I. Water Storage: Joseph and Mary had their water turned off (they’re broke), so they’d like to collect runoff from their roof (20’×72’). They found some old 55-gallon barrels at a waste processing plant. (2 pts ea)

1. How many rain barrels would they need to store an inch of rain? (1 ft$^3 = 7.48$ gal)

2. How long would this supply last if they only use 20 gal/person/day?

3. How long it last if they also irrigated a garden (10’×20’) with 1”/wk?

4. A nearby industry has a smokestack that emits radioactive and heavy metals. What are the potential pathways that these materials might affect the family? (3 pts)

II. True - False: Circle one (1 pt ea)

T - F A rain shadow is found under a tree.
T - F The infiltration rate in tilled soils is higher than in no-till soils.
T - F The dry air lapse rate (5.5°/1000 ft) is used to predict the increase in temperature with altitude in a clear sky.
T - F A cold front occurs when a maritime polar air mass advances into a maritime tropical air mass.
T - F Interception is greater in forests than in agricultural watersheds.
T - F The soil osmotic potential ($\phi$) is the force most likely to cause water movement in soils.
T - F Turbidity (NTU) is a good indicator of whether erosion is occurring or not.
T - F The specific conductance ($\mu$S/cm) is used to measure the ability of water to flow in a stream.
T - F The erosion tolerance ($T$) is the factor used to evaluate whether too much erosion is taking place.
T - F A Secchi disk is used to measure water clarity in small streams.
T - F A stream measuring 7’ wide, 3” deep, and flowing at 2.6 ft/s has a discharge of 273 ft$^3$/min.
T - F Many fish require a minimum dissolved oxygen concentration of 4 to 5 mg/L.
T - F An LNAPL is usually found on the surface of confined aquifers.
T - F Placing a well as deep as possible is the best way to avoid DNAPLs.
T - F Suspended solids are mostly clays and silts.
T - F Bedload solids are mostly sands and gravels.
III. Fill in the blank: (1 pt ea)

1. Method (or equation) used to find the –
   a. water velocity in a stream:
   b. flow in an aquifer:
   c. total volume of runoff:
   d. total annual erosion yield:

2. Type of aquifer with flowing wells:

3. Return period for a flood with a 2-percent probability:

4. Source of water for baseflow in streams:

5. Source of water for stormflow in streams:

6. Flow of water through the unsaturated zone:

7. Flow of water into the soil surface:

IV. Multiple Choice: Circle the best answer (1 pt ea)

1. Clouds are formed and/or precipitation occurs when:
   a. The condensation rate of water vapor exceeds the evaporation rate
   b. The air pressure decreases
   c. The air temperature cools
   d. The saturation vapor pressure is exceeded

2. Which of the following statements is incorrect:
   a. There is more water storage in forest soils than urban or agricultural soils
   b. There are more roots in forest soils than urban or agricultural soils
   c. There is better infiltration in forest soils than urban or agricultural soils
   d. The air is hotter and drier near forests than in urban or agricultural areas
   e. There is greater leaf area in forests than in urban or agricultural areas

V. Water Quality: Identify the three components of water quality. Give two examples for each: (4 pts ea)

1. ______________________:

2. ______________________:

3. ______________________:
VI. Soil Water: Use this soil moisture characteristic curve (MCC) to answer the following questions. (1 pt ea)

<table>
<thead>
<tr>
<th>Soil Water Characteristic</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Saturation (SAT)</td>
<td></td>
</tr>
<tr>
<td>Field Capacity (FC)</td>
<td></td>
</tr>
<tr>
<td>Wilting Point (WP)</td>
<td></td>
</tr>
<tr>
<td>Air Dry (AD)</td>
<td></td>
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<tr>
<td>Oven Dry (OD)</td>
<td></td>
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<tr>
<td>Porosity (PS)</td>
<td></td>
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<tr>
<td>Bulk Density (BD)</td>
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<tr>
<td>Plant Available Water (PAW)</td>
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<tr>
<td>PAW in 8” of soil (in)</td>
<td></td>
</tr>
<tr>
<td>PAW residence time (τ) if plants use 0.1”/day</td>
<td></td>
</tr>
</tbody>
</table>

VII. Soil Potential: Use this profile to answer the following questions: (2 pts ea)

1. Depth of:
   - water table =
   - perched zone =
2. What causes the perched zone?
3. Flow direction (up/down/none) at:
   - surface:       5 m:       12 m:       17 m:
4. Flow rate \(q = -Kdh/dz\) at 12 m if the hydraulic conductivity is 7 cm/day:
5. Volumetric water content at surface using MCC from earlier problem (1 bar ≈ 10 m):