Samuel Miller
Computer Networking HW 1

1. R4
   Digital Subscriber Line – Home access
   Ethernet – Enterprise access
   Wi-Fi – Home/enterprise access
   5G – Wide-area wireless access

2. R7
   DSL is faster than dial-up because the former uses a different frequency range for transmitting data, while the latter uses voice channels only. Voice channels have much less bandwidth so data transfer is slower.

3. R11
   $L/R_1 + L/R_2$

4. R18
   Total delay = transmission delay + propagation delay
   1500 bytes = 12000 bits = 0.012 Mb
   Wireless: 0.012 Mb / 2 Mbps + 1000m / 3 * 10^8 m/s = 0.00600333… seconds
   Wired: 0.012 Mb / 100 Mbps + 1000m / 2 * 10^8 m/s = 0.000125 seconds

5. R25
   Router: Network layer
   Link-layer switch: Data link layer
   Host: Application, transport, network, data link, physical layers

6. P5a
   175km / (100 km / hr) = 1.75 hr = 105 min propagation delay. 10 cars / (5 cars / min) = 2 min transmission delay. Total time for the trip = 3 * transmission delay + propagation delay = 111 min.

7. P8a
   10 Mbps / (0.2 Mbps / user) = 50 users

8. P8c
$$P(X = n) = \frac{N!}{n!\,(N-n)!} * p^n * (1-p)^{N-n}$$
$$P(X = n) = \frac{120!}{n!\,(120-n)!} * 0.1^n * (0.9)^{120-n}$$

9. P12
   To transmit the information from the client to the router, it still takes L / R time. However, the router can begin to transmit the information earlier once it has received at

least h bytes. This takes h / R time. The router and client are transmitting information at the same time until the last h bytes, so the total end to end delay is (L + h) / R. For n routers, the additional delay of h/R is multiplied by n. So the total delay is now (L + n*h) / R.

10. P29
    a. Propagation delay = 36000000m / $2.4*10^8$m/s = 0.15s
    b. Bandwidth delay product = 10Mbps * 0.15s = 1.5Mb
    c. 10Mbps * 60s = 600 Mb