Mass density (ρ):

It is defined as the mass of unit volume of an object or substance.

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

Typical Unit: $^{g}/_{cm^3}$, $^{Kg}/_{m^3}$

Weight density (D):

It is defined as the weight of unit volume of an object or substance.

$$D = \frac{W}{V}$$

Typical Unit: $^{N}/_{m^3}$, $^{gf}/_{cm^3}$

Since: W = M. g
Therefore: $D = \rho \cdot g$
Where:
"g" the nominal gravitational acceleration of an object in a vacuum near the surface of the Earth is:
g = 9.8 m/s^2

Example 1: The mass density of steel is 7.8 gr/cm^3. A solid chunk of steel has a volume of 141cm^3. Determine (a) its mass in grams and (b) its weight density in N/m^3.

Solution:

(a) Since ρ = M/V; M = ρV; **M** = (7.8gr/cm^3) (141cm^3); **M = 1100 gr.**

Before going to Part (b), let's first convert (gr/cm^3) to **SI** that means (kg/m^3). Use horizontal fraction bars.

7.8gr/cm^3 = 7.8 (0.001kg) / (0.01m)^3 = 7800 kg/m^3.

1 kg is equal to **1000gr.** This means that **1gr is 0.001kg** as is used above.

Also, 1m is **100cm.** This means that **1cm is 0.01m.** Cubing each, results in: 1cm^3 = 0.000001m^3 as is used above. Now, let's solve Part (b).

(b) D = ρg ; D = [7800 kg /m^3] [9.8 m/s^2] = 76000 N/m^3.

Not only you should write Part (b) with horizontal fraction bars, but also check the correctness of the units as well.

Source: http://www.pstcc.edu/nbs/WebPhysics/