Question#47026 – Chemistry – Organic Chemistry

Question:

What is the maximum mass of H_2O that can be produced by combining 66.6 g of each reactant in the equation $4\ NH_{3\ (g)}+5\ O_{2\ (g)} = 4\ NO_{\ (g)}+6\ H_2O_{\ (g)}$

Answer:

One can calculate the amount of moles of each reagent:

$$n(NH_3)=\frac{m(NH_3)}{M(NH_3)}=\frac{66.6g}{17g/mol}=3.9mol$$

$$n(O_2)=\frac{m(O_2)}{M(O_2)}=\frac{66.6g}{32g/mol}=2.1mol$$

The limiting reagent is O_2, because there is an excess of ammonia NH_3 in the system. The maximum mass of water obtained according to the reaction equation has to be calculated after the amount of moles of oxygen gas O_2. If 5 of oxygen O_2 produces 6 moles of water H_2O, than 2.1 mole of O_2 can produce:

$$m(H_2O)=\frac{2.1mol\times 6}{5}=2.5mol$$

The corresponding mass of water is the maximum possible mass of water produced:

$$m(H_2O)=n(H_2O)\times M(H_2O)=2.5mol\times 18g/mol=45g$$