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Quiz 3: Force

Force equals mass times acceleration

1. A large box is being pushed across the floor at a **constant speed** of 4.0 m/s. What can you conclude about the forces acting on the box?

   ☐ If the force applied to the box is doubled, the constant speed of the box will increase to 8.0 m/s.

   ☐ The amount of force applied to move the box at a constant speed must be more than its weight.

   ■ The amount of force applied to move the box at a constant speed must be equal to the amount of the frictional forces that resist its motion.

   ☐ The amount of force applied to move the box at a constant speed must be more than the amount of frictional forces that resist its motion.

   ☐ There is a force being applied to the box to make it move, but the external forces such as friction are not "real" forces, they just resist motion.

Solution: If the box is being pushed across the floor, we would have to assume it is moving in a straight line. If it is moving in a straight line at constant speed, then its acceleration is zero. If the acceleration is zero, Newton's second law tells us that there is no net force. Clearly there are forces present if the box is moving, but the fact that the speed is constant means that the force that initiated motion is being exactly compensated by resistive forces.

2. An object experiences no acceleration. Which of the following *cannot* be true for the object?

   ■ A single force acts on the object.

   ☐ No forces act on the object.

   ☐ Forces act on the object, but the forces cancel.

   ☐ The object is at rest.

Solution: If a single force acts, this force constitutes the net force and there is an acceleration according to Newton's second law. The second and third choices *could* be true - no forces would mean no acceleration, as would several forces canceling each other out. Newton's second law says that the *net* force gives acceleration, so zero net force mean zero acceleration. Finally, the last choice is somewhat obviously correct . . . no motion clearly means no acceleration.

3. A ball rolls without slipping down incline A, starting from rest. At the same time, a box starts from rest and slides down incline B, which is identical to incline A except that it is frictionless. Which arrives at the bottom first?

☐ the ball

■ the box

☐ Both arrive at the same time

☐ impossible to determine

Solution: You have to figure that friction is a bad thing, and will only cause the object to take longer to get to the bottom. Friction is an acceleration in the direction opposite motion, which means it will only serve to decrease the velocity at any given instant, and the whole trip will take longer.

Now that sounds simple and obvious enough, but there is one subtle point. If the ball rolls without slipping, such that the surface of the ball and the ramp never rub against one another, does friction really matter? It seems obvious that it should, and it seems to be empirically true, but it is not obvious. We'll come back to this when we cover rotation.