

PhyzGuide: Sources of Forces

Thanks to Fred Heller/University of Michigan

REAL OBJECTS FOR REAL FORCES

All forces in Newtonian mechanics are exerted by **real objects**. A foot, for example, is a real object that can exert a force on a buttock. Now, for most real objects to exert a force, there must be “physical contact.” If the foot does not come into contact with the buttock, the foot will not exert a force on the buttock. “How can anything exert a force,” you might ask, “without contact?” Imagine yourself suspended 100 m up in the air, then suddenly released. You begin to accelerate, so there must be a force acting despite the fact that there appear to be no objects exerting any forces on you. So what force (and what object) pulls you down? That’s right: gravity (due to the earth) is acting on you. Other exceptions to the contact rule are electric, magnetic, and so-called “inertial forces.”

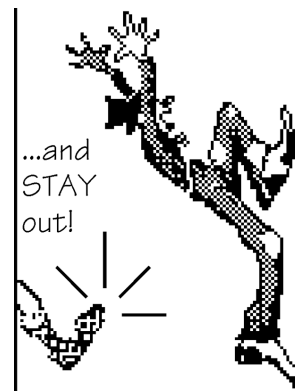
It is important, as you solve force problems, that you think in terms of real objects in contact with a system as the “agents of force.” Whenever you draw a force on a force diagram, you must also be able to identify the source (a real object) associated with that force.

“Inertia,” “momentum,” “centrifugal,” and “centripetal” are *not* forces: Where’s the real object? “Mr. Centripetal” does not exert a force, although a string certainly can.

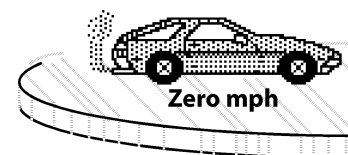
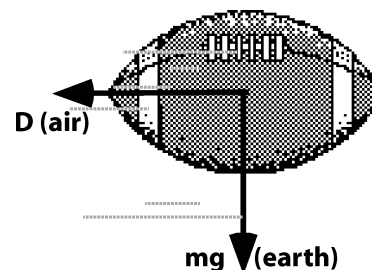
A football in mid-air is in contact only with air. Only the earth and air exert forces (gravity and drag) on it; the kicker does not. The kicker exerts a force only as long as his or her foot is in *contact* with the ball.

The road—through friction—exerts the forward force that acts on a car, not its velocity, momentum, Mr. Centripetal, or the engine (a 200 hp engine cannot accelerate a car on sheer ice).

Below is a list of objects that forces can be attributed to, and a list of things forces cannot be attributed to. Dig in.



Did the foot come into contact with the buttock?



Legitimate Objects (OK)

string
body
earth
hand
road
table
charge
magnet

floor
spring
exhaust gas
feet
air
water
current

Illegitimate Objects (No-No's)

centripetal forces or
acceleration
centrifugal forces
friction
acceleration
gravity
inertia
velocity
momentum
 mv , ma , $\frac{1}{2}mv^2$

thrower (of a ball after the ball has
been released)
kicker (same as thrower)
tension
drag
lift
normal force
thrust
electricity
magnetism

Remember: FORCES don't exert forces; OBJECTS exert forces!