1 (a) $t_{avg} = h * t_c + (1-h) t_m$

$$= (0.9 * 100) + (0.1)(1000) = 190 \text{ ns}$$

(b) $t_{avg} = h * t_c + (1-h) \left(\frac{B}{C} * t_m + \frac{B}{C} * t_m + t_c \right)$

$$= 0.9(100) + (0.1) \left(\frac{8}{1} * 1000 + 8 * 1000 + 100 \right)$$

$$= 1700 \text{ ns}$$

(c) OP #1 : $t_{avg} = .9(100) + .1(8*500 + 8*500 + 100)$

$$= 900 \text{ ns}$$

Speedup $= \dfrac{1100}{900} = 1.22$

$\dfrac{\text{Cost}}{\text{speedup}} = \dfrac{x}{1.22}$

OP #2 : $t_{avg} = (.9)(100) + .1 \left(\frac{8}{4} * 1000 + \frac{8}{4} * 1000 + 100 \right) = 500 \text{ ns}$

Speedup $= \dfrac{1100}{500} = 2.20$

$\dfrac{\text{Cost}}{\text{speedup}} = \dfrac{x}{2.20}$

→ option 2 is better because it yields more speedup for the same cost. Cost/speedup is lower

2] (a) total ReadHitTime = $(1-w) \cdot t_c$

(b) total WriteHitTime = $w * t_m$

(c) total ReadMissPenalty = $(1-w)(\frac{B}{c} * t_m + t_c)$

(d) total WriteMissPenalty = $w * t_m$

3] (a) $t_{avg} = .9(100) + .1(1000) = 190$ ns

(b) $t_{avg} = .9(100) + .1((\frac{8}{2})(1000) + (\frac{8}{2})(1000) + 100) = 900$ ns

(c) $t_{avg} = h(t_c) + (1-h)\left[w(t_m) + (1-w)((\frac{B}{c})(t_m) + (\frac{B}{c})(t_m) + t_c)\right]$

$= .9(100) + .1\left[.3(1000) + .7((\frac{8}{2})(1000) + (\frac{8}{2})(1000) + 100)\right]$

$= 687$

4] (a) $t_{avg} = .95(100) + .05(1000) = 145$ ns

(b) $t_{avg} = .95(100) + .05\left([(\frac{8}{4})(1000)](2) + 100\right) = 300$ ns

(c) $t_{avg} = h(t_c) + (1-h)(w(t_m) + (1-w)((2)(\frac{B}{c})(t_m) + t_c))$

$= .95(100) + 0.05\left[0.25(1000) + 0.75((2)(\frac{8}{4})(1000) + 100)\right]$

$= 261.25$ ns

(d) $t_{avg} = h(w(t_m) + (1-w)(t_c)) + (1-h)(w(t_m) + (1-w)(\frac{B}{c}(t_m) + t_c))$

$= .95(.25(1000) + .75(100)) + .05(0.25(1000) + .75(\frac{8}{4}(1000) + 100))$

$= 400$ ns