**Breaking Bad Chemistry Calculations**

**Scenario:**

*Walt uses the Nagai method to produce his crystal meth. It follows two steps as shown below:*

***Step 1:*** *Ephedrine + hydroiodic acid → iodoephedrine (+ water)*

*C10H15NO + HI → C10H15NI (+ H2O)*

***Step 2:*** *Iodoephedrine + phosphorous → methamphetamine + phosphorous triiodide*

*3C10H15NI + P → 3C10H15N + PI3*

**TASK 1:** *Calculate the relative formula mass for each of the following compounds:*

1. *Phosphorous (P) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_*
2. *Phosphorous triiodide (PI3) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_*
3. *Hydroiodic acid (HI) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_*
4. *Methamphetamine (C10H15N) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_*

**TASK 2:**

*The reactive component in methamphetamine is called the amine group (formula NHCH3). Calculate the percentage (%) by mass of this group in the overall compound (C10H15N).*

*Remember: (Ar ÷ Mr) x 100*

**Extension**: Calculate the % of each of the following in methamphetamine:

1. Carbon *\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_*
2. Hydrogen *\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_*
3. Nitrogen *\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_*

**TASK 3: *Reacting Masses (Higher)***

*The equation in step 2 shows that* ***3*** *moles of* ***iodoephedrine*** *react to form* ***3*** *moles of* ***methamphetamine****.*

*The equation in the formula triangle below can be used to work out the mass of product that could theoretically be formed from a certain mass of reactant.*

*Based on the number of moles given above, and the formula masses of each compound, calculate the mass of:*

* 1. *Iodoephedrine*
	2. *Methamphetamine*

Hint: use the formula triangle!

**TASK 4: Percentage yield (Higher)**

Percentage yield = $\frac{amount of product produced}{theoretical maximum}×100$

E.g. A + B → C

*Using known masses of iodoephedrine (828g) it was worked out that the maximum amount of methamphetamine that could be produced was 447g. However when Jesse did this reaction he only produced 300g.*

*What was his percentage yield?*

**Extension:** *On the second attempt, a more established cook (Walt) had a crack at the method and managed to produce 400g.*

1. *What was his percentage yield?*
2. *Explain why a greater % yield is beneficial for Walt.*