21. We introduce the notion of density (which the students have probably seen in other courses):

$$\rho = \frac{m}{V}$$

and convert to SI units: $1\,\text{g} = 1 \times 10^{-3}\,\text{kg}$.

(a) For volume conversion, we find $1\,\text{cm}^3 = (1 \times 10^{-2}\,\text{m})^3 = 1 \times 10^{-6}\,\text{m}^3$. Thus, the density in kg/m^3 is

$$1\,\text{g/cm}^3 = \left(\frac{1\,\text{g}}{\text{cm}^3}\right)\left(\frac{10^{-3}\,\text{kg}}{\text{g}}\right)\left(\frac{\text{cm}^3}{10^{-6}\,\text{m}^3}\right) = 1 \times 10^3 \text{ kg/m}^3 \ .$$

Thus, the mass of a cubic meter of water is 1000 kg.

(b) We divide the mass of the water by the time taken to drain it. The mass is found from $M = \rho V$ (the product of the volume of water and its density):

$$M = (5700\,\text{m}^3)(1 \times 10^3 \text{ kg/m}^3) = 5.70 \times 10^6 \text{ kg} \ .$$

The time is $t = (10\,\text{h})(3600\,\text{s/h}) = 3.6 \times 10^4\,\text{s}$, so the *mass flow rate* R is

$$R = \frac{M}{t} = \frac{5.70 \times 10^6\,\text{kg}}{3.6 \times 10^4\,\text{s}} = 158 \text{ kg/s} \ .$$