

13. Gravitational fields

Starter Quiz · 课前小测

A-Level Physics

Name: _____ Score: _____

1. Gravitational field strength is the force per unit:

- ☐ mass
- ☐ charge
- ☐ area
- ☐ volume

2. Newton's law of gravitation gives the force between two masses as:

- ☐ $\frac{Gm_1m_2}{r^2}$
- ☐ $\frac{Gm_1m_2}{r}$
- ☐ $Gm_1m_2r^2$
- ☐ $\frac{m_1m_2}{Gr^2}$

3. The gravitational field strength at distance r from a point mass M is:

- ☐ $\frac{GM}{r^2}$
- ☐ $\frac{GM}{r}$
- ☐ $\frac{GMm}{r^2}$
- ☐ GMr^2

4. Gravitational potential is:

- ☐ negative everywhere (zero at infinity)
- ☐ positive everywhere
- ☐ zero everywhere
- ☐ always increasing with depth

5. A 2.0 kg mass feels a gravitational force of 20 N. What is g there?

_____ N/kg

6. Gravity is always attractive.

- ☐ True
- ☐ False

7. Climbing a tall building changes the value of g by a large amount.

- ☐ True
- ☐ False

8. Gravitational potential is taken to be zero at _____.

9. The unit N/kg is the same as m/s².

- ☐ True
- ☐ False

10. Two masses attract with 40 N at separation r . What is the force at separation $2r$?

_____ N

A-Level Physics

1. **mass**

$g = \frac{F}{m}$ — the gravitational force on each kilogram of a small test mass.

2. $\frac{Gm_1m_2}{r^2}$

The pull is proportional to each mass and inversely proportional to the distance squared.

3. $\frac{GM}{r^2}$

From $g = \frac{F}{m}$ with $F = \frac{GMm}{r^2}$, the test mass cancels: $g = \frac{GM}{r^2}$.

4. **negative everywhere (zero at infinity)**

Gravity does the work as a mass falls in, so $\phi = -\frac{GM}{r}$ is negative, reaching zero only at infinity.

5. **10 N/kg**

$$g = \frac{F}{m} = \frac{20}{2.0} = 10 \frac{\text{N}}{\text{kg}}.$$

6. **True**

Yes — masses only ever pull together; there is no gravitational repulsion.

7. **False**

Earth's radius is ~6400 km, so a few metres of height barely changes r — g is effectively constant.

8. **infinity**

That choice makes the potential negative everywhere a mass actually is.

9. **True**

Yes — g is also the acceleration of free fall, so its units are equivalent.

10. **10 N**

Inverse-square: $\frac{40}{2^2} = \frac{40}{4} = 10 \text{ N}.$