1 Exercise 1

Assumption:

$$P(A \cup D) = P(A) + P(D) - P(A \cap D) \tag{1}$$

Convert D $\rightarrow$ B $\cup$ C:

$$P(A \cup B \cup C) = P(A) + P(B \cup C) - P(A \cap (B \cup C)) \tag{2}$$

Evaluate $P(B \cup C)$ with (1):

$$P(A \cup B \cup C) = P(A) + P(B) + P(C) - P(B \cap C) - P(A \cap (B \cup C)) \tag{3}$$

Notice that $A \cap (B \cup C) = (A \cap B) \cup (A \cap C)$ and evaluate $P(A \cap (B \cup C))$ with (1):

$$P((A \cap B) \cup (A \cap C)) = P(A \cap B) + P(A \cap C) - P(A \cap B \cap C) \tag{4}$$

Where I used $(A \cap B) \cap (A \cap C) = ((A \cap B) \cap A) \cap ((A \cap B) \cap C) = (A \cap B) \cap (A \cap B \cap C) = A \cap B \cap C$.

Plugging (4) into (3) results in:

$$P(A \cup B \cup C) = P(A) + P(B) + P(C) - P(B \cap C) - P(A \cap B) - P(A \cap C) + P(A \cap B \cap C) \tag{5}$$

2 Exercise 2

2.1

Law: Performance doubles every 18 months.
Data: 148,600.0 (Summit)
Equation: $148,600TFlop/s * 2^{(x/18months)} = 1,000,000TFlop/s$
$\rightarrow x = 49.5months$ (Source: Wolframalpha)

2.2

Data:
11/2007: 478.2 TFlop/s (LLNL)
11/2011: 10500 TFlop/s (K Computer)
Equation: $478.2TFlop/s * 2^{(48mo/x)} = 10500TFlop/s$
$\rightarrow x = 10.8$ (Wolframalpha)
If we replace 18 months with 10.8 months, we get 1 ExaFlop/s in 29.7 months.

3 Exercise 3

3.1

$t_{Old} = t_{Calc} + t_{IO}$
$t_{New} = t_{Calc}/10 + t_{IO}$
$t_{Calc} = 0.4 * t_{Old}$
$t_{IO} = 0.6 * t_{Old}$
$\rightarrow Speedup = t_{Old}/t_{New} = 1/(0.4 * 0.1 + 0.6) = 1/0.64 = 156.25\%$

3.2

As above:
$\rightarrow SpeedupSQR = t_{OldSQR}/t_{NewSQR} = 1/(0.2 * 0.1 + 0.8) = 1/0.82 = 122.95\%$
$\rightarrow SpeedupFP = t_{OldFP}/t_{NewFP} = 1/(0.5/1.6 + 0.5) = 1/0.8125 = 123.07\%$
FP is faster, but not by much.

3.3

As above:
$Amdahl : Speedup = 1/((1 - P) + P/N)$
$\rightarrow 100 = Speedup = 1/(S + (1 - S)/128)$
$\rightarrow 0.01 = (S + (1 - S)/128)$
$\rightarrow 1.28 = 128 * S + (1 - S)$
$\rightarrow 0.28 = 127 * S$
$\rightarrow S = 0.002205$
The serial fraction can be up to 0.2205%.