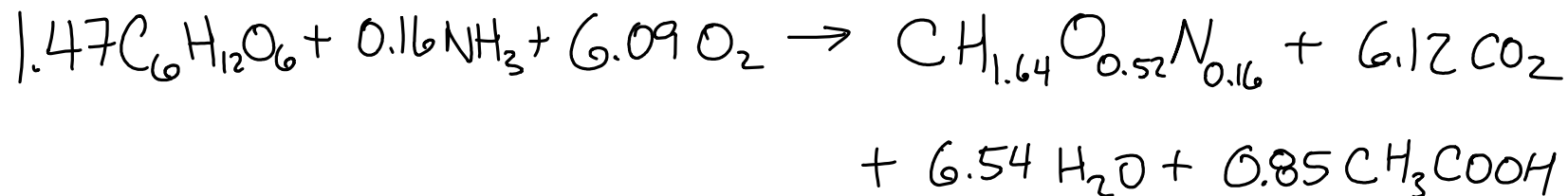


EXAMPLE 1

ONLY 2 REACTIONS OCCUR

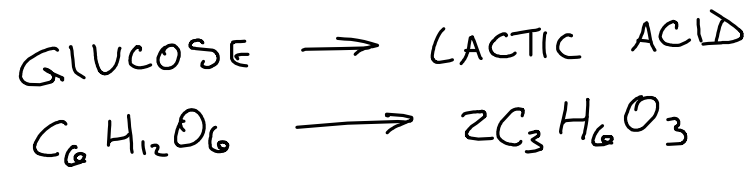
RXN #1

GLUCOSE + AMMONIA + OXYGEN $\rightarrow$ CELLS + CO₂ + H₂O + ACETIC ACID



- NOTE:
- 1) CELLS HAVE A THEORETICAL CHEMICAL FORMULA, DEFINED SO THAT SUBSCRIPT FOR CARBON IS 1.
 - 2) STOICHIOMETRIC COEFFICIENTS ARE NON-INTEGERS. BY CONVENTION COEFFICIENT SO CELLS IS ONE.

REACTION #2



PROBLEM:

YOU SUPPLY 200g GLUCOSE, 2.00g NH_3 , AND AN UNLIMITED SUPPLY OF OXYGEN TO CELLS. YOU OBTAIN 140g LACTIC ACID ("DESIRED PRODUCT"). ALL GLUCOSE IS CONSUMED.

- WHAT IS YIELD?
- WHAT QTY OF ACETIC ACID IS GENERATED?
- WHAT IS SELECTIVITY?
- HOW MUCH NH_3 REMAINS?

INFORMATION:

$$M_G = 180.0 \text{ g/mol}$$

$$M_{\text{con}} = 44.0 \text{ g/mol}$$

$$M_C = 24.2 \text{ g/mol}$$

$$M_{\text{H}_2\text{O}} = 18.0 \text{ g/mol}$$

$$M_{\text{AA}} = 60.0 \text{ g/mol}$$

$$M_{\text{NH}_3} = 17.0 \text{ g/mol}$$

$$M_{\text{LA}} = 90.0 \text{ g/mol}$$

GLUCOSE IS LIMITING REACTANT.

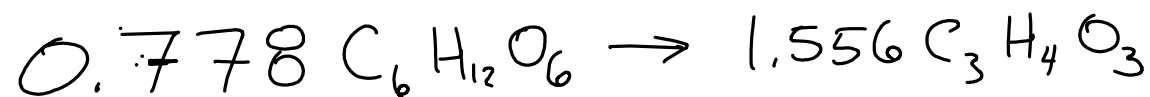
$$140 \text{ g LA} \times \frac{\text{mol}}{90 \text{ g LA}} = 1.556 \text{ mol LA}$$

GLUCOSE CONSUMED TO GENERATE LA

$$1.556 \text{ mol LA} \times \frac{1 \text{ mol G CONS}}{2 \text{ mol LA FORMED}} = 0.778 \text{ mol G}$$

STOICHIOMETRIC RATIO
(RXN #2)

RXN #2



How much Glucose WAS CONSUMED IN TOTAL?

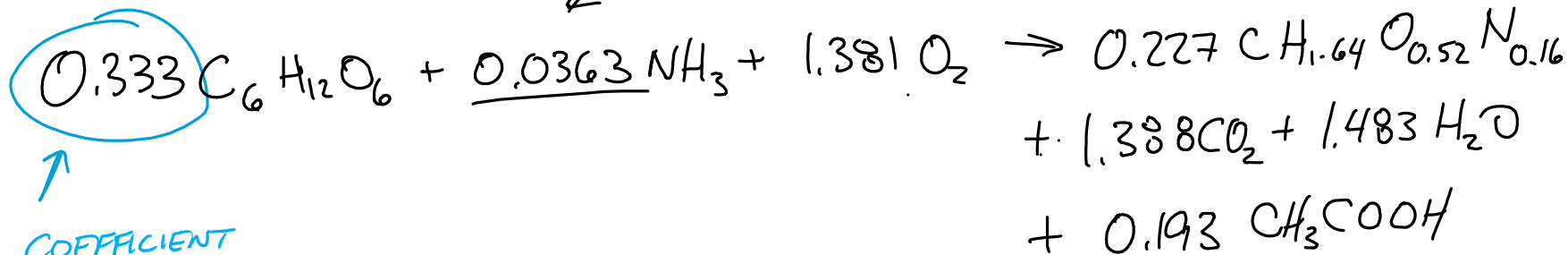
$$200\text{g G} \times \frac{\text{mol}}{180\text{g G}} = 1.111 \text{ mol G}$$

Amount OF GLUCOSE CONSUMED BY RXN #1:

$$\begin{array}{rcl} 1.111 \text{ mol G} & - & 0.778 \text{ mol G} \\ \text{(TOTAL)} & \text{(RXN \#2)} & \text{(RXN \#1)} \end{array} = 0.333 \text{ mol G}$$

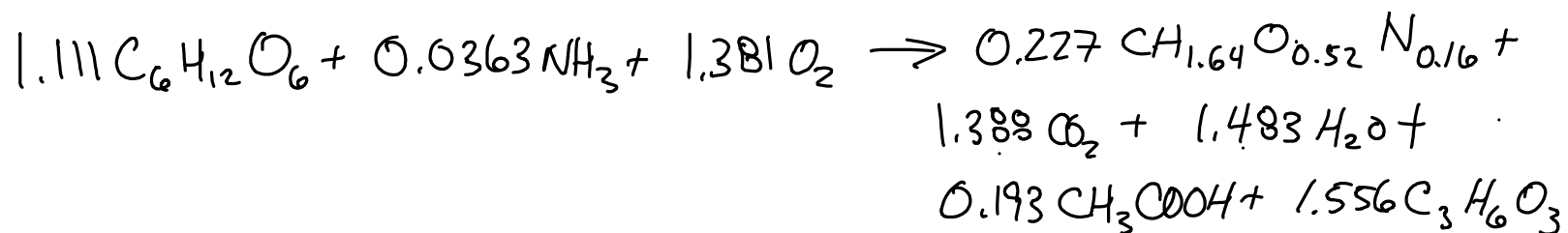
SO, RXN #1 IS

$$0.16 \left(\frac{0.333}{1.47} \right)$$



↑
THE COEFFICIENT
IS "FORCED" TO BE 0.333

OVERALL CHEMICAL REACTION IS:



a) YIELD BY MASS

$$\frac{\text{MASS DESIRED PRODUCT FORMED}}{\text{MASS SUBSTRATE CONSUMED}}$$

$$\frac{140\text{g LA}}{200\text{g G}} = \underline{\underline{0.70}}$$

BY MOLES

$$\frac{\text{MOLES DESIRED PRODUCT FORMED}}{\text{MOLES SUBSTRATE CONSUMED}}$$

$$= \frac{1.556 \text{ mols LA}}{1.111 \text{ mols G}} = \underline{\underline{1.40}}$$

MAXIMUM THEORETICAL YIELD

(i.e., IF ALL THE GLUCOSE
FORMED LACTIC ACID)

=

2.0 mols/mol

1.0 g/g

$$b) \quad 0.193 \text{ mol AA} \times \frac{60 \text{ g AA}}{\text{mol AA}} = \underline{11.6 \text{ g Acetic Acid}}$$