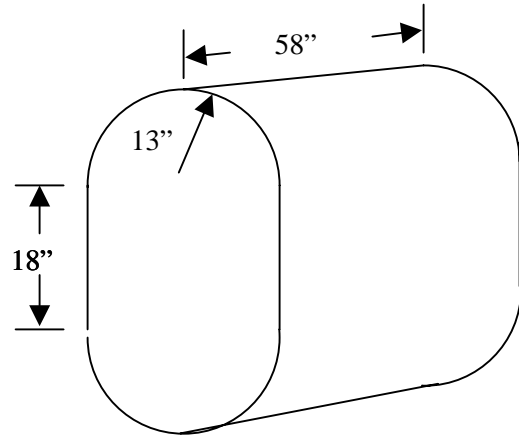


## Random assignments

1. [math warmup] Denise currently has an old 27" TV set, and she's interested in one of these new wide-screen models. What size should she buy so that she gets an equivalent viewing area? What size would she need if she wanted to duplicate the vertical dimension of the viewing area?
2. [design] Design a Rube Goldberg-type gadget to butter toast. Make sure that there are at least eight independent actions in your mechanism. Communicate your design via a Rube Goldberg-style cartoon that describes and illustrates its operation.
3. [communication] Take apart an old, should-be-thrown-away rotary telephone, or hand mixer, or fishing reel, or other gadget of similar complexity. Produce an assembly drawing which shows how its parts relate to one another and how your gadget could be reassembled.
4. [communication] Develop two sets of instructions of how to prepare a fried-egg (over easy). One set should be entirely verbal; the other should be entirely pictorial.
5. [design] A pantograph is a mechanical device that helps one trace a figure to make an enlarged or reduced copy. Build a pantograph (out of sticks or cardboard). Use it to produce a twice-sized copy of a drawing and a one-third-sized copy of a drawing. Finally, design and build a pantograph-like gadget to produce a mirror-image copy of the drawing. (This will require a bit of thought.)
6. [materials] Suppose we have found a planet—call it Earth-II—that is similar to our Earth in every way, except that its gravity is ten times larger than that of Earth. We want to develop Earth-II as a potential living site for mankind. To ensure that Earth-II reminds new settlers of their original heritage, the first things to be built are replicas of the Parthenon, the Pont du Gard, and the Golden Gate bridge. With what you know about materials and their strengths (and weaknesses), how would you have to redesign these structures to accommodate this new environment? Features should be addressed both qualitatively and quantitatively.
7. [materials] Materials fail in compression in two principal ways: crushing and bending. Consider a mountain of granite. At some height the weight of the granite itself will crush the base. Essentially a mountain can be no higher than when its base begins to crumble. If mountains on earth are made of granite, estimate the maximum height that a mountain on earth could attain. What about a granite mountain on Jupiter?
8. [warmup math] Build a measuring stick that reads out the area of a square (in  $\text{cm}^2$ ) when the stick is placed along the square's diagonal.

9. [math warmup] You are an engineer working for a storage-tank fabrication plant. Consider the fuel tank shown. Build a dipstick that can be inserted into the top of the tank to indicate how many gallons of fuel remain. Mark the stick in increments of ten gallons.



10. [finance] Maria and Denise each have a five year-old pickup truck that they use in their engineering firms. Life expectancy of the trucks is an additional five years. Denise is hot to get a new truck today (\$20K) and will pay for it with 5 years of monthly payments. Maria thinks she will wait, but will put aside monthly dollars at the same rate, then buy her truck for cash when she has enough money. How much money will each be paying for her truck? What assumptions need to be made? Are there considerations other than simply the price of the truck? If so, what?

11. [finance] Boris's engineering office is air-conditioned. The air-conditioning unit is seven years old and works fine except that it has a small leak and requires a recharge or refrigerant each spring. The cost for the recharge is \$200, so Boris is considering replacing it with a new model (\$6K). Figure out the finances? Would that be a wise decision? What other factors should contribute to the decision?

12. [measurement] Describe three entirely different (but practical) ways for determining the area of the darkened region to within 0.1%. Pick one. Then deduce the area (in  $\text{cm}^2$ ).

Would a different method give a more accurate result with less effort? Explain. Might one method be better for rough estimates, another better for precise estimates. Explain. Does the effectiveness of your methods depend on the shape of the figure? Explain.

