

Name: _____

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Bulk Density Worksheet

Terms and Formulas:

Bulk Density: mass of oven-dry soil per unit volume (natural state).

$$\text{B.D.} = \text{oven-dry soil mass (g)} / \text{soil volume (cm}^3\text{)}$$

Particle Density: mass of oven-dry soil per unit volume of solid particles.

$$\text{P.D.} = \text{oven-dry soil mass (g)} / \text{soil solid volume (cm}^3\text{)}$$

Assume P.D. to be 2.65 g cm^{-3}

Porosity: percentage of total soil volume not occupied by solid soil particles.

$$\%P.S. = 100 - (\text{B.D.} / \text{P.D.} * 100)$$

Acre Furrow Slice: volume or mass of soil in one tilled acre (approx. 6 inches deep)

$$\begin{aligned}\text{AFS (volume)} &= 21,780 \text{ ft}^3 \\ \text{AFS (mass)} &= \text{AFS(volume)} * \text{B.D.} \\ \text{Approximate AFS(mass)} &= 2,000,000 \text{ lb}\end{aligned}$$

Expected Range for Bulk Density Values, g/cm⁻³

Most soils: 1.0 - 1.8	Sandy soils: 1.4 - 1.7
Construction sands: 1.45 - 1.65	Clayey soils: 1.0 - 1.5
Peat: 0.05 - 0.5	Compacted soils: 1.6 - 2.0
8:2 sand:peat mix: 1.17 - 1.42	

SAMPLE PROBLEMS: Show YOUR WORK use UNITS!

1. What is the bulk density of a 765 g dry soil sample that has an undisturbed volume of 510 cm^3 ?

2. What is the porosity of the soil in Question #1? (assume P. D. = 2.65 g/cm^3)

3. Convert the bulk density of the soil in Question #1 from metric units (g cm^3) to standard English units (lb/ft^3).

$$\text{Conversion factor: } (1.0 \text{ g/cm}^3)(1.0 \text{ lb/454 g})(28,330 \text{ cm}^3/\text{ft}^3) = 62.4 \text{ lb/ft}^3$$

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4. Expand your answer in Question #3 to express how many pounds of that soil are in an acre furrow slice.

5. The average mass for an acre furrow slice is 2,000,000 lb. What bulk density is required to achieve this average value?

6. Research has shown that corn roots are unable to penetrate a layer of soil having a bulk density of 1.85 g/cm^3 . What is the porosity in a soil this dense?

7. Compaction by tillage implements changed the bulk density from 1.2 g/cm^3 to 1.7 g/cm^3 in a portion of the root zone. What was the initial porosity? What is the compacted porosity? What percent of the soil's porosity was lost due to compaction?

8. During construction of new golf greens, workers use an 8:2 sand-to-peat mix. If their mix has the mean bulk density of the range shown in the table above, what is the porosity of a golf green made from this material?