

# Home Base

*Problems about numbers in various bases.*

Here is an opportunity for some practice.

Geogebra link: <https://tube.geogebra.org/m/1527705>

**Problem 1** Explain why the following “joke” is “funny:” There are 10 types of people in the world. Those who understand base two and those who don’t.

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**Problem 2** You meet some Tripod aliens, they tally by threes. Thankfully for everyone involved, they use the symbols 0, 1, and 2.

- (a) Can you explain how a Tripod would count from 11 to 201? Be sure to carefully explain what number comes after 22.
  - (b) What number comes immediately before 10? 210? 20110? Explain your reasoning.
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**Problem 3** You meet some people who tally by sevens. They use the symbols  $O$ ,  $A$ ,  $B$ ,  $C$ ,  $D$ ,  $E$ , and  $F$ .

- (a) What do the individual symbols  $O$ ,  $A$ ,  $B$ ,  $C$ ,  $D$ ,  $E$ , and  $F$  mean?
  - (b) Can you explain how they would count from  $DD$  to  $AOC$ ? Be sure to carefully explain what number comes after  $FF$ .
  - (c) What number comes immediately before  $AO$ ?  $ABO$ ?  $EOFFA$ ? Explain your reasoning.
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**Problem 4** Now, suppose that you meet a hermit who tallies by thirteens. Explain how he might count. Give some relevant and revealing examples.

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Learning outcomes:

Author(s): Bart Snapp and Brad Findell

**Problem 5** While visiting Mos Eisley spaceport, you stop by Chalmun's Cantina. After you sit down, you notice that one of the other aliens is holding a discussion on fractions. Much to your surprise, they explain that  $1/6$  of 36 is 7. You are unhappy with this, knowing that  $1/6$  of 36 is in fact 6, yet their audience seems to agree with it, not you. Next the alien challenges its audience by asking, "What is  $1/4$  of 10?" What is the correct answer to this question, and how many fingers do the aliens have? Explain your reasoning.

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**Problem 6** When the first Venusian to visit Earth attended a sixth grade class, it watched the teacher show that

$$\frac{3}{12} = \frac{1}{4}.$$

"How strange," thought the Venusian. "On Venus,  $\frac{4}{12} = \frac{1}{4}$ ." What base do Venusians use? Explain your reasoning.

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**Problem 7** When the first Martian to visit Earth attended a high school algebra class, it watched the teacher show that the only solution of the equation

$$5x^2 - 50x + 125 = 0$$

is  $x = 5$ .

"How strange," thought the Martian. "On Mars,  $x = 5$  is a solution of this equation, but there also is another solution." If Martians have more fingers than humans, how many fingers do Martians have on both hands? Explain your reasoning.

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**Problem 8** In one of your many space-time adventures, you see the equation

$$\frac{3}{10} + \frac{4}{13} = \frac{21}{20}$$

written on a napkin. How many fingers did the beast who wrote this have? Explain your reasoning.

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**Problem 9** What is the smallest number of weights needed to produce every integer-valued mass from 0 grams to say  $n$  grams? Explain your reasoning.

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**Problem 10** *Starting at zero, how high can you count using just your fingers?*

- (a) *Explain how to count to 10.*
- (b) *Explain how to count to 35.*
- (c) *Explain how to count to 1023.*
- (d) *Explain how to count to 59048.*
- (e) *Can you count even higher?*

*Explain your reasoning.*

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