

How Large is a Mole of M&M's?

Introduction: Because atoms are so small, we must use very large numbers of atoms in order to have conveniently measurable quantities. The quantity we use, called a MOLE, is 6.02×10^{23} (also called Avogadro's number). Just how big is a mole? In this lab, we will use objects much bigger than atoms to visualize just how big a mole is.

Procedure: (Keep candy on a paper towel at all times!)

1. Pour M&M's into a clean beaker.
2. Pour the M&M's onto a clean paper towel and count them.
3. Determine the volume of your sample of M&M's.
4. Determine the mass of your sample of M&M's (use a paper towel on the balance).

Data/Calculations:

Number of M&M's in your sample _____

Volume of your sample of M&M's _____

Mass of your sample of M&M's _____

Volume of ONE M&M _____

Mass of ONE M&M _____

1. Determine the mass (in grams) of one mole of M&M's.
2. Determine the mass (in tons) of one mole of M&M's. (1000 g = 1 kg, 1 kg = 2.2 lb, 2000 lb = 1 ton)
3. The mass of the moon is 7.35×10^{22} kg. How many moles of M&M's have a mass equal to the mass of the moon?
4. Determine the volume of one mole of M&M's.
5. Determine the volume of the big gym by using the following dimensions: length is 40 m or 4000 cm; width is 20 m or 2000 cm; height is 15 m or 1500 cm.
6. How many M&M's are needed to fill up the gym?
7. How many moles of M&M's will fill the gym?
8. Doing the calculation another way, how many gyms are needed to hold 1 mole of M&M's?
9. The volume of the moon is 7.00×10^{24} cm³. How many moles of M&M's have the same volume as the moon?
10. a) The milk chocolate in M&M's is 70% sucrose, $C_{12}H_{22}O_{11}$. What is the molar mass of one mole of sucrose?
b) Caffeine is found in small amounts in the chocolate of M&M's. The formula for caffeine is $C_8H_{10}N_4O_2$. What is the molar mass of caffeine?

BONUS

If the continental United States, excluding Alaska and Hawaii, were covered with 1 mole of M&M's, how many miles deep would the M&M's be? (volume = area x depth)

Area of continental US: 7,693,000 square miles 1 cubic km = 1,000,000,000 cubic m

1 square km = 1,000,000 square m 1 cubic m = 1,000,000 cubic cm

1 square m = 10,000 square cm 1 km = 0.62 miles