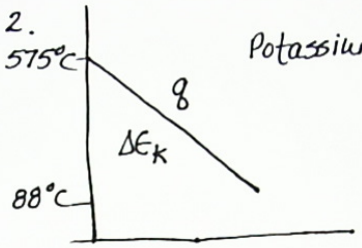
review for test 2018.doc

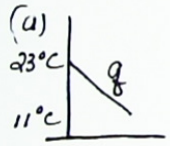
1. (a) endothermic
(b) exothermic
(c) exothermic
(d) endothermic

2.



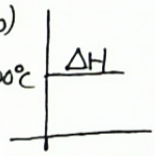
Potassium:

3. (a)



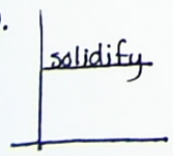
$q = mc\Delta t$
$= 350g \times 4.18\frac{J}{g°C} \times 12°C$
$= 17556J$

(b)



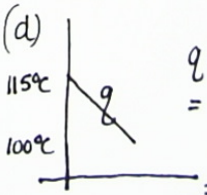
$\Delta H = nH$
$= 125g \times \frac{1mol}{18.02g} \times \frac{40.7kJ}{mol}$
$= 282.33kJ$

(c).



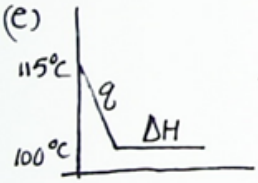
$\Delta H = nH$
$= 70g \times \frac{1mol}{58.08g} \times \frac{17.6kJ}{mol}$
$= 20.99kJ$

(d)



$q = mc\Delta T$
$= 250g \times 1.7\frac{J}{g°C} \times 15°C$
$= 6375J$

(e)



$q = mc\Delta t$
$= 250g \times 1.7\frac{J}{g°C} \times 15°C$
$= 6375J$
$= 6.375kJ$

$\Delta H = nH$
$= 250g \times \frac{1mol}{18.02g} \times \frac{40.7kJ}{mol}$
$= 564.65kJ$

Total $\Rightarrow$ $6.375kJ + 564.65$

571.025 kJ

(f)

Condense Nickel

Determine mass

$\Delta H = n H$

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

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

$6.8156\ mol = n$

→ Convert moles to grams

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

$= 400.01\ g\ Ni$

(g). copper is heated:

$q = mc\Delta T$

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

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

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

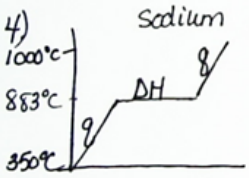
$16.5°C = \Delta T$

→ Final temp

$30°C + 16.5°C$

$= 46.5°C$

4)



$q = mc\Delta T$

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

$= 131118\ J$

$131.118\ kJ$

$\Delta H = n H$

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

$= 847.50\ kJ$

$q = mc\Delta T$

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

$= 28782\ J$

$= 28.782\ kJ$

Total

131.118

847.50

28.782

1007.49 kJ

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

6. same as 5

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

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

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

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

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

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

$= -851.5\text{ kJ}$ ∴ exothermic

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

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

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

$= -5754.8\text{ kJ}$

10. Hess's Law

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

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

③↔ $CS_{2(\ell)} \rightarrow C_{(s)} + 2S_{(s)}$ -87.9

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

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

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

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

② $C_{(s)} + O_{2(g)} \rightarrow CO_{2(g)}$ -393.5 kJ

③↔ $CO_{2(g)} + 2H_2O_{(\ell)} \rightarrow CH_{4(g)} + 2O_{2(g)}$ 890.4 kJ

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

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

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

11.5g

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

11. $33\,g\ C_3H_8 \times \frac{1\,mol}{44.11\,g} \times \frac{2220\,kJ}{1\,mol}$

$= 1660.8\,kJ$

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

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

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

$= -890.1$

(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	$2NH_{3(g)} + 2.5\,O_{2(g)} \rightarrow 2NO_{(g)} + 3H_2O$	-585
② ↔ ÷2	$3H_2O_{(g)} + N_{2(g)} \rightarrow 2NH_{3(g)} + 1.5O_{2(g)}$	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. $C_2H_5OH_{(l)} + 3O_{2(g)} \rightarrow 2CO_{2(g)} + 3H_2O_{(g)}$
-228, 0, -394, -286

$\Delta H_{rxn} = [2(-394) + 3(-286)] - [(-228) + 3(0)]$
$= (-1646) - (-228)$
$= -1418\ kJ$

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

$-296.8 \quad 0 \quad -395.7$

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

$= -98.9\ kJ$

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

exothermic

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

$-634.9 \quad -285.8 \quad -986.1$

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

$= -65.7\ kJ$

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

exothermic

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

$0 \quad 0 \quad -45.9$

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

$= -91.8\ kJ$

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

exothermic

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

$49.0 \quad 0 \quad 0 \quad -285.8$

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

$= -906.4\ kJ$

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

exothermic

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

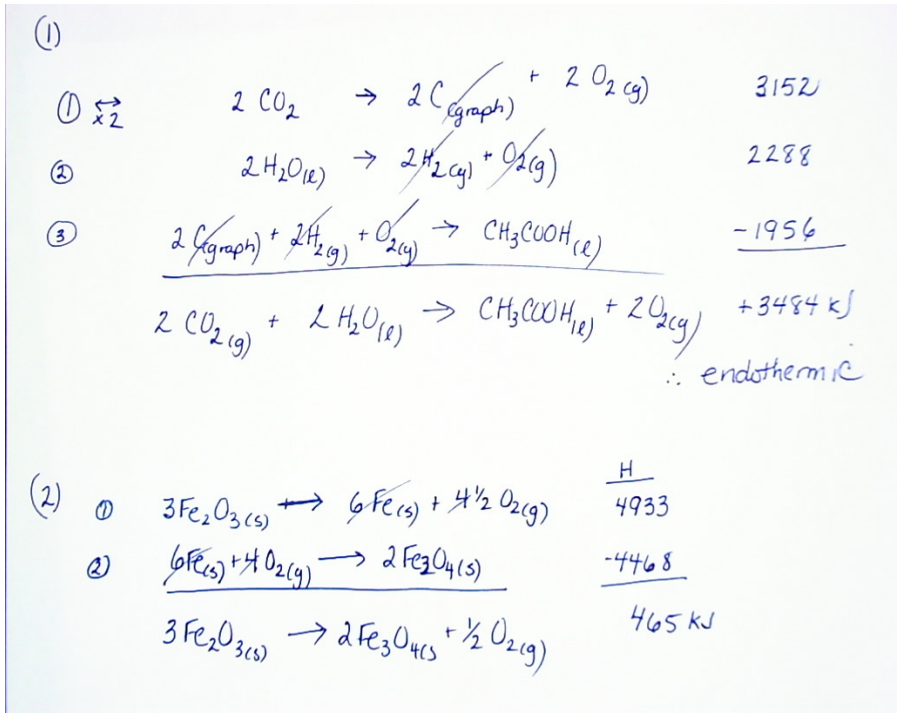
$-45.9 \quad -92.3 \quad 314.4$

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

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

endothermic

Hess's Law


(1)
① ⇄ ×2 2 CO2 → 2 C(graph) + 2 O2(g) 3152
② 2 H2O(l) → 2 H2(g) + O2(g) 2288
③ 2 C(graph) + 2 H2(g) + O2(g) → CH3COOH(l) -1956
2 CO2(g) + 2 H2O(l) → CH3COOH(l) + 2 O2(g) +3484 kJ
∴ endothermic
(2) H
① 3 Fe2O3(s) → 6 Fe(s) + 4½ O2(g) 4933
② 6 Fe(s) + 4 O2(g) → 2 Fe3O4(s) -4468
3 Fe2O3(s) → 2 Fe3O4(s) + ½ O2(g) 465 kJ

Calorimetry

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

$mc\Delta T = mc\Delta T$

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

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

$69\,\frac{J}{^\circ C}\,T_f - 6555\,J = 2090\,\frac{J}{^\circ C}\,T_f - 52250\,J$

$69\,\frac{J}{^\circ C}\,T_f - 2090\,\frac{J}{^\circ C}\,T_f = -52250\,J + 6555\,J$

$-2021\,\frac{J}{^\circ C}\,T_f = -45695\,J$

$T_f = \frac{-45695\,J}{-2021\,J/^\circ C}$

$= 22.6\,^\circ C$

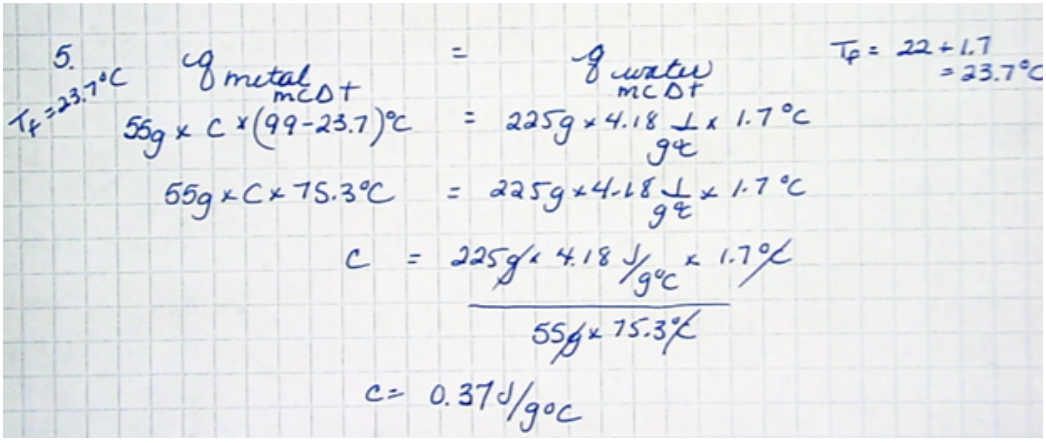
4. $q_{metal} = q_{water}$

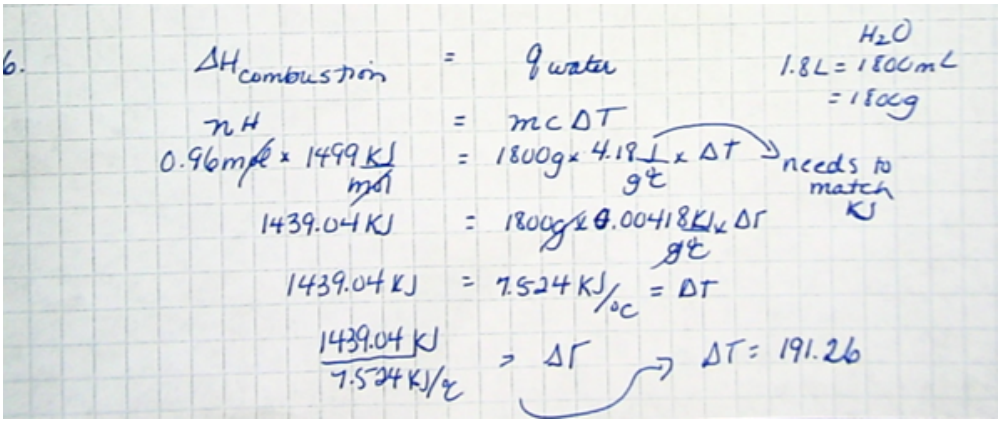
$mc\Delta T = mc\Delta T$

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

$c = \frac{100\,g \times 4.18\,J/g\,^\circ C \times 6\,^\circ C}{80\,g \times 54\,^\circ C}$

$c = 0.58\,J/g\,^\circ C$


5.
$T_f = 23.7°C$
$q_{metal} = q_{water}$
$mc\Delta t$
$55g \times C \times (99 - 23.7)°C = 225g \times 4.18 \frac{J}{g°C} \times 1.7°C$
$55g \times C \times 75.3°C = 225g \times 4.18 \frac{J}{g°C} \times 1.7°C$
$C = \frac{225g \times 4.18 J/g°C \times 1.7°C}{55g \times 75.3°C}$
$C = 0.37 J/g°C$
$T_f = 22 + 1.7 = 23.7°C$


6.
$\Delta H_{combustion} = q_{water}$
$n\Delta H = mc\Delta T$
$0.96 mol \times 1499 \frac{KJ}{mol} = 1800g \times 4.18 \frac{J}{g°C} \times \Delta T$
needs to match KJ
$1439.04 KJ = 1800g \times 0.00418 \frac{KJ}{g°C} \times \Delta T$
$1439.04 KJ = 7.524 KJ/°C = \Delta T$
$\frac{1439.04 KJ}{7.524 KJ/°C} = \Delta T$
$\Delta T = 191.26$
H_2O
$1.8L = 1800mL = 1800g$

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

$\Delta H \quad q$

$nH = mc\Delta T$

$8.3g \times \frac{1mol}{284.54g} \times H = 1520g \times 0.00418 \frac{kJ}{g°C} \times 6.21°C$

$H = 1342.9\ kJ/mol$

3. C_6H_{14} comb q water

$\Delta H = q$

$nH = mc\Delta T$

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

$H = 4153.59\ kJ/mol$

4. C_3H_8 Propane Comb Water

$\Delta H \quad q$

$nH = mc\Delta T$

$22g \times \frac{1mol}{44.11g} \times H = 3350g \times 0.00418 \frac{J}{g°C} \times 29.5°C$

$H = 803.5\ kJ/mol$

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

$n\,H = mc\Delta T$

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

$H = 1584\,kJ/mol$

7. Comb = Water

ΔH = q

$n\,H = mc\Delta T$

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

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

$166.23^\circ C = \Delta T$

8.

combustion	water
mass = 62.3 g	m = 500 g
$\Delta H = 1160 \frac{kJ}{mole}$	$c = 4.18 \frac{J}{g°C} = 0.00418 \frac{kJ}{g°C}$
n = ?	$\Delta T = 48°C$

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

$\Delta H^{n\,H}_{comb} = -mc\Delta t$

$n \times 1160 \frac{kJ}{mol} = -q_{water} = -500g \times 4.18 \frac{J}{g°C} \times 48°C$

$n\,H \quad n = 86.48\,\Delta J_{mole}$

$n = \frac{g}{mole} = \frac{500g}{86.48 mol} \times \frac{62.3g}{} \times \frac{0.00418 J}{g°C} \times \frac{48°C}{} \times \frac{g}{J}$

$n = 0.08648 moles$

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

$= 720.398 g/mol$

Attachments

review for test 2014.doc

CALORIMETRY Worksheet #2.docx