Here are some very sketchy solutions for Problem Set 2.

Problem 1:

(a) How many hours to send map data?

100 PB of data at 100 GB/sec is $10^6$ seconds. Divide by 60*60 to get about 275 hours.

(b) How many SD cards?

100 PB of data = $100 * 10^{15} / 10^{12}$ per card is $10^5$ cards

(c) Transfer rate from SF to NY in hours?

2500 miles at 50 mph is 50 hours. $100 * 10^{15}$ bytes / $10^{9}$ = $10^{8}$ GB

$10^{8}$ GB in 50 hours, so $10^8 / 50 / 3600 = \text{about} 550$ GB/sec

Anything like 500 GB/sec

(d) How many U-Haul trucks?

Truck is maybe 3 by 2 by 2 meters, or say 10 cubic meters.

One SD card is $0.01 \times 0.01 \times 0.001$ cubic meters = $10^{-7}$. There are only $10^5$ cards, so takes way under a cubic meter.

(e) Throughput of avian carriers in MB / sec?

1 TB in 2 hours is $10^6$ MB in 2 hours. Divide by $2 \times 60 \times 60$ to get 140 MB/sec

Problem 2:

(a) How many meters thick is the folded paper?

Thickness is $2^{25} \times 0.1 \text{mm}$. 32 million $\times 0.1 \text{ mm}$ is 3.2 million mm or 3200 meters.

(b) How good is the thickness estimate of 0.1mm and why?

Pretty accurate. A ream of 500 sheets of paper is about 2 inches thick.

Problem 3:

(a) (i) How many bits for American cars?

Say 300 million cars, so probably 29 bits (covers 500 million) but 27 or 28 is ok
(ii) How many bytes is that?

4 bytes

(iii) How many bytes if Canadian cars are also included?

4 bytes – another 30 million cars makes no difference.

(b)   (i) Range of numbers you can make with 10 fingers?

0 .. 1023 inclusive

(ii) Range with fingers and toes?

0 .. 2^{20}-1 inclusive