5. Let M_{col} = column-integrated mass
P_s = surface pressure $(= M_{col} \cdot g)$

Thus
$$M_{col} = \frac{P_s}{g} = \frac{1.013(0.1\ MPa)}{9.81\ m\,s^{-2}}$$
$$= \frac{1.013 \times 10^{5}\ Pa}{9.81\ m\,s^{-2}} = \boxed{1.033 \times 10^{4}\ kg\ m^{-2}}$$

or, to remember this easily, $M_{col} \simeq \underline{1}\ kg\ cm^{-2}$,

Then, $N_{col} = \frac{M_{col}}{m} = \frac{1.033 \times 10^{4}}{28.96(1.67 \times 10^{-27})} = \boxed{2.14 \times 10^{29}\ m^{-2}}$

6. MKS:

Earth's surface area (SA) $= 4\pi r_E^2 = 4\pi (6.371 \times 10^{6}\ m)^2$
$= 5.10 \times 10^{14}\ m^2$

Density of water $= 1\ g\,cm^{-3} = 10^{3}\ kg\ m^{-3}$

So

Volume of ocean (V) $= 1.4 \times 10^{21}\ kg \left(\frac{1\ m^3}{10^3\ kg}\right)$
$= 1.4 \times 10^{18}\ m^3$

Average depth of ocean (D):
$$D = V/SA = \frac{1.4 \times 10^{18}\ m^3}{5.1 \times 10^{14}\ m^2}$$
$$= 2.745 \times 10^{3}\ m$$
$$\boxed{D = 2.745\ km}$$

Column mass: $M_{col} = \rho D = 10^{3}\ kg\ m^{-3}(2.745 \times 10^{3}\ m)$
$= 2.745 \times 10^{6}\ kg\ m^{-2}$

Pressure at bottom: $P_{bot} = M_{col} \cdot g = 2.745 \times 10^{6}\ kg\ m^{-2} \cdot (9.81\ m\,s^{-2})$
$= 2.69 \times 10\ Pa = \boxed{269\ bar}$

Column number density (next page) ⇒