(3) (a) $\lambda = 1/4 = \dfrac{1}{4 \times 1/60}$ arrival/hr. $= \dfrac{60}{4} = 15$ arrivals/hr.

$E(S_{\text{tool crib}}) = 3$ minutes $= \dfrac{3}{60}$ hours $= \dfrac{1}{20}$ hrs

$\Rightarrow \mu_{\text{tool crib}} = 20$

Average cost per mechanic $= 15W$

Average cost for all mechanics spending time in the tool crib $= 15L$

Total cost of "c" server $= 10c$

Total cost of system $= 15L + 10c$

$$L(c) = 10c + 15\left(c\rho + \frac{\rho}{1-\rho} P(m \geq c)\right)$$

$$P(m \geq c) = \frac{(\rho c)^c P_0}{c!(1-\rho)}$$

$$P_0 = \left(\sum_{m=0}^{c-1} \frac{(c\rho)^m}{m!} + \frac{(c\rho)}{c!} \left(\frac{1}{1-\rho} \right) \right)$$

$$\rho = \frac{\lambda}{c\mu} = \frac{15}{c \times 20} = \frac{3}{4c}$$

$$P_0 = \left(\sum_{m=0}^{c-1} \frac{(3/4)^m}{m!} + \frac{(3/4)^c}{c!} \left(\frac{1}{1 - 3/4c} \right) \right)^{-1}$$

To compute the loss function and use online calculators, I plug in everything and obtain an equation.

$$f(c) = 15 \left(\frac{3}{4} + \frac{\rho (3/4)^c \left(\sum_{m=0}^{c-1} \frac{(3/4)^m}{m!} + \left(\frac{(3/4)^c}{c!} \times \frac{1}{1-\rho} \right) \right)^{-1}}{c!\,(1-\rho)^2} \right)$$

Upon using online tools,

$c = 2$ and $f(c) = f(2) = 33.09$

(i) This is an M/M/c/10/10 queue.

(b)

$$l = \sum_{m=0}^{c-1} m \, {}^{10}C_m \left(\frac{3}{20}\right)^m P_0 + \sum_{m=c+1}^{10} m \left(\frac{k!}{(k-n)!\, c!\, c^{n-c}}\right) \times \left(\frac{3}{20}\right)^m P_0$$

$$L = 6c + 10l$$

Using online tools, I obtained $c = 2$ and

$f(2) = 28.77$