Home Base

Problems about numbers in various bases.

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.*

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.*

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.*

Problem 4 *Now, suppose that you meet a hermit who tallies by thirteens. Explain how he might count. Give some relevant and revealing examples.*

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*

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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.*

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.*

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.*

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.

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.*

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.