MIDTERM SOLUTION CEE 6400 2011

1. a) $E_{land} = \dfrac{71000 + 1000}{1.49 \times 10^6}$ $\dfrac{km^3\ yr^{-1}}{km^3}$

$= 0.48 \times 10^{-3}$ km/yr

$= 0.48$ m/yr

b) $LE = \rho L_v E$

$L_v = 2.45$ MJ/kg From HW 3

$= 2.45 \times 10^6$ J kg^{-1}

$\therefore LE = 1000 \times 2.45 \times 10^6 \times 0.48$

kg m^{-3} J kg^{-1} m yr^{-1}

$= 1.18 \times 10^9$ J m^{-2} yr^{-1}

$\div (365 \times 24 \times 3600)$ s yr^{-1}

$= 37.3$ W m^{-2}

c) $E_{ocean} = \dfrac{505\,000}{361 \times 10^6} = 1.4 \times 10^{-3}$ km/yr

$= 1.4$ m/yr

d) $LE = \dfrac{1000 \times 2.45 \times 10^6 \times 1.4}{365 \times 24 \times 3600} = 109$ W m^{-2}

e) Fig 3-2 has 24/100 units of LE. This combines land and ocean. It is over the surface area, not disk area so is equivalent to

$\dfrac{24}{100} \times \dfrac{1367}{4} = 82$ W/m^2

Weighting the land and sea heat fluxes

$$\frac{37.3 \times 149 + 109 \times 361}{149 + 361}$$

$$= 88 \text{ W m}^{-2}$$

This is close to 82 W m^{-2}

So the values are consistent

2 a) $e_s = 6.108 \exp\left(\frac{17.27 \times 25}{237.3 + 25}\right)$

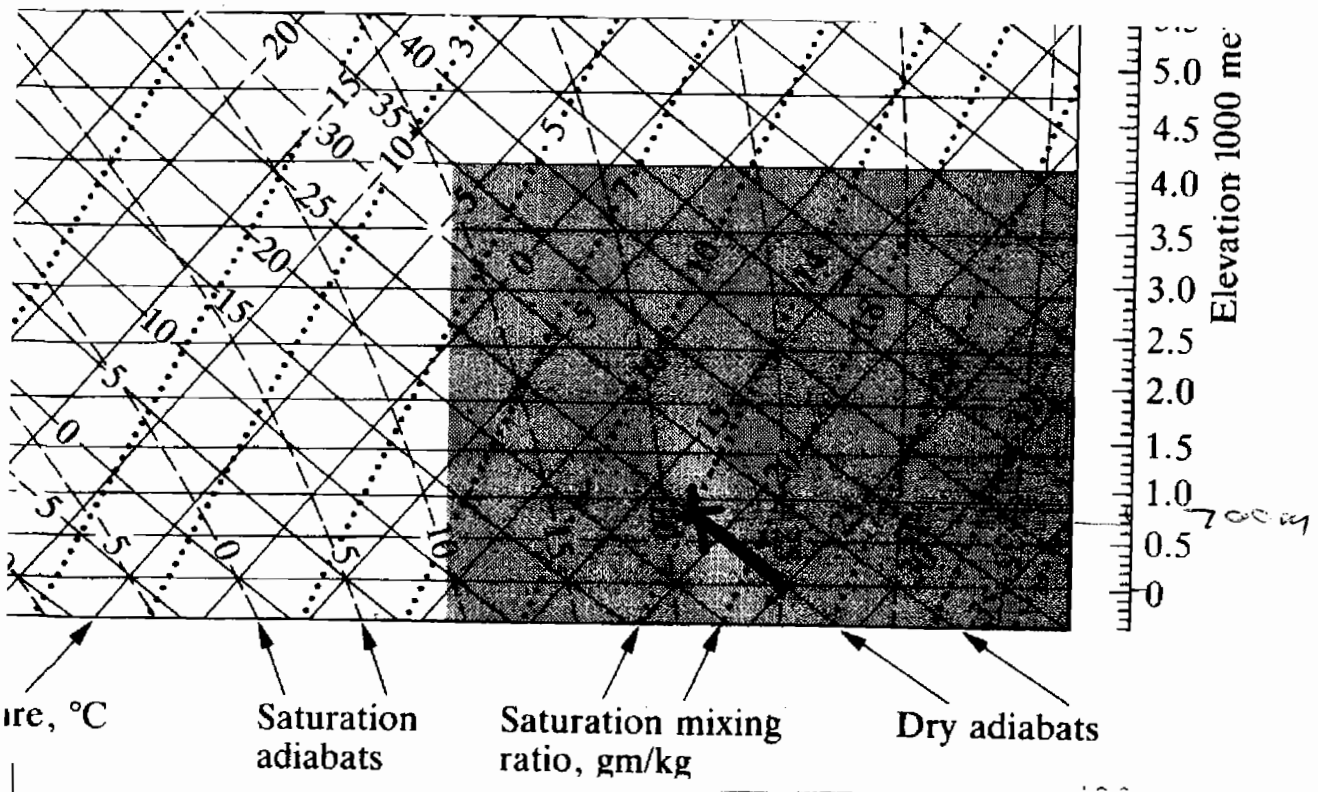
$= 31.68 \text{ hPa}$

$e = 0.7\, e_s = 22.2 \text{ hPa}$ →

b) $m = \frac{0.622\, e}{p - e} = \frac{0.622 \times 22.2}{1000 - 22.2}$

$= 0.0141$ →

c) 700 m



3 a) $\psi = \psi_a \left(\frac{\theta}{n}\right)^{-b}$

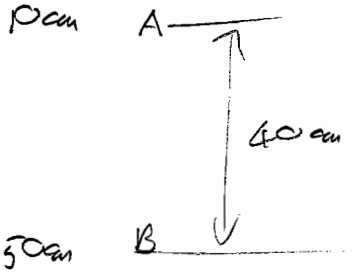
$\psi_A = 21.8 \times \left(\frac{0.35}{0.435}\right)^{-4.9}$

$= -63.3$ cm →

$\psi_B = 21.8 \times \left(\frac{0.38}{0.435}\right)^{-4.9}$

$= -42.3$ →

b)



$h_A = -63.3 - 10 = -73.3$

$h_B = -42.3 - 50 = -92.3$

∴ FLOW IS FROM A TO B.
INFILTRATION

c) $\frac{\Delta h}{\Delta z} = \frac{92.3 - 73.3}{40} = 0.475$

K - case average $\theta = 0.365$

$K(\theta) = K_{sat}\left(\frac{\theta}{n}\right)^{c}$

case $c = 26 + 3 = 12.8$

∴ $K(\theta) = 1.32$ cm h^{-1}

∴ $q = K(\theta)\frac{\Delta h}{\Delta z} = 0.475 \times 1.32$

$= 0.63$ cm/hr →