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Rex pours water into a graduated cylinder. He notices that the surface of the water is curve. Which of the following identifies the phenomenon and explains how it is formed?

a) The curved surface is a concave meniscus which has formed because of surface tension
b) The curved surface is a convex meniscus which has formed because of surface tension
c) The curved surface is a concave meniscus which has formed because of capillary action
d) The curved surface is a convex meniscus which has formed because of capillary action

Answer: C - Capillary action occurs because the water molecules are more attracted to the cylinder than they are to each other. This causes the upward movement of the water along the sides of the glass, forming a curved surface called a concave meniscus.

REWARD: Advance 1 square

What is the name of the zone above the phreatic surface?

a) Phreatic Zone

b) Dry zone

c) Vadose Zone

d) Medium zone

Answer: C - The zone above the phreatic surface is named vadose zone and is characterized by negative pore-water pressures and degrees of saturation generally lower than unity.

REWARD: Advance 3 squares

Concave menisci are formed...

a) On the air side generating water pressures equal to the air pressure

b) On the air side generating water pressures lower than the air pressure

c) On the water side generating water pressures greater than the air pressure

d) On the water side generating water pressures lower than the air pressure

Answer: B

REWARD: Advance 1 square

The water pressure at the back of the meniscus in a capillary tube with diameter d depends on:

a) The surface tension and the contact angle

b) Air pressure, the surface tension and the contact angle

c) The pore pressure and the contact angle

d) Tube height, air pressure, surface tension and contact angle

Answer: B

REWARD: Advance 1 square


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What are the main differences between saturated and unsaturated soil profiles with respect to pore water pressure distribution under hydrostatic conditions?

a) Generally, vary linearly with depth, increasing below the water table (saturated), and decreasing above the water table (unsaturated)

b) Generally, vary non-linearly with depth, increasing below the water table (saturated), and decreasing above the water table (unsaturated)

c) Generally, vary non-linearly with depth, decreasing below the water table (saturated) and increasing above the water table (unsaturated).

d) Generally, vary linearly with depth, decreasing below the water table (saturated) and increasing above the water table (unsaturated).

Answer: A

REWARD: Advance 2 squares

A capillary tube (600mm long) is described by two different radii (0.15mm and 0.05mm). The larger radius is 200mm long located in the middle of the tube. If the tube is initially filled with water, where will the water level in the tube be if it is put in contact with a water reservoir (in mm)?

a) 192
b) 200
c) 576
d) 600

Answer: C – The capillary rise associated with the diameter of 0.15 is 192mm while the capillary rise associated with a diameter of 0.05mm is 576mm. The section of the tube with 0.15mm diameter is below 576mm therefore, the water in the tube behaves as if the whole tube has a diameter of 0.05mm and the water level lowers until it reaches a height of 576mm from the water surface.

REWARD: Advance 3 squares

What are the major mechanisms that explains soil-water hysteresis?

a) The pore pressure, geometrical effects and process of wetting and swelling

b) The process of condensation, wetting and swelling

c) The pore pressure, the geometric nonuniformity of individual pores and the pore fluid contact angle

d) The geometric nonuniformity of individual pores, the pore fluid contact angle, entrapped air, swelling, shrinking and aging

Answer: D

REWARD: Advance 1 square

What is the water pressure generated by the meniscus for the case of a capillary tube of radius r=1μm (assume T=0.072 N/m and θ=0° and ua = 100kPa)?

a) - 39kPa

b) - 55kPa

c) - 44kPa

d) - 48kPa

Answer: C

$$u_w - u_a = -\frac{2T\cos\theta}{r}$$

$$u_w - 100 = -\frac{2 \times 0.072 \times \cos 0}{\frac{1 \times 10^{-6}}{1000}}$$

$$u_w = -44kPa$$

REWARD: Advance 2 squares


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Consider the capillary tube radius r=0.1µm (size representative of clay pore size). What is the height of the capillary rise (assume T=0.072 N/m and θ=0°)?

a) 150m

b) 163m

c) 144m

d) 148m

Answer: C

$$u_w - u_a = -\frac{2T\cos\theta}{r}$$

$$u_w - 0 = -\frac{\frac{2 \times 0.072 \times \cos 0}{0.1 \times 10^{-6}}}{1000} = -1440kPa$$

$$u_w = -\gamma_w h$$

$$h = -\frac{u_u}{\gamma_w} = -\frac{-1440}{10} = 144m$$

REWARD: Advance 2 squares

A capillary tube (600mm long) is described by two different radii (0.15mm and 0.05mm). The larger radius is 200mm long located in the middle of the tube. If the tube is initially dry, where will the water level in the tube be if it is put in contact with a water reservoir (in mm)?

a) 192
b) 200
c) 576
d) 600

Answer: B. The capillary rise associated with the diameter of 0.15 is 192mm while the capillary rise associated with a diameter of 0.05mm is 576mm. Since the tube was dry and then put into contact with water, if the whole tube had a 0.05mm diameter the water rise would have been 576mm, if instead the whole tube had a 0.15mm diameter the water rise would have been 192mm. The part of the tube in contact with the water surface has 0.05mm in diameter, the water then starts filling the tube, and it would like to get to 576mm height, however at a height of 200mm the diameter of the tube changes to 0.15mm. Since the water rise associated with this diameter (0.15mm) is smaller than the current height of the water (192mm < 200mm) the water cannot enter the 0.15mm section of the tube.

REWARD: Advance 3 squares

Which one of the sentences below about capillary systems upon evaporation is correct?

a) Initially, water pressure decreases generating a small decrease in the water volume

b) As the air-entry pressure is reached, water volume decreases at a constant pore water pressure

c) When the air-entry pressure is reached, water pressure decreases

d) All the answers are correct

Answer: D

REWARD: Advance 2 squares

The relationship between degree of saturation and (negative) pore water pressure for a capillary system is known as?

a) The hydraulic conductivity curve

b) The water retention curve

c) The suction control curve

d) The degrees of saturation curve

Answer: B

REWARD: Advance 1 square


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The states of saturation are?

a) Saturated, partially saturated and residual

b) Saturated, partially saturated and final

c) Saturated, quasi-saturated, partially saturated and residual

d) Saturated, virtually saturated and residual

Answer: C

REWARD: Advance 1 square

In the water retention curve, the state in which water and air are both continuous in the pore space can be referred to as?

a) Saturated

b) Quasi-saturated

c) Partially saturated

d) Residual

Answer: C

REWARD: Advance 1 square

Between sand, silt, and clay, which one would have the lowest air-entry value?

a) Clay

b) Silt

c) Sand

d) All of them

Answer: C - Sand has the largest pores, therefore it have the lowest air-entry value.

REWARD: Advance 2 squares

The volumetric water content is defined as the ratio of the volume of water to the total volume of the sample. This parameter is related to the porosity and the saturation of the soil.

a) True

b) False

Answer: A

REWARD: Advance 3 squares


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Water is in a capillary tube at equilibrium. The tube has an inner radius of 2 x 10^{-5}m, the contact angle is 60°, and the surface tension is 0.072 N/m. What is the pressure of the water in the tube? Assume the air pressure equal to 101.3kPa

a) 101.5kPa

b) 103.8 kPa

c) 95.7 kPa

d) 97.7kPa

Answer: D

$$u_2 = 101.3kPa - \frac{2(0.072\frac{N}{m})(\cos 60°)}{2 * 10^{-5}m * 1000\frac{N}{kN}}$$

REWARD: Advance 3 squares

Which of these sentences is correct regarding the hysteresis of the SWRC?

a) The water retention behaviour of a soil dried from saturated state ("main drying") is equal to that of a soil wetted from dry state ("main wetting")

b) The water retention behaviour is reversible along the main drying and main wetting curves

c) The water retention behaviour of a soil dried from saturated state ("main drying") differs from that of a soil wetted from dry state ("main wetting")

d) The "scanning curves" mark out the domain of impossible attainable states (hysteresis domain)

Answer: C

REWARD: Advance 1 square

A U-shape saturated tube is connected to a water reservoir. On the side of the tube

a) The capillary tube will not remain saturated because the negative pressure cannot be sustained by the curvature of the meniscus at the top of the tube

b) The water level is lowered to the bottom of the tube

c) The capillary tube will remain saturated because the negative pressure can be sustained by the curvature of the meniscus at the top of the tube

d) The water level is lowered to half the length of the tube

Answer: C

REWARD: Advance 3 squares

Calculate the water pressure generated by the meniscus for the case of β=53° (assume T=0.072 N/m and r=1μm). Consider c = 6.6 × 10^{-7}mm and b = 6.7 × 10^{-7}mm, and u_a = 0kPa.

a) 1.2 kPa

b) 4.4 kPa

c) 0 kPa

d) 9.8 kPa

Answer: C

$$u_w - 0 = -0.072\left(\frac{1}{6.6 \times 10^{-7}} - \frac{1}{6.7 \times 10^{-7}}\right) = 0.62kPa \sim 0kPa$$

REWARD: Advance 2 squares


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Calculate the water pressure generated by the meniscus for the case of β=45° (assume T=0.072 N/m and r=1μm). Consider c = 4.1 × 10^{-7}mm and b = 5.9 × 10^{-7}mm and u_a = 0kPa.

a) 55 kPa

b) 51 kPa

c) 49 kPa

d) 53 kPa

Answer: B

$$u_w - 0 = -0.072\left(\frac{1}{4.1 \times 10^{-7}} - \frac{1}{5.9 \times 10^{-7}}\right) = 51kPa$$

REWARD: Advance 2 squares

Calculate the water pressure generated by the meniscus for the case of β=30° (assume T=0.072 N/m and r=1μm). Consider c = 1.5 × 10^{-7}mm and b = 4.2 × 10^{-7}mm and u_a = 0kPa.

a) 300 kPa

b) 280 kPa

c) 295 kPa

d) 315 kPa

Answer: C

$$u_w - 0 = -0.072\left(\frac{1}{1.5 \times 10^{-7}} - \frac{1}{4.2 \times 10^{-7}}\right) = 295kPa$$

REWARD: Advance 2 squares

Calculate the water pressure generated by the meniscus for the case of β=15° (assume T=0.072 N/m and r=1μm). Consider c = 3.5 × 10^{-8}mm and b = 2.3 × 10^{-7}mm and u_a = 0kPa.

a) 1821 kPa

b) 1445 kPa

c) 1732 kPa

d) 1546 kPa

Answer: C

$$u_w - 0 = -0.072\left(\frac{1}{3.5 \times 10^{-8}} - \frac{1}{2.3 \times 10^{-7}}\right) = 1732kPa$$

REWARD: Advance 2 squares

For the same water content, which of these soils has the highest value of suction?

a) Silt

b) Clay

c) Gravel

d) Sand

Answer: B - Clay has the highest value of suction at a given water content as compared to sand, silt and gravel.

REWARD: Advance 1 square


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For the same value of suction, which soil has the lowest water content?

a) Clay

b) Silt

c) Sand

d) Gravel

Answer: D - For the same value of suction, gravel has the lowest water content.

REWARD: Advance 1 square

What is the capillary rise in a 5 x10^{-5} m diameter capillary tube for free water with surface tension of 0.072 N/m? Assume zero contact angle and u_a = 0kPa.

a) 0.685 m

b) 0.576 m

c) 0.546 m

d) 0.642 m

Answer: B

$$u_w - 0 = -\frac{\frac{2 \times 0.072 \times cos0}{\frac{5 \times 10^{-5}}{2}}}{1000} = -5.76kPa$$

$$h = -\frac{u_u}{\gamma_w} = -\frac{-5.76}{10} = 0.576m$$

REWARD: Advance 3 squares

If the ambient air pressure is 101.3 kPa, what is the pressure inside the water meniscus for a capillary tube with diameter of 0.001 mm? (assume T=0.072 N/m and θ=0°).

a) -154.6 kPa

b) -157.8 kPa

c) -186.7 kPa

d) -147.7 kPa

Answer: C

$$u_w - u_a = -\frac{2T cos\theta}{r}$$

$$u_w - 101.3 = -\frac{\frac{2 \times 0.072 \times cos0}{\frac{0.001}{2} \times 10^{-3}}}{1000}$$

$$u_w = -186.7kPa$$

REWARD: Advance 3 squares

Which one of the following factors does not affect soil suction?

a) Water content

b) Temperature

c) Plasticity index

d) Atmospheric pressure

Answer: D - The atmospheric pressure it does not have any effect on water in the soil mass. It does not contribute to the affecting factor.

REWARD: Advance 1 square


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Capillary tension develops in saturated soil, when_____

a) Soil is dry

b) Water content is reduced

c) Water content is increased

d) Soil particle is large

Answer: B - On decreasing of water content, the menisci recede, resulting in reduction of curvature and corresponding increase in capillary tension.

REWARD: **Advance 3 squares**

When does surface tension in the water become zero?

a) When the soil is completely dried

b) When the water evaporates

c) When the soil is fully saturated

d) None of the mentioned

Answer: D.

REWARD: **Advance 1 square**

Which of the following does not justify hysteresis of the SWRC?

a) Air entrapment

b) Geometric non-uniformity of individual pores, resulting from the Ink-bottle effect

c) Different spatial connectivity of pores during drying or wetting process

d) Change in magnitude of surface tension

Answer: D - The surface tension of the water does not change in magnitude unless there is change in the temperature of the water.

REWARD: **Advance 2 squares**

The general shape of the SWRC for various soils reflect the dominant influence of which of the following material properties?

a) Pore size distribution

b) Mineralogy

c) Grain size

d) All of the above

Answer: D - Pore size distribution, mineralogy and grain size are all important material properties to the determination of the shape of the SWRC.

REWARD: **Advance 1 square**


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Put in ascending order the capillary rise of the materials listed below: Fine sand, Clay, Silt and Coarse sand.

a) Silt, Coarse sand, Fine sand and Clay

b) Fine Sand, Silt, Coarse sand and Clay

c) Coarse sand, Fine sand, Silt and Clay

d) Clay, Fine Sand, Silt, Coarse sand

Answer: C - The capillary rise is inversely proportional to the size of the "throats" in the soil. Coarse sand, Fine sand, Silt and Clay.

REWARD: Advance 1 square

Which of these variables do not influence the intergranular stress?

a) Normal Stress

b) Wetted Area

c) Perimeter

d) Shear stress

Answer: D

REWARD: Advance 1 square

Water retention behaviour is generally represented via a number of phase variables. Which of these variables cannot represent the water retention behaviour?

a) Gravimetric Water Content

b) Water Ratio

c) Degree of saturation

d) Void ratio

Answer: D

REWARD: Advance 1 square

Water retention behaviour is generally represented via a number of phase variables. Select the alternative that list all variables that represent the water retention behaviour.

a) Water Ratio, Degree of saturation and Volumetric Water content

b) Gravimetric Water Content and Water Ratio

c) Gravimetric Water Content, Water Ratio, Degree of saturation and Volumetric Water content

d) Gravimetric water content and Volumetric water content

Answer: C

REWARD: Advance 1 square


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The degree of the saturation depends on?

a) The mass of water and solids

b) The total mass and the mass of water

c) The volume of water and the total volume

d) The volume of water and the volume of voids

Answer: D

REWARD: Advance 2 squares

To obtain the gravimetric water content and the water ratio of a soil sample, you would be required to determine:

a) Wet and dry mass of the sample and specific gravity of soil

b) Wet mass of the sample

c) Dry mass of the sample

d) Wet mass of the sample and sample volume

Answer: A

REWARD: Advance 3 squares

Which relationship is correct?

a) By knowing specific gravity and porosity you can obtain water ratio

b) By knowing saturation and volume of voids you can obtain volumetric water content

c) By knowing porosity and volume of voids you can obtain volumetric water content

d) By knowing saturation and porosity you can obtain volumetric water content

Answer: D

REWARD: Advance 3 squares

Let us consider the case of a clay deposit normally consolidated with the groundwater table initially at the ground surface. What is the pore water pressure of a sample 3 meters below the ground surface?

a) Negative

b) Positive

c) Zero

d) Negative but is negligible

Answer: B

REWARD: Advance 2 squares