CHM 110-01 - Summer 2013 - In-Class Practice Work

Write your names in the blanks below:

SOLUTIONS , _____ , _____

Solve the problem, and show your work on the page below.

1) What volume of hydrogen gas at 125 °C and 1.05 atm pressure would be required to provide 1550 kJ of heat via the following reaction?

$$2H_2(g) + O_2(g) \rightarrow 2H_2O(g) \; ; \quad \Delta H = -484\,kJ$$

Answer: 199 L H_2

$2\ mol\ H_2 = -484\ kJ$

$-1550\ kJ \times \frac{2\ mol\ H_2}{-484\ kJ} = 6.404958678\ mol\ H_2$

$V = \frac{nRT}{P}$ | $n = 6.404958678\ mol\ H_2$ $T = 125°C = 398\ K$ $R = 0.08206\ \frac{L\text{-}atm}{mol\cdot K}$ $P = 1.05\ atm$

$V = \frac{(6.404958678\ mol\ H_2)(0.08206\ \frac{L\text{-}atm}{mol\cdot K})(398\ K)}{(1.05\ atm)}$

$= 199.223982684\ L\ H_2$

CHM 110-01 - Summer 2013 - In-Class Practice Work

Write your names in the blanks below:

SOLUTIONS _____ , _____ , _____

Solve the problem, and show your work on the page below.

2) What is the enthalpy change on burning 175 g of ammonia, NH_3, in the following reaction?

17.034

$$4NH_3(g) + 3O_2(g) \rightarrow 2N_2(g) + 6H_2O(g) \; ; \quad \Delta H = -1267 \text{ kJ}$$

Answer: −3250 kJ

$17.034\ g\ NH_3 = 1\ mol\ NH_3 \qquad 4\ mol\ NH_3 = -1267\ kJ$

$$175\ g\ NH_3 \times \frac{1\ mol\ NH_3}{17.034\ g\ NH_3} \times \frac{-1267\ kJ}{4\ mol\ NH_3} = -3254.153459\ kJ$$

CHM 110-01 - Summer 2013 - In-Class Practice Work

Write your names in the blanks below:

SOLUTIONS _____ , _____ , _____

Solve the problem, and show your work on the page below.

3) What mass of TiO_2 solid would (given enough carbon and chlorine) be required to produce 375 L of CO_2 gas at 525 °C and 1.25 atm in the following reaction?

$$TiO_2(s) + C(s) + 2Cl_2(g) \rightarrow TiCl_4(g) + CO_2(g)$$

Answer: 572 g TiO_2

$n = \frac{PV}{RT}$ | $P = 1.25\ atm$ $V = 375\ L$ $R = 0.08206\ \frac{L \cdot atm}{mol \cdot K}$

$T = 525^\circ C = 798\ K$

$$n_{CO_2} = \frac{(1.25\ atm)(375\ L)}{\left(0.08206\ \frac{L \cdot atm}{mol \cdot K}\right)(798\ K)} = 7.158250244\ mol\ CO_2$$

$mol\ CO_2 : mol\ TiO_2$ $79.87\ g\ TiO_2 : mol\ TiO_2$

$$7.158250244\ mol\ CO_2 \times \frac{mol\ TiO_2}{mol\ CO_2} \times \frac{79.87\ g\ TiO_2}{mol\ TiO_2} = 571.729447003\ g\ TiO_2$$

CHM 110-01 - Summer 2013 - In-Class Practice Work

Write your names in the blanks below:

SOLUTIONS _____ , _____ , _____

Solve the problem, and show your work on the page below.

4) What volume (in mL) of 6.00 M HCl solution would be required to produce 55.0 L of CO_2 gas at 0.975 atm and 27.0 °C in the following reaction? Assume there is sufficient sodium carbonate

$$2HCl(aq) + Na_2CO_3(s) \rightarrow 2NaCl(aq) + H_2O(l) + CO_2(g)$$

Answer: 726 mL of 6.00 M HCl

$n = \frac{PV}{RT}$ | $P = 0.975$ atm $V = 55.0$ L $R = 0.08206 \frac{L\cdot atm}{mol\cdot K}$

$T = 27.0\,^{\circ}C = 300.2$ K

$$n_{CO_2} = \frac{(0.975\ atm)(55.0\ L)}{\left(0.08206 \frac{L\cdot atm}{mol\cdot K}\right)(300.2\ K)} = 2.17683296\ mol\ CO_2$$

2 mol HCl : mol CO_2 6.00 mol HCl : L mL : 10^{-3} L

$$2.17683296\ mol\ CO_2 \times \frac{2\ mol\ HCl}{mol\ CO_2} \times \frac{L}{6.00\ mol\ HCl} \times \frac{mL}{10^{-3}\ L} = 725.610986777\ mL$$

CHM 110-01 - Summer 2013 - In-Class Practice Work

Write your names in the blanks below:

SOLUTIONS _____ , _____ , _____

Solve the problem, and show your work on the page below.

5) What volume of ammonia gas is produced at STP from the reaction of 25.0 g of Mg_3N_2 with sufficient water in the following reaction?

100.95

$$Mg_3N_2(s) + 6H_2O(l) \rightarrow 3Mg(OH)_2(s) + 2NH_3(g)$$

Answer: 11.1 L NH_3

$100.95\ g\ Mg_3N_2 = mol\ Mg_3N_2$ $\quad 2\ mol\ NH_3 = mol\ Mg_3N_2$

$$25.0\ g\ Mg_3N_2 \times \frac{mol\ Mg_3N_2}{100.95\ g\ Mg_3N_2} \times \frac{2\ mol\ NH_3}{mol\ Mg_3N_2} = 0.4952947\ mol\ NH_3$$

$V = \frac{nRT}{P}$ | $n = 0.4952947\ mol\ NH_3$ $\quad R = 0.08206\ \frac{L \cdot atm}{mol \cdot K}$

$T = 0°C = 273.15K$ $\quad P = 1.00\ atm$

$$V = \frac{(0.4952947\ mol\ NH_3)(0.08206\ \frac{L \cdot atm}{mol \cdot K})(273.15K)}{(1.00\ atm)}$$

$= 11.101876672\ L$

CHM 110-01 - Summer 2013 - In-Class Practice Work

Write your names in the blanks below:

SOLUTIONS _____ , _____ , _____

Solve the problem, and show your work on the page below.

6) Using standard enthalpies of formation (see your textbook), calculate the enthalpy change ΔH^o for the reaction below, as written:

$$2CH_4(g) + O_2(g) \rightarrow 2CO(g) + 4H_2(g)$$

(−74.87 kJ) (0) (−110.5 kJ) (0)

Answer: $\Delta H^o =$ −71.3 kJ

$\Delta H^o = [2(-110.5) + 4(0)] - [2(-74.87) + 1(0)]$

$= -71.26$ kJ