1.

$$1000 \frac{W}{m^2} = 1 \frac{kW}{m^2}$$

$$\frac{3.5 \ kW}{1 \frac{kW}{m^2}} = 3.5 \ m^2$$

June:

$$6.5 \frac{kWh}{day \cdot m^2} \cdot 3.5 m^2 = 22.75 \frac{kWh}{day}$$

$$\sim \frac{15}{24} = .63$$

December:

$$1 \frac{kWh}{day \cdot m^2} \cdot 3.5 m^2 = 3.5 \frac{kWh}{day}$$

$$\sim \frac{10}{24} = .42$$

2. $I_{sc} = 250\ A/m^2$, $I_0 = 1.7E-8\ A/m^2$

$T_c = 300\ K$ $\quad \gamma = .9$ $\quad k = 1.3806488E-23$

$$V_{oc} = \frac{\gamma k T}{q} \ln\left(\frac{I_{sc}}{I_0} + 1\right) = .5457\ V$$

b) using solver $\Rightarrow$ $V_{max} = .474\ V$

c) $$I_{max} = \frac{1.602E-19 \times .47}{.9 \cdot k \cdot T_c + 1.6E-8 \cdot .47}(I_{sc} + I_0)$$

$$= 238.5\ A/m^2$$

d) $P_{max} = I_{max} V_{max}$

$$= 113.14\ W/m^2$$

e) $$\eta_{max} = \frac{113.14}{670} = 13.8\%$$

f) $$\frac{20}{113.14}\ \frac{W}{W/m^2} \Rightarrow .177\ m^2$$

3.

$$V_{OC} = 36(.6) = 21.6\ V \cdot 2 = \underline{43.2\ V}$$

$$I_{SC} = \frac{300}{} \cdot \left(\pi \frac{(.100^2)}{4}\right) = 2.3565\ A$$

$$\Rightarrow 2 \times 2.356 = \underline{4.7124\ A}$$

4.

$$.75 = \frac{P_{max}}{V_{OC} I_{SC}} = \frac{P_{max}}{.6(2)} \Rightarrow P_{max} = .9\ W$$

$$V_{OC}(n+1) = V_{OC}(n) - .003(30)(V_{OC})$$

$$V_{OC} = V_{OC}(25)(1 - .06) = .546\ V$$

$$I_{SC}(55) = I_{SC}(25) + (1 + .0006 \times 30) = 2.036\ A$$

$$FF(55) = FF(25) - (.0015(30)(FF(25)))$$

$$= .716$$

$$FF(55) = \frac{P_{max}}{V_{OC} I_{SC}} \Rightarrow .716 = \frac{P_{max}}{.546(2.036)} = \underline{.796\ W}$$

4. b.

$P_{max} = .9 \quad (25°C)$

$P_{max} = .796 \quad (55°C)$

$\%\ \text{decrease} = \frac{.9 - .796}{.9} \times 100 = 11.55\%$

5

$3(1700) = 5100\ \text{Wh}$

$\frac{5100}{.75(.7)} = 9714.28\ \text{Wh}$

$N = \frac{9714.28}{125(6)} = 12.95 \approx 13\ \text{batteries}$

$N_{Panels} = \frac{1700\ \text{Wh/day}}{5\ \text{hrs} \cdot 50\text{w}} = 6.8 \approx 7\ \text{Panels}$

require 8 wires to series connections