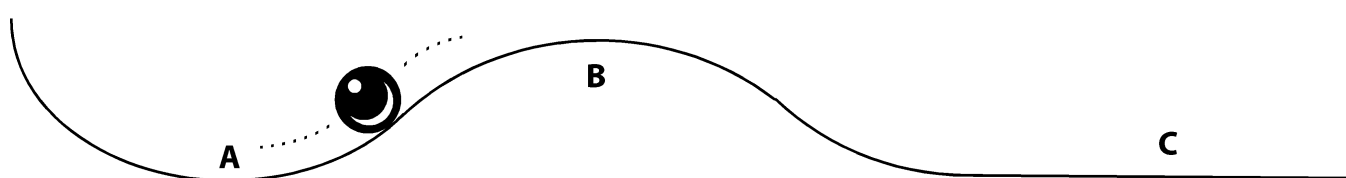


PhyzGuide: Equilibrium and Stability



WHERE IT STOPS, NOBODY KNOWS

If a marble were rolled across the surface shown above, at what point do you think it would eventually come to rest: A, B, or C? In reality, the marble could eventually settle at any of those three points. In each case, the normal force would be straight up and could therefore balance the gravitational force on the marble. When the forces are balanced, we say the marble is in **equilibrium**. There are, however, fundamental differences between the equilibrium characteristics of A, B, and C. For example, the likelihood of the marble coming to rest at A is larger than that of it settling at B. Luckily for you, we have terminology to help us distinguish between A, B, and C.

STABLE EQUILIBRIUM

If the marble settles at point A, it is said to be in **stable equilibrium**. This form of equilibrium is stable because if the marble is “tweaked” (moved slightly) from this equilibrium position, it will settle back to point A.

UNSTABLE EQUILIBRIUM

If the marble settles at point B, it is said to be in **unstable equilibrium**. This form of equilibrium is unstable because if the marble is “tweaked” from this equilibrium position, it will roll away from B in a runaway fashion and never return.

NEUTRAL EQUILIBRIUM

If the marble settles at point C, it is said to be in **neutral equilibrium**. This form of equilibrium is neutral because if the marble is “tweaked” from this equilibrium position, it will neither return nor fall into a runaway condition.

SO WHAT?

Systems of particles throughout the universe behave in a way analogous to the marble. Some systems are stable; others are not. Stability and instability surround us everywhere. For example, the curved surface may be a chemical, such as gasoline vapor. The marble may be analogous to temperature. The equilibrium is stable or neutral up to a certain point (temperature). Beyond that point, the vapor becomes unstable (yo—that means it blows up). Other examples abound throughout the universe on every level from subnuclear to intergalactic.

