Problem 1: Exercise 1.8 (p. 65)
a. \((1.35)^{10} = \text{approximately} 20\)
b. \(3200 \times (1.4)^{12} = \text{approximately} 181,420\)
c. \(3200 \times (1.01)^{12} = \text{approximately} 3605\)
d. Power density, which is the power consumed over the increasingly small area, has created too much heat for heat sinks to dissipate. This has limited the activity of the transistors on the chip. Instead of increasing the clock rate, manufacturers are placing multiple cores on the chip.
e. Anything in the 15–25% range would be a reasonable conclusion based on the decline in the rate over history. As the sudden stop in clock rate shows, though, even the declines do not always follow predictions.

Problem 2: Exercise 1.14 (p. 66-67)
a. Figure

![Graph](image)

Figure: Plot of the equation: \(y = \frac{100}{((100 - x) + x/10)}\)

b. \(2 = \frac{1}{((1 - x) + x/10)}\)

\(5/9 = x = 0.56 \text{ or } 56\%\)

c. \(0.056/0.5 = 0.11 \text{ or } 11\%\)

d. Maximum speedup = \(1/(1/10) = 10\)
5 = 1/((1 – x) + x/10)

8/9 = x = 0.89 or 89%

e. Current speedup: 1/(0.3 + 0.7/10) = 1/0.37 = 2.7

Speedup goal: 5.4 = 1/((1 – x) + x/10) = x = 0.91

This means the percentage of vectorization would need to be 91%

**Problem 3: Exercise 1.15 (p. 67)**

a. old execution time = 0.5 new + 0.5 × 10 new = 5.5 new

b. In the original code, the unenhanced part is equal in time to the enhanced part sped up by 10, therefore:

\[(1 – x) = x/10\]

\[10 – 10x = x\]

\[10 = 11x\]

\[10/11 = x = 0.91\]

**Problem 4: Exercise 1.18 (p. 67)**

a. \[1/(.2 + .8/N)\]

b. \[1/(.2 + 8 × 0.005 + 0.8/8) = 2.94\]

c. \[1/(.2 + 3 × 0.005 + 0.8/8) = 3.17\]

d. \[1/(.2 + \log N × 0.005 + 0.8/N)\]

e. \[d/dN(1/((1 – P) + \log N × 0.005 + P/N)) = 0\]

**Problem 5**

How many bytes is the program? 19

How many bytes of instructions need to be fetched if b = 10?

\[(2+2) + 10*(13) + (6+2+2) = 144\]

Assuming 32-bit data values, how many bytes of data memory need to be fetched?

Stored?

Fetched: the compare instruction accesses memory, and brings in a 4 byte word b+1 times: \[4 * 11 = 44\]

Stored: 0