# Algebra 1 Unit 1 worksheet: Estimating a huge quantity from small facts

Name _____ Date _____ Period _____

**1.** Hannah's school has 1300 students. Assume each student uses about 9 sheets of paper on a school day, and that a school year has 180 school days. Estimate how many sheets of paper the school uses in a school year. Write the chain with its units, give the answer in scientific notation to two significant figures, and give its order of magnitude.

**2.** Hannah is sure that a quantity is more than 30 and less than some high guess $H$, and works out that the middle of this range on the power-of-ten scale is 150.

(a) Find $H$.

(b) How many times the low end is the high end? Explain how that number is related to how many times the low end the middle is.

**3.** Hannah can guess each factor of a chain to within a factor of 5 of its true value, and wants a product that is sure to be within a factor of 1000 of the true quantity.

(a) What is the greatest number of factors the chain can have?

(b) With that many factors, within what factor of the truth is the product sure to be?

**4.** Some books give "order of magnitude" a second meaning: round to the nearest power of ten on the power-of-ten scale, where the cut-off between $10^n$ and $10^{n+1}$ is $\sqrt{10} \times 10^n \approx 3.16 \times 10^n$.

(a) Give the order of magnitude of each number in the lesson's sense and in this second sense: $2.5 \times 10^4$, 400, 0.07, $3.2 \times 10^8$.

(b) Ordinary rounding would send $3.2 \times 10^8$ down to $10^8$. Explain why the second sense sends it up instead.

**5.** A high school has 1200 students. Assume each student sends at least 3 and at most 192 text messages on a school day.

(a) Find the middle of this range on the power-of-ten scale.

(b) Use it to estimate how many texts the whole school sends on a school day, and give low and high bounds for that total.


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**6.** An above-ground pool holds between 4800 and 12960 liters of water. A garden hose delivers between 12 and 40 liters a minute.

(a) What are the fewest and the most hours it could take to fill the pool with the hose?

(b) Find the middle of that range of times on the power-of-ten scale.

**7.** Kevin estimates how many pet dogs live in a city. His assumptions, each with a low and a high value:

- the city has between 2.0 million and 2.4 million people;
- a household has between 2 and 3 people;
- between one household in 10 and one household in 2 has a dog (count one dog each).

(a) Write the chain for the number of dogs, with its units.

(b) Find low and high bounds for the number of dogs.

(c) How many times the low bound is the high bound?

(d) Kevin has time to research one assumption. Which should it be? Explain using how many times its high value is its low value.


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8. Hannah estimates how many pizzas are ordered in one week in a town of 30,000 people, assuming that about one person in 8 orders one pizza a week. The town's pizzerias later report 15,000 pizzas that week.

   (a) Find Hannah's estimate.

   (b) How many times the estimate is the reported figure?

   (c) The report suggests a better value for the assumption "one person in 8". What is it?

9. Estimate how many sheets of printer paper, stacked flat, would reach the Moon, about 384 000 km away. State the thickness you assume for one sheet, with a low and a high value for it, and give your estimate in scientific notation with low and high bounds.


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