How Well Do You "Know" Physics?

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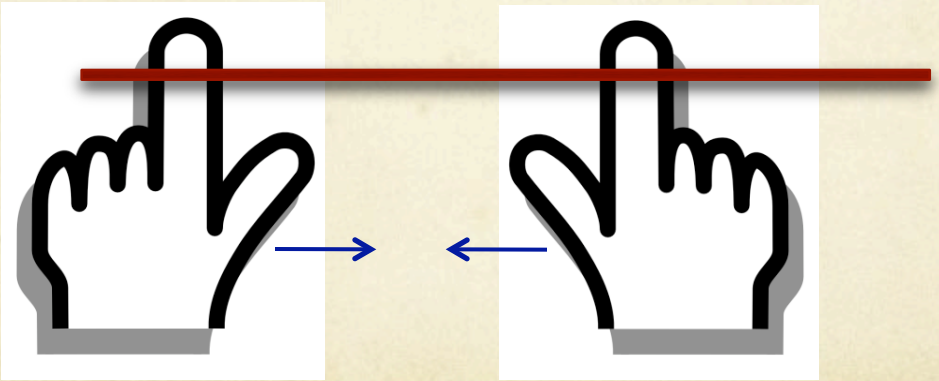
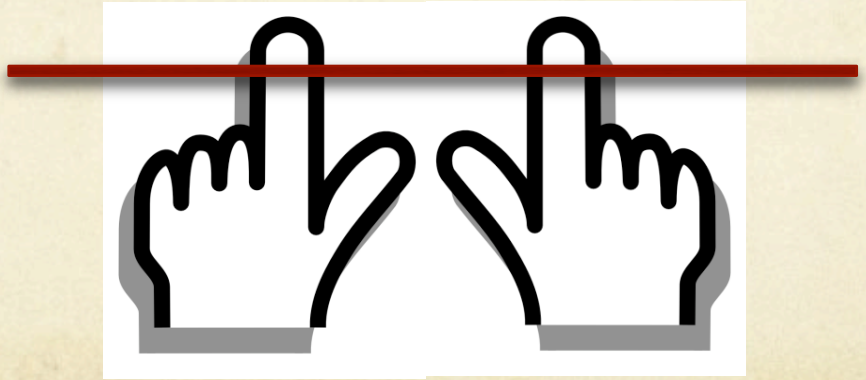
Q1: Which side will the pen fall?

Put a pen between your fingers with one finger closer to the center of the pen, as shown below. As you slowly move your fingers together, which side will the pen fall?



A1: The pen will not fall. It stays balanced.

The finger that is closer to the CM of the pen supports more weight, thus exerts more friction, pushing the pen to the other side until the two fingers support the same weight.

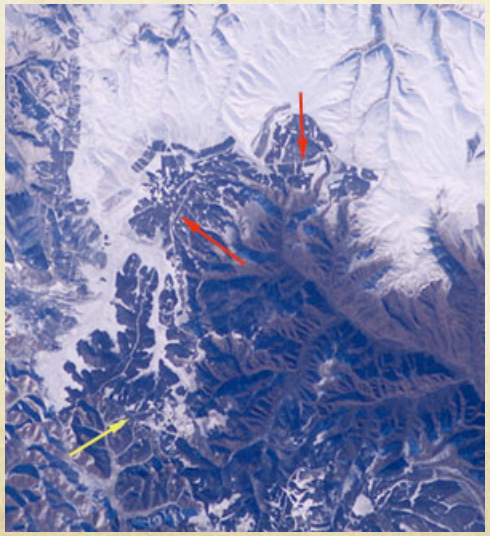


Q2: The Great Wall of China can be seen with unaided eye from the low Earth orbit spacecraft. Truth or myth?

The Great Wall is about 9,000 km long and a little more than 9 m wide. The low Earth orbit altitude is, say, roughly 200 km. Do you think an astronaut can see it with naked eyes?

A2: Very likely, a myth.

The European Space Agency claimed to take photos of the Wall, which later turned out to be a river. Many NASA astronauts said they could not see the Wall without visual aid. A photo taken from International Space Station shows sections of the Wall, though it is barely visible, and the photographer, Leroy Chiao, said he did not think he saw it with naked eyes.



So, the conclusion is not totally clear, but it is very likely that, unless knowing precisely where the Wall is, seeing perfect weather condition, and having exceptional eyesight, you cannot see the Great Wall.

Q3: Between running and walking in the rain, which one makes you less wet?

Some people argue that, even though running shortens the duration of you staying in the rain, you run into more rain drops in front of you, and it will not make any difference from walking.

A3: Running keeps you dryer.

Traveling from point A to B, you sweep equal amount of volume horizontally, but you collect more water from above if you walk slowly.

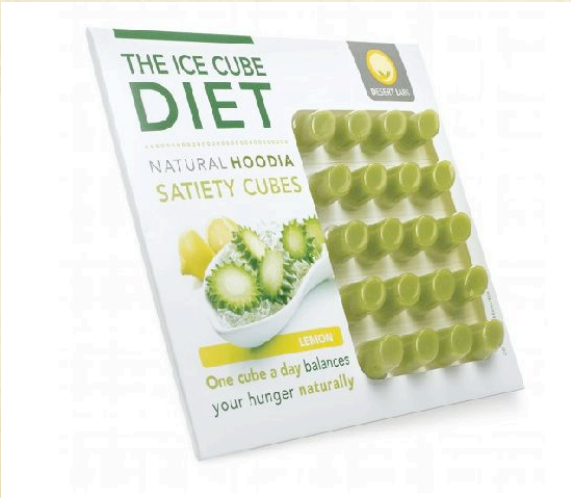
Discovery show MythBusters once attempted this and concluded that running got you wetter, but later "re-busted" itself, saying the artificial rain used in the first trial produced false results. Doug Craigen wrote a simulation and agreed that running is favorable.

Q4: Ice diet. Eating a lot of ice will make you lose weight. Truth or myth?

Your need to burn calories to stabilize your body temperature after eating ice. So, just keep eating and you will lose weight.

A4: True! But...

Well, is it practical? One big glass of ice requires about 20 Calories to heat up to our body temperature. (1 Calorie = 1,000 calories.) Compare that to normal, daily 2,000 Calories diet, it will not help much.

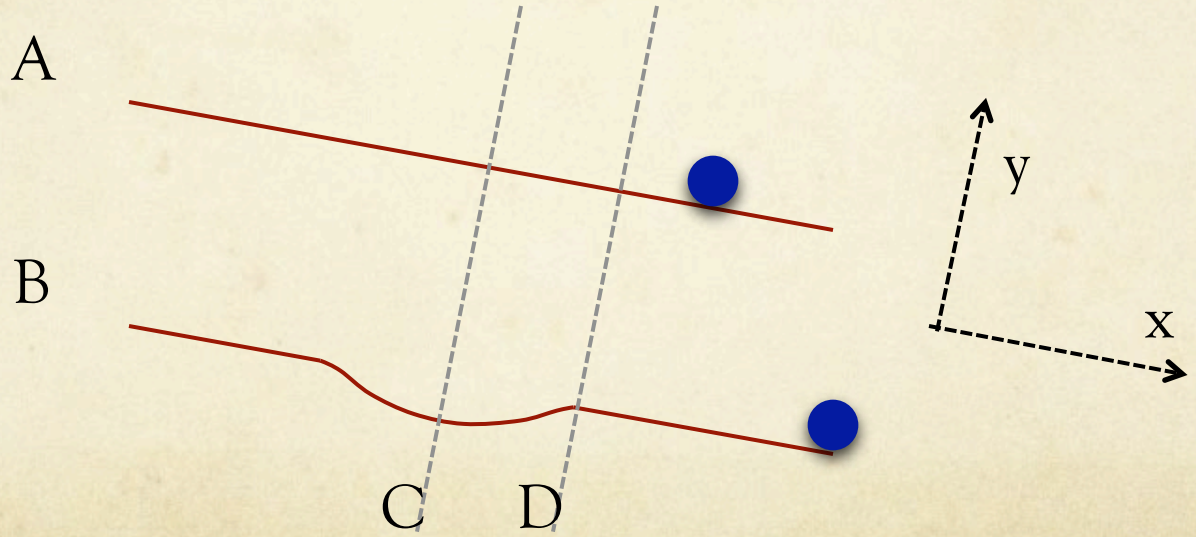


But, still, if you keep eating lots and lots of ice the whole day for a few months, it does help you burn some calories!

Q5: Two balls are released from the top of two frictionless tracks. Given that they stay on the tracks at all times (no unpredictable jumping or bouncing), which ball will reach the other end first?

A5: I think, with the given conditions, the ball on the dip track finishes first.

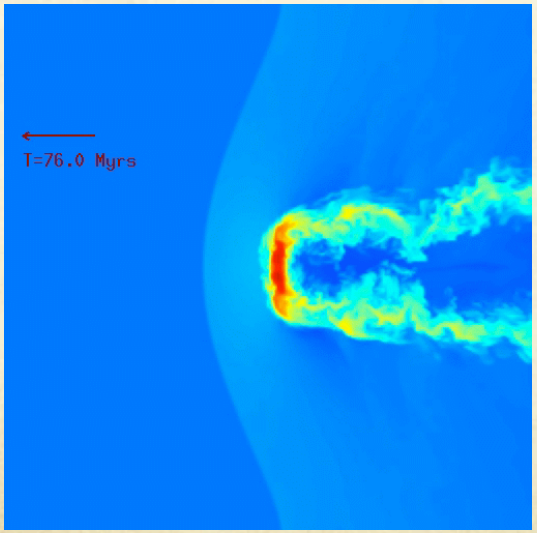
Since $a^B_x >= a^A_x$ up to C, $v^B_x > v^A_x$ at C.
And since $v^B_x = v^A_x$ at D, $v^B_x >= v^A_x$ between C and D. These imply shorter time for B.



Q6: Spacecrafts or meteors entering the Earth atmosphere are heated up by air friction. True or false?

A6: False.

The heat is produced by the air in front of an extremely fast object being compressed, called the “ram pressure”. The hot air transfers heat to the object, making it hot and glow.



Q7: While driving in a deserted area, you are caught in a thunderstorm with no shelter nearby. Obviously, you park off the road and turn on the emergency light, but would you

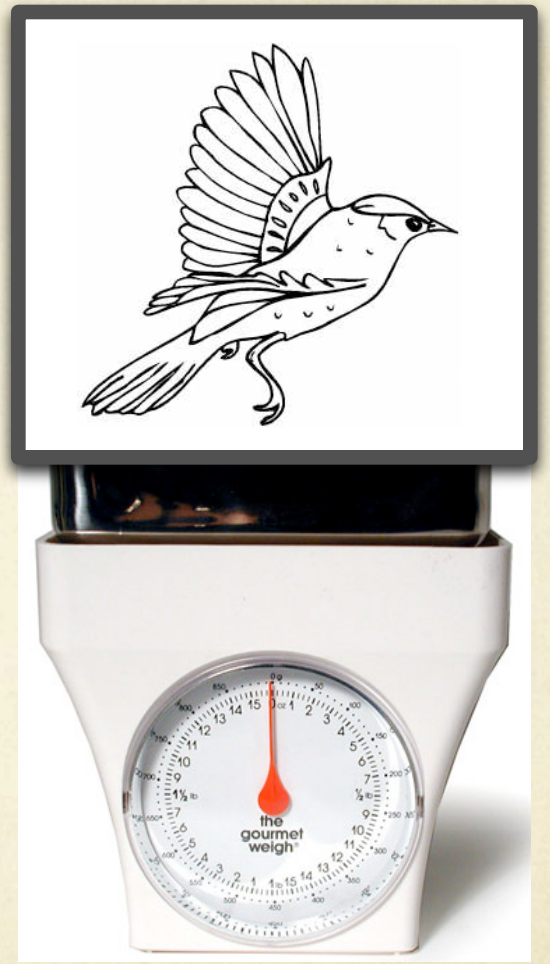
A. Stay in your metal-topped, closed car, or

B. Get out and stay away from your car?

A7: A. Stay in the car.

If your car is metal-topped and closed, make sure you do not touch any metal or wet part of the car, and you would be pretty safe. Staying out on wet ground without shelter is more dangerous.

Q8: A bird in a box. Suppose a bird weighs 10 g, and a box 50 g. You put the bird inside the closed box and put the whole system on a scale. Assuming the bird is flying still in the box, how much weight would the scale read?

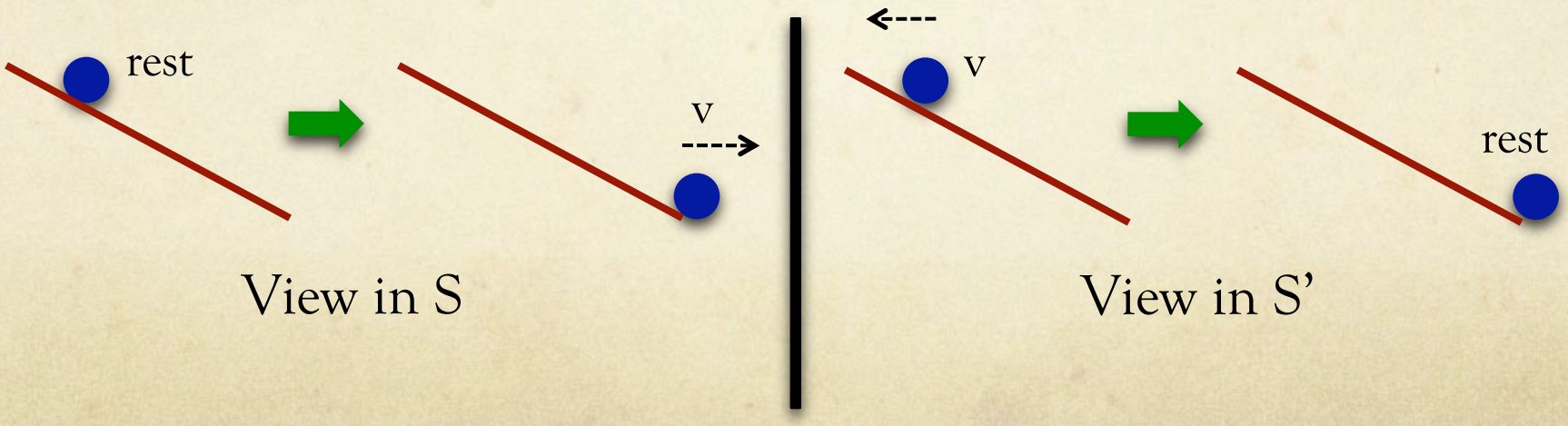


A8: My answer is 60 g.

Just consider the CM of the system. If the whole system weighs 60 g and the CM has no acceleration, then the scale must read 60 g. If the bird is flying upward, then the CM has an upward acceleration, and the scale would read more than 60 g. If the bird is free-falling inside, the scale would read 50 g as the scale has no way to know what object is falling.

Q9: Can you catch the incorrect argument?

In an inertial frame S, a ball starts from rest and rolls down a slope. You see normal conversion of potential and kinetic energy. But if you stay in another inertial frame S' moving at the same terminal velocity as that of the ball in S, you see the ball initially having kinetic and potential energy at the top of the slop but ending up having no energy at the bottom. Energy is not conserved in different inertial frames.



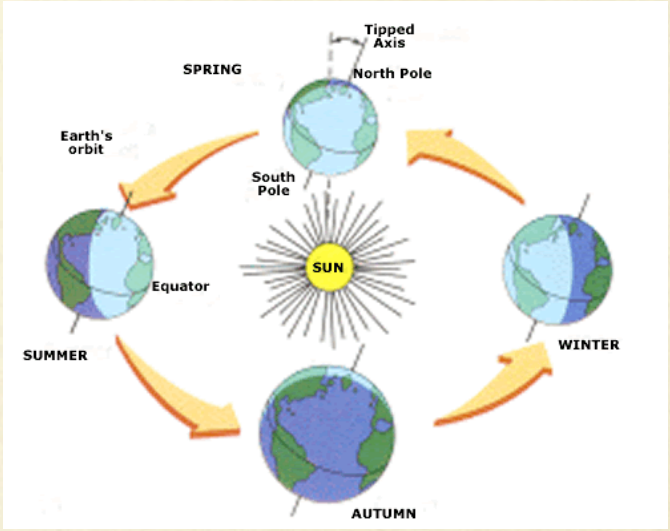
A9: The setup pretends that the slope has infinite mass!

If you take into account the mass of the ramp, then things will make more sense. If you forget this fact, the momentum is not even conserved in either frame. This makes me wonder if many careless setups of physics problems we have solved make sense or not.

Q10: What is the main reason the Earth has different seasons?

A10: The Earth rotation axis is about 23.5 tilted from the Sun-Earth orbital axis.

Quite many people mistakenly think that the seasons are created by the elliptical orbit of the Earth around the Sun. But in fact the Earth is about 3% closer to the Sun in January than it is in July. Also, when it is winter in the northern hemisphere, it is summer in the southern hemisphere. This easily disproves the misconception.



A lot more interesting questions…

- Is it faster flying from east to west?
- Do living things violate the 2nd law of thermodynamics?
- How the cosmological inflation works?
- Do you have any?