21. (a) We use the expression for the variation of pressure with height in an incompressible fluid: $p_2 = p_1 - \rho g(y_2 - y_1)$. We take y_1 to be at the surface of Earth, where the pressure is $p_1 = 1.01 \times 10^5$ Pa, and y_2 to be at the top of the atmosphere, where the pressure is $p_2 = 0$. For this calculation, we take the density to be uniformly $1.3\,\text{kg/m}^3$. Then,

$$y_2 - y_1 = \frac{p_1}{\rho g} = \frac{1.01 \times 10^5\ \text{Pa}}{\left(1.3\,\text{kg/m}^3\right)\left(9.8\,\text{m/s}^2\right)} = 7.9 \times 10^3\ \text{m} = 7.9\ \text{km}\ .$$

(b) Let h be the height of the atmosphere. Now, since the density varies with altitude, we integrate

$$p_2 = p_1 - \int_0^h \rho g\, dy\ .$$

Assuming $\rho = \rho_0(1 - y/h)$, where ρ_0 is the density at Earth's surface and $g = 9.8\,\text{m/s}^2$ for $0 \le y \le h$, the integral becomes

$$p_2 = p_1 - \int_0^h \rho_0 g \left(1 - \frac{y}{h}\right) dy = p_1 - \frac{1}{2}\rho_0 g h\ .$$

Since $p_2 = 0$, this implies

$$h = \frac{2p_1}{\rho_0 g} = \frac{2(1.01 \times 10^5\ \text{Pa})}{(1.3\,\text{kg/m}^3)(9.8\,\text{m/s}^2)} = 16 \times 10^3\ \text{m} = 16\ \text{km}\ .$$