

## Gravitation Equations Worksheet

Level: A-Level / AP Physics 1 & 2 | Difficulty: Advanced | Topic: Mechanics

Practice gravitation with 10 problems on Newton's universal law, field strength, and orbital motion. Includes full worked solutions.

### Equations you will need

$F = Gm_1m_2/r^2$	Newton's law of universal gravitation
$g = GM/r^2$	Gravitational field strength
$v = \sqrt{GM/r}$	Orbital speed for circular orbit
$T^2 = (4\pi^2/GM)r^3$	Kepler's 3rd law
$U = -Gm_1m_2/r$	Gravitational potential energy

### Symbol key

Symbol	Quantity	Unit
F	force	N
G	gravitational constant	$6.67 \times 10^{-11} \text{ N} \cdot \text{m}^2/\text{kg}^2$
m	mass	kg
M	central body mass	kg
r	separation / orbit radius	m
g	field strength	N/kg or $\text{m/s}^2$
v	orbital speed	m/s
T	orbital period	s

### Practice problems

- Find gravitational force between two 100 kg masses 2 m apart.
- Find g at Earth's surface. ( $M=5.97 \times 10^{24}$  kg,  $r=6.37 \times 10^6$  m)
- Find orbital speed at  $7 \times 10^6$  m above Earth's centre.
- Find period of a satellite orbiting Earth at radius  $8 \times 10^6$  m.
- Find gravitational PE of a 1000 kg satellite at  $4 \times 10^7$  m from Earth's centre.

6. Find  $g$  at  $2 \times 10^7$  m above Earth's centre (about 3 Earth radii).
7. At what height above Earth's surface is  $g$  half its surface value?
8. Find the mass of the Sun given Earth's orbital radius ( $1.5 \times 10^{11}$  m) and period ( $3.16 \times 10^7$  s).
9. Find the escape velocity from Earth's surface.
10. A geostationary satellite has  $T = 86,400$  s. Find its orbital radius.