Solution

1. $m = 12, t_0 = 2 \text{ hr}, MTTF = 80 \text{ hr}, MTTR = 4 \text{ hr}$

$$A = \frac{MTTF}{MTTF + MTTR} = \frac{80}{80+4} = 0.952381$$

$$t_e = \frac{t_0}{A} = \frac{2}{0.952381} = 2.1 \text{ hr/q}$$

$$r_e = \frac{m}{t_e} = \frac{12}{2.1} = 5.714286 \text{ q/hr}$$

2. $r_d = 90 \text{ q/hr}, \ y = 0.9, t_0 = \frac{2.16}{60} = 0.036 \text{ hr/q}, MTTF = 45 \text{ hr}, MTTR = 5 \text{ hr}$

$$A = \frac{MTTF}{MTTF + MTTR} = \frac{45}{45+5} = 0.9$$

$$t_e = \frac{t_0}{A} = \frac{0.036}{0.9} = 0.04 \text{ hr/q}$$

$$r_a = \frac{r_d}{y} = \frac{90}{0.9} = 100 \text{ q/hr}$$

$$m_{\min} = \lfloor r_a t_e + 1 \rfloor = \lfloor 100(0.04) + 1 \rfloor = 5$$

3.

W/S		(a)	(b)	(c)	(e)		
Arrival Rate	(r_a, q/hr)	75	75	93.75	93.75		
Natural Process Time	(t_0, hr)	0.05	0.05	0.05	0.05		
MTTF	(hr)		25	25	25		
MTTR	(hr)	0	5	5	5		
Availability	(A)	1	0.833333	0.833333	0.833333		
Effective Process Time	(t_e, hr)	0.05	0.06	0.06	0.06		
Number of M/C	(m)	4	5	5	6		
Utilization	(u)	0.9375	0.9	0.9	0.9375		
Yield	(y)	1	1	0.8	0.8		
Departure Rate (r_a*y)	(r_d, q/hr)	75	75	75	75		
Required M/C Hours	$r_a t_e$ =	3.75	4.5		5.625		
	$r_d t_e$ =			4.5			
	(f) Service rate			r_e =	100	**(f)**	
	(g) Annual Hours of Operation			H =	2000	(hr/yr)	
	(i) Proc or repaired			r_a*t_e*H =	11250	(m-hr/yr)	**(i)**
	(ii) Processing			r_a*t_0*H =	9375	(m-hr/yr)	**(ii)**
	(iii) Repaired		r_a*(t_e - t_0)*H =		1875	(m-hr/yr)	**(iii)**
	(iv) Idle		(m - r_a*t_e)*H =		750	(m-hr/yr)	**(iv)**

4. $$r_a = \frac{r_d}{Y} = \frac{r_d}{y_1 y_2 y_3} = \frac{125}{0.85 \cdot 0.92 \cdot 0.90} = 177.6073 \text{ parts}$$