Homework #1 Solutions – 5 Points Each

1.

The dog can carry 21 gigabytes, or 168 gigabits. A speed of 18 km/hour equals 0.005 km/sec. The time to travel distance x km is x /0.005 = 200x sec, yielding a data rate of 168/200x Gbps or 840/x Mbps. For $x < 5.6$ km, the dog has a higher rate than the communication line.

15.

Negotiation has to do with getting both sides to agree on some parameters or values to be used during the communication. Maximum packet size is one example, but there are many others.

18. (a) Data link layer. (b) Network layer.

20. With n layers and h bytes added per layer, the total number of header bytes per message is hn, so the space wasted on headers is hn. The total message size is $M + nh$, so the fraction of bandwidth wasted on headers is $hn/(M + hn)$.

24.

Doubling every 18 months means a factor of four gain in 3 years. In 9 years, the gain is then 4^3 or 64, leading to 6.4 billion hosts. Many possible explanations.

28.

The image is 1024 · 768 · 3 bytes or 2,359,296 bytes. This is 18,874,368 bits. At 56,000 bits/sec, it takes about 337.042 sec. At 1,000,000 bits/sec, it takes about 18.874 sec. At 10,000,000 bits/sec, it takes about 1.887 sec. At 100,000,000 bits/sec, it takes about 0.189 sec.