Full Name: February 22, 2023

**0.1** Balance the following reactions:

(a) $FeS(s) + O_2(g) \longrightarrow Fe_2O_3(s) + SO_2(g)$

(b) $NH_3(g) + O_2(g) \longrightarrow NO(g) + H_2O(g)$

**0.2** Balance the following reactions:

(a) $P_4(s) + O_2(g) \longrightarrow P_4O_{10}(s)$

(b) $Al(s) + O_2(g) \longrightarrow Al_2O_3(s)$

**0.3** Balance the following reactions:

(a) $H_{2(g)} + Br_{2(g)} \longrightarrow HBr_{(g)}$

(b) $C_{(g)} + O_{2(g)} \longrightarrow CO_{(g)}$

(c) $O_{3(g)} \longrightarrow O_{2(g)}$

(d) $NH_4NO_{2(aq)} \longrightarrow N_{2(g)} + H_2O_{(l)}$

(e) $Na_3PO_{4(aq)} + MgCl_{2(aq)} \longrightarrow Mg_3(PO_4)_{2(aq)} + NaCl_{(aq)}$

**0.4** Classify next reaction as combination, decomposition, single replacement, double replacement, or combustion:

(a) $Pb_{(s)} + FeSO_{4(s)} \longrightarrow PbSO_{4(s)} + Fe_{(s)}$

(b) $C_6H_{12(g)} + 9\,O_{2(g)} \longrightarrow 6\,CO_{2(g)} + 6\,H_2O_{(g)}$

(c) $2\,RbNO_{3(aq)} + BeF_{2(aq)} \longrightarrow Be(NO_3)_{2(aq)} + 2\,RbF_{(aq)}$

**0.5** Calculate the molar weight of the following molecules: (a) $NH_3$ (b) $O_2$

**0.6** Calculate the molar weight of the following molecules: (a) $CO$ (b) $H_2$ (c) $Fe_2(CO_3)_3$

**0.7** Fill the conversion factor that calculates the final property:

$$10 \text{ g of NO} \times \frac{\quad \text{moles of NO}}{\quad \text{g of NO}} = \quad \text{moles of NO.}$$

**0.8** Fill the conversion factor that calculates the final property:

$$4 \text{ moles of } CO_2 \times \frac{\quad \text{g of } CO_2}{\quad \text{moles of } CO_2} = \quad \text{g of } CO_2.$$

**0.9** Fill the conversion factor that calculates the final property:

$$7 \text{ g of } \cancel{\text{CH}_4\text{N}_2\text{O}} \times \frac{\quad}{\quad}$$
$$= \quad \text{moles of } \text{CH}_4\text{N}_2\text{O}.$$

**0.10** Fill the conversion factor that calculates the final property:

$$5 \text{ moles of } \cancel{\text{C}_6\text{H}_{12}\text{O}_6} \times \frac{\quad}{\quad}$$
$$= \quad \text{g of } \text{C}_6\text{H}_{12}\text{O}_6.$$

**0.11** Fill the conversion factor that calculates the final property:

$$10^{22} \text{ atoms of } \cancel{\text{O}} \times \frac{\quad \text{molecules of } \text{H}_2\text{O}}{\quad \cancel{\text{atoms of O}}}$$
$$= \quad \text{molecules of } \text{H}_2\text{O}$$

**0.12** Fill the conversion factor that calculates the final property:

$$10^{26} \text{ molecules of } \cancel{\text{NO}_2} \times \frac{\quad \text{atoms of O}}{\quad \cancel{\text{molecules of NO}_2}}$$
$$= \quad \text{atoms of O}.$$

**0.13** Fill the conversion factor that calculates the final property:

$$10^{21} \text{ } \cancel{\text{atoms of N}} \times \frac{\quad}{\quad}$$
$$= \quad \text{molecules of } \text{CH}_4\text{N}_2\text{O}.$$

**0.14** Fill the conversion factor that calculates the final property:

$$6 \text{ molecules of } \cancel{\text{C}_6\text{H}_{12}\text{O}_6} \times \frac{\quad}{\quad}$$
$$= \quad \text{atoms of C}.$$

**0.15** Answer the following questions: (a) How many grams are there in 4 moles of $C_6H_{12}O_6$? (b) How many C atoms are there in 3 moles of $C_6H_{12}O_6$?(c) How many O atoms are there in 3 moles of $C_6H_{12}O_6$?

**0.16** Answer the following questions: (a) Calculate the number of C atoms in 3 moles of $C_{10}H_{14}N_2$? (b) Calculate the number of H atoms in 3 moles of $C_{10}H_{14}N_2$? (c) Calculate the number of N atoms in 3 moles of $C_{10}H_{14}N_2$

**0.17** Calculate the molar weight of the following molecules: (a) Sulfur dioxide, $SO_2$ (b) Unsymmetrical dimethyl hydrazine, $(CH_3)_2NNH_2$ (c) Dimethyl sulfide, $(CH_3)_2S$

**0.18** Calculate the molar weight of the following molecules: (a) benzene, $C_6H_6$ (b) Carbon disulfide, $CS_2$ (c) Nitrogen tetroxide, $N_2O_4$

**0.19** Fill the conversion factor that calculates the final property, given that the molar mass of $C_2H_6$ is 30g/mol:

$$5 \times 10^{25} \text{ atoms of H} \times \frac{\quad}{\quad} \times \frac{\quad}{\quad} \times \frac{\quad}{\quad} = \quad \text{g of } C_2H_6$$

**0.20** Fill the conversion factor that calculates the final property, given that the molar mass of $C_2H_6$ is 30g/mol:

$$7 \times 10^{21} \text{ atoms of C} \times \frac{\quad}{\quad} \times \frac{\quad}{\quad} = \quad \text{moles of } C_2H_6$$

**0.21** Six moles of nitrogen gas react to produce two moles of ammonia according to the following reaction:

**0.22** Six moles of nitrogen gas react to produce three moles of ammonia according to the following reaction:

$$\underset{6 \text{ moles}}{3\,H_2(g) + N_2(g)} \longrightarrow \underset{3 \text{ moles}}{2\,NH_3(g)}$$

**0.23** We mix three moles of hydrogen gas with half a mole of nitrogen gas.

$$\underset{3 \text{ moles}}{3\,H_2(g) +} \underset{0.5 \text{ moles}}{N_2(g)} \longrightarrow 2\,NH_3(g)$$

Calculate the limiting reagent.



**0.24** We mix three moles of hydrogen gas with three moles of nitrogen gas.

$$\underset{3\text{ moles}}{3\,H_2(g)} + \underset{3\text{ moles}}{N_2(g)} \longrightarrow 2\,NH_3(g)$$

Calculate the limiting reagent.



**0.25** We mix six moles of hydrogen gas with two moles of nitrogen gas.

$$\underset{6\text{ moles}}{3\,H_2(g)} + \underset{2\text{ moles}}{N_2(g)} \longrightarrow 2\,NH_3(g)$$

Calculate the limiting reagent.



**0.26** We mix two moles of hydrogen gas with five moles of nitrogen gas.

$$\underset{2\text{ moles}}{3\,H_2(g)} + \underset{5\text{ moles}}{N_2(g)} \longrightarrow 2\,NH_3(g)$$

Calculate the limiting reagent.



**0.27** Mercury(II) halides can be converted into mercury (I) halides by combination with metallic mercury. Mercury(I) halides are known as mercurous halides. When chlorine is the halide, the resulting mercury salt is known as calomel:

$$HgCl_2(s) + Hg(l) \longrightarrow Hg_2Cl_2(s)$$

When 2 grams of mercury(II) chloride reacts to produce 2 grams of calomel, calculate the percent yield of the reaction.



**0.28** Liquid mercury reacts with gas chlorine to produce mercury(II) choride, a white solid:

$$Hg(l) + Cl_2(g) \longrightarrow HgCl_2(s)$$

In an experiment, 5-mL of mercury (AW=200.59g/mol) with density 5g/mL, reactants with 4-g of chlorine to produce 6g of $HgCl_2$. What is the percent yield of the reaction.



**0.29** Nitriles with stannous chloride ($SnCl_2$) in the presence of hydrochloric acid produce an imine.

$$\underset{nitrile}{CH_3CN(aq)} + SnCl_{2(aq)} + HCl_{(aq)} \longrightarrow \underset{imine}{CH_3CHNH(aq)}$$

How many moles of imine (MW=43g/mol) are produced if we react 3g of nitrile (MW=41g/mol), with 2g of stannous chloride (MW=188g/mol) and 1g of hydrochloric acid (MW=36g/mol).

**0.30** The Wurtz reaction results from the reaction of bromomethane ($CH_3Br$) with sodium to produce ethylene ($C_2H_6$)

$$2\,CH_3Br_{(g)} + 2\,Na_{(s)} \longrightarrow C_2H_{6(g)} + 2\,NaBr_{(s)}$$

How many grams of sodium are need to produce 3g of ethylene given that the yield of the reaction is 30%.

**0.31** Fill the mole ratio for the following reaction:

$$C_6H_{12}O_6(s) + 6\,O_2(g) \longrightarrow 6\,CO_2(g) + 6\,H_2O(g)$$

$$\frac{\text{\_\_\_\_\_ moles of } O_2}{\text{\_\_\_\_\_ moles of } CO_2}$$

**0.32** Fill the mole ratio for the following reaction:

$$C_6H_{12}O_6(s) + 6\,O_2(g) \longrightarrow 6\,CO_2(g) + 6\,H_2O(g)$$

$$\frac{\text{\_\_\_\_\_ moles of } C_6H_{12}O_6}{\text{\_\_\_\_\_ moles of } O_2}$$

**0.33** Fill the conversion factor that calculates the moles of AgO produced from 2 moles of Silver:

$$2\,Ag(s) + O_2(g) \longrightarrow 2\,AgO(s)$$

$$2\ \cancel{\text{moles of Ag}} \times \frac{\text{\_\_\_\_\_ moles of AgO}}{\text{\_\_\_\_\_ } \cancel{\text{moles of Ag}}}$$

$$= 2 \text{ moles of AgO}.$$

**0.34** Fill the conversion factor that calculates the moles of oxygen needed to react with 2 moles of Silver producing AgO:

$$2\,Ag(s) + O_2(g) \longrightarrow 2\,AgO(s)$$

$$2\ \cancel{\text{moles of Ag}} \times \frac{\text{\_\_\_\_\_ moles of } O_2}{\text{\_\_\_\_\_ } \cancel{\text{moles of Ag}}}$$

$$= 1 \text{ moles of } O_2.$$

**0.35** Fill the conversion factor that calculates the moles of AgO produced from 5 moles of oxygen:

$$2\,Ag(s) + O_2(g) \longrightarrow 2\,AgO(s)$$

$$5\ \cancel{\text{moles of } O_2} \times \frac{\text{\_\_\_\_\_ moles of AgO}}{\text{\_\_\_\_\_ } \cancel{\text{moles of } O_2}}$$

$$= 10 \text{ moles of AgO}.$$

**0.36** Fill the conversion factor that calculates the moles of AgO produced from 10 moles of oxygen:

$$2\,\mathrm{Ag(s)} + \mathrm{O_2(g)} \longrightarrow 2\,\mathrm{AgO(s)}$$

$$10\ \cancel{\text{moles of } \mathrm{O_2}} \times \frac{\qquad\ \text{moles of AgO}}{\qquad\ \cancel{\text{moles of } \mathrm{O_2}}} = 20 \text{ moles of AgO.}$$

**0.37** Calculate the number of grams of nitrogen needed to react with 4 moles of hydrogen, to produce ammonia:

$$\underset{4\text{ moles}}{3\,\mathrm{H_2(g)}} + \underset{\qquad\ \text{grams}}{\mathrm{N_2(g)}} \longrightarrow 2\,\mathrm{NH_3(g)}$$

**0.38** Calculate how many moles of nitrogen are needed to react with 5 moles of hydrogen, to produce ammonia:

$$\underset{5\text{ moles}}{3\,\mathrm{H_2(g)}} + \underset{\qquad\ \text{moles}}{\mathrm{N_2(g)}} \longrightarrow 2\,\mathrm{NH_3(g)}$$

**0.39** Calculate the number of molecules in: (a) 4 moles of $NH_3$ (b) 50 moles of $H_2SO_4$

**0.40** Calculate the number of molecules in: (a) 8 moles of CO (b) 10 moles of $CO_2$

**0.41** Calculate the number of moles in: (a) $3.2 \times 10^{21}$ molecules of $H_2O$ (b) $2 \times 10^{23}$ molecules of $CO_2$

**0.42** Calculate the number of moles in: (a) $6 \times 10^{23}$ molecules of NO (b) $5 \times 10^{15}$ molecules of NaCl(c) $3 \times 10^{27}$ molecules of MgO

**0.43** Fill the conversion factor that calculates the final property:

$$3\ \cancel{\text{moles of NO}} \times \frac{\qquad\ \text{molecules of NO}}{\qquad\ \cancel{\text{moles of NO}}} = \qquad\ \text{molecules of NO.}$$

**0.44** Fill the conversion factor that calculates the final property:

$$10^{24}\ \text{molecules of } NO_2 \times \frac{\square\ \text{moles of } NO_2}{\square\ \text{molecules of } NO_2} = \square\ \text{moles of } NO_2.$$

**0.45** Fill the conversion factor that calculates the final property:

$$10^{25}\ \text{molecules of } CH_4N_2O \times \frac{\square}{\square} = \square\ \text{moles of } CH_4N_2O.$$

**0.46** Fill the conversion factor that calculates the final property:

$$6\ \text{moles of } C_6H_{12}O_6 \times \frac{\square}{\square} = \square\ \text{molecules of } C_6H_{12}O_6.$$

**0.47** Calculate the number of grams of hydrogen needed to react with 5 moles of nitrogen, to produce ammonia:

$$\underset{\square\ \text{grams}}{3\,H_2(g)} + \underset{0.3\ \text{moles}}{N_2(g)} \longrightarrow 2\,NH_3(g)$$

**0.48** Calculate the number of grams of hydrogen needed to react with 0.3 moles of nitrogen, to produce ammonia:

$$\underset{\square\ \text{grams}}{3\,H_2(g)} + \underset{0.3\ \text{moles}}{N_2(g)} \longrightarrow 2\,NH_3(g)$$