Powers of ten

We will be using very large numbers and very small numbers. In order to do calculations it is advisable to write the products or divisors using powers of ten. If $A = c \times 10^x$, $B = d \times 10^y$, $C = AB$, $D = A/B$,

$$C = cd \times 10^{(x+y)} \tag{1a}$$

$$D = \frac{c}{d} \times 10^{(x-y)} \tag{1b}$$

Suppose we use as an example the gravitational force on a 100kg person due to the earth. The distance of the person from the center of the earth is R_e. For this we use Newton's law of gravity

$$F = \frac{G m_e m}{R_e^2} \tag{2}$$

For $m = 100kg$, $m_e = 5.98{\times}10^{24}$ kg, $R_e = 6.38^6$ m, $G = 6.67{\times}10^{-11} Nm^2/kg^2$. We can write $100kg = 1.0 \times 10^2 kg$, thus

$$F = \frac{(6.67 \times 5.98 \times 1.0) \times 10^{(-11+24+2)}}{6.38^2 \times 10^{(6+6)}} \tag{3a}$$

$$F = \frac{39.89 \times 10^{15}}{40.70 \times 10^{12}} \tag{3b}$$

$$F = \frac{39.89}{40.70} \frac{10^{15}}{10^{12}} \tag{3c}$$

$$F = 0.98 \times 10^3 N \tag{3d}$$

For any other solar system object use the minimum distance between the earth and the planet,

$$Rep = |R_e - R_p| \tag{4}$$