Energy Stoichiometry Answers

1. Calculate the amount of heat absorbed when 5.66 grams of carbon disulfide form from the synthesis of C (s) and S (s).

$C(s) + 2\,S(s) \rightarrow CS_2(l) \quad \Delta H° = +89.3\ kJ$

5.66 grams CS_2 = 76.2 grams CS_2 = 6.63 kJ
x 89.3 kJ

2. How many grams of methane (CH_4) are needed to produce 2100. kJ of energy?

$CH_4(g) + 2\,O_2(g) \rightarrow CO_2(g) + 2\,H_2O(l) \quad \Delta H° = -890.4\ kJ$

-2100. kJ = -890.4 kJ = 37.85 grams CH_4
x 16.05 grams CH_4

3. How much heat is given off when 1106 grams of phosphorus trichloride are formed?

$2P + 3Cl_2 \rightarrow 2PCl_3 \quad \Delta H° = -574\ kJ$

1106 grams PCl_3 = 274.64 grams PCl_3 = -2311.5 → -2310 kJ
x -574 kJ

4. How many grams of magnesium oxide are produced when 350 kJ of energy is released?

$2Mg(s) + O_2(g) \rightarrow 2MgO(s) \quad \Delta H° = -1204\ kJ$

-350 kJ = -1204 kJ = 23.43 → 23 grams MgO
x 80.60 grams MgO

5. How much energy is required to break down 300.0 grams of phosphorus pentachloride?

$PCl_5 \rightarrow PCl_3 + Cl_2 \quad \Delta H° = -87.9\ kJ$

300.0 grams PCl_5 = 208.22 grams PCl_5 = -126.64 = -127 kJ
x -87.9 kJ

6. How many grams of water vapor are released in the production of 3000. kilocalories of energy?

$2H_2 + O_2 \rightarrow 2H_2O \quad \Delta H° = -484\ kJ$

3000 kcal x 4.184 = 12552 kJ

-12552 kJ = -484 kJ = 935 grams H_2O
x 36.04 grams H_2O

7. How much energy is released in the break down of 999 grams of iron(III) oxide?

$Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2 \quad \Delta H° = -26.3\ kJ$

999 grams Fe_2O_3 = 159.7 grams Fe_2O_3 = -164.5 = -165 kJ
x -26.3 kJ

8. A mountain climber, wanting a drink of water, must melt the snow from the mountain with a propane burner. How many grams of propane (C_3H_8) would the mountain climber have to use to generate the 55.5 kJ of energy?

$C_3H_8(g) + 5\,O_2(g) \rightarrow 4\,H_2O(l) + 3\,CO_2(g) \quad \Delta H° = -2220\ kJ$

-55.5 kJ = -2220 kJ = 1.10 grams C_3H_8
x 44.11 grams C_3H_8

9. How many kJ of energy are needed to produce 2.0 kilograms of glucose?

$6\,H_2O(l) + 6\,CO_2(g) \rightarrow C_6H_{12}O_6(s) + 6\,O_2(g) \quad \Delta H° = 2870\ kJ$

2.0 kilograms x 1000 = 2.0 x 10^3 grams

2.0 x 10^3 grams $C_6H_{12}O_6$ = 180.18 grams $C_6H_{12}O_6$ = 31857.0= 32000 kJ
x 2870 kJ

10. How many kJ of energy are released when 560. liters of sulfur dioxide react with excess oxygen at STP?

$2SO_2(g) + O_2(g) \rightarrow 2SO_3(g) \quad \Delta H° = -197.8\ kJ$

560 liters SO_2 = 44.8 liters SO_2 = -2472.5 = -2470 kJ
x -197.8 kJ

1. Calculate the amount of heat absorbed when 5.66 grams of carbon disulfide form from the synthesis of C (s) and S (s).

$C\ (s) + 2\ S\ (s) \rightarrow CS_2\ (l) \quad \Delta H = +89.3\ kJ$

$\frac{5.66\ grams\ CS_2}{1} \times \frac{1\ mole\ CS_2}{76.2\ grams\ CS_2} \times \frac{89.3\ kJ}{1\ mole\ CS_2} = 6.63\ kJ$

2. How many grams of methane (CH_4) are needed to produce 2100 kJ of energy?

$CH_4\ (g) + 2\ O_2\ (g) \rightarrow CO_2\ (g) + 2\ H_2O\ (l) \quad \Delta H = -890.4\ kJ$

$\frac{2100\ kJ}{1} \times \frac{1\ mole\ CH_4}{-890.4\ kJ} \times \frac{16.0\ grams\ CH_4}{1\ mole\ CH_4} = 37.7 \rightarrow 38\ grams\ CH_4$

3. How much heat is given off when 1106 grams of phosphorus trichloride are formed?

$2P + 3Cl_2 \rightarrow 2PCl_3 \quad \Delta H = -574\ kJ$

$\frac{1106\ grams\ PCl_3}{1} \times \frac{1\ mole\ PCl_3}{137.2\ grams\ PCl_3} \times \frac{-574\ kJ}{2\ mole\ PCl_3} = -2313.6 = -2310\ kJ$

4. How many grams of magnesium oxide are produced when 350 kJ of energy is released?

$2Mg\ (s) + O_2\ (g) \rightarrow 2MgO\ (s) \quad \Delta H = -1204\ kJ$

$\frac{350\ kJ}{1} \times \frac{2\ moles\ MgO}{-1204\ kJ} \times \frac{40.3\ grams\ MgO}{1\ mole\ MgO} = 23.4 \rightarrow 23\ grams\ MgO$

5. How much energy is required to break down 300.0 grams of phosphorus pentachloride?

$PCl_5 \rightarrow PCl_3 + Cl_2 \qquad \Delta H = -87.9\ kJ$

$\frac{300.0\ grams\ PCl_5}{1} \times \frac{1\ mole\ PCl_5}{208.5\ grams\ PCl_5} \times \frac{-87.9\ kJ}{1\ mole\ PCl_5} = -126.47 = -126\ kJ$

6. How many liters of water vapor are released in the production of 3000. kilocalories of energy?

$2H_2 + O_2 \rightarrow 2H_2O \qquad \Delta H = -572\ kJ$

3000 kcal x 4.184 = 12552 kJ

$\frac{12552\ kJ}{1} \times \frac{2\ moles\ H_2O}{-572\ kJ} \times \frac{22.4\ liters\ H_2O}{1\ mole\ H_2O} = 983\ liters\ H_2O$

7. How much energy is released in the break down of 999 grams of iron(III) oxide?

$Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2 \qquad \Delta H = -26.3\ kJ$

$\frac{999\ grams\ Fe_2O_3}{1} \times \frac{1\ mole\ Fe_2O_3}{159.6\ grams\ Fe_2O_3} \times \frac{-26.3\ kJ}{1\ mole\ Fe_2O_3} = -164.6 = -165\ kJ$

8. A mountain climber, wanting a drink of water, must melt the snow from the mountain with a propane burner. How many grams of propane (C_3H_8) would the mountain climber have to use to generate the 55.5 kJ of energy?

$C_3H_8\ (g) + 5\ O_2\ (g) \rightarrow 4\ H_2O\ (l) + 3\ CO_2\ (g) \quad \Delta H = -2220\ kJ$

$\frac{55.5\ kJ}{1} \times \frac{1\ mole\ C_3H_8}{2220\ kJ} \times \frac{44.0\ grams\ C_3H_8}{1\ mole\ C_3H_8} = 1.10\ grams\ C_3H_8$

9. How many kJ of energy are needed to produce 2.0 kilograms of glucose?

$6\ H_2O\ (l) + 6\ CO_2\ (g) \rightarrow C_6H_{12}O_6\ (s) + 6\ O_2\ (g) \qquad \Delta H = 2870\ kJ$

2.0 kilograms x 1000 = 2.0 x 10^3 grams ← 3/25/2009 Elisha Johnson

$\frac{2.0 \times 10^3\ grams\ C_6H_{12}O_6}{1} \times \frac{1\ mole\ C_6H_{12}O_6}{180.0\ grams\ C_6H_{12}O_6} \times \frac{2870\ kJ}{1\ mole\ C_6H_{12}O_6} = 31888.9 = 32000\ kJ$

10. How many kJ of energy are released when 560 liters of sulfur dioxide react with excess oxygen?

$2SO_2\ (g) + O_2\ (g) \rightarrow 2SO_3\ (g) \qquad \Delta H = -197.8\ kJ$

$\frac{560\ liters\ SO_2}{1} \times \frac{1\ mole\ SO_2}{22.4\ liters\ SO_2} \times \frac{-197.8\ kJ}{2\ mole\ SO_2} = -2472.5 = -2500\ kJ$