Gold Case Study Answer Key

Au = 196.97
Cl = 35.45

1) $Au(OH)_3$ 247.99 g/mol

2) $AuCl_3$ 303.32 g/mol

3) NaOH 39.997 g/mol

4) $AuCl_3 + 3NaOH \rightarrow 3NaCl + Au(OH)_3$

5) $\frac{280\ g\ AuCl_3}{} \left| \frac{1\ mol\ AuCl_3}{303.32\ g\ AuCl_3} \right| \frac{1\ mol\ Au(OH)_3}{1\ mol\ AuCl_3} \left| \frac{247.99\ g}{1\ mol\ Au(OH_3)} \right. = 229\ g\ Au(OH)_3$

$\frac{12\ g\ NaOH}{} \left| \frac{1\ mol\ NaOH}{39.997\ g\ NaOH} \right| \frac{1\ mol\ Au(OH)_3}{3\ mol\ NaOH} \left| \frac{247.99\ g\ Au(OH)_3}{1\ mol\ Au(OH)_3} \right. = 24.8\ g\ Au(OH)_3$

NaOH is the limiting reactant because it makes less $Au(OH)_3$. You (John) could only make **24.8 g $Au(OH)_3$**

6) % yield = $\frac{act.}{theo.} \times 100$

$= \frac{24}{24.8} \times 100 = 96.8\%$

(24 ← from story; 24.8 → from 5)

7)

$$\frac{2800\ g\ AuCl_3}{} \left| \frac{1\ mol\ AuCl_3}{303.32\ g\ AuCl_3} \right| \frac{1\ mol\ Au(OH)_3}{1\ mol\ AuCl_3} \left| \frac{247.99\ g}{1\ mol\ Au(OH)_3} \right. = 2289\ g\ Au(OH)_3$$

$$\frac{120\ g\ NaOH}{} \left| \frac{1\ mol\ NaOH}{39.997\ g\ NaOH} \right| \frac{1\ mol\ NaOH}{3\ mol\ NaOH} \left| \frac{247.99\ g}{1\ mol\ Au(OH)_3} \right. = 248\ g\ Au(OH)_3$$

NaOH = limiting reactant

248 g $Au(OH)_3$ can be made

8) Excess = $AuCl_3$

$$\frac{12\ g\ NaOH}{} \left| \frac{1\ mol\ NaOH}{39.997\ g\ NaOH} \right| \frac{1\ mol\ AuCl_3}{3\ mol\ NaOH} \left| \frac{303.32\ g\ AuCl_3}{1\ mol\ AuCl_3} \right.$$

$= 30.3\ g\ AuCl_3$ ← how much is needed

what he used ↓

$280\ g - 30.3 =$ **249.7 g $AuCl_3$ extra!!!!**

9) Excess = $AuCl_3$

120 g NaOH => 303 g $AuCl_3$ needed

2800 g (used) − 303 g (needed) = **2497 g $AuCl_3$ extra!**

10) 5 batches a week
× 5 weeks
25 batches of 2nd reaction
+ 1 batche of 1st reaction

⇓

$25 \times 2497\,g\ AuCl_3$
$+\ 1 \times 249.7\,g\ AuCl_3$
$62674.7\,g\ AuCl_3$

11) Down the drain!

12) a) $\% = \frac{Au}{AuCl_3} \times 100 = \frac{196.97}{303.32} \times 100 = 64.9\%\ Au$

b) $62674.7\,g\ AuCl_3 \cdot .649 = 40,676\,g\ Au$

c) $40,676\,g\ Au \times \$43.61/g = \$1,773,875.14$

13) $\$1,773,875.14 \times .05$ (5%) $= \$88,693.76$ Lost!!

14) $\frac{200\,g\ Au(OH)_3}{1} \left| \frac{1\,mol\ Au(OH)_3}{247.99\,g\ Au(OH)_3} \right| \frac{1\,mol\ AuCl_3}{1\,mol\ Au(OH)_3} \left| \frac{303.32\,g}{1\,mol\ AuCl_3} \right| = 244.6\,g\ AuCl_3$

15) FIRED!!!