Lect 8: Chp 6: Lecture Notes: Forces etc.

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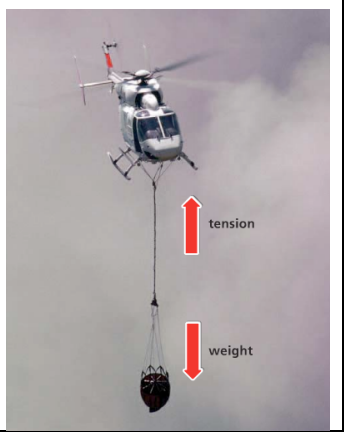
Elastic Forces

When you squeeze on a sponge, the sides come together, but it does not break. To pull on a pair of gym shorts, you stretch the waistband, and it doesn't break either. Why don't the sponge or waistband break? They are elastic. Matter is elastic if it _____ to its _____ after being squeezed or stretched. Two types of elastic forces are compression & tension.

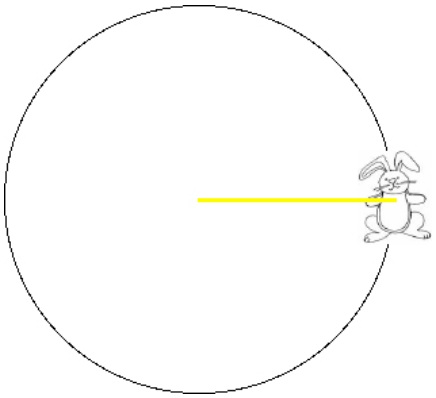
Compression
Compression is an elastic force that _____ or _____ the particles of a material together. Some materials are easy to compress: Rubber, foam, cushions, marshmallows. Some materials are hard to compress & require a large force to overcome the elastic forces: Wood, steel, rocks. Materials respond differently to compression. Some materials, like clay, change shape permanently if the elastic forces are not great enough for it to hold its shape.

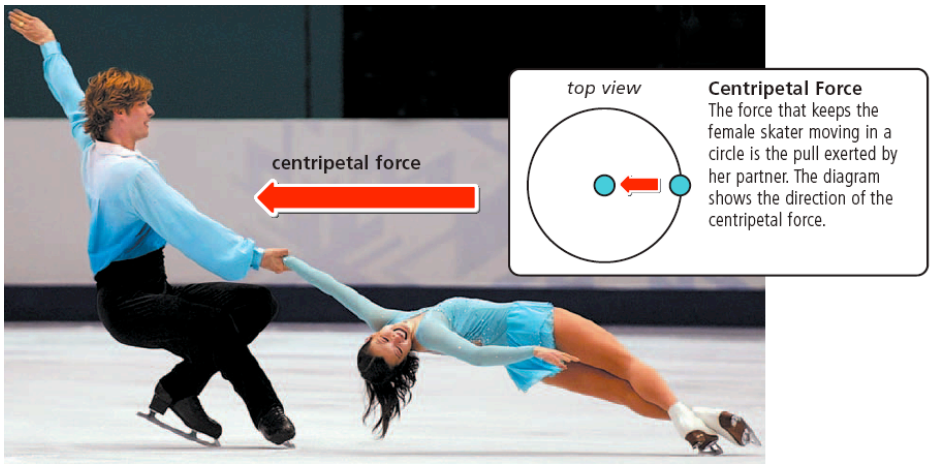
Tension
Tension is an elastic force that _____ or _____ matter together. An example is any object hanging by a string or cable. Tension acts along the direction of the string and is present only if an object is stretched. Tension in a string or rope can support the weight of hanging objects… like a firefighting helicopter or a fishing pole.



Centripetal Force

To accurately predict what will happen to the bunny, you have to know what forces are involved. You should know that the bunny wants to keep going in one direction. This forward motion is _____. However, the force of the string is pulling the bunny back to me. If I let go, this force disappears and the bunny is now allowed to go in the direction it wants to go in. Any force that keeps an object moving in a _____ is known as centripetal force. This force points _____ the _____ of the circle. Without centripetal forces, objects would fly off in a straight line.

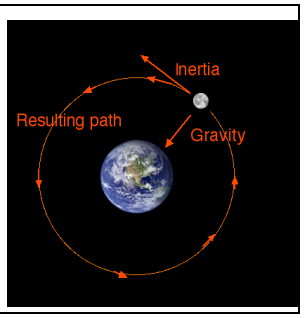




The Amazing Waiter's Tray!

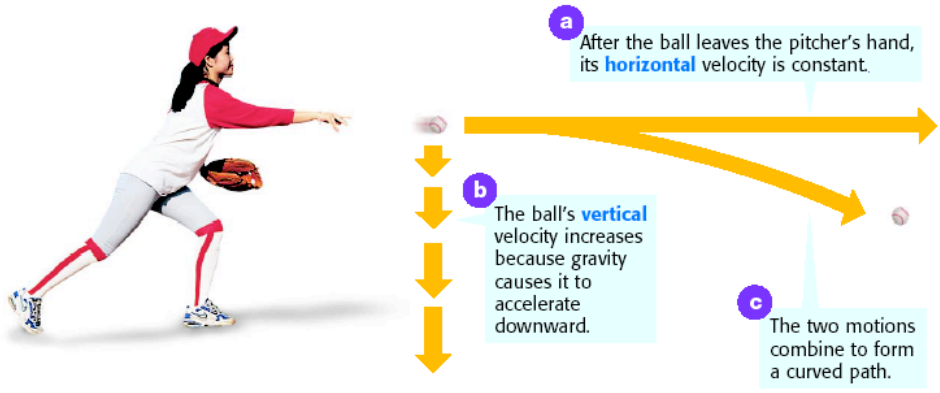
Example: Racecars
Centripetal force also explains how racecars stay on the road. The tire's friction actually supplies the centripetal force to keep the car on the road. In order to increase this force on curves, the track is banked or angled. The degree of banking will determine how fast the car can go and still stay on the track.

Example: Satellites
Centripetal force also explains how satellites (natural & artificial) remain in orbit. _____ pulls the moon towards Earth. The moon's _____ pulls it at a 90° right angle away from the Earth. The resulting path is a circular _____.



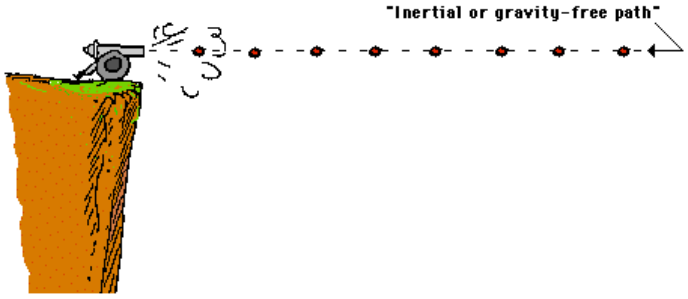
Projectile Motion

It is the _____ an object follows when thrown near the surface of the Earth. A projectile is an object upon which the only forces acting are gravity and its own inertia. Projectile motion has two components: horizontal & vertical movement. Projectiles often move in _____. Examples of projectile motion include: arrows, frogs jumping, footballs, baseballs, golf balls, leaping dancers, eater spray, marshmallows, vomit…



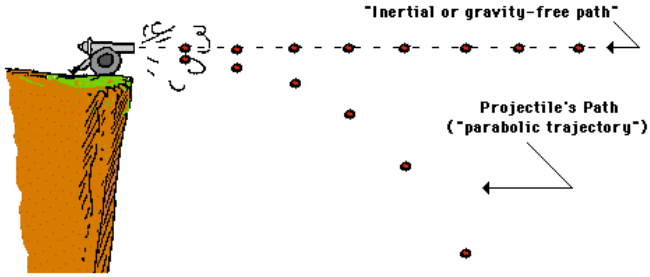
Why do things arc? One force acting on the object is the forward motion, inertia Remember, an object in motion remains in motion (Newton's 1st law). The second is gravity, which pulls the objects downwards towards the Earth.

What would happen to a projectile without gravity?



Without gravity, an object in motion will continue in motion with the same speed and in the same direction.

What would happen to a projectile with gravity?

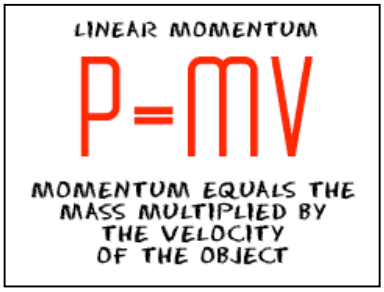


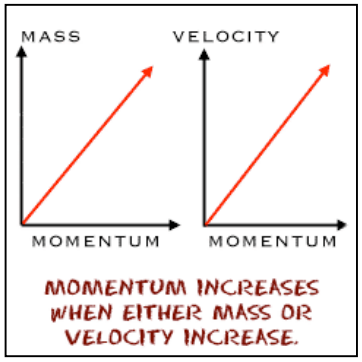
With gravity, a "projectile" fall below its inertial path. Gravity acts downward to cause a downwards acceleration. There are not horizontal forces needed to maintain the cannonball's motion. (Remember the concept of inertia.)

What would happen to a projectile with gravity? In a vacuum, gravity pulls all objects down with an acceleration of 9.8 m/s^2. Even though the red ball was dropped and the yellow ball was pushed, they accelerate and land at the same exact time.

Momentum

What takes more force to stop? a mini-Cooper or a Hummer? a bicycle traveling at 25 mph or a high speed train moving at 120 mph? A linebacker weighing 350 pounds or a quarterback weighing 180 pounds? These aren't trick questions. The more mass an object has, the more force needed to stop or change its motion. Similarly, the faster an object is traveling, the longer it takes to stop. This is because larger and faster objects have more momentum.





Momentum is a property of moving objects that depends on the _____ and _____.

Examples

When you get hit by a ball, it hurts because of the momentum. The bigger the ball, the more momentum… the more it hurts! A bullet is an object with A LOT of momentum. Even though bullets have small mass, they have extremely high velocities, causing a deadly momentum behind a tiny object.