# Practice Calculations Test Problems - Solutions
## Do-overs Allowed - only 3 significant figures in answers needed.

In the following formulas, use $G = 6.67\times10^{-11}\,\frac{\mathrm{N\cdot m^2}}{\mathrm{kg^2}}$ and $c = 3.00\times10^{8}\,\mathrm{m/s}$ .

1. Calculate the gravitational force in newtons using the formula $F = G\frac{m_1 m_2}{d^2}$ where, $m_1 = 5.3\times10^{23}\mathrm{kg}$ , $m_2 = 64.9\,\mathrm{kg}$ and $d = 8.3\times10^{8}\mathrm{m}$ .

$$\boldsymbol{F = \left(6.67\times10^{-11}\,\frac{\mathrm{N\cdot m^2}}{\mathrm{kg^2}}\right)\frac{(5.3\times10^{23}\,\mathrm{kg})\cdot(64.9\,\mathrm{kg})}{(8.3\times10^{8}\,\mathrm{m})^2} = 3.330\times10^{-3}\,\mathrm{N} = 3.330\,\mathrm{mN}}$$

2. Calculate the dimensionless relativistic factor $\gamma = \frac{1}{\sqrt{1-\frac{v^2}{c^2}}}$ where $v = 2.8\times10^{8}\,\mathrm{m/s}$ .

$$\boldsymbol{\gamma = \frac{1}{\sqrt{1-\frac{(2.8\times10^{8}\,\mathrm{m/s})^2}{(3.00\times10^{8}\,\mathrm{m/s})^2}}} = \frac{1}{\sqrt{1-\left(\frac{2.8\times10^{8}\,\mathrm{m/s}}{3.00\times10^{8}\,\mathrm{m/s}}\right)^2}} = 2.785}$$

3. Using $E = m\,c^2$ , calculate the energy in joules released when $3.7\times10^{-3}\mathrm{kg}$ is converted to energy.

$$\boldsymbol{E = (3.7\times10^{-3}\,\mathrm{kg})\cdot(3.00\times10^{8})^2 = 3.33\times10^{14}\,\frac{\mathrm{kg\cdot m^2}}{\mathrm{s^2}} = 3.330\times10^{14} = 3.33\times10^{14}\,\mathrm{N\cdot m} = 3.33\times10^{14}\,\mathrm{J} = 333\,\mathrm{TJ}}$$

4. Using $\lambda = \frac{c}{f}$ , calculate the wavelength in meters of a photon that has a frequency of $5\times10^{15}\,\mathrm{Hz}$ .

$$\boldsymbol{\lambda = \frac{3.00\times10^{8}\,\mathrm{m/s}}{5\times10^{15}\,\mathrm{Hz}} = 6.00\times10^{-8}\,\mathrm{m} = 0.06\mu\,m = 60\,\mathrm{nm}}$$