1. $H_2O(\ell)$ $\Delta H_f^\circ = -286$ kJ/mol
$NaCl(s)$ $\Delta H_f^\circ = -411$
$SO_2(g)$ $\Delta H_f^\circ = -297$
$NO(g)$ $\Delta H_f^\circ = +90$
$Fe_2O_3(s)$ $\Delta H_f^\circ = -826$

Most stable
Fe_2O_3 $\Delta H_{decomp} = +826$ (energy in)
$NaCl$
SO_2
H_2O
NO $\Delta H_{decomp} = -90$
Least stable

2. $N_2(g) + 2H_2(g) \rightarrow N_2H_4(\ell)$

	ΔH (kJ)
$N_2H_4(\ell) + O_2(g) \rightarrow N_2(g) + 2H_2O(\ell)$	-622.2
flip: $H_2(g) + \frac{1}{2}O_2(g) \rightarrow H_2O(\ell)$	-285.8
x2: $N_2(g) + 2H_2O(\ell) \rightarrow N_2H_4(\ell) + 2H_2$	$+622.2$
$2H_2(g) + O_2(g) \rightarrow 2H_2O(\ell)$	-571.6
$N_2(g) + O_2(g) \rightarrow N_2H_4(\ell)$	$\Delta H_r = 50.6$ kJ

3. $C_2H_4(g) + 6F_2(g) \rightarrow 2CF_4(g) + 4HF(g)$

$2H_2(g) + 2F_2(g) \rightarrow 4HF(g)$	$\Delta H = (-537\text{ kJ})2$
$2C(s) + 4F_2(g) \rightarrow 2CF_4(g)$	$\Delta H = (-680\text{ kJ})2$
$2C(s) + 2H_2(g) \rightarrow C_2H_4(g)$	$\Delta H = +52.3$ kJ
$C_2H_4(g) \rightarrow 2C(s) + 2H_2(g)$	$\Delta H = -52.3$ kJ

$6F_2(g) + C_2H_4(g) \rightarrow 4HF(g) + 2CF_4(g)$ $\Delta H_r = +2486$ kJ

4. $2C_{(s)} + 3H_{2(g)} \rightarrow C_2H_{6(g)}$

$2C_{(s)} + 2O_{2(g)} \rightarrow 2CO_{2(g)}$ $(-394\ kJ)2$

flip $2C_2H_{6(g)} + 7O_{2(g)} \rightarrow 4CO_{2(g)} + 6H_2O_{(l)}$ $-3120\ kJ$

$3H_{2(g)} + \frac{3}{2}O_{2(g)} \rightarrow 3H_2O_{(l)}$ $(-572\ kJ)\frac{3}{2}$ $-858\ kJ$

$4CO_{2(g)} + 6H_2O_{(l)} \rightarrow 2C_2H_{6(g)} + 7O_{2(g)}$ $+1560\ kJ$

$2C_{(s)} + 3H_{2(g)} \rightarrow 2C_2H_{6(g)}$ $-86\ kJ$

5. $2F_{2(g)} + 2H_2O_{(l)} \rightarrow 4HF_{(g)} + O_{2(g)}$

$2H_{2(g)} + 2F_{2(g)} \rightarrow 4HF_{(g)}$ $\Delta H = (-537\ kJ)2$

flip $2H_{2(g)} + O_{2(g)} \rightarrow 2H_2O_{(l)}$ $\Delta H = -572\ kJ$

$2H_2O_{(l)} \rightarrow 2H_{2(g)} + O_{2(g)}$ $\Delta H = +572\ kJ$

$2F_{2(g)} + 2H_2O_{(l)} \rightarrow 4HF_{(g)} + O_{2(g)}$ $\Delta H_r = -502\ kJ$

6. $4NH_{3(g)} + 5O_{2(g)} \rightarrow 4NO_{(g)} + 6H_2O_{(g)}$

A) $\Delta H_r = [\text{PRODUCTS}] - [\text{REACTANTS}]$

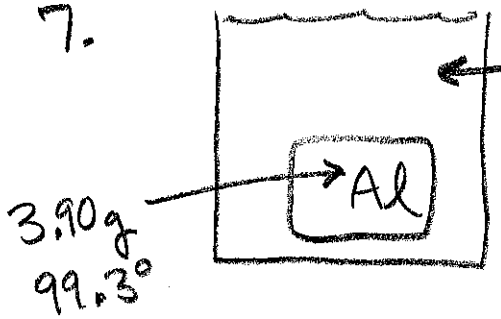
$= [4(90) + 6(-242)] - [4(-46) + 5(0)]$

$= [-1092] - [-184] = -908\ kJ$

B) exothermic $\rightarrow \Delta H_r$ is (−)

C) $\frac{65.0\ g\ NH_3}{1} \left| \frac{1\ mol\ NH_3}{17.04\ g\ NH_3} \right| \frac{908\ kJ}{4\ mol\ NH_3} = 866\ kJ$ released

7.



Heat lost by Al = Heat gained by H_2O

$mC\Delta T = mC\Delta T$

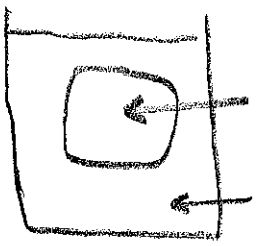
$(3.90g)(.9025 \frac{J}{g°C})(99.3 - T_f) = (100.0g)(4.18 \frac{J}{g°C})(T_f - 22.6)$

$349.5 - 3.52 T_f = 418 T_f - 9446.8$

$9796.3 = 421.52 T_f$

$T_f = 23.2°C$

8.



$T_f = 32.5°C$

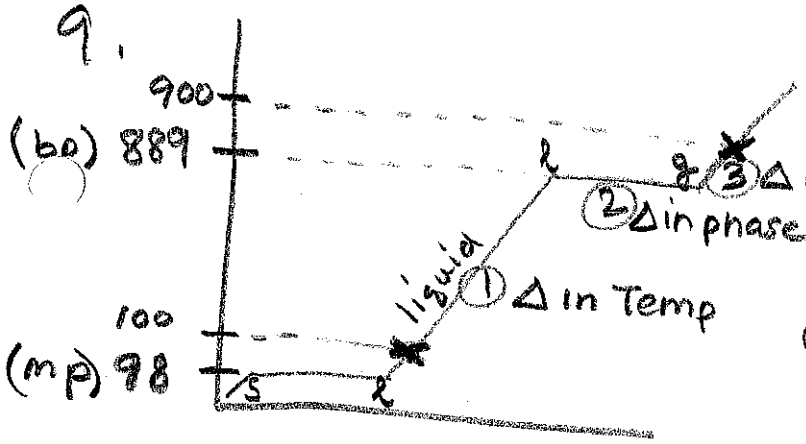
Heat lost by metal = Heat gained by water

$mC\Delta T = mC\Delta T$

$(23.8g)(C)(100.0°C - 32.5) = (50.0g)(4.18 \frac{J}{g°C})(32.5°C - 24.0)$

$C = 1.11 \frac{J}{g°C}$

9.



① $q = mC\Delta T$

$= (55.0\,g)(.836\,J/g°C)(-789°C)$

$= 36278.22\,J = \boxed{36.3\,kJ}$

② $q = \Delta H_{vap} \times moles$

$= \left(100.74\,\frac{kJ}{mol}\right)(55.0\,g)\left(\frac{1\,mol\,Na}{22.99\,g}\right)$

$= \boxed{241\,kJ}$

③ $q = mC\Delta T$

$= (55.0\,g)(1.672\,J/g°C)(11°C)$

$= 1011.56\,J = \boxed{1.01\,kJ}$

$q_{total} = 278\,kJ$