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43. a) endothermic
b) exothermic
c) exothermic
d) endothermic

45. $4Fe(s) + 3O_2(g) \rightarrow 2Fe_2O_3(s) \quad \Delta H = -1652\ kJ$

a) $\frac{4.00\ mol\ Fe}{} \cdot \frac{1652\ kJ}{4\ mol\ Fe} = \boxed{1650\ kJ}$

b) $\frac{1.00\ mol\ Fe_2O_3}{} \cdot \frac{1652\ kJ}{2\ mol\ Fe_2O_3} = \boxed{826\ kJ}$

c) $\frac{1.00\ g\ Fe}{} \cdot \frac{1\ mol\ Fe}{55.85\ g\ Fe} \cdot \frac{1652\ kJ}{4\ mol\ Fe} = \boxed{7.39\ kJ}$

d) $\frac{10.0\ g\ Fe}{} \cdot \frac{1\ mol\ Fe}{55.85\ g\ Fe} \cdot \frac{1652\ kJ}{4\ mol\ Fe} = 73.9\ kJ$

Limiting Reactant Problem

$\frac{2.00\ g\ O_2}{} \cdot \frac{1\ mol\ O_2}{32\ g\ O_2} \cdot \frac{1652\ kJ}{3\ mol\ O_2} = \boxed{34.4\ kJ}$

61. $Ag^+(aq) + Cl^-(aq) \rightarrow AgCl(s)$

50.0 mL	50.0 mL	$T_i = 22.60\ °C$
0.100 M	0.100 M	$T_f = 23.40\ °C$
		$\Delta T = 0.80\ °C$

$q_{surr} = mC_p\Delta T = (100.0\ g)(4.18\ \frac{J}{g\ °C})(0.80\ °C) = 334.4\ J$

$q_{sys} = -334.4\ J$

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$$\Delta H = \frac{q_{sys}}{\text{mol LR}} = \frac{-334.4\ J}{0.00500\ mol} = -66880\ J/mol = \boxed{-67\ kJ/mol}$$

$(0.100\ M\ Ag^+)(0.0500\ L) = 0.00500\ mol\ Ag^+$

63. $q_{surr} = mC_p\Delta T$

$q_{surr} = (125g + 10.5g)(4.18\ \frac{J}{g \cdot °C})(21.1°C - 24.2°C)$

$q_{surr} = -1756\ J$

$q_{sys} = +1756\ J$

$$\frac{10.5\ g\ KBr}{} \left| \frac{1\ mol\ KBr}{119\ g\ Kr} \right. = 0.08824\ mol\ KBr$$

$$\Delta H = \frac{1756\ J}{0.08824\ mol} = 19900\ J/mol = \boxed{20.\ kJ/mol}$$

$$\Delta H = \frac{1756\ J}{10.5\ g} = 167.2\ J/g = \boxed{170\ J/g}$$

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71. $\Delta H = (-92\ kJ)(2) + (+484\ kJ)(3) = \boxed{1268\ kJ}$

No, this rxn is not a useful rxn for making NH_3 because it is highly endothermic, thus it would require much heat and money to produce NH_3 with this rxn.

73. $\frac{1}{2}(3O_{2(g)} \rightarrow 2O_{3(g)})$ $\Delta H = +427\ kJ$ Reverse

$\frac{1}{2}(2O_{(g)} \rightarrow O_{2(g)})$ $\Delta H = -495\ kJ$ Reverse

$NO_{(g)} + O_{3(g)} \rightarrow NO_{2(g)} + O_{2(g)}$ $\Delta H = -199\ kJ$

$\cancel{\frac{3}{2}O_{2(g)}} \rightarrow \cancel{O_{3(g)}}$ $\Delta H = +427(\frac{1}{2}) = 213.5$

$O_{(g)} \rightarrow \cancel{\frac{1}{2}O_{2(g)}}$ $\Delta H = -495(\frac{1}{2}) = -247.5$

$NO_{(g)} + \cancel{O_{3(g)}} \rightarrow NO_{2(g)} + \cancel{O_{2(g)}}$ $\Delta H = -199\ kJ$

$NO_{(g)} + O_{(g)} \rightarrow NO_{2(g)}$ $\Delta H = 213.5\ kJ - 247.5\ kJ - 199\ kJ$

$\boxed{\Delta H = -233\ kJ}$

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79. a) $2NH_3(g) + 3O_2(g) + 2CH_4(g) \rightarrow 2HCN(g) + 6H_2O(g)$

$\Delta H^\circ = [(2)(135.1\ kJ/mol) + (6)(-242\ kJ/mol)]$
$- [(2)(-46\ kJ/mol) + (3)(0\ kJ/mol) + (2)(-75\ kJ/mol)]$

$\Delta H^\circ = [-1181.8\ kJ/mol] - [-242\ kJ/mol]$

$\Delta H^\circ = -939.8 = \boxed{-940.\ kJ/mol}$

b) $Ca_3(PO_4)_2(s) + 3H_2SO_4(l) \rightarrow 3CaSO_4(s) + 2H_3PO_4(l)$

$\Delta H^\circ = [(3)(-1433\ kJ/mol) + (2)(-1267\ kJ/mol)]$
$- [(1)(-4126\ kJ/mol) + (3)(-814\ kJ/mol)]$

$\Delta H^\circ = [-6833\ kJ/mol] - [-6568\ kJ/mol]$

$\boxed{\Delta H^\circ = -265\ kJ/mol}$

c) $NH_3(g) + HCl(g) \rightarrow NH_4Cl(s)$

$\Delta H^\circ = [(1)(-314\ kJ/mol)] - [(1)(-46\ kJ/mol) + (1)(-92\ kJ/mol)]$

$\Delta H^\circ = [-314\ kJ/mol] - [-138\ kJ/mol]$

$\boxed{\Delta H^\circ = -176\ kJ/mol}$

81. a) $4NH_3(g) + 5O_2(g) \rightarrow 4NO(g) + 6H_2O(g)$

$\Delta H^\circ = [(4)(90\ kJ/mol) + (6)(-242\ kJ/mol)] - [(4)(-46\ kJ/mol) + 5(0\ kJ/mol)]$

$\Delta H^\circ = [-1092\ kJ/mol] - [-184\ kJ/mol]$

$\boxed{\Delta H^\circ = -908\ kJ/mol}$

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81a cont'd.

$2NO_{(g)} + O_{2(g)} \rightarrow 2NO_{2(g)}$

$\Delta H° = [(2)(34\ kJ/mol)] - [(2)(90\ kJ/mol) + (1)(0\ kJ/mol)]$

$\Delta H° = [68\ kJ/mol] - [180\ kJ/mol]$

$\boxed{\Delta H° = -112\ kJ/mol}$

$3NO_{2(g)} + H_2O_{(l)} \rightarrow 2HNO_{3(aq)} + NO_{(g)}$

$\Delta H° = [(2)(-207\ kJ/mol) + (1)(90\ kJ/mol)] - [(3)(34\ kJ/mol) + (1)(-286\ kJ/mol)$

$\Delta H° = [-324\ kJ/mol] - [-184\ kJ/mol]$

$\boxed{\Delta H° = -140\ kJ/mol}$

83. $3Al_{(s)} + 3NH_4ClO_{4(s)} \rightarrow Al_2O_{3(s)} + AlCl_{3(s)} + 3NO_{(g)} + 6H_2O_{(g)}$

$\Delta H° = [(1)(-1676\ kJ/mol) + (1)(-704\ kJ/mol) + (3)(90\ kJ/mol) + (6)(-242\ kJ/mol)$
$- [(3)(0\ kJ/mol) + (3)(-295\ kJ/mol)]$

$\Delta H° = [-3562\ kJ/mol] - [-885\ kJ/mol]$

$\boxed{\Delta H° = -2677\ kJ/mol}$