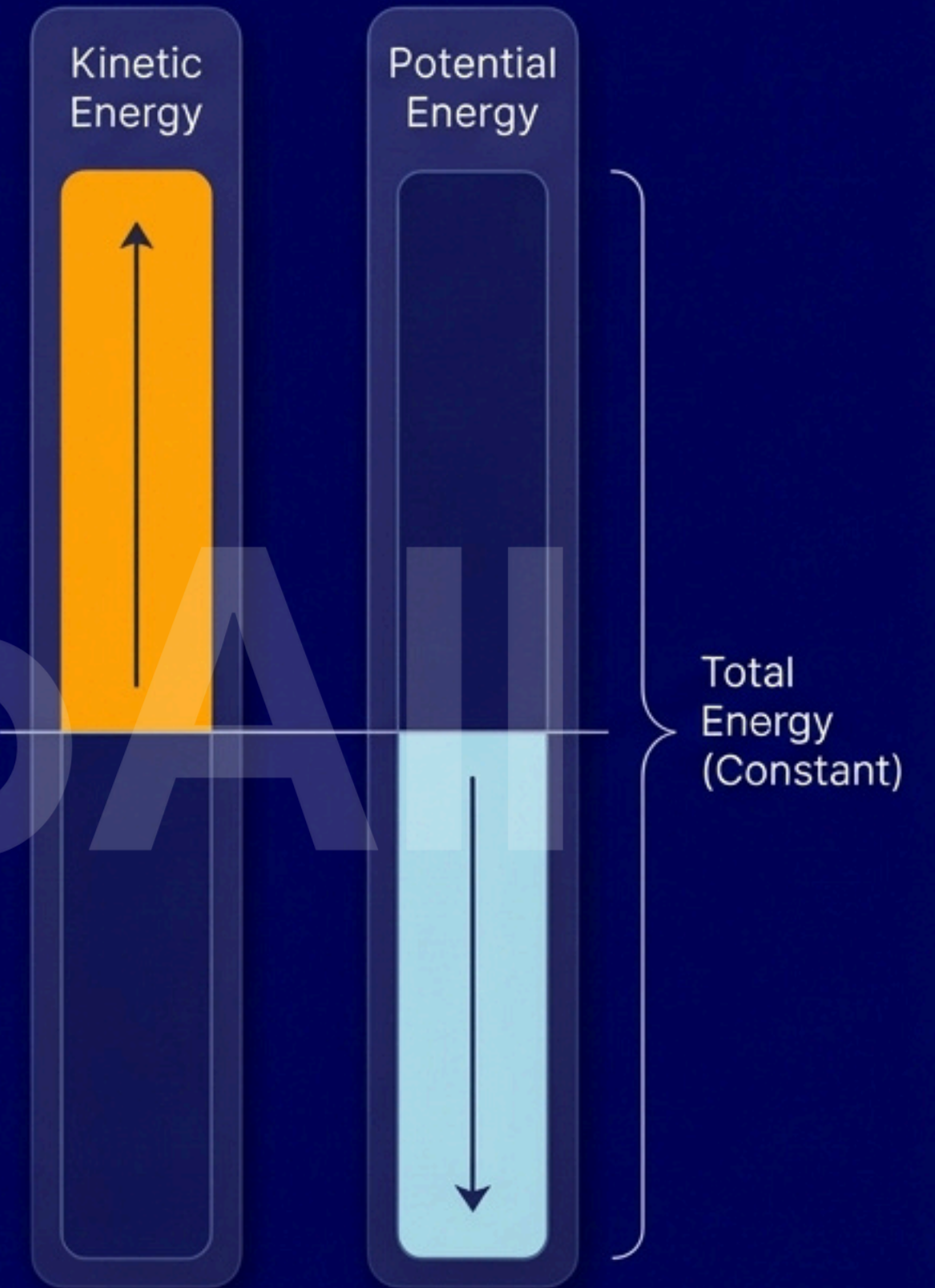
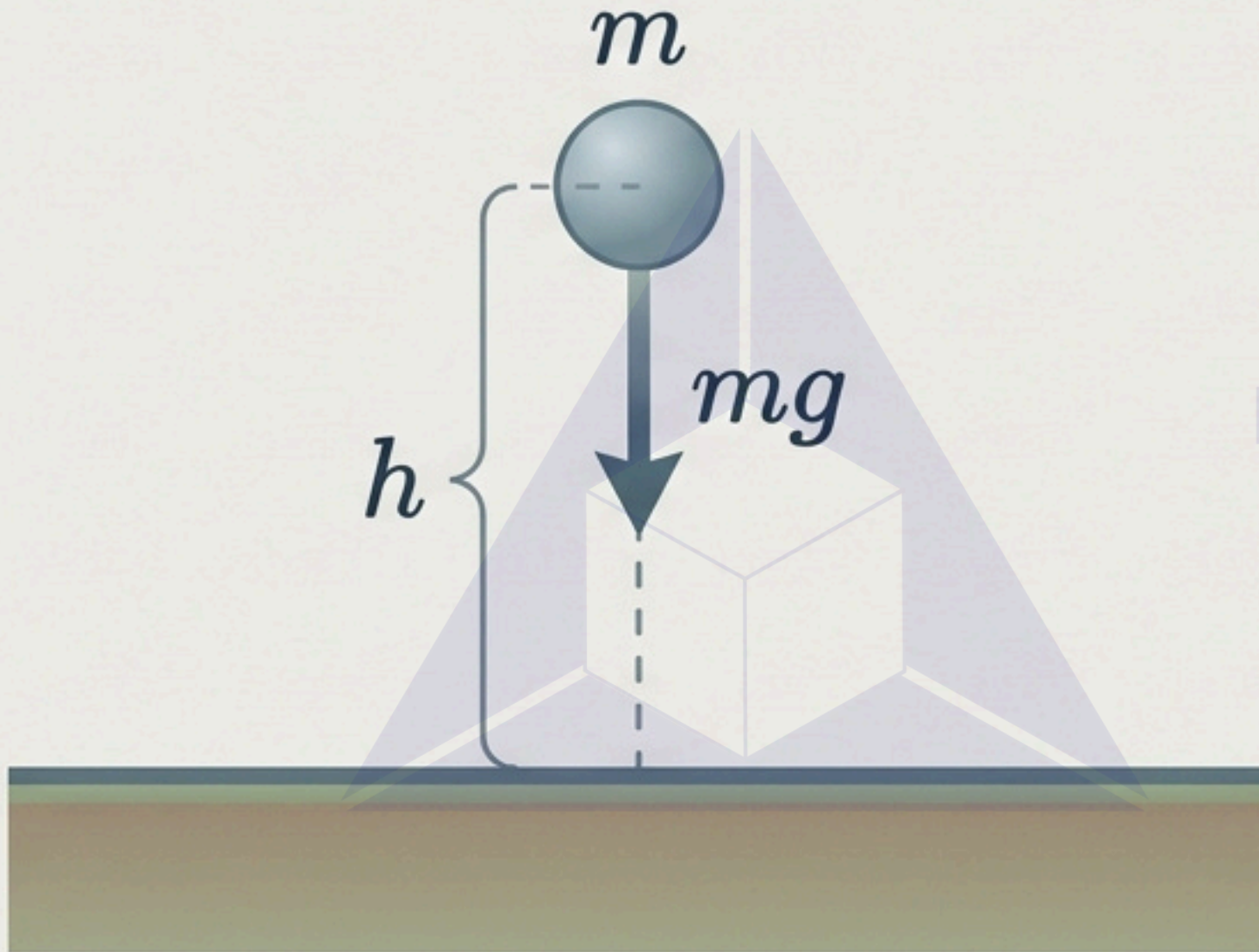


Gravitational Potential Energy

Why gravitational energy is negative

Class 11 Physics • Chapter 7.7





The Familiar Foundation

For objects close to Earth's surface, the gravitational force (mg) is practically constant.

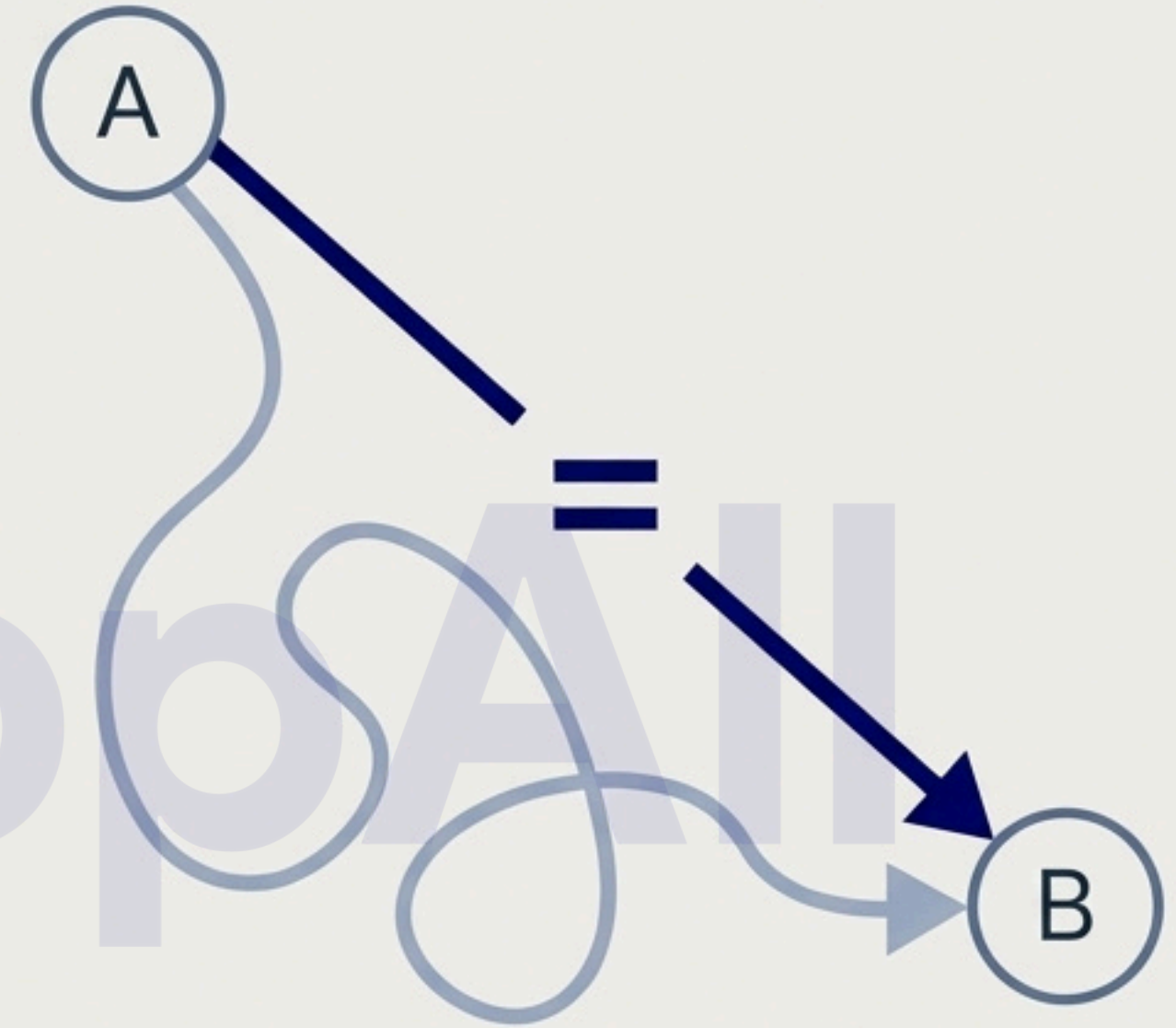
$$U = mgh$$

Works only when $h \ll R_E$ (height is much smaller than Earth's radius).

The Conservative Nature of Gravity

The work done by gravity in moving a mass depends only on the initial and final positions, not the path taken.

Because gravity is a **conservative force**, we can assign a definitive value of Potential Energy to every point in space.



$$W_{A \rightarrow B}(\text{Path 1}) = W_{A \rightarrow B}(\text{Path 2})$$



**You've Learned the Theory.
Let's Test Them Now.**

$$E=mc^2$$



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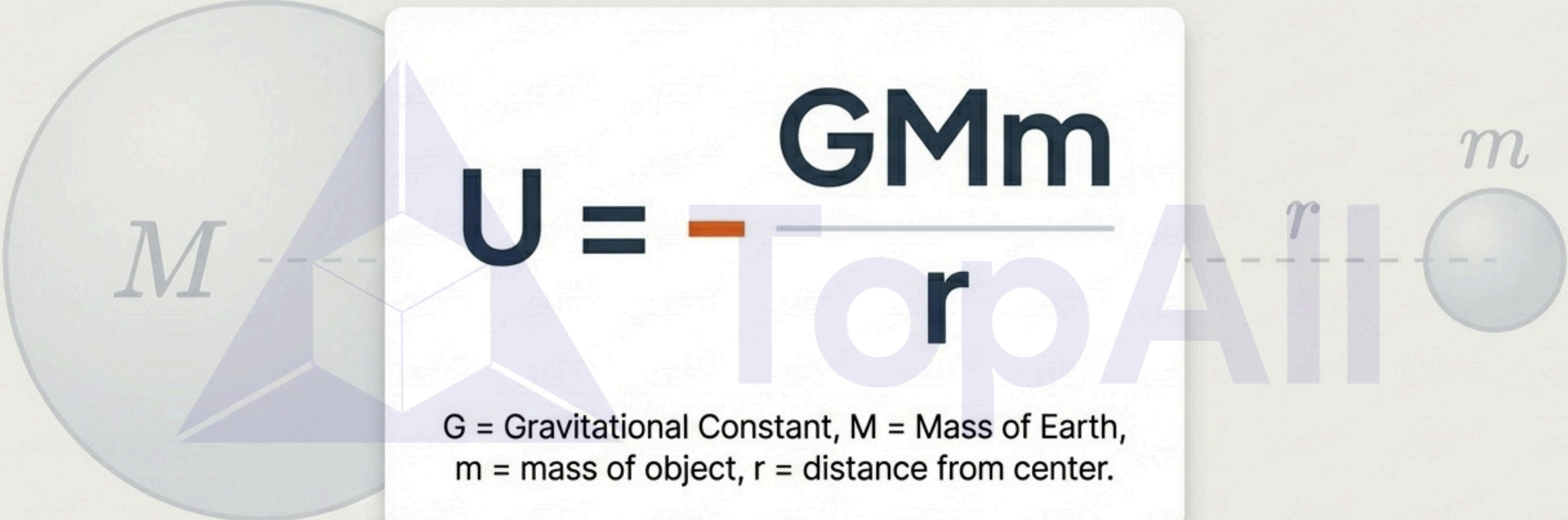
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- » Track Your Performance Smarter



The Universal Formula


$$U = -\frac{GMm}{r}$$

G = Gravitational Constant, M = Mass of Earth,
 m = mass of object, r = distance from center.

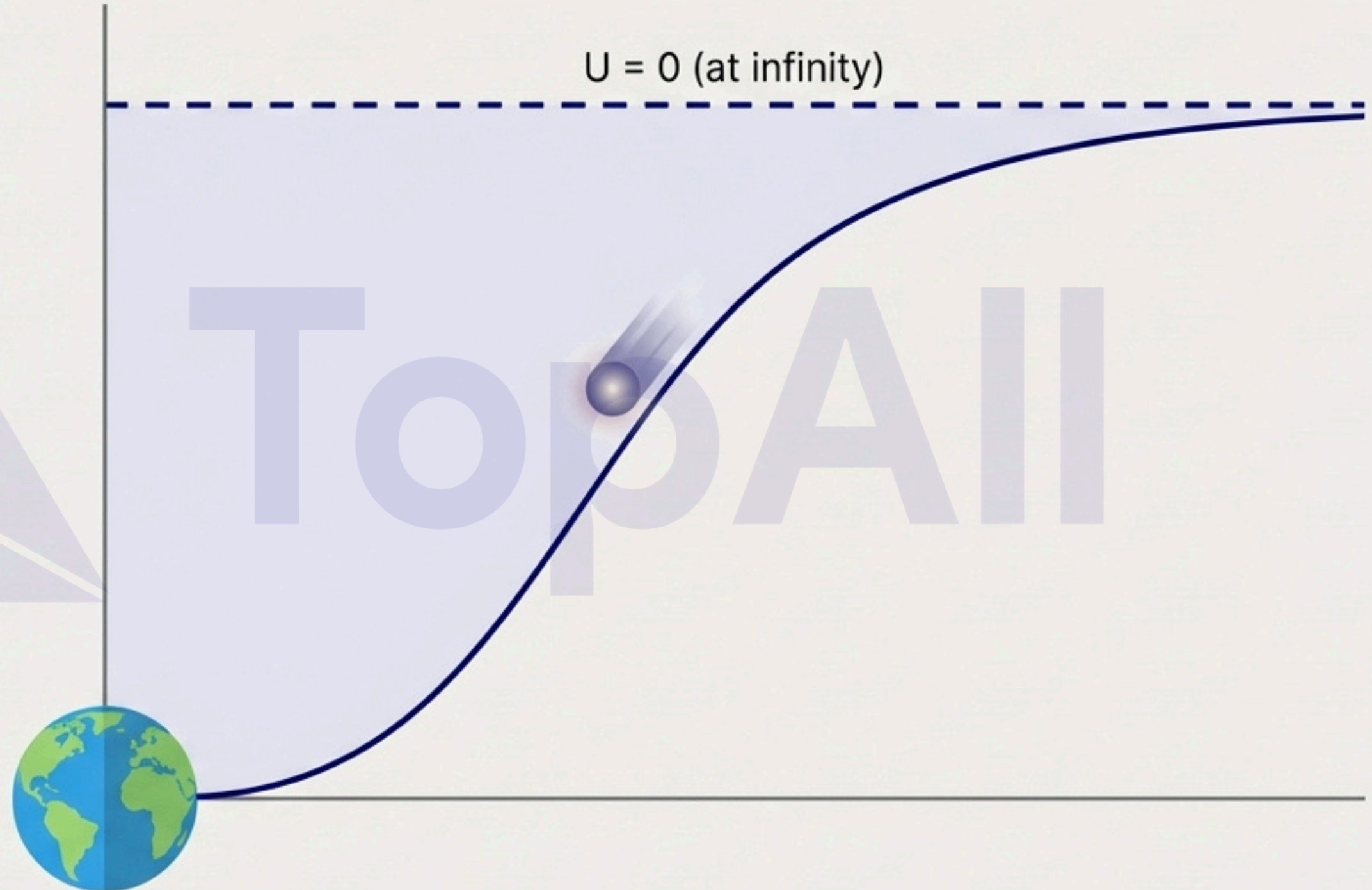
Pro Tip: This applies at any distance, making it the true, universal calculation for gravitational potential energy.

The Negative Energy Well

Step 1: We must define a zero point. By convention, we set our reference set Potential Energy to exactly 0 at an infinite distance (where Earth's pull is zero).

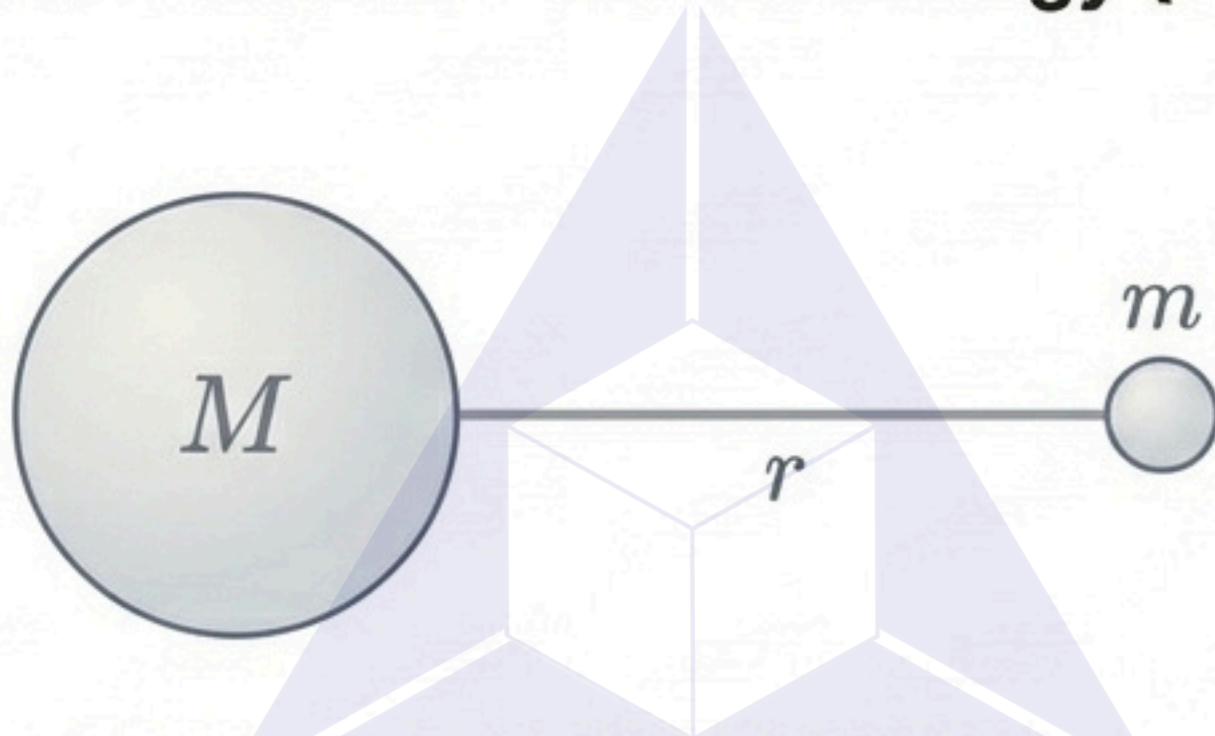
Step 2: As an object falls toward Earth from infinity, gravity does positive work, meaning the object loses potential energy.

Conclusion: Since it starts at 0 and decreases, the energy must become negative. The object is trapped in a gravity well.



Energy vs. Potential

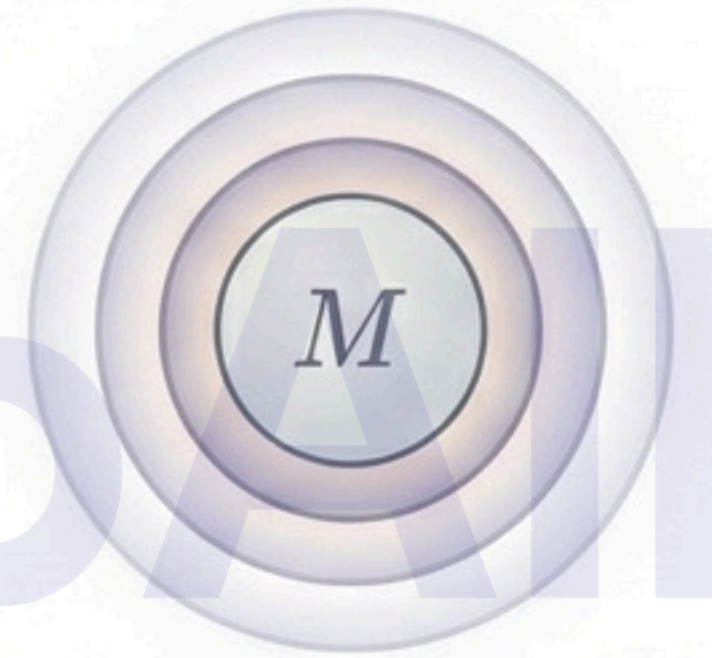
Gravitational Potential Energy (U)



- The energy shared between two masses.
- Depends on the test mass m .

$$U = -\frac{GMm}{r}$$

Gravitational Potential (V)



- The potential energy per unit mass at a point in space.
- A property of the field itself (the small m is removed).

$$V = -\frac{GM}{r}$$

Summary for the Exam



	Near Surface (Local)	Universal (Cosmic)
Formula	$U = mgh$	$U = -\frac{GMm}{r}$
Behavior	Varies linearly with height (h)	Varies inversely with distance (1/r)
The Zero Point	$U = 0$ at Earth's surface	$U = 0$ at Infinity

The negative sign simply means the object is mathematically and physically bound to Earth's gravitational field.



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