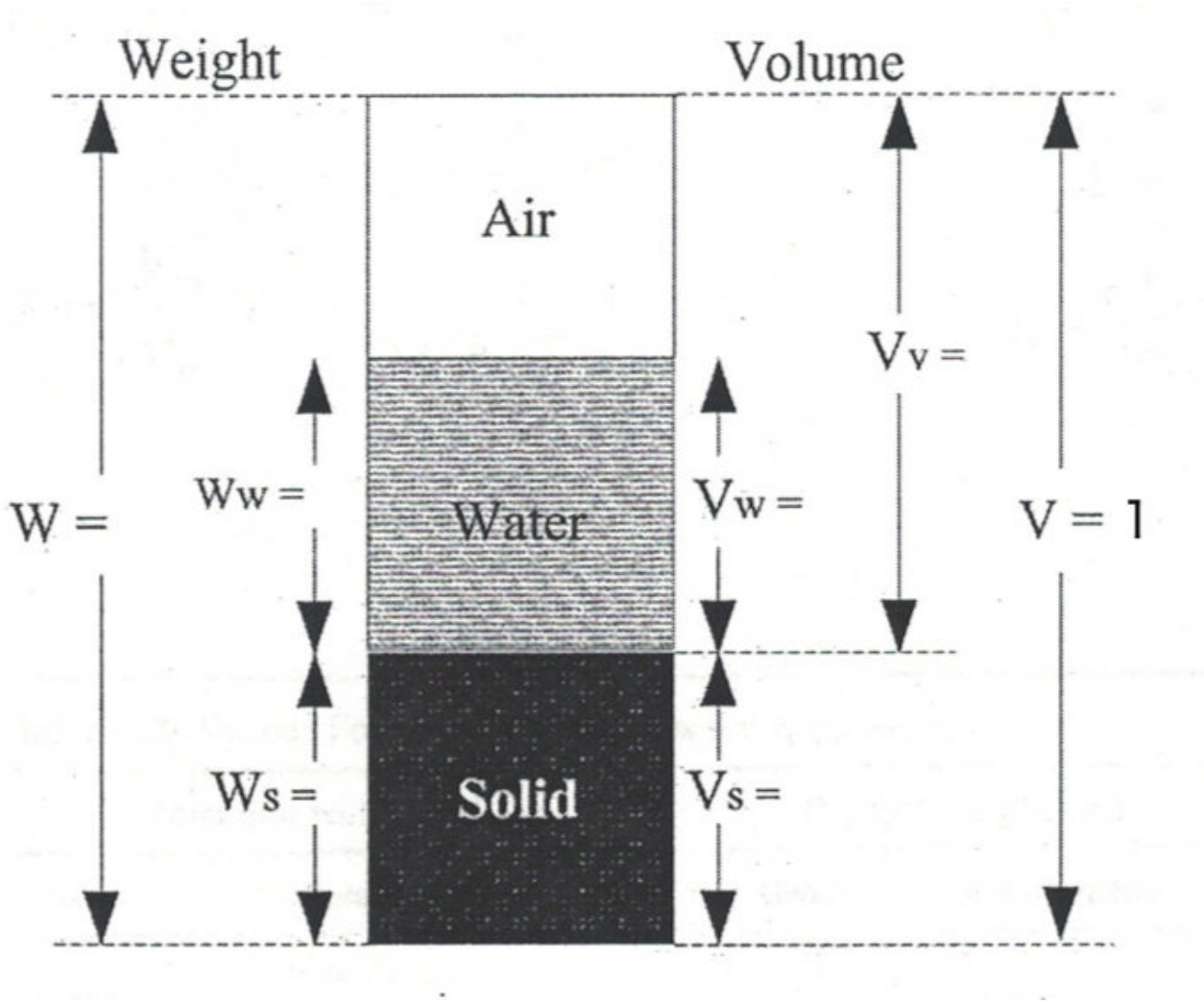
Problem

The dry unit weight of a soil is $14.8\ kN/m^3$. Given that $\omega = 17\%$ and $G_s = 2.71$, determine the various quantities of the phase diagram shown in the figure for a unit volume of the soil.

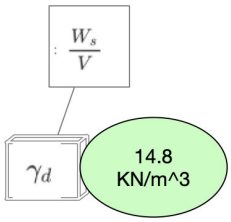


Known variables of the problem:

$$\gamma_d = 14.8\ kN/m^3$$
$$\omega = 17\%$$
$$G_s = 2.71$$
$$Constant: \gamma_w = 9.81\ kN/m^3$$
$$V = 1\ (unit\ volume\ of\ the\ soil;\ not\ solid)$$

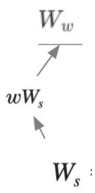
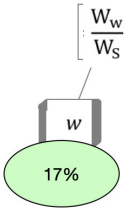
Solution:

1)$W_s, V = 1$



$$W_s = \gamma_d * V = 14.8 * 1 = 14.8\ KN$$

2) $W_w,\ W$

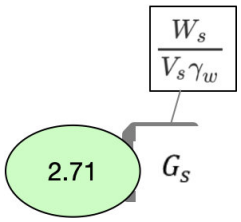
	

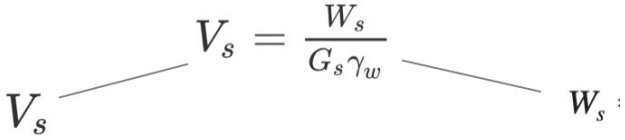
$$W_w = \omega * W_s = 17\% * 14.8 = 2.516\ KN$$
$$W = W_w + W_s = 14.8 + 2.516 = 17.316\ KN$$

method 1:

3) V_s ; V_v

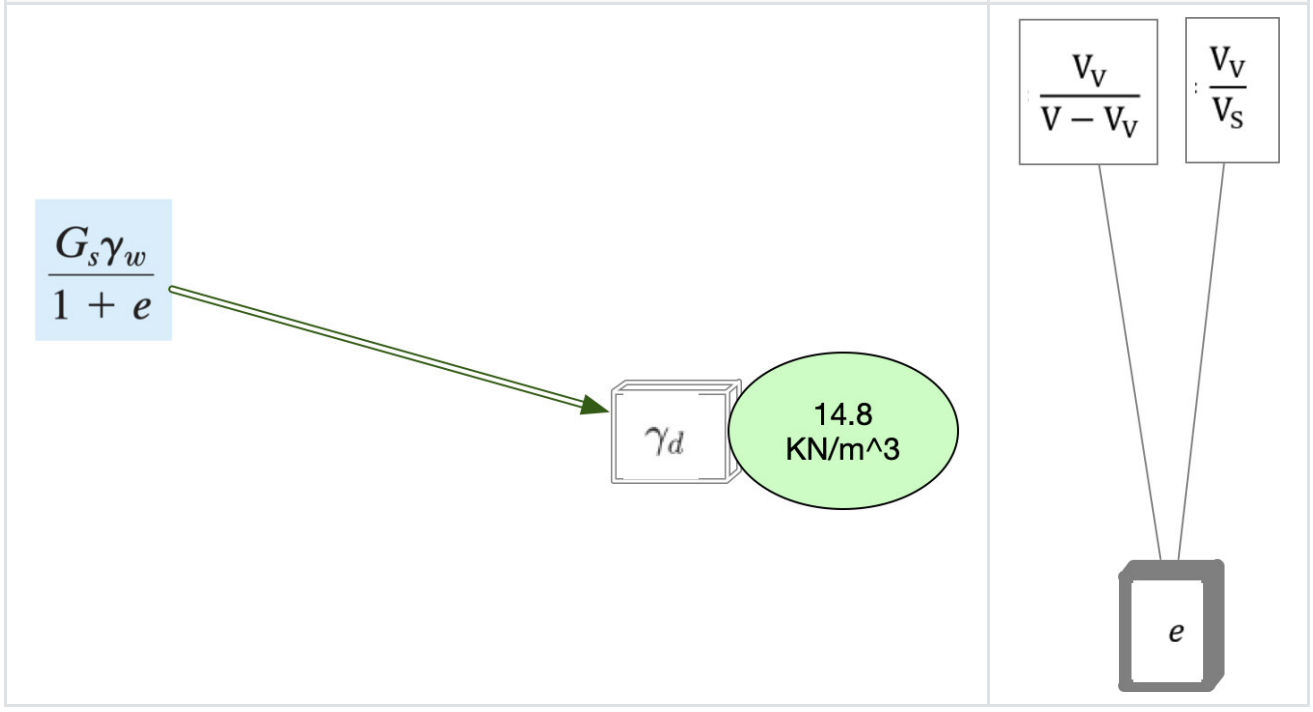
Method 1:





$$V_s = \frac{W_s}{G_s\gamma_w} = \frac{14.8}{2.71 * 9.81} = 0.557\ m^3$$
$$V_v = V - V_s = 1 - 0.557 = 0.443\ m^3$$

Method 2:



$$e = \frac{G_s\gamma_w}{\gamma_d} - 1 = \frac{2.71 * 9.81}{14.8} - 1 = 0.796$$

$$e = \frac{V_v}{V - V_v} = \frac{V_v}{1 - V_v} = 0.796$$

$$V_v = 0.443m^3$$

$$V_s = \frac{V_v}{e} = \frac{0.443}{0.796} = 0.557m^3$$

5) V_w

$$V_w = \frac{W_w}{\gamma_w} = \frac{2.516}{9.81} = 0.256\ m^3$$