

Universal Physics Journal

Question 6: What is kinetic energy's role during braking?

Ethan:

If you are correct in saying that kinetic energy is imaginary, then how do you explain the heat being generated by the application of a moving car's brakes? Is not the car's stored kinetic energy being converted into heat energy as the car's speed is being reduced? mkleist, Bonn, Germany

Hello mkleist:

First understand that according to the Universal Physics principal of rest-motion, there are but two states of activity for an object. Either the object is active, meaning that acceleration is occurring to the object as it travels with a non-uniform motion, or it is inactive, meaning that acceleration is absent for the object as it travels with a uniform motion. That is it. Active means that acceleration is present and inactive means that acceleration is absent. Meanwhile, there is no difference between an inactive object with a uniform motion observed to be a straight and steady zero miles-per-hour, and an identical inactive object with a uniform motion observed to be a straight and steady 5,000 miles-per-hour, or a straight and steady 5,000,000 miles-per-hour or traveling at the speed of light (in a vacuum) at a straight and steady 669,600,000 miles-per-hour.

Instead of the object moving, think of it as being at rest and, at first, of the observer as also being at rest next to the object. Now think of the observer as traveling past the object at the straight and steady rate of 5,000 miles-per-hour. Now think of the observer as traveling past the same resting object at a straight and steady rate of 5,000,000 miles-per-hour. Now think of the observer as traveling past the object at light speed. Understand that the speed at which the observer passes by the resting object changes nothing for the object. It continues to remain inactively at rest during all four events. Now the observer can mistakenly assign all sorts of imaginary concepts including "kinetic energy" and "momentum" to the resting object but that does not mean that these frame-related concepts of his invention have any reality for the object. The observer made them up in an attempt to answer questions causing confusion in the observer's mind. Logically, the resting object remains unchanged and unaffected in any way by whatever motion the observer is thought to possess at the time of these four different, non-impartial, observer-oriented observations.

While I have purposely set up this example with the object at rest and all the motion attributed to the observer to show how logically the motion of the observer cannot possibly have any effect upon the resting object, recognize that the outcome will be no different if all the motion is thought to occur to the object and the observer is thought to be at rest or each is thought to share a portion of the motion between them. In practice, if this test is performed in deep space, far from any other body, as long as the motions are uniform (acceleration absent) no matter whether you are the observer or the object, you will swear that you are the one who is at rest during each of the four events. If you are sitting still while reading this reply, do you not feel at rest? Since you feel so much at rest, do you think we should ignore the fact that your body is traveling at over 60,000 miles-per-hour in its current orbit of the Sun? Have you considered just how fast 60,000 miles-per-hour actually is, in practice? It is perhaps 10 times faster than our fastest experimental aircraft. It is more than twice as fast as the orbital speed of the Space Shuttle. Yet you are so at

"rest" on Earth while traveling through space at this great speed that you can easily think of yourself as being stationary, without motion. Let us face the truth, rest and uniform motion mean the same thing - the inactive state where acceleration is absent. This is why in Universal Physics, these two historically different concepts are bonded together to form the single Universal concept of rest-motion as fully explained in Article II - The Equality of Rest and Uniform Motion.

In our example here, the rest-motion of the observer has no effect whatsoever on the object, just as the rest-motion of the object has no effect whatsoever on the observer. Imaginary concepts such as "kinetic" energy that are invented by the observer to "explain" imaginary changes supposedly occurring to the object as the observer adjusts the speed of his rest-motion relative to the object are unreal concepts.

Except for the rotating components, your moving car is no different than when it is at rest on Earth. If instead of driving along under its own power, it is being carried along just inches above the road's surface by its attachment with cables to a helicopter above, the car can move along in a uniform motion with its engine off and none of its components rotating. Then the car will be in the same non-accelerative state of rest-motion as an identical car that is at rest relative to Earth's surface. Now you may say that the moving helicopter car is different because it takes a great force to cause it to suddenly change its motion to match that of the resting Earth car. I will counter by pointing out that it takes the same great force to cause the Earth car to just as suddenly change its motion to match that of the helicopter car given that the Earth car is resting on a frictionless surface. No difference here. Both cars equally obey Newton's formula, $\text{Force} = \text{mass} \times \text{acceleration}$. In fact, there is no experiment that can successfully prove that it takes a greater force to change the rest-motion of an object that is thought to be "moving" than it does to cause an equal change to the rest-motion of an object that is thought to be "non-moving", given equal frictional environments. There is nothing by its behavior to indicate that the helicopter car contains any such imaginary thing as "kinetic" energy. That is why one cannot purchase a "kinetic" energy meter at the local electronics store. There is nothing present within a resting or moving object for such a meter to measure.

Now what does the previous example have to do with your (de) accelerating car? Well, in reality, the car is not in possession of a "kinetic" energy before the braking, during the braking or after the braking. Thus "kinetic" energy is not real and therefore cannot be, in truth, the source of the heat energy being radiated off by the brakes. Also there is no absolute connection between a slowing of your car and the release of heat by the car's brakes for it is quite possible to rearrange the example so that a release of heat energy by the brakes occurs when your car is observed to be speeding up. I will demonstrate.

In my first example, you are standing on the curb next to your car which is tethered to the parking meter. The car's engine is off, its transmission is in neutral and its parking brake is released. The tether is required to keep the car stationary before you while being supported on a moving roadway. Meanwhile, the car's wheels are rotating at normal speed for city driving. You feel somewhat apprehensive as you open the car door and step inside the non-moving car from the non-moving curb. Once buckled in, you then consider just exactly what you need to do to accelerate your car up to road-speed. For certain, no force is needed from the car's engine but

you decide to start it anyway to provide cabin heat and power assist to the vehicle's steering and brakes. Next you release the tether and apply the car's brakes while turning the steering wheel ever so slightly toward the curb. The car, equipped with four wheel steering, immediately begins to accelerate forward as it shifts sideways from the parking lane into the driving lane. Finally you straighten out the steering wheel as you arrive at roadway speed where the car's wheels stop turning altogether. You set the parking brake and are able to get out of the car and visit with other drivers as the moving roadway carries all the cars along through the city. As you walk around your car, you stop to reach down and feel one of the brake disks. It is quite hot from the friction that occurred while the brakes were generating the force required to accelerate your car up to roadway speed. It is now that you wonder what logic someone who believes in "kinetic" energy could use to explain this event. Have not the car's brakes caused an increase in the car's speed, relative to Earth and therefore, if one thought of "kinetic" energy as real, have the brakes also not caused an increase in the car's level of "kinetic" energy? Yet the car's brakes are emitting heat energy indicating, if one so believed, that a reduction of the car's level of "kinetic" energy of motion has occurred. While you are pondering this example, let me propose another.

Your car is at rest near the bow of an aircraft carrier which is steaming along the channel at full speed. As the carrier passes a nearby point that is crowded by observers, you start your car and accelerate it up to a steady velocity directed toward the stern. Now, relative to the crowd on the shore, your car is at rest and therefore could be said by believers on the shore to be without kinetic energy of motion, except for the rotating wheels. But soon you must take some action for the carrier is steaming out from under your resting car. Should you delay your action until it is too late, you and your car will lose the carrier's support and you both will fall (accelerate) vertically down toward the water below. Wanting to avoid this unpleasant outcome, you step firmly on the car's brakes causing your vehicle to accelerate back up to the carrier's speed. As before on the moving roadway, you again are able to get out of the car and walk around it to inspect the brakes. Again they are hot indicating that they are emitting energy at the same time that the car's speed of rest-motion and supposed level of "kinetic" energy have increased relative to the crowd of observers on the shore. How so?

Now you may feel that these examples are unfair since in each case the car stopped relative to a surface that is seen as moving by the observer. At this point you must realize that the car's supposed level of "kinetic" energy is at best a relative "level" since on the moving roadway, when the car comes to rest, even a believer will have to admit that the car has one "level" of "kinetic" energy relative to the moving roadway and quite another "level" of "kinetic" energy relative to the non-moving sidewalk. The same may be said about the car's supposed "level" of "kinetic" energy on the aircraft carrier. Even if it were real, the concept of "kinetic" energy is relative to the point where it becomes meaningless. Every object can easily be said to possess a million different "levels" of "kinetic" energy, all at the same time, relative to a million different observers in possession of a million different velocities of rest-motion.

Suppose we consider an event where your car's engine is governed to run at 2500 rpm which is its rate of revolution at normal highway speeds. Initially, you and the car are at rest on a normal non-moving roadway. Unfortunately, your car's manual transmission has lost the use of all forward gears except for its top gear where the ratio through the transmission is 1 to 1. In order

for you to cause the car's acceleration up to highway speed, you need to slip or partially engage the vehicle's clutch. Once up to speed the vehicle's clutch may be fully engaged without stalling the engine. After reaching highway speed, you decide to slow the car to a stop and crawl under it to check the temperature of the clutch components including the friction disk, pressure plate and the engine's flywheel. You discover that they are all quite hot and emitting a considerable amount of heat energy. In this new example, the car's speed and supposed "level" of "kinetic" energy are increased yet the clutch components are busy emitting heat energy in the same manner that the car's brakes emit heat energy when the car's speed and supposed "level" of "kinetic" energy are being reduced.

It is important to recognize that the one constant in all of these events is that heat energy is emitted by the surfaces responsible for generating the forces necessary to cause linear acceleration (speeding up or slowing down) for the car. Newton's LAW I tells us that it takes force, not energy, to cause acceleration for an object. In our examples, the brakes provide this force when the car slows relative to its supporting surface while the slipping clutch provides this force when the car speeds up relative to its supporting surface. Understanding friction is the key to understanding the real source of the emitted energy. In our several examples, when friction is present, heat energy is emitted by the matter of which the friction surfaces are composed, regardless of whether the car is seen as slowing down or speeding up, relative to the observer's frame. It is now safe for you to accept that there is absolutely no evidence here that any such thing like "kinetic" energy is being stored or released from the car's matter since the accelerating car's slipping clutch emits heat energy when the car is seen to be speeding up, while the accelerating car's slipping brakes emit heat energy when the car is seen to be slowing down.

Are you wondering now if I am ready to reveal the true source of the heat energy from these various friction surfaces? Prior to the braking or clutching event, the energy that is soon to be emitted as heat energy is being stored as atomic energy within the heavy atoms located in the surfaces of the very materials that are soon to be involved in the upcoming frictional event. There is no denying that an incredible amount of energy is stored in the iron and other heavy metal atoms that make up these braking and clutching components. When these components are forced together while in possession of different rates of rotation, friction between their contact surfaces occurs. What is friction? Friction is a grinding process whereby atomic components from each surface are scrubbed from their location on the friction surface by successive collisions with atomic components located on the opposing friction surface. Is it so hard to understand that some of the energy previously stored within these heavy atoms is released as heat energy emissions that travel away at the speed of light energy until they are absorbed by neighboring components? In this manner, some of the heat energy released by the frictionalized surface atoms of the iron brake disks and the heavy metal brake pads is absorbed by the myriad of undisturbed iron atoms located deeper within the disks causing their overall temperature to dramatically increase. These heated disks then emit this excess energy as the heat energy you experience when checking the temperature of these components after a frictional event.

So there you have it, mkleist. The heat energy is emitted atomic energy released during the frictional event. After the frictional event is over, you will find that the Earth weight of the frictional components is reduced due to the destruction of some of the atoms that make up their

contact surfaces. Over time, these heavy components will need to be replaced as much of their surface material will be worn away. If properly designed, several sets of brake pads will be replaced before a braking disk needs replacement. If you inspect them closely you will see that even the brake pads are composed, in part, of heavy metals, especially those pads used in sports cars. You will see the label "semi-metallic" on the box indicating that there is considerable atomic energy stored in these heavy "semi-metallic" braking components that is ready to be released as heat energy upon their destruction by the mechanics of friction.

Now that we understand the true source of the heat energy during these frictional events, it is easy to understand why heat energy is released from friction materials in your car, regardless of whether you think the forces produced by these friction materials are causing your car to speed up or slow down. With a complete and logical explanation such as this, there is no need for a second, imaginary, illogical explanation such as the concept of "kinetic" energy. One true explanation of the cause of an event is all we require.

It is time to demote "kinetic" energy from being a real Physical concept to instead be recognized for what it really is, which is a useful but unreal observer-oriented system for rating the relative motion of an object. In fact if one studies braking charts for race cars one will find that it takes about the same time for the brakes to slow a race car from 200 mph to 180 mph as it does to slow the same car from 20 mph to 0 mph. Now should "kinetic" energy supporters decide to calculate the supposed reductions of "kinetic" energy, they will find that their calculations will show 19 times more "kinetic" energy being converted to heat at the higher 20 mph speed reduction than at the lower 20 mph speed reduction. Yet each of these speed reductions takes about the same 1 second of time. So do they think the brakes are somehow 19 times more efficient at 200 mph than they are at 20 mph? If so, then why does it appear that they produce equal amounts of force since equal amounts of (de)acceleration is occurring in equal amounts of elapse time in accord with Newton's LAW I? The reason? In truth, there is no such thing as "kinetic" energy.

Instead, through the mechanics of friction, considerably more atomic energy is released from the heavy braking components as considerably more destruction of these components occurs at the higher vehicle speed reduction than at the lower vehicle speed reduction. Also while it may at first appear that the braking forces are equal since in practice equal vehicle speed reductions occur in equal 1 second intervals, in fact, despite the greater release of atomic energy at the 200 mph to 180 mph speed reduction, the braking forces must be considerably less in magnitude than are the braking forces present at the 20 mph to 0 mph speed reduction. Why? Consider the high force required for the speeding car to part the still air at 200 mph. The considerable force of air friction plays a major role in slowing the car from 200 mph to 180 mph while at the lower speed reduction, air friction plays almost no role whatsoever. At 200 mph it takes nearly all the force from the car's high-performance engine just to equal the forces of air and mechanical friction and thereby maintain the car's 200 mph velocity. Once the driver lifts her foot from the gas pedal, these major forces of air friction combined with the forces of mechanical friction along with the retarding compression forces known as "engine braking" will quickly slow the car's velocity to 180 mph without any help from the vehicle's brakes. Thus it is logical to accept that during the

high-speed slowing event, the brakes emit considerably more stored atomic energy as heat while producing considerably less braking force than is produced during the low-speed slowing event.

The only way there can be any truth to the position that "kinetic energy of motion" is responsible for the heat energy being released during braking events, is for there to be no heat energy whatsoever being released during the destruction of the heavy braking components. After all, if 100 percent of the heat energy being released is accounted for by the theory of "kinetic energy" then none of the heat energy released can possibly be coming from any other source. Thus "kinetic energy" supporters are in no position to explain the loss of matter and energy from the destruction of the heavy braking components. Either they must believe there is no atomic energy contained within these components or they believe that these components are not reduced in mass during such braking events. Since it is well proven that cast iron rotors and semi-metallic pads are jamb-packed with atomic energy, and further that all automotive braking components wear out with use, it is easy to recognize that their "kinetic energy of motion" belief is just that, a belief unable to logically and fully explain these events and therefore a belief vacant of the truth.

Meanwhile the Universal Physics understanding of braking events has no such difficulty. Release of previously stored energy within the atomic makeup of the heavy braking components is the true source of 100% of the heat energy released during a braking event. No explanation need be offered to include the supposed "kinetic energy" theory for in fact this man-invented rating system for relative motion is not real in nature.

Hope this helps,

Ethan Skyler
08/05/2001

Copyright © 2001 - 2009 by Ethan Skyler. All rights reserved.

The author grants each visitor to The Universal Physics Journal the right to make one copy of Question 6 for his or her own personal archive as long as the author's copyright notice is permanently affixed to the archive copy.