14.26 (a) We are asked to compute the densities of totally crystalline and totally amorphous polypropylene ($\rho_c$ and $\rho_a$) from Equation 14.8. From Equation 14.8 let $C = \frac{\% \text{ crystallinity}}{100}$, such that

$$C = \frac{\rho_c (\rho_s - \rho_a)}{\rho_s (\rho_c - \rho_a)}$$

Rearrangement of this expression leads to

$$\rho_c (C \rho_s - \rho_a) + \rho_a - C \rho_s \rho_a = 0$$

in which $\rho_c$ and $\rho_a$ are the variables for which solutions are to be found. Since two values of $\rho_s$ and $C$ are specified in the problem, two equations may be constructed as follows:

$$\rho_c (C_1 \rho_{s1} - \rho_{s1}) + \rho_a - C_1 \rho_{s1} \rho_a = 0$$
$$\rho_c (C_2 \rho_{s2} - \rho_{s2}) + \rho_a - C_2 \rho_{s2} \rho_a = 0$$

In which $\rho_{s1} = 0.904 \text{ g/cm}^3$, $\rho_{s2} = 0.895 \text{ g/cm}^3$, $C_1 = 0.628$, and $C_2 = 0.544$. Solving the above two equations for $\rho_a$ and $\rho_c$ leads to

$$\rho_a = \frac{\rho_{s1} \rho_{s2} (C_1 - C_2)}{C_1 \rho_{s1} - C_2 \rho_{s2}}$$
$$= \frac{(0.904 \text{ g/cm}^3)(0.895 \text{ g/cm}^3)(0.628 - 0.544)}{(0.628)(0.904 \text{ g/cm}^3) - (0.544)(0.895 \text{ g/cm}^3)} = 0.841 \text{ g/cm}^3$$

And

$$\rho_c = \frac{\rho_{s1} \rho_{s2} (C_2 - C_1)}{\rho_{s2} (C_2 - 1) - \rho_{s1} (C_1 - 1)}$$
$$= \frac{(0.904 \text{ g/cm}^3)(0.895 \text{ g/cm}^3)(0.544 - 0.628)}{(0.895 \text{ g/cm}^3)(0.544 - 1.0) - (0.904 \text{ g/cm}^3)(0.628 - 1.0)} = 0.946 \text{ g/cm}^3$$

(b) Now we are asked to determine the density of a specimen having 74.6% crystallinity. Solving for $\rho_s$ from Equation 14.8 and substitution for $\rho_a$ and $\rho_c$ which were computed in part (a) yields
\[
\rho_s = \frac{-\rho_c \rho_a}{C(\rho_c - \rho_a) - \rho_c}
\]

\[
= \frac{-(0.946 \text{ g/cm}^3)(0.841 \text{ g/cm}^3)}{(0.746)(0.946 \text{ g/cm}^3 - 0.841 \text{ g/cm}^3) - 0.946 \text{ g/cm}^3}
\]

\[
= 0.917 \text{ g/cm}^3
\]