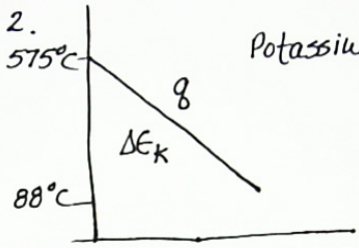
review for test 2017.doc

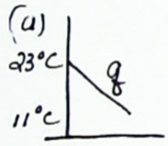
1. (a) endothermic
(b) exothermic
(c) exothermic
(d) endothermic

2.



Potassium:

3. (a)

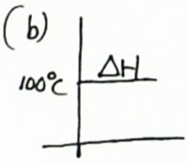


$q = mc\Delta t$

$= 350\,g \times 4.18\,\frac{J}{g°C} \times 12°C$

$= 17556\,J$

(b)

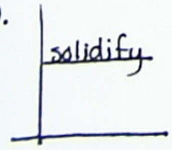


$\Delta H = nH$

$= 125\,g \times \frac{1\,mol}{18.02\,g} \times 40.7\,\frac{kJ}{mol}$

$= 282.33\,kJ$

(c).

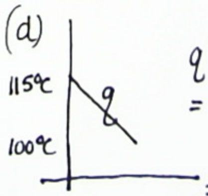


$\Delta H = nH$

$= 70\,g \times \frac{1\,mol}{58.69\,g} \times 17.6\,\frac{kJ}{mol}$

$= 20.99\,kJ$

(d)

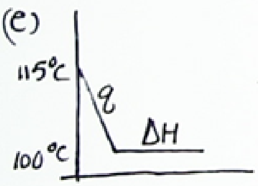


$q = mc\Delta T$

$= 250\,g \times 1.7\,\frac{J}{g°C} \times 15°C$

$= 6375\,J$

(e)



$q = mc\Delta t$

$= 250\,g \times 1.7\,\frac{J}{g°C} \times 15°C$

$= 6375\,J$

$= 6.375\,kJ$

$\Delta H = nH$

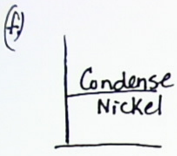
$= 250\,g \times \frac{1\,mol}{18.02\,g} \times 40.7\,\frac{kJ}{mol}$

$= 564.65\,kJ$

Total $\Rightarrow$ 6.375 kJ + 564.65

571.025 kJ

(f)



Determine mass

$\Delta H = nH$

$2524.5\ kJ = n \times 370.4\ \frac{kJ}{mol}$

$\frac{2524.5\ kJ}{370.4\ kJ/mol} = n$

$6.8156\ mol = n$

→ Convert moles to grams

$6.8156\ mol\ Ni \times \frac{58.69\ g}{1\ mol}$

$= 400.01\ g\ Ni$

(g). copper is heated:

$q = mc\Delta T$

$539.96\ J = 85\ g \times 0.385\ \frac{J}{g°C} \times \Delta T$

$539.96\ J = 32.725\ J/°C \times \Delta T$

$\frac{539.96\ J}{32.725\ J/°C} = \Delta T$

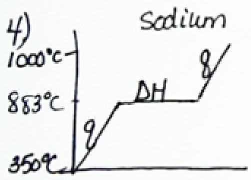
$16.5°C = \Delta T$

→ Final temp

$30°C + 16.5°C$

$= 46.5°C$

4)



$q = mc\Delta T$

$= 200\ g \times 1.23\ \frac{J}{g°C} \times 533°C$

$= 131118\ J$

$131.118\ kJ$

$\Delta H = nH$

$= 200\ g \times \frac{1\ mol}{22.99\ g} \times 97.42\ \frac{kJ}{mol}$

$= 847.50\ kJ$

$q = mc\Delta T$

$= 200\ g \times 1.23\ \frac{J}{g°C} \times 117°C$

$= 28782\ J$

$= 28.782\ kJ$

Total

131.118
847.50
28.782

1007.49 KJ

5. $345g\ CaC_2 \times \frac{1 mol\ CaC_2}{64.10g\ CaC_2} \times \frac{127.2 kJ}{1 mol\ CaC_2} = 684.62 kJ$ energy released

6. same as 5

7. $500g\ H_2O \times \frac{1 mol\ H_2O}{18.02g\ H_2O} \times \frac{802.7 kJ}{2 mol\ H_2O} = 11136.24 kJ$

8. $2Al_{(s)} + Fe_2O_3 \rightarrow Al_2O_{3(s)} + 2Fe_{(s)}$

(0.00) $(-824.2 \frac{kJ}{mol})$ $(-1675.7 \frac{kJ}{mol})$ (0.00)

$2Al_{(s)} + Fe_2O_3 \rightarrow Al_2O_{3(s)} + 2Fe_{(s)} + 851.5\ kJ$

$\Delta H_{rxn} = \sum H_{products} - \sum H_{reactants}$

$= [1(-1675.7) + 2(0)] - [2(0) + 1(-824.2)]$

$= -851.5 kJ$ $\therefore$ exothermic

9. $2C_4H_{10(g)} + 13O_{2(g)} \rightarrow 8CO_{2(g)} + 10H_2O_{(l)}$

(-125.6) (0.00) (-393.5) (-285.8)

$\Delta H_{rxn} = [8(-393.5) + 10(-285.8)] - [2(-125.6) + 13(0)]$

$= -5754.8 kJ$

10. Hess's Law

① $\cancel{C_{(s)}} + O_{2(g)} \rightarrow CO_{2(g)}$ $\Delta H = -393.5$

②×2 $2\cancel{S_{(s)}} + 2O_{2(g)} \rightarrow 2SO_{2(g)}$ -593.6

③ ⇆ $CS_{2(l)} \rightarrow \cancel{C_{(s)}} + 2\cancel{S_{(s)}}$ -87.9

$CS_{2(l)} + 3O_{2(g)} \rightarrow CO_{2(g)} + 2SO_{2(g)}$ $\Delta H = -1075 kJ$ $\therefore$ exothermic

11. Need the reaction for the enthalpy of formation of CH_4:

$\boxed{C + 2H_{2(g)} \rightarrow CH_{4(g)}}$

①×2 $2H_{2(g)} + \cancel{O_{2(g)}} \rightarrow \cancel{2H_2O_{(l)}}$ $-571.6 kJ$

② $C_{(s)} + \cancel{O_{2(g)}} \rightarrow \cancel{CO_2}_{(g)}$ $-293.5 kJ$

③ ⇆ $\cancel{CO_{2(g)}} + \cancel{2H_2O_{(l)}} \rightarrow CH_{4(g)} + \cancel{2O_{2(g)}}$ $890.4 kJ$

$2H_{2(g)} + C_{(s)} \rightarrow CH_{4(g)}$ $25.3 kJ$

$\therefore$ endothermic

1. $\Delta H = -890\ kJ$, exothermic
$\Delta H = 185\ kJ$, endothermic
$\Delta H = -1169\ kJ$, exothermic

2. Endothermic (KNO_3 absorbed energy from the water making water cooler)

3. Potential Energy - stored energy (ex: phase change, reaction, ...)

Kinetic Energy - energy of motion (ex: temperature)

4. Joule

5. Energy is neither created nor destroyed it is transformed from one form to another.

6. B

7. omit

8. (a) SO_2: $S_{(g)} + O_{2(g)} \rightarrow SO_{2(g)} + 296.8\ kJ$

(b) C_3H_8: $3C + 4H_{2(g)} \rightarrow C_3H_8 + 104.7\ kJ$

(c) $BaSO_4$: $Ba_{(s)} + S_{(g)} + 2O_{2(g)} \rightarrow BaSO_{4(s)} + 1473.2\ kJ$

(d) NO: $\frac{1}{2}N_{2(g)} + \frac{1}{2}O_{2(g)} + 90.2\ kJ \rightarrow NO_{(g)}$

9. $S + O_2 \rightarrow SO_{2(g)} + 297\ kJ$

$$25g\ SO_2 \times \frac{1mol\ SO_2}{64.06\ g\ SO_2} \times \frac{297\ kJ}{1mol\ SO_2} = 115.91\ kJ$$

10. $C_2H_5OH_{(l)} + 3O_{2(g)} \rightarrow 2CO_{2(g)} + 3H_2O_{(l)} + 950\ kJ$
11.5g

$$11.5\cancel{g}\ C_2H_5OH_{(l)} \times \frac{1\cancel{mol}\ C_2H_5OH}{46.08\cancel{g}\ C_2H_5OH} \times \frac{950\ kJ}{1\cancel{mol}} = 237.09\ kJ$$

11. $33g\ C_3H_8 \times \frac{1\,mol}{44.11g} \times \frac{222\,kJ}{1\,mol}$

$= 166.08\ KJ$

12. (a) $2\,CO_{(g)} + O_{2\,(g)} \rightarrow 2\,CO_{2\,(g)}$

$(-110.5) \quad (0.0) \quad (-393.5)$

$\Delta H_{rxn} = [2(-393.5)] - [2(-110.5) + 0]$

$= -566\,KJ$

(b) $CH_{4\,(g)} + 2O_{2\,(g)} \rightarrow CO_{2\,(g)} + 2\,H_2O_{(l)}$

$(-74.4) \quad 0.0 \quad (-393.5) \quad (-285.8)$

$\Delta H_{rxn} = [(-393.5) + 2(-285.8)] - [(-74.4)]$

$= -890.1$

(c). $2\,H_2S_{(g)} + 3O_{2\,(g)} \rightarrow 2H_2O_{(l)} + 2SO_{2\,(g)}$

$(-20.6) \quad (0.00) \quad (-285.8) \quad (-296.8)$

$\Delta H_{rxn} = [2(285.8) + 2(-296.8)] - [2(-20.6) + 3(0)]$

$= -1124$

13. a) exothermic

(b) endothermic

14. Hot because the reaction is exothermic

15. Endothermic because energy was taken from the water

16. Calorimetry is the precise measurement of heat flow into or out of a system.

17. Graph 1 → exothermic ; ΔH is negative

Graph 2 → endothermic ; ΔH is positive

18. Want $N_{2(g)} + O_{2(g)} \rightarrow 2NO_{(g)}$

		ΔH
① ÷2	$2\cancel{NH_{3(g)}} + 2.5\,O_{2(g)} \rightarrow 2NO_{(g)} + \cancel{3H_2O}$	-585
② ↔ ÷2	$\cancel{3H_2O_{(g)}} + N_{2(g)} \rightarrow \cancel{2NH_{3(g)}} + 1.5\,O_{2(g)}$	765
	$O_{2(g)} + N_{2(g)} \rightarrow 2NO_{(g)}$	180 kJ

∴ endothermic

19. $H_{2(g)} + F_{2(g)} \rightarrow 2HF$

436 kJ   158 kJ   568 KJ

$\Delta H_{rxn} = [2(568)] - [(436) + (158)]$

$= 542\ KJ$

20. $C_2H_5OH_{(l)} + 3O_{2(g)} \rightarrow 2CO_{2(g)} + 3H_2O_{(l)}$

-228   0   -394   -286

$\Delta H_{rxn} = [2(-394) + 3(-286)] - [(-228) + 3(0)]$

$= (-1646) - (-228)$

$= -1418\ KJ$

21. (a) $SO_{2(g)} + \frac{1}{2}O_{2(g)} \rightarrow SO_{3(g)}$

-296.8   0   -395.7

$$\Delta H_{rxn} = ((-395.7)) - ((-296.8) + (0))$$
$$= -98.9\ kJ$$

$SO_2 + \frac{1}{2}O_2 \rightarrow SO_{3(g)} + 98.9\ kJ$

exothermic

(b) $CaO_{(s)} + H_2O_{(\ell)} \rightarrow Ca(OH)_{2(s)}$

-634.9   -285.8   -986.1

$$\Delta H_{rxn} = [(-986.1)] - [(-634.9) + (-285.8)]$$
$$= -65.7\ kJ$$

$CaO_{(s)} + H_2O_{(\ell)} \rightarrow Ca(OH)_{2(s)} + 65.7\ kJ$

exothermic

(c) $N_{2(g)} + 3H_{2(g)} \rightarrow 2NH_{3(g)}$

0   0   -45.9

$$\Delta H_{rxn} = [2(-45.9)] - [0]$$
$$= -91.8\ kJ$$

$N_{2(g)} + 3H_{2(g)} \rightarrow 2NH_{3(g)} + 91.8\ kJ$

exothermic

(d) $C_6H_{6(\ell)} + 1\frac{1}{2}O_{2(g)} \rightarrow 6C_{(s)} + 3H_2O_{(\ell)}$

49.0   0   0   -285.8

$$\Delta H_{rxn} = [0 + 3(-285.8)] - [(49.0) + 0]$$
$$= -906.4\ kJ$$

$C_6H_{6(\ell)} + 1\frac{1}{2}O_{2(g)} \rightarrow 6C_{(s)} + 3H_2O_{(\ell)} + 906.4\ kJ$

exothermic

(e) $NH_{3(g)} + HCl_{(g)} \rightarrow NH_4Cl_{(s)}$

-45.9   -92.3   314.4

$$\Delta H_{rxn} = [(314.4)] - [(-45.9) + (-92.3)] = 452.6\ kJ$$

$NH_{3(g)} + HCl_{(g)} + 452.6\ kJ \rightarrow NH_4Cl_{(s)}$

endothermic

Hess's Law

(1)

① $\overleftrightarrow{\times 2}$ $2CO_2 \rightarrow 2\cancel{C_{(graph)}} + 2O_{2(g)}$ 3152

② $2H_2O_{(l)} \rightarrow \cancel{2H_{2(g)}} + \cancel{O_{2(g)}}$ 2288

③ $\cancel{2C_{(graph)}} + \cancel{2H_{2(g)}} + \cancel{O_{2(g)}} \rightarrow CH_3COOH_{(l)}$ −1956

$2CO_{2(g)} + 2H_2O_{(l)} \rightarrow CH_3COOH_{(l)} + 2O_{2(g)}$ +3484 kJ

∴ endothermic

(2)

	H
① $3Fe_2O_{3(s)} \longleftrightarrow \cancel{6Fe_{(s)}} + \cancel{4}\tfrac{1}{2}O_{2(g)}$	4933
② $\cancel{6Fe_{(s)}} + \cancel{4}O_{2(g)} \longrightarrow 2Fe_3O_{4(s)}$	−4468
$3Fe_2O_{3(s)} \longrightarrow 2Fe_3O_{4(s)} + \tfrac{1}{2}O_{2(g)}$	465 kJ

Calorimetry

3. $q_{iron} = q_{water}$

$$mc\Delta T = mc\Delta T$$

$$150\cancel{g} \times 0.46\frac{J}{\cancel{g}°C} \times (T_f - 95°C) = 500\cancel{g} \times 4.18\frac{J}{\cancel{g}°C} \times (T_f - 25°C)$$

$$69\frac{J}{°C}(T_f - 95°C) = 2090\frac{J}{°C}(T_f - 25°C)$$

$$69\frac{J}{°C}T_f - 6555J = 2090\frac{J}{°C}T_f - 52250J$$

$$69\frac{J}{°C}T_f - 2090\frac{J}{°C}T_f = -52250J + 6555J$$

$$-2021\frac{J}{°C}T_f = -45695J$$

$$T_f = \frac{-45695J}{-2021J/°C}$$

$$= 22.6°C$$

4. $q_{metal} = q_{water}$

$$mc\Delta T = mc\Delta T$$

$$80g \times c \times 54°C = 100g \times 4.18\frac{J}{g°C} \times 6°C$$

$$c = \frac{100\cancel{g} \times 4.18J/g°C \times 6\cancel{°C}}{80\cancel{g} \times 54\cancel{°C}}$$

$$c = 0.58 J/g°C$$

5. $T_f = 23.7°C$ $\quad q_{metal} = q_{water}$ $\quad T_f = 22 + 1.7 = 23.7°C$

$$mc\Delta T = mc\Delta T$$

$$55g \times c \times (99 - 23.7)°C = 225g \times 4.18 \frac{J}{g°C} \times 1.7°C$$

$$55g \times c \times 75.3°C = 225g \times 4.18 \frac{J}{g°C} \times 1.7°C$$

$$c = \frac{225\cancel{g} \times 4.18\ J/\cancel{g}°C \times 1.7\cancel{°C}}{55\cancel{g} \times 75.3\cancel{°C}}$$

$$c = 0.37\ J/g°C$$

6. $\Delta H_{combustion} = q_{water}$ $\quad H_2O$: $1.8L = 1800mL = 1800g$

$$nH = mc\Delta T$$

$$0.96\cancel{mol} \times 1499 \frac{kJ}{\cancel{mol}} = 1800g \times 4.18 \frac{J}{g°C} \times \Delta T$$ needs to match kJ

$$1439.04\ kJ = 1800\cancel{g} \times 0.00418 \frac{kJ}{\cancel{g}°C} \times \Delta T$$

$$1439.04\ kJ = 7.524\ kJ/°C \times \Delta T$$

$$\frac{1439.04\ kJ}{7.524\ kJ/°C} = \Delta T \rightarrow \Delta T = 191.26$$

CALORIMETRY Worksheet #2.docx

Calorimetry Sheet

1. 7.1746 kJ/mol
2. 1342.9 kJ/mol
3. 4153.59 kJ.mol
4. 803.5 kJ/mol
5. 38.19 kJ/mol
6. 1584 kJ/mol
7. **166.23 °C**
8. 720.398 g/mol

1. H_2SO_4 dissolves — water heats

$$\Delta H = q$$

$$nH = mc\Delta T$$

$$49g \times \frac{1mol}{98.07g} \times H = 175g \times 0.00418 \frac{kJ}{g°C} \times 4.9°C$$

$$H = 7.17\ kJ/mol$$

2. $C_{18}H_{36}O_2$ comb — water

$$\Delta H \quad q$$

$$nH = mc\Delta T$$

$$8.36g \times \frac{1mol}{284.54g} \times H = 1520g \times 0.00418 \frac{kJ}{g°C} \times 6.21°C$$

$$H = 1342.9\ kJ/mol$$

3. C_6H_{14} comb — q water

$$\Delta H = q$$

$$nH = mc\Delta T$$

$$0.315 \text{ moles} \times H = 5650g \times 0.00418 \frac{kJ}{g°C} \times 55.4°C$$

$$H = 4153.59\ kJ/mol$$

4. Propane Comb (C_3H_8) — Water

$$\Delta H \quad q$$

$$nH = mc\Delta T$$

$$22g \times \frac{1mol}{44.11g} \times H = 3250g \times 0.00418 \frac{J}{g°C} \times 29.5°C$$

$$H = 803.5\ kJ/mol$$

5. melt wax — Water

$$\Delta H_{fus} \quad q$$

$$nH = mc\Delta T$$

$$10.1g \times \frac{1mol}{198.44g} \times H = 155g \times 4.18 \frac{J}{g°C} \times 3°C$$

$$H = 38.19\ kJ/mol$$

6. Combustion Water

ΔH q

$nH = mc\Delta T$

$0.285\,mol \times H = 3000\,g \times 0.00418\,\frac{J}{g°C} \times 36°C$

$H = 1584\,kJ/mol$

7. Comb Water

ΔH q

$nH = mc\Delta T$

$0.875\,mol \times 1350\,\frac{kJ}{mol} = 1700\,g \times 0.00418\,\frac{kJ}{g°C} \times \Delta T$

$\frac{0.875\,mol \times 1350\,kJ/mol}{1700\,g \times 0.00418\,kJ/g°C} = \Delta T$

$166.23°C = \Delta T$

8. combustion

mass = 62.3 g

$\Delta H = 1160 \frac{kJ}{mole}$

$n = ?$

water

$m = 500\,g$

$c = 4.18\ J/g^\circ C = 0.00418 \frac{kJ}{g^\circ C}$

$\Delta T = 48^\circ C$

$\Delta H_{comb} = q_{water}$

$\Delta H_{comb}\ nH = q_{water} = mc\Delta T$

$n \times 1160 \frac{kJ}{mol} = 500g \times 4.18 \frac{J}{g^\circ C} \times 48^\circ C$

$n = 86.48\ moles$

$n = \frac{500g \times 0.00418 \frac{J}{g^\circ C} \times 48^\circ C}{1160}$

molar mass $= \frac{g}{mole} = \frac{62.3g}{86.48 mol}$

$n = 0.08648\ moles$

Molar mass $= \frac{g}{mol} = \frac{62.3g}{0.08648 mol}$

$= 720.398\ g/mol$

Attachments

review for test 2014.doc

CALORIMETRY Worksheet #2.docx