Show calculation setups and answers for all problems below.

1. A sample of nickel(II) phosphate, Ni₃(PO₄)₂, weighs 114 g. How many moles are in this sample?

2. What is the mass (in kg) of 35.6 moles of methane gas, CH₄?

3. How many molecules of water, H₂O, are present in 28.4 g of H₂O?

4. Determine the weight (in g) of nitrogen atoms in 6.14 x 10³⁰ molecules of dinitrogen tetroxide, N₂O₄.

5. Ammonia gas will react with oxygen gas to yield nitrogen monoxide gas and water vapor.
   (a) Write the balanced chemical equation for this reaction.
   (b) Determine the theoretical yield of water vapor when 2.51 g of ammonia react with 3.76 g of oxygen.
   (c) What is the percentage yield of water when 2.27 g of water vapor are produced?
6. Use the balanced equation below to solve the following problems:

\[ 2 \text{KMnO}_4 + 16 \text{HCl} \rightarrow 5 \text{Cl}_2 + 2 \text{KCl} + 2 \text{MnCl}_2 + 8 \text{H}_2\text{O} \]

(a) How many moles of HCl are required to react with 28 g of KMnO\(_4\)?


(b) How many Cl\(_2\) molecules will be produced using 1.5 mol KMnO\(_4\)?


(c) To produce 29.0 g of MnCl\(_2\), what mass (in g) of HCl will need to react?


(d) What is the maximum mass of Cl\(_2\) that can be produced by reacting 65.9 g of KMnO\(_4\) with 18.0 g of HCl?