Given: The force of gravity, Einstein's Mass–energy equivalence, and Planck's Energy Frequency Relation

$$F = G\frac{m_1 m_2}{r^2}$$

$$E = mc^2 \text{ or } m = \frac{E}{c^2}$$

$$E = hf$$

$$F = G\frac{m_1 m_2}{r^2} = G\frac{\frac{E_1}{c^2}\frac{E_2}{c^2}}{r^2} = G\frac{hf_1 hf_2}{c^4 r^2}$$

$$F = G\frac{h^2 f_1 f_2}{c^4 r^2}$$

Where:

- F – is the force between two photons [kg m $s^{-2}$]
- G – is the gravitational constant [6.67e-11 $m^3$ $kg^{-1}$ $s^{-2}$]
- h – is Planck's constant [6.63e-34 $m^2$ kg $s^{-1}$]
- c – is the speed of light [3.00e8 m $s^{-1}$]
- r – is the distance between a photon in EM wave 1 and EM wave 2 [m]
- $f_1$ – is the frequency of a photon in EM wave 1 [$s^{-1}$]
- $f_2$ – is the frequency of a photon in EM wave 2 [$s^{-1}$]

A unit analysis of both sides of the equation shows that the units match.

$$F = \frac{m\,kg}{s^2} = \frac{m^3}{kg\,s^2} \times \left(\frac{m^2 kg}{s}\right)^2 \times \frac{1}{s} \times \frac{1}{s} \times \left(\frac{m}{s}\right)^{-4} \times (m)^{-2} = \frac{m^7\,kg^2\,s^4}{m^6\,kg\,s^6} = \frac{m\,kg}{s^2}$$

Calculating the value of the constants, denoted as $Y_1$, gives the following value:

$$Y_1 = \frac{Fr^2}{f_1 f_2} = G\frac{h^2}{c^4} = 6.67 \times 10^{-11}\ \frac{m^3}{kg\,s^2}\left[\frac{\left(6.63 \times 10^{-34}\ \frac{m^2\,kg}{s}\right)^2}{\left(3.00 \times 10^8\ \frac{m}{s}\right)^4}\right]$$

$$Y_1 = 3.62 \times 10^{-111}\ m^3\ kg$$

This will give the equation:

$$F = Y_1 \frac{f_1 f_2}{r^2}$$

A unitless multiple *k* can be included to denote the number of photons at a specific point in each of the two waves. This means that the photons will have to be the same distance away from the point in the other wave. This will give the final equation:

$$F = Y_1 \frac{k_1 f_1 k_2 f_2}{r^2}$$

Where:

- F – is the force between two photons [kg m $s^{-2}$]
- $Y_1$ – is a constant [3.61e-111 $m^3$ kg]
- r – is the distance between a point in EM wave 1 and EM wave 2 [m]
- $f_1$ – is the frequency of a photon in EM wave 1 [$s^{-1}$]
- $f_2$ – is the frequency of a photon in EM wave 2 [$s^{-1}$]
- $k_1$ – is the number of photons at a point in EM wave 1
- $k_2$ – is the number of photons at a point in EM wave 2

Given: The force of gravity, Einstein's Mass–energy equivalence, and Planck's Energy Frequency Relation

$$F = G \frac{m_1 m_2}{r^2}$$

$$E = mc^2 \text{ or } m = \frac{E}{c^2}$$

$$E = hf$$

$$F = G \frac{m_1 m_2}{r^2} = G \frac{\frac{E}{c^2} m}{r^2}$$

$$F = G\frac{hfm}{c^2r^2}$$

Where:

F – is the force between a photon and an object with mass [kg m $s^{-2}$]
G – is the gravitational constant [6.67e-11 $m^3$ $kg^{-1}$ $s^{-2}$]
h – is Planck's constant [6.63e-34 $m^2$ kg $s^{-1}$]
c – is the speed of light [3.00e8 m $s^{-1}$]
r – is the distance between a photon and an object with mass [m]
f – is the frequency of a photon [$s^{-1}$]

A unit analysis of both sides of the equation shows that the units match.

$$F = \frac{m\,kg}{s^2} = \frac{m^3}{kg\,s^2} \times \frac{m^2 kg}{s} \times \frac{1}{s} \times kg \times \left(\frac{m}{s}\right)^{-2} \times (m)^{-2} = \frac{m^5\,kg^2\,s^2}{m^4\,kg\,s^4} = \frac{m\,kg}{s^2}$$

Calculating the value of the constants, denoted as $Y_2$, gives the following value:

$$Y_2 = \frac{Fr^2}{fm} = G\frac{h}{c^2} = 6.67 \times 10^{-11}\ \frac{m^3}{kg\,s^2}\left[\frac{6.63 \times 10^{-34}\ \frac{m^2\,kg}{s}}{\left(3.00 \times 10^8\ \frac{m}{s}\right)^2}\right]$$

$$Y_2 = 4.91 \times 10^{-61}\ m^3\ s^{-1}$$

This will give the equation:

$$F = Y_2\frac{fm}{r^2}$$

A unitless multiple *k* can be included to denote the number of photons at a point in a wave. This means that the photons will have to be the same distance away from the object with mass. This will give the final equation:

$$F = Y_2 k\frac{fm}{r^2}$$

Where:

F – is the force between a photon and an object with mass [kg m $s^{-2}$]
$Y_2$ – is a constant [4.91e-61 $m^3$ $s^{-1}$]
r – is the distance between a point in the EM wave and an object with mass [m]

f – is the frequency of a photon [$s^{-1}$]
m – is the mass of an object [kg]
k – is the number of photons at a point in the EM wave