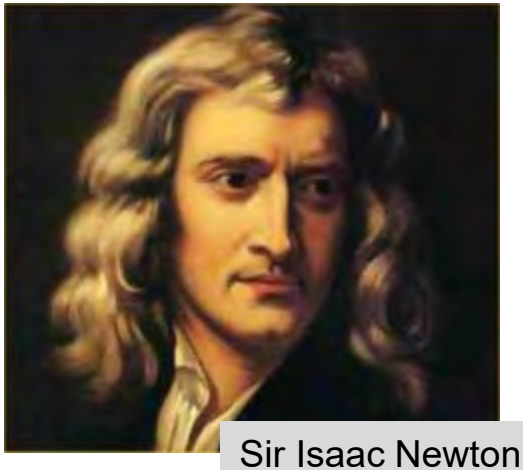
Law of Acceleration Part 2

Law of Acceleration

The Law of Acceleration explains the connection between forces and acceleration.

It's important not to confuse acceleration with speed.



Sir Isaac Newton

The Law of Acceleration is also known as Newton's Second Law of Motion. Mathematically, it's written as $F = m\,a$

Acceleration vs. Speed

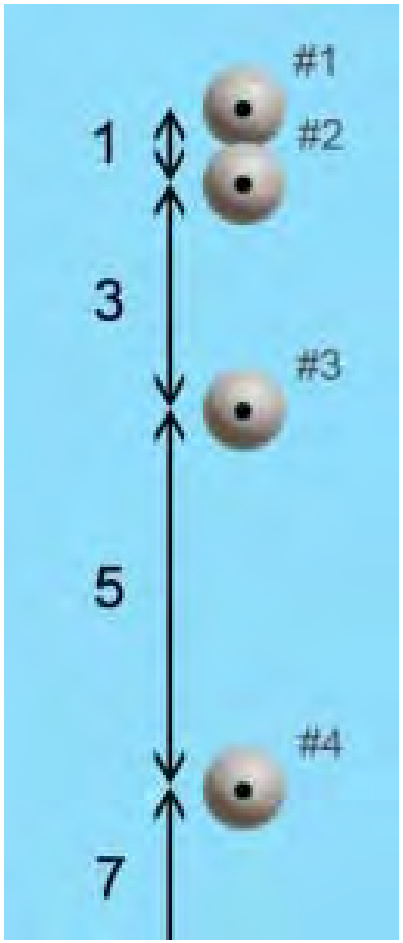
During take-off an airplane has a *large acceleration* and so its speed is increasing rapidly.

http://www.flickr.com/photos/m_koto/with/2303745255/

In mid-flight the airplane has a *large speed* but if that speed is constant then there's *no acceleration*.

http://www.flickr.com/photos/kittysfotos/with/6652901277/

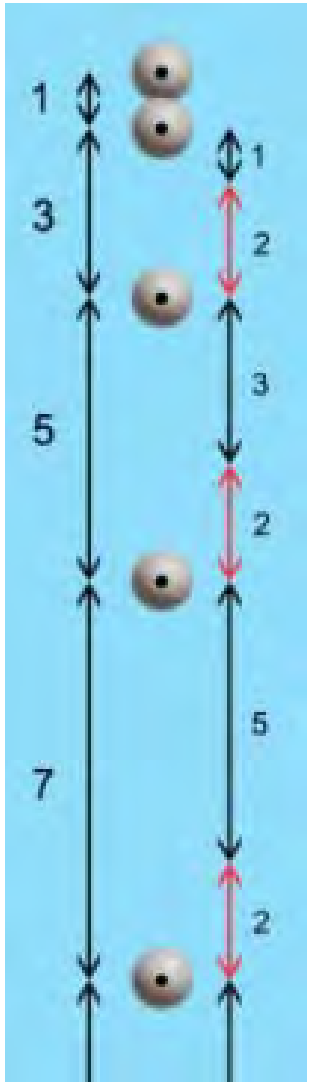
Speed, Acceleration, Spacing



The spacing between positions gives the speed.

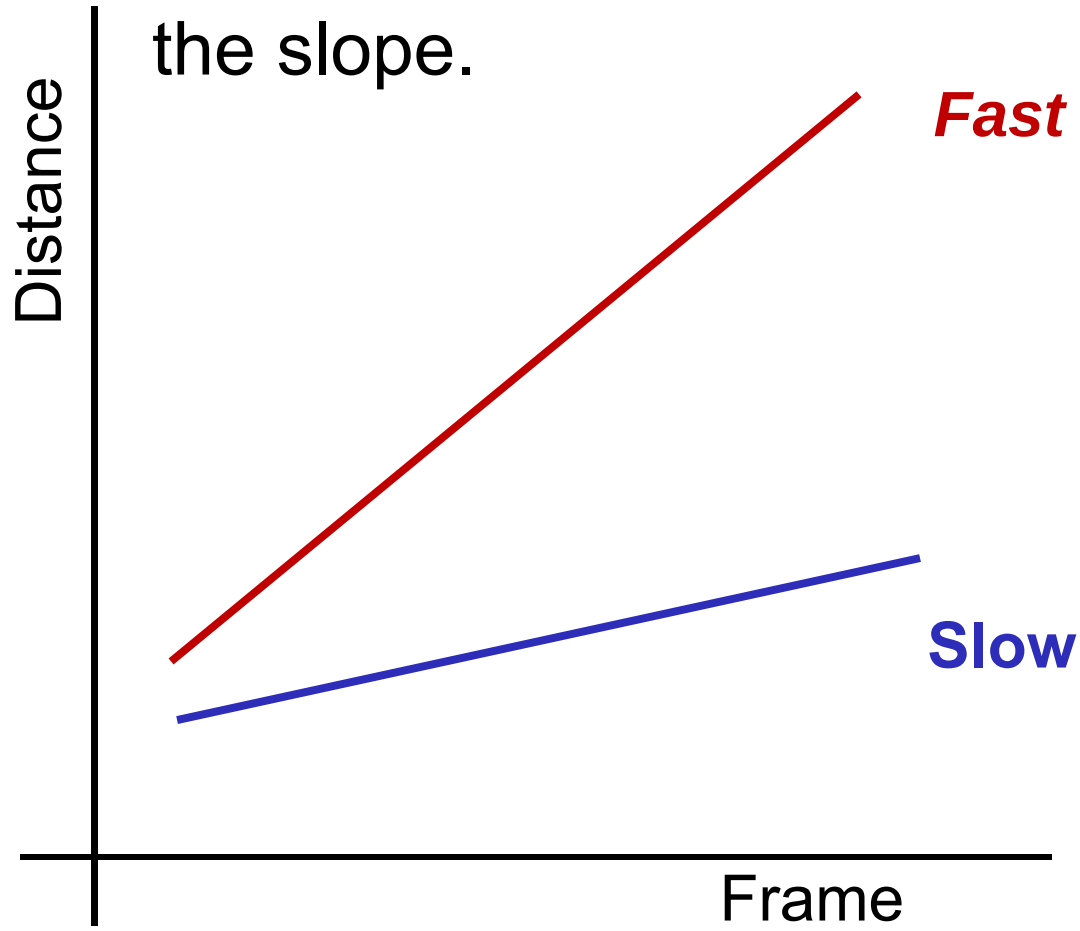
The *change* in the spacings gives the acceleration.

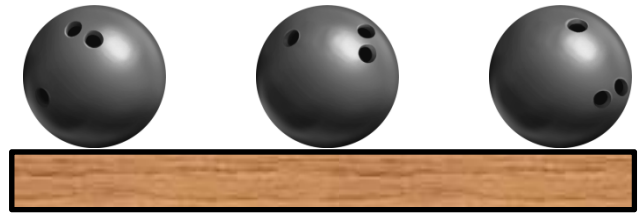
For falling motion the change in the spacings due to gravity is a constant $^{2}/_{3}$ of an inch per frame.

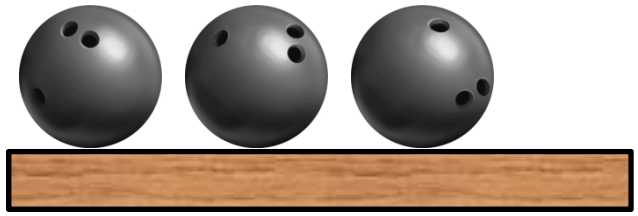


Motion Graphs - Speed

Greater the speed, steeper the slope.

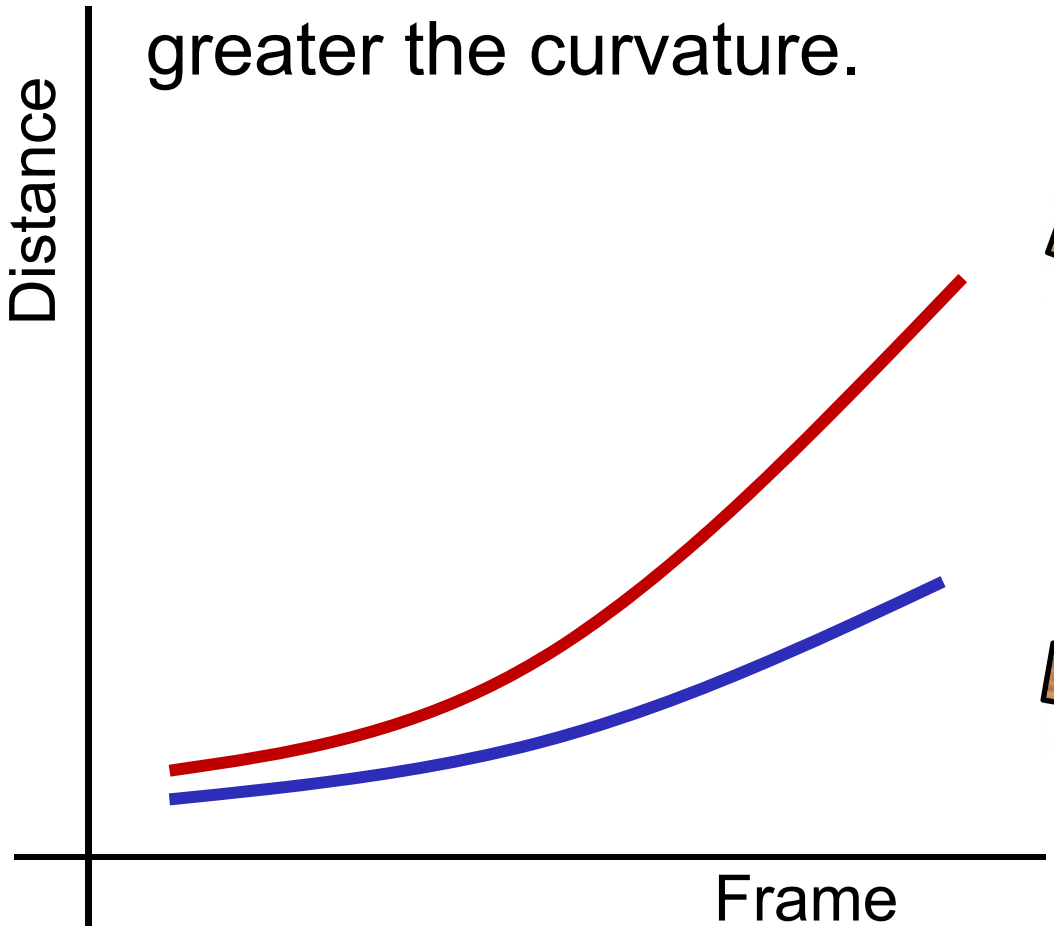




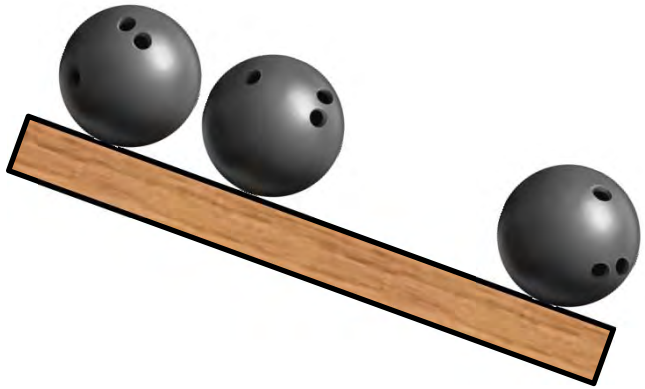


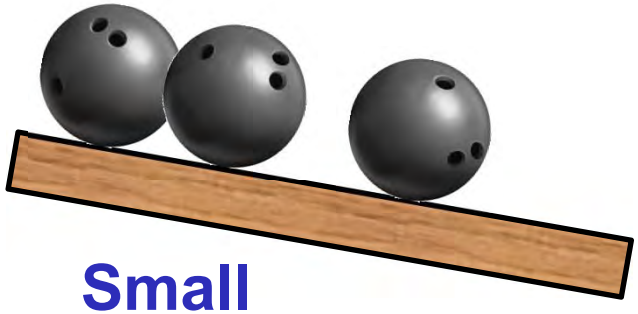
Motion Graphs - Acceleration

Greater the acceleration, greater the curvature.



Big Acceleration

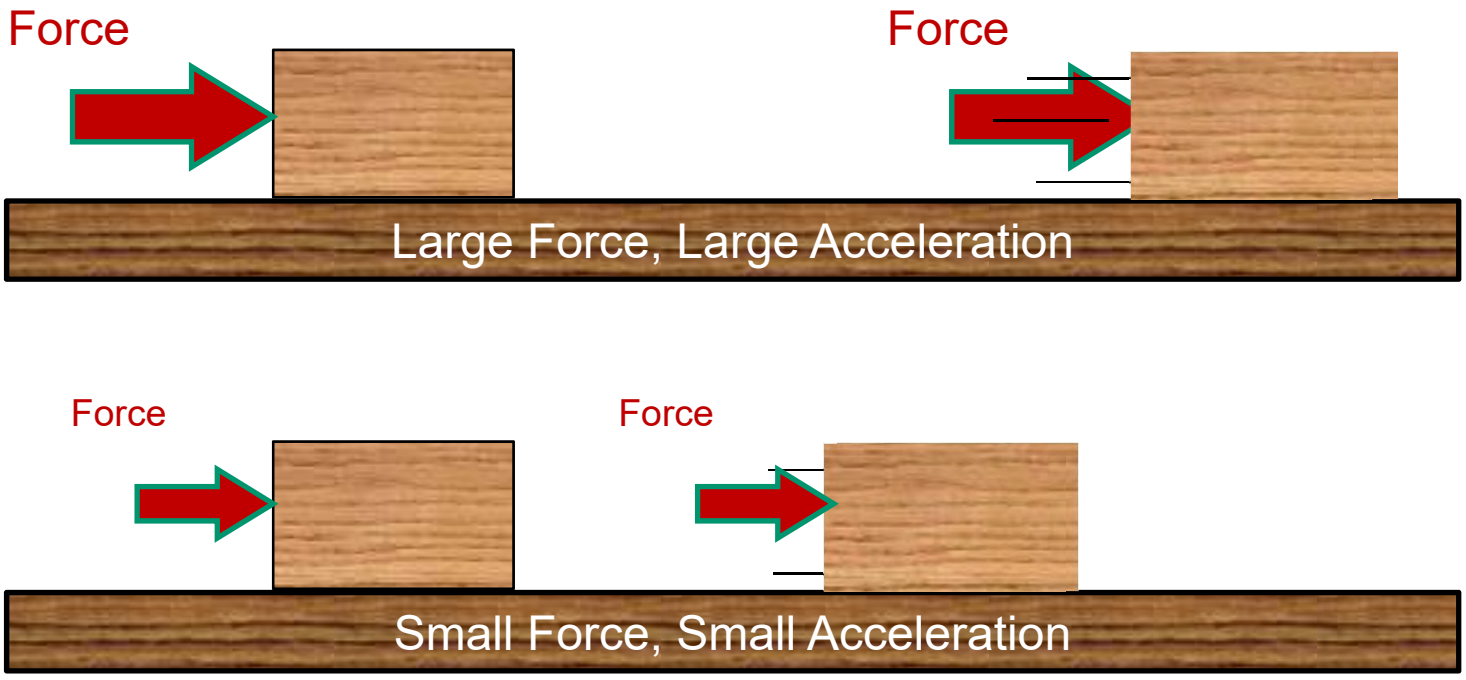




Small Acceleration

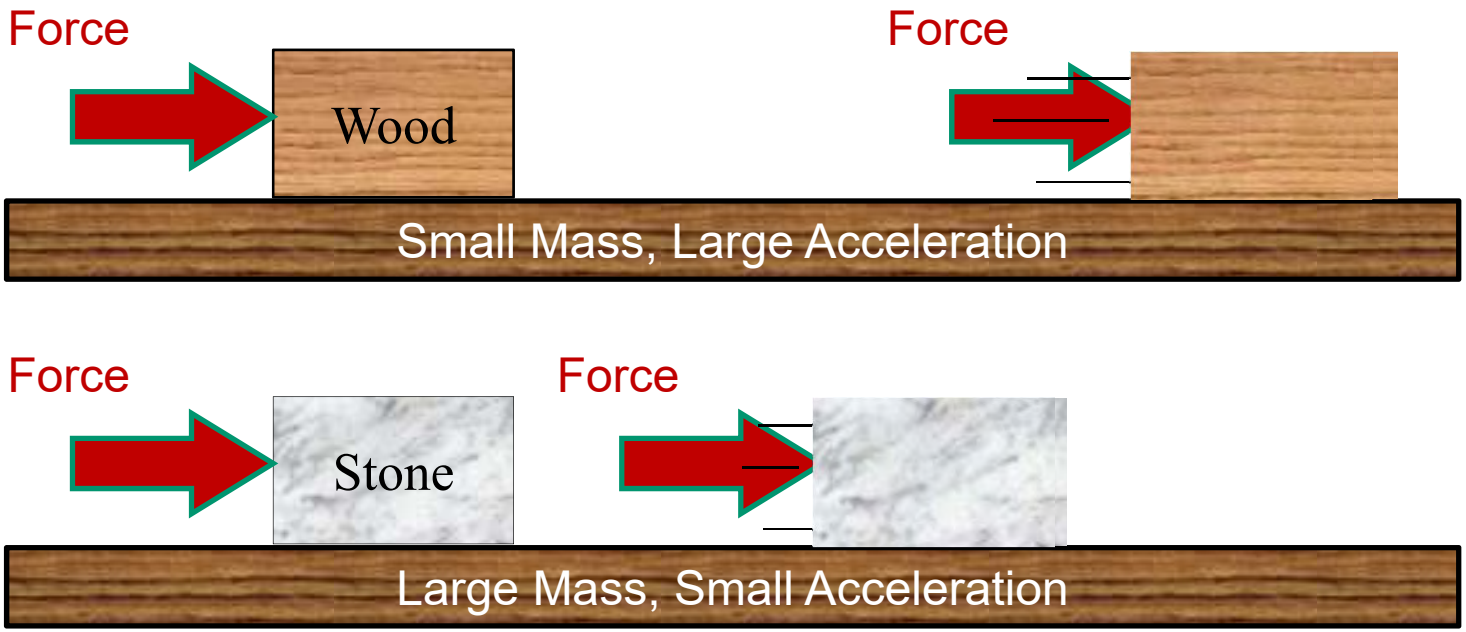
More Force, More Acceleration

The greater the net force on an object, the greater the acceleration of that object.



More Mass, Less Acceleration

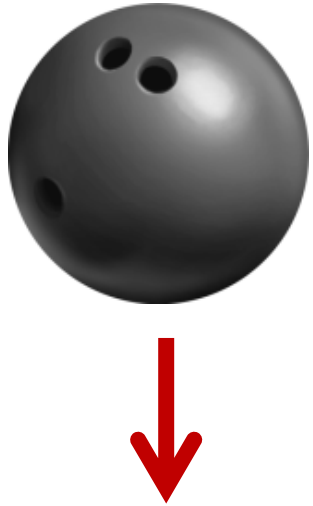
The greater the mass of an object, the less it accelerates when acted on by a force.



Large Weight ↔ Large Mass

Constant Forces

Some forces are constant, that is, they pull or push with a magnitude and direction that doesn't change.

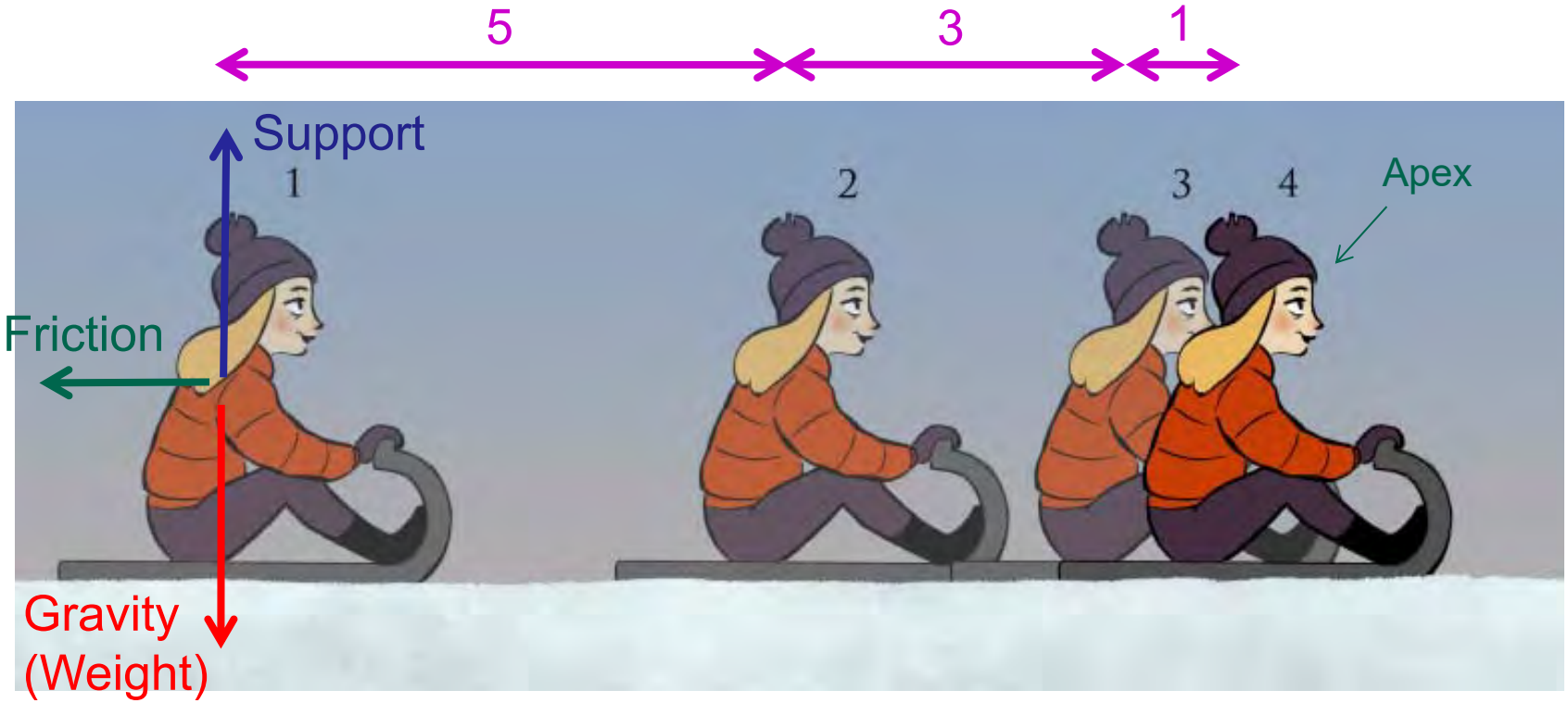


Gravity force is constant

Friction force in sliding is (nearly) constant

Odd Rule & Forces

Odd Rule applies if the net force is constant.

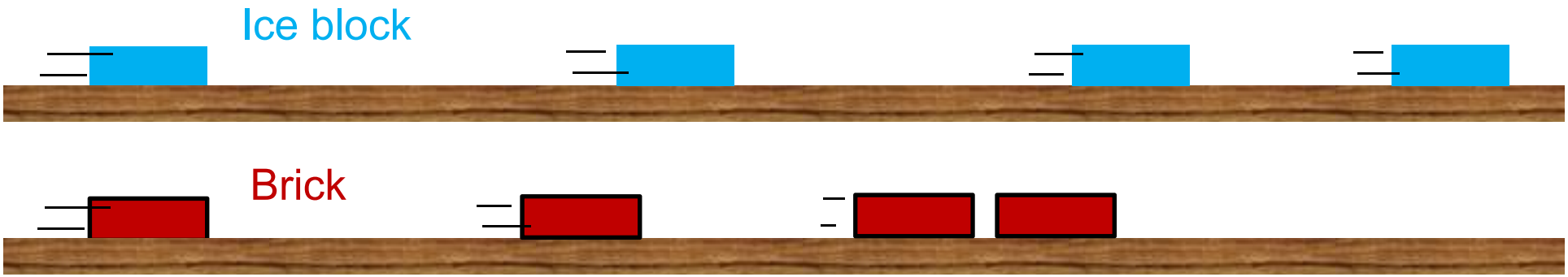


Forces here are constant; the support force by the ground balances the weight, leaving only the (constant) friction force.

Law of Acceleration, Part 2

If the net force equals object's weight then the acceleration is the same as when falling.

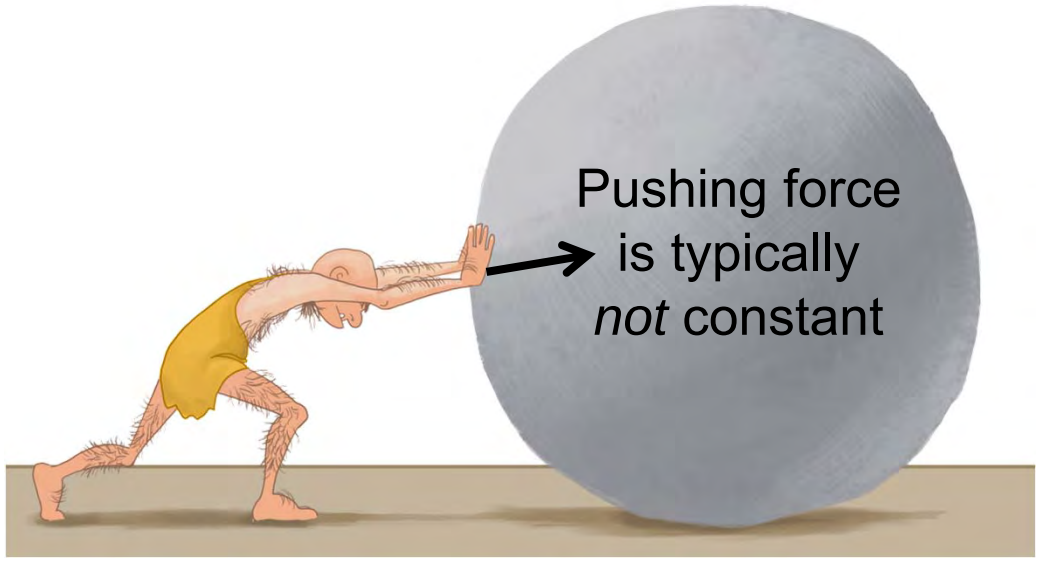
If the net force is greater (or less) than the weight then the acceleration is greater (or less) than when falling.



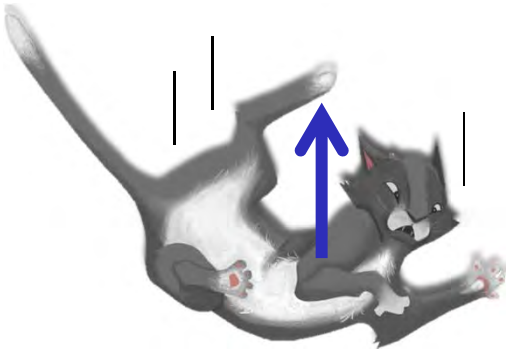
Bigger the frictional force, the quicker the timing (spacings change quickly).

Non-Constant Forces

Most forces are not constant, that is, their magnitude and/or direction varies during the motion.



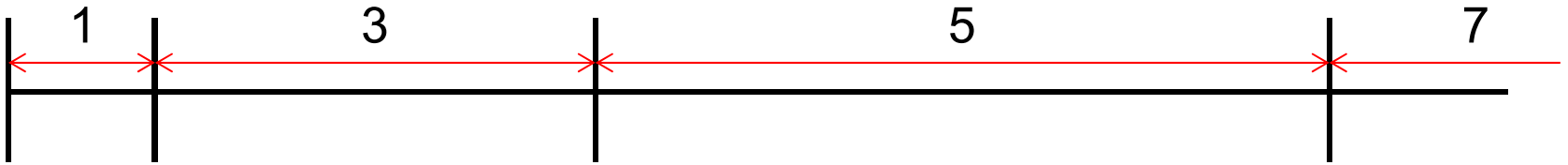
Air resistance force is *not* constant



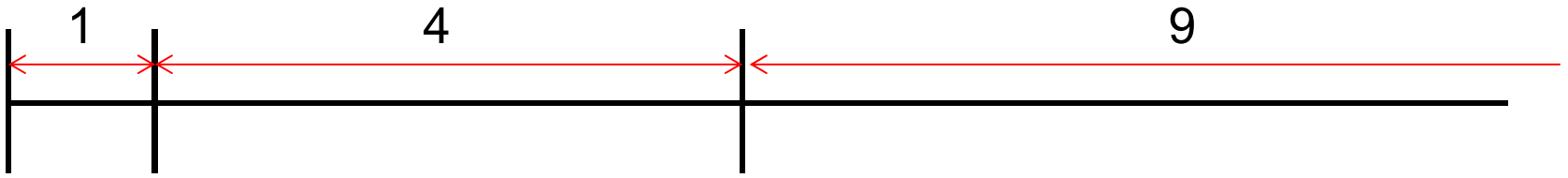
Acceleration changes as the force changes.

Texture in Timing & Spacing

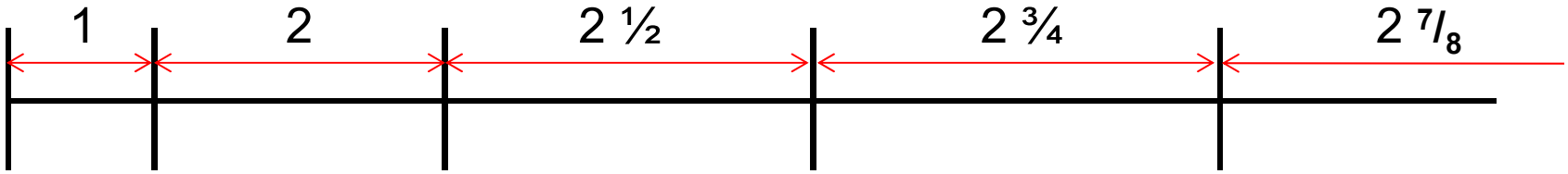
Constant Force: Odd Rule spacing



Increasing Force: More textured spacing



Decreasing Force: Less textured spacing



Summary

- Acceleration is not the same as speed.
- Greater the force, the greater the acceleration.
- For a given force, the smaller the mass of the object, the greater the acceleration.
- If the net force is larger (or smaller) than the object's weight then the acceleration is greater (or less) than falling.
- For constant forces the acceleration is constant and the spacings follows the Odd Rule.
- If the forces are not constant then there is texture in the timing and spacing.