A SOIL WATER CALCULATION (Or: Why Farmers Pray for Rain) CRSSS/FANR 3060

A soil sample from an A horizon is adjusted to various soil moisture tensions, and weighed at each tension. The sample was taken in a ring with r=4 cm and h= 5 cm. Fill in the table below:

Tension (name)	Bars	soil mass (g)	water mass (g)	θg	θv
Saturation		482			
Field capacity		437			
Wilting point		396			
Air-dry		376			
Oven dry		370			

BD = _____

A. What is the total porosity of this soil? Show two different ways to calculate it.

B. What percentage of the total porosity is macropores? What % are meso- and micro-pores?

C. What is the available water is this horizon in terms of θv? Assume this Ap is 15 cm thick; how many cm of available water are held when this horizon is at field capacity?

D. Assume water loss thru ET is 0.4 cm/day in mid-summer, and that plants are extracting water from only this 15-cm deep horizon; if this soil is at field capacity initially, how long before the plants begin to permanently wilt?

E. Calculate how many gallons of irrigation water need to be applied to a 40-acre field to bring this horizon back to field capacity, once it has dried down to the wilting point.

ANSWERS (don't look at these until you have tried to actually DO the problems):

Tension (name)	Bars	soil mass (g)	water mass (g)	θg	θv
Saturation	**0**	482	**487-370=112**	**112/370=0.30**	**0.30*1.47=0.445**
Field capacity	**0.1**	437	**67**	**0.18**	**0.266**
Wilting point	**15**	396	**26**	**0.07**	**0.10**
Air-dry	**1000**	376	**6**	**0.016**	**0.024**
Oven dry	**10000**	370	**0**	**0**	**0**

BD = 370/(4^2*3.14*5)=**1.47 g/cm^3**

A. 1-(1.47/2.65)=0.445; θv(saturation) is also equal to porosity

B. macro= θv(sat)- θv(FC) = 0.179, or 0.179/0.445=40% of total porosity
meso= θv(FC)- θv(WP) = 0.266-0.10=0.166, 37%
micro = θv(WP)- θv(OD) = 0.01-0 = 0.10, 22%

C. θv(avail) = θv(FC)- θv(WP) = 0.166; 0.166 x 15 cm soil = 2.49 cm avail water (about 1")

D. 2.49 cm x (1day/0.4 cm lost) = 6.2 days (6 days)

E. Apply 2.49 cm water over 40 acres: 2.49 cm x (1"/2.54 cm)x(1'/12") = 0.082' x 43,560 ft^2/ac x 40 ac = 142,000 ft^3;
x (7.48 gal/ft^3) = 1.06 million gallons [[[Without rain, it takes about a million gallons to irrigate 1 medium-sized field EACH WEEK during the summer… this is why farmers pray for rain!]]]