NAME:_____   Spring 1999

(20 points)   1.
(10 points)   A.   Compare and contrast the vadose zone and the saturated zone.

(10 points)   B.   Why do we use boundary conditions to solve groundwater
                       flow equations?

(20 points)   2.   Discuss the relationship between the volumetric water content
                       and the pressure head in the vadose zone. Support your answer
                       with a diagram.

(20 points)   3.   List and <u>DISCUSS</u> the methods that can be used to solve the
                       groundwater flow equations.

(20 points)   4.

(10 points)   A.

Prove mathematically that there is an angle between the specific discharge vector and
the hydraulic gradient vector in anisotropic porous media with two-dimensional flow.

(10 points)   B.

Prove mathematically that in the absence of recharge, the equation of hydraulic head
(h) in unconfined aquifers with steady horizontal flow is: $h^2(x) = c_1 x + c_2$, where x is
the horizontal distance, c_1 and c_2 are constants.

(20 points)   5.

The diagram below shows a layered unconfined aquifer.   Flow in the aquifer is
horizontal and steady.   The thickness of the lower layer $= B$ meters.   Units of heads
and horizontal distances are meters; units of hydraulic conductivities are m/day.

(7 points)   A.   Derive an equation for the discharge per unit width (Q_1') in the
                       upper layer.

(6 points)   B.   Derive an equation for the hydraulic head in the upper layer.

(6 points)   C.   Derive an equation for the hydraulic head in the lower layer.