Name Key

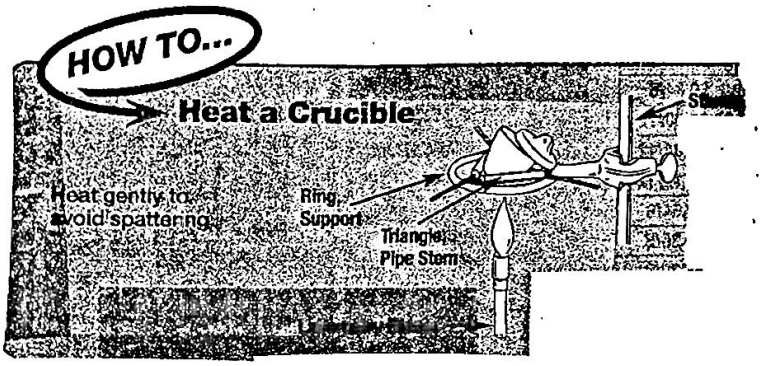
Regents Chemistry

Period ____

Percent by Mass of Water in a Hydrate Worksheet

Skill: The water of hydration is a definite mass of water that is part of a crystalline compound, such as $CuSO_4 \cdot 5H_2O$. Compounds containing water are called hydrates. Careful heating of the hydrate can drive off the water. The percentage of water in the hydrate can be calculated from the difference in mass of the compound before heating and after heating.

To find the percent by mass of water in a hydrate, place a known mass of the compound to be studied in a crucible.



Then measure the mass of the compound and the crucible together. Heat the crucible gently for several minutes until the crystal turns to powder. Find the mass of the crucible with the remains of the crystal. Subtract your results from the initial mass of the crucible and crystal together. The difference is the mass of the water of hydration. Divide by the original mass of the hydrate and multiply by 100 % to find the percent of water in the hydrate.

$$\text{Percent water} = \frac{\text{mass of water of hydration}}{\text{mass of hydrate}} \times 100$$

Questions: Show all of your work.

1. The data below were obtained by a student in an experiment to determine the percent of water in a hydrate:

Mass of hydrate.....	5.0 g
Mass of anhydrous compound.....	3.4 g

$$\%\ H_2O = \frac{\text{mass } H_2O \text{ removed}}{\text{mass hydrate}} \times 100$$

Determine the percent of water in the hydrate.

mass H_2O = mass hydrate − mass anhydrous

mass H_2O = 5.0 g − 3.4 g = 1.6 g H_2O

$$\frac{1.6\text{ g } H_2O}{5.0\text{ g hydrate}} \times 100 = \boxed{32\%\text{ water}}$$

2. Base your answers to the questions below on the following table, which shows the data collected during the heating of a 5.0 g sample of a hydrated salt.

Mass of Salt (g)	Heating Time (min)
5.0	0.0
4.1	5.0
3.1	10.
3.0	15.
3.0	30.
3.0	60.

After 60 minutes, how many grams of water appear to remain in the salt?

After 60 min there is no remaing water because the mass of sample stops changing

What is the percent of water in the original sample?

mass H_2O = 5.0 − 3.0 = 2.0 g H_2O

$\%\ H_2O = \frac{2.0\ g\ H_2O}{5.0\ g\ hydrate} \times 100 =$ **40% H_2O**

3. A student obtained the following data to determine the percent by mass of water in a hydrate.

Mass of empty crucible + cover.....	11.70 g
Mass of crucible + cover + hydrated salt before heating....	14.90 g
Mass of crucible + cover + anhydrous salt after thorough heating.....	14.53 g

14.90 g − 11.70 g = 3.20 g hydrated salt

14.90 g − 14.53 g = 0.6 g H_2O removed

What is the approximate percent by mass of the water in the hydrated salt?

$\frac{.6\ g\ H_2O}{3.20\ g\ hydrate} \times 100 =$ **18.8% H_2O**

4. A student calculated the percent by mass of water in a sample of $BaCl_2 \cdot 2H_2O$ to be 16.4%, exp but the accepted value is 14.8%. What was the student's percent error?

$\frac{measured - accepted}{accepted} \times 100$ $\quad \frac{16.4 - 14.8}{14.8} \times 100 =$ **10.8% error**

5. What is the percent by mass of water in $NiSO_4 \cdot 6H_2O$? (nickel (II) sulfate hexahydrate

Ni 1 (58.69) = 58.69
S 1 (32.07) = 32.07
O 4 (16.00) = 64.00
H_2O 6 (18.02) = 108.12 / 262.88 g/mol

$\frac{108.12\ g\ H_2O}{262.88\ g\ hydrate} \times 100 =$ **41.1% H_2O**

6. What is the percent by mass of water in $FeSO_4 \cdot 7H_2O$? (iron (II) sulfate heptahydrate)

Fe 1(55.85) = 55.85
S 1(32.07) = 32.07
O 4(16.00) = 64.00
H_2O 7(18.02) = 126.14
278.06 g

$\frac{126.14\ g\ H_2O}{278.06\ g\ hydrate} \times 100 =$ **45.4% H_2O**