



University of Maryland Fermi Problem Samples

General Estimation Problems

1. Estimate the total number of hairs on your head.
2. Estimate the number of square inches of pizza consumed by all the students at the University of Maryland during one semester.
3. When it rains, water would accumulate on the roofs of flat-topped buildings if there were no drains. A heavy rain may deposit water to a depth of an inch or more. Given that water has a mass of about 1 gm/cm^3 , estimate the total force the roof of the physics lecture hall would have to support if we had an inch of rain and the roof drains were plugged.
4. One suggestion for putting satellites into orbit cheaply without using rockets is to build a tower 300 km high containing an elevator. One would put the payload in the elevator, lift it to the top, and just step out into orbit. Ignoring other problems (such as structural strain on the tower), estimate the weight of such a tower if its base were the size of Washington DC and it were made of steel. (Steel is about 5 times as dense as water, which has a density of 1 gm/cm^3 .)
5. Estimate the total amount of time 19 year olds in the US spent during this past semester studying for exams in college. (Not counting finals.)
6. The deficit in the Federal Budget this past year was approximately \$100 Billion ($\10^{11}).
 - (a) Assuming this was divided equally to every man, woman, and child in the country, what is your share of the debt?
 - (b) Supposing the deficit were paid in \$1 bills and they were laid out on the ground without overlapping. Estimate what fraction of the District of Columbia could be covered.
 - (c) Suppose you put these \$1 bills in packages of 100 each and gave them away at the rate of 1 package every 10 seconds. If you start now, when will you be finished giving them away?
 - (d) Are any of these calculations relevant for a discussion which is trying to understand whether the deficit is ridiculously large or appropriate in scale? Explain your reasoning.
7. The Federal Budget Deficit is approximately \$100 Billion this year. Compare this to what we spend on what we eat by estimating the total amount US consumers spend on food in grocery stores, markets, and restaurants in one year.
8. In the 1989 Loma Prieta earthquake in California, approximately 2 million books fell off the shelves at the Stanford University library. If you were the library administrator and wanted to hire enough part-time student labor to put the books back on the shelves in order in 2 weeks, how many students would you have to hire? (You may assume that the books just fell off the shelves and got a bit mixed up but books in different aisles did NOT get shuffled together.)

9. Estimate the total number of sheets of 8.5 x 11 inch paper used by all the students at the University of Maryland in one semester.
10. If the land area of the earth were divided up equally for each person on the planet, about how much would you get?
11. After the gulf war, large areas of desert had to be cleared of mines using special bulldozers that simply sweep the sand in front of them like a snowplow, but whose blades are strong enough to withstand the explosion of a mine. Estimate how long it would take a single bulldozer to clear a patch of desert that is 10 km square.
12. This winter, the East coast has been hit by a number of snow storms. Estimate the amount of work a person does shoveling the walk after a snow storm. Among your estimates you may take the following:
 - o The length of a typical path from a house to the street is 10 meters.
 - o Assume the snow fell to a depth of 4 inches.
 - o Assume the snow was only moderately packed so that its density was equal to 0.2 g/cm^3 -- about one fifth that of water.

In doing this problem, you should estimate any other numbers you need to one significant figure. Be certain to state what assumptions you are making and to show clearly the logic of your calculation. (In this problem, the answer is only worth 2 points. Almost all of the credit is given for your showing correct reasoning clearly.)

13. A floppy disk for a computer stores information by magnetizing small regions of the disk. For a typical floppy disk, estimate the area of the disk that corresponds to a single bit of information. (Remember: the storage capacity of a disk is cited in bytes where 1 byte = 8 bits.)
14. Ali El-Ectrical is an Engineering student at your university taking a "normal" load (for Engineers!) and paying full tuition. Estimate how much he is paying for each hour of class time he spends with an instructor over one semester.
15. Estimate the number of blades of grass a typical suburban house's lawn has in the summer.
16. How many notes are played on a given radio station in a given year?
17. How many pencils would it take to draw a straight line along the entire Prime Meridian of the earth?
18. If all the string was removed from all of the tennis rackets in the US and layed out end-to-end, how many round trips from Detroit to Orlando could be made with the string?
19. How many drops of waters are there in all of the Great Lakes.
20. How many piano tuners are there in New York?
21. How many atoms are there in the jurisdiction of the continental US?
22. How far can a crow fly without stopping?
23. How many golf balls can be fit in a typical suitcase?
24. How tall is this building?
25. Estimate the number of cars and planes entering the state at any given time.
26. How much air (mass) is there in the room you are in?

27. How long does it take a light bulb to turn off?
28. How much energy does it take to split a 2×4 ?
29. How much milk is produced in the US each year?
30. If you drop a pumpkin from the top of a ten story building what is the farthest a single pumpkin seed can land from the point of impact?
31. How many flat tires are there in the US at any 1 time?

To find more problems like these, go to: <http://www.physics.umd.edu/perg/problems.htm>

These problems written and collected by E. F. Redish. General problems 16-31 were contributed by subscribers to the PhysLrn listserve. These problems may be freely used in classrooms. They may be copied and cited in published work if the *University of Maryland Fermi Problems site* is mentioned and the URL given.

To contribute problems, send them to redish@quark.umd.edu.