Formulas

Gravitational force
near earth’s surface: \( mg \)
far from earth’s surface: \( \frac{mgR^2}{(R^2 + x^2)^{3/2}} \) where \( R \) is the radius of the earth.

Definition: The Wronskian of two differential functions, \( f \) and \( g \) is
\[
W(f, g) = fg' - f'g = \begin{vmatrix} f & g \\ f' & g' \end{vmatrix}
\]

\[
\cos(y \mp x) = \cos(x \mp y) = \cos(x)\cos(y) \pm \sin(x)\sin(y)
\]

Mechanical Vibrations:
\[
mu''(t) + \gamma u'(t) + ku(t) = F_{\text{external}}, \quad m, \gamma, k \geq 0
\]
\[
mg - kL = 0, \quad F_{\text{viscous}}(t) = \gamma u'(t)
\]

\( m = \) mass,
\( k = \) spring force proportionality constant,
\( \gamma = \) damping force proportionality constant
\( g = 9.8 \text{ m/sec} \)

Electrical Vibrations:
\[
L \frac{dI(t)}{dt} + RI(t) + \frac{1}{C} Q(t) = E(t), \quad L, R, C \geq 0 \text{ and } I = \frac{dQ}{dt}
\]

\( L = \) inductance (henrys),
\( R = \) resistance (ohms)
\( C = \) capacitance (farads)
\( Q(t) = \) charge at time \( t \) (coulombs)
\( I(t) = \) current at time \( t \) (amperes)
\( E(t) = \) impressed voltage (volts).

1 volt = 1 ohm \cdot 1 ampere = 1 coulomb / 1 farad = 1 henry \cdot 1 amperes/ 1 second