PM-1 Soln)

Consider a thin slab of atmosphere with a volume *d*V = 1m × 1m × dh. Then,

$$\mathrm{M} = \iiint \mathrm{D}(\vec{\mathrm{r}})\ d\mathrm{V} = 1\mathrm{m}^2 \int \mathrm{D}(\mathrm{h})\, d\mathrm{h} = \int_0^{\infty} 1.3\, \mathrm{e}^{-\mathrm{h}/7640}\, d\mathrm{h} = -7640\,(1.3)\, \mathrm{e}^{-\frac{\mathrm{h}}{7640}}\Big|_0^{\infty}$$

$$= -9932\left[\mathrm{e}^{-\frac{\infty}{7640}} - \mathrm{e}^{-\frac{0}{7640}}\right] = -9932[0-1] = 9932\ \mathrm{kg}.$$

This is consistent with our original notion that atmospheric pressure at the surface is due to the column of air pushing downward on the earth's surface. Using NII:

$$+\mathrm{F_N} - \mathrm{gm} = \mathrm{ma_y} = 0$$

$$\mathrm{P} = \frac{\mathrm{F_N}}{\mathrm{A}} = \frac{\mathrm{gm}}{\mathrm{A}}$$

$$\mathrm{m} = \frac{\mathrm{PA}}{\mathrm{g}} = \frac{1.01 \times 10^5 (1^2)}{9.8} = 10{,}306\ \mathrm{kg}\ .$$

Remember of course that g is not constant at different altitudes above the earth's surface, so this is a rough estimate.