Ch. 12 HW
12.1, 12.6
12.14, 12.15

12.1 Dec. 21 $\theta = 23 + 52 = 75°$ | JUNE 21 $\theta = 52 - 23 = 29°$

Mar. 20 equinox $\theta = 52°$

12.6 Chicago Latitude = 42° $\quad \theta_{NOON}^{Dec.22} = 42 + 23 = 65°$

$$S_{NOON} = (434)\left(e^{-\frac{1}{3 \times \cos 65°}}\right)^{\sin 65°}$$

$e^{-.7887}$

S_{NOON} $(434) \times 0.454 \times (0.906) = 179 \frac{BTU}{ft^2 - h}$

Gain $I = (0.8)(0.9)(179)\left(\frac{T}{\pi}\right)$

clouds Trans

$\left(\frac{20}{\pi}\right) =$ **821 BTU/ft²-day** gain

Loss $UA(\Delta T)(\Delta t)$

$(0.5)(1)(65-20)(24) =$ **540 BTU/ft²-d**

Net Gain $821 - 540 =$ **281 BTU/ft²-d**

12.14 $I = S_o \frac{T}{\pi} = (270)\left(\frac{24}{\pi}\right) = 2064 \frac{BTU}{ft^2 - d}$

Spring day equinox $T = 24$

Gain $(0.5)(2064) = 1032 \frac{BTU}{ft^2 d}$

Assume: size of ? Collector? → $A = 10 ft^2$

$Loss = UA\Delta T = \left(\frac{1}{6}\right)(61.2)(60-60) = 0$ initial

$A = 2\pi r^2 + 5(2\pi R)$

$= 2\pi(1.5)^2 + 10\pi(1.5)$

$14.1 + 47.1 = 61.2 ft^2$

Temp rise: $\Delta T\, mc = \Delta Q$

$\Delta T = \frac{(1032\ BTU)A}{mc}$

80gal × 8# = 640# H_2O

$C = 1 \frac{BTU}{\#\ °F}$

$\Delta T = \frac{(1032)(10)}{(640)(1)} = 16°F$

$\therefore 60 + 16 = 76°F$

but lose some

Avg temp = 68°F = $\langle T \rangle$

$UA\Delta T = \left(\frac{1}{6}\right)(61)(68-60) = 80 \frac{BTU}{d}$ small correction

12.15 $\theta_{NOON} = 35 + 23 = 58°$

$$S_{NOON} = (434)(\sin 58°)\left(e^{-\frac{1}{3\cos 58°}}\right)\left(\frac{1}{2}\right)$$

$$(434)(.848) \quad e^{-.629} \quad (0.5331) \quad \left(\frac{1}{2}\right) = 98 \ \frac{BTU}{ft^2\text{-}h}$$

$$I = S_{NOON}\frac{T}{\pi} = 98\ \frac{20}{\pi} = 624\ \frac{BTU}{ft^2\text{-}d}$$

$$Q^{low}_{loss/day} = (500)(65-45) = 10{,}000\ \frac{BTU}{d} = 624\, A_{low} \qquad A_{low} = \frac{10{,}000}{624} = 16\ ft^2$$

$$Q^{high}_{day} = 2000(\quad) = 40{,}000\ \frac{BTU}{d} = 624\, A_{High}$$

$$A_{High} = \frac{40{,}000}{627} = 64\ ft^2$$