= -847.6\ kJ$

$\boxed{73}$ a. $2SO_2 + O_2 \rightarrow 2SO_3$

$[2(-395.2\,kJ)] - [2(-296.9\,kJ) - 0]$

$\Delta H^\circ_{rxn} = -196.6\ kJ$

b. $Mg(OH)_{2(s)} \rightarrow Mg_{(s)} + H_2O$

$\Delta H^\circ_{rxn} = [-601.8\,kJ + (-285.85\,kJ)]$

$- [-924.7\,kJ]$

$= 37.1\ kJ$

c. $N_2O_4 + 4H_2 \rightarrow N_2 + 4H_2O$

$\Delta H^\circ_{rxn} = [4(-241.82\,kJ) + 0] -$

$[9.66\,kJ - 4(0)]$

$= -976.94\ kJ$

d. $SiCl_4 + 2H_2O \rightarrow SiO_2 + 4HCl$

$\Delta H^\circ_{rxn} = [-910.9\text{ kJ} + (-92.30)] - [-640.1 - 2(-285.83\text{ kJ})]$

$= -68.3\text{ kJ}$

$\boxed{75}$ $C_3H_6O + 4O_2 \rightarrow 3CO_2 + 3H_2O$

$-1790\text{ kJ} = [3(-393.5\text{ kJ} + 3(-285.83\text{ kJ}$

$- [\Delta H^\circ_f + 4(0)]$

$\Delta H^\circ_f = -248\text{ kJ}$

$\boxed{76}$ $CaC_{2(s)} + 2H_2O \rightarrow$

$Ca(OH)_2 + C_2H_2$

$$-127.2\ kJ = \left[-986.2\ kJ + 226.77\ kJ\right]$$

$$-\left[2(-285.83) + \Delta H^\circ_f\ CaC_2\right]$$

$$\Delta H^\circ_f\ CaC_2 = -60.57\ kJ$$