CHAPTER 6 BLM ANSWER KEY

BLM 6-1: Salt-Sand Mixture/Problem Solving

Answers

Conclusion

The percent composition will depend on the mixture prepared.

Discussion

The class results should be consistent, if the mixture was well mixed. Small variations can occur if there are clumps of salt or sand in the mixture. The results from different classes using different mixtures will not be the same. The law of definite proportions does not apply to mixtures.

BLM 6-2: Using the Law of Definite Proportions/Reinforcement

Answers

In the solution to the sample problem, one way to find z is to use conservation of mass.

$z = 212.6$ g

1.

	zinc sulfide	zinc	sulfur
First sample	45.6 g	30.6 g	
Second sample	250 g	x g	y g

Now, 45.6 / 250 = 30.6 / x gives x = 167.8 or 168 g and y = 250 − 168 = 82 g

Thus, 250 g of zinc sulfide contain 168 g of zinc and 82 g of sulfur.

2.

	cobalt	bromine	A
First sample	39.5 g	107 g	39.5 + 107 = 146.5 g
Second sample	250 g	excess	x g

Now 39.5 / 250 = 146.5 / x gives x = 927.2 or 927 g

Thus 927 g of compound A would be formed.

3.

	calcium oxide	calcium	oxygen
First sample	24.1 g	17.2 g	
Second sample	x g	60.0 g	

Now, 24.1 / x = 17.2 / 60.0 gives x = 84.06 or 84.1 g

Thus, 84.1 g of the compound contains 60.0 g of calcium.

BLM 6-3: Multiple Proportions/Inquiry Assessment

Answers

Consider 100 g of compound X.

45.11 g of gold react with 54.89 g of bromine.

1.000 g of gold reacts with 54.89 / 45.11 = 1.2168 g of bromine.

Consider 100 g of compound Y.

71.14 g of gold react with 28.86 g of bromine.

1.000 g of gold reacts with 28.86 / 71.14 = 0.40567 g of bromine.

Compare the two amounts of bromine that react with 1.000 g of gold.

1.2168 / 0.40567 = 2.999 / 1 or 3 / 1

Thus the amount of bromine that reacts with the same amount of gold is in the simple ratio of 3 : 1. (The compounds are $AuBr_3$ and AuBr.)

BLM 6-4: Illustrating the Law of Definite Proportions/Inquiry Assessment

Tips

- Avoid using "mossy" zinc. Use pieces of either zinc rod or zinc sheet. Try the reaction yourself ahead of time to ensure that the zinc fits in the tube and is not all consumed.
- You may choose to do these steps for the students.
  - Use full-strength, stock hydrochloric acid. It should be poured into the tube while the tube is tilted to let the liquid run down the side.
  - Slide the piece of zinc down the side as well, to avoid splash.
- Heating until the dry residue melts ensures that no water is trapped.
- The compound may be removed from the evaporating dish by adding a small amount of water to loosen it.
- The pieces of leftover zinc may be dipped (by the teacher, using tongs) into a small beaker of acetone in a fume hood. Any water on the zinc dissolves in the acetone. The acetone evaporates quickly from the zinc leaving it dry, ready for mass measurement.

Answers

$ZnCl_2$ is 48.0% Zn, 52.0% Cl. Class results should be close to this and support the law of definite proportions. Individual values that are "off" usually mean lost product or calculation errors.

BLM 6-7: Chapter 6 Test

Answers

1. **(a)** definite proportions
(b) They would all have the same proportions of magnesium and of oxygen.

2. **(a)** The identity of the constituent elements and the simplest ratio of their atoms in the compound.
(b) The actual numbers of atoms of each type in one molecule.

3. **(a)** Water is trapped in the crystals.
(b) hydrate
(c) heating
(d) anhydrous
(e) Find the molar mass.
M = 137.33 + 2(16.00 + 1.01) + 8[2(1.01) + 16.00] g/mol
M = 171.35 + 144.16 = 315.51 g/mol
The mass percent of
H_2O = (144.16 g / 315.51 g)(100)% = 45.7%

4. Percent H = (3.740 g / 316.0 g)(100)% = 1.18%
Percent Cl = (132.8 g / 316.0 g)(100)% = 42.03%
Percent O = (179.5 g / 316 g)(100)% = 56.80%
The compound is 1.18% H; 42.03% Cl; 56.80% O.5. For $AgNO_3$,
M = 107.87 g/mol + 14.01 g/mol + 3(16.00 g/mol) = 169.88 g/mol

Percent Ag = (107.87 g/169.88 g)(100)% = 63.5%
Percent N = (14.01 g/169.88 g)(100)% = 8.25%
Percent O = (48.00 g/169.88 g)(100)% = 28.25%
$AgNO_3$ is 63.5% Ag, 8.25% N, 28.25% O.

6. Consider 100 g of the compound.

Element	*m* (g)	*M* (g/mol)	*n* (mol)	Ratio to Smaller *n*	Revised Ratio
Cr	68.4	52.00	1.315	1.00	2
O	31.6	16.00	1.975	1.50	3

The empirical formula is Cr_2O_3.

7. From the empirical formula, NH_2, find M_e.
M_e = 14.01 + 2(1.01) = 16.03 g/mol
Given M_m = 32.1 g/mol
The ratio M_m/M_e = 32.1/16.03 = 2/1
The molecular formula is N_2H_4.

8. Consider the water produced.
m = 1.174 g and M = 18.02 g/mol, so
$n = m/M$ = 1.174 g/18.02 g/mol = 0.0651 mol
Each mole of water contains two moles of H so there were 2(0.0651) = 0.1302 mol of H in the original sample.

Now for H:
n = 0.1302 mol and M = 1.01 g/mol so
$m = nM$ = 0.1315 g
Consider the carbon dioxide produced.
m = 1.913 g and M = 44.01 g/mol, so
$n = m / M$ = 1.913 / 44.01 = 0.04346 mol
Each mole of carbon dioxide contains one mole of C so there were 0.04346 mol of C in the original sample.

Now for the C:
n = 0.04346 mol, M = 12.01 g/mol, so
$m = nM$ = (0.04346)(12.01) g = 0.5236 g
The rest of the original sample was oxygen.

Substance	Mass (g)
compound	1.000
carbon	0.5236
hydrogen	0.1315
oxygen	1.000 − (0.5236 + 0.1315) = 0.3449

9. Given that there were 3.00 g of the hydrate.

Substance	*m* (g)	*M* (g/mol)	*n* (mol)
$CoCl_2$	1.64	129.83	0.01263
H_2O	3.00 − 1.64 = 1.36	18.02	0.07547

Divide the number of moles of water by the number of moles of $CoCl_2$
0.07547 / 0.01263 = 5.98 / 1 = 6 / 1
Thus the formula of the hydrate is $CoCl_2 \cdot 6H_2O$.