Exercise 3.68 - Enhanced - with Feedback

MISSED THIS? *Read Section 3.8 (Pages 111 - 113) ; Watch IWE 3.13 .*

Calculate the mass (in grams) of each sample.

$1 mol = 6.022 \times 10^{23}$

Part A

7.3×10^{25} O_3 molecules

Express your answer to two significant figures and include the appropriate units.

ANSWER:

m_{O_3} =

O_3

$3 \times O = 3 \times 16.00$

$48.009 g/mol$

$7.3 \times 10^{25} O_3 \times \frac{1 mol\ O_3}{6.022 \times 10^{23} O_3} \times \frac{48.00 g\ O_3}{1 mol\ O_3} = 5800 g\ O_3$

Part B

6.93×10^{19} CCl_2F_2 molecules

Express your answer to three significant figures and include the appropriate units.

ANSWER:

$m_{CCl_2F_2}$ =

Part C

3 water molecule(s)

Express your answer to four significant figures and include the appropriate units.

ANSWER:

m_{H_2O} =

$3\ H_2O \times \frac{1 mol\ H_2O}{6.022 \times 10^{23} H_2O} \times \frac{18.02 g\ H_2O}{1 mol\ H_2O} = 9 \times 10^{-23} g\ H_2O$

H_2O

$2 \times H = 2 \times 1.008$

$1 \times O = 16.00$

$18.02 g/mol$

Stoichiometry

mol ↔ mol ✓

g X ↔ mol Y ✓

g ↔ g

ex: $C_3H_8(g) + 5O_2(g) \longrightarrow 3CO_2(g) + 4H_2O(l)$

? mol C_3H_8 —② coefficients→ ? mol CO_2

① molar mass C_3H_8 ↑ 454 g C_3H_8

③ molar mass CO_2 ↓ ? g CO_2

Q: what mass CO_2 is made when we burn 454 g C_3H_8?

① C_3H_8

$3 \times C = 3 \times 12.01$

$8 \times H = 8 \times 1.008$

44.09 g/mol

③ CO_2

$1 \times C = 1 \times 12.01$

$2 \times O = 2 \times 16.00$

44.01 g/mol

② 1 mol C_3H_8 = 3 mol CO_2

$$454\ g\ C_3H_8 \times \frac{1\ mol\ C_3H_8}{44.09\ g\ C_3H_8} \times \frac{3\ mol\ CO_2}{1\ mol\ C_3H_8} \times \frac{44.01\ g\ CO_2}{1\ mol\ CO_2} = 1359.5\ g\ CO_2$$

(① ② ③)

$= 1360\ g\ CO_2$

Q: $CH_4 + 2O_2 \longrightarrow CO_2 + 2H_2O$.

? mol CH_4 —② coefficients→ ? mol H_2O

① molar mass CH_4 ↑ 23.0 g CH_4

↓ ③ molar mass H_2O ? g H_2O

what mass of H_2O is formed from 23.0 g CH_4?

CH_4

$1 \times C = 12.01$

$4 \times H = 4 \times 1.008$

$16.04\ g/mol$ ①

H_2O

$2 \times H = 2 \times 1.008$

$1 \times O = 16.00$

$18.02\ g/mol$ ③

$$23.0\ g\ CH_4 \times \frac{1\ mol\ CH_4}{16.04\ g\ CH_4} \times \frac{2\ mol\ H_2O}{1\ mol\ CH_4} \times \frac{18.02\ g\ H_2O}{1\ mol\ H_2O} = 51.7\ g\ H_2O$$

Limiting Reactant/Reagent (LR)

ex: 2 sl bread + 1 sl. cheese ⟶ 1 cheese sw

LR → (4 sw) (5 sw) ← XS

8 sl. bread + 5 sl. cheese = 4 cheese sw ← theoretical yield!

XS LR

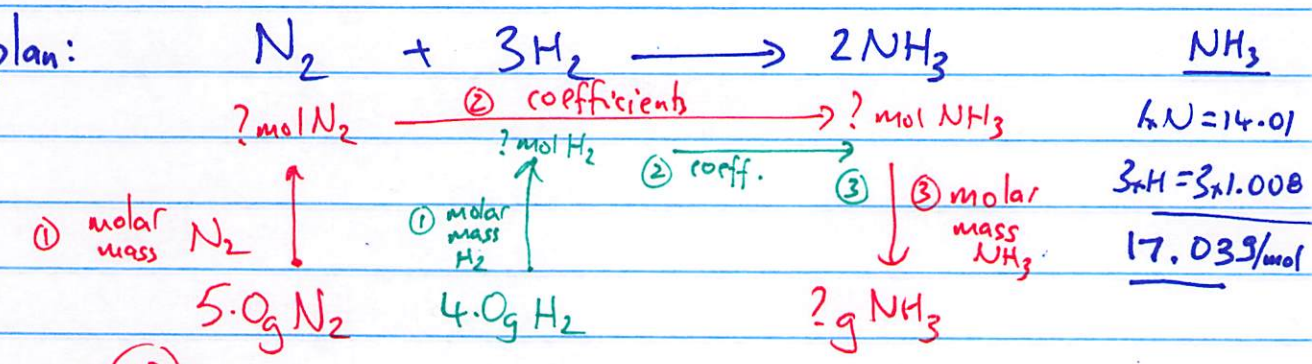
6 sl. bread + 2 sl. cheese = 2 cheese sw

(3 sw) (2 sw)

ex: $N_2 + 3H_2 \longrightarrow 2NH_3$

Q: what mass NH_3 can we make from $5.0\,g\ N_2$ and $4.0\,g\ H_2$?

plan:



(LR)

$$5.0\,g\,N_2 \times \frac{1\,mol\,N_2}{28.01\,g\,N_2} \times \frac{2\,mol\,NH_3}{1\,mol\,N_2} \times \frac{17.03\,g\,NH_3}{1\,mol\,NH_3} = 6.1\ g\,NH_3$$

↑ theoretical yield

(XS)

$$4.0\,g\,H_2 \times \frac{1\,mol\,H_2}{2.016\,g\,H_2} \times \frac{2\,mol\,NH_3}{3\,mol\,H_2} \times \frac{17.03\,g\,NH_3}{1\,mol\,NH_3} = 23\,g\ NH_3$$

$$\%\,yield = \frac{actual\ yield}{theoretical\ yield} \times 100$$

ex: if we only got $3.8\,g\ NH_3$, $\%\,yield = \frac{3.8\,g}{6.1\,g} \times 100 = 62\%$