

Q Why is it possible for an air passenger to get an electric shock when he touches the knob of the toilet door in a high altitude flying plane?

Ans The air in the cabin of an aircraft at high altitude can be very dry, which is conducive to building up a static charge. The act of walking down the aisle can easily build up static charge which is then discharged to ground when we touch the metal door handle. It's harmless, but gives a nasty jolt.

Q2. What would you do if you are caught on thunderstorm.

If caught outside in a thunderstorm, we should find a low spot away from the trees, fences, and poles.

If the skin tingles and hair stands on end, lightning is about to strike. We should crouch down immediately, balancing on the balls of our feet, placing hands on knees with head between them. This will make us into the smallest target possible, and minimizes contact with the ground.

Lightning can strike homes and send a jolt of electricity through the metal plumbing.

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Qs Why room light turns on quickly upon switching them on even though electrons have a slow drift velocity?

Ans Bcz it is the electromagnetic field, rather than the electrons that moves so quickly. As soon as we flip the power switch, the whole circuit (the wires and the light bulb) is connected to an electrical energy source. Therefore, the electrons that are already present inside the electrical circuit are energized instantly due to being moved to a higher energy ~~app~~ level by the energy source. Bcz electrons with higher energy try to move towards a location of lower energy, they start interacting with neighbouring electrons. The electrostatic interaction b/w neighbouring electrons causes the movement of electrons everywhere in the circuit. This is what we call current. The current in-turn creates a magnetic field around the wire. All of this happens instantly. This electromagnetic wave is what travels so fast. The speed of current is minimal ($\sim 0.5\text{mm/sec}$) but the EM wave travels close to the speed of light.

Q How bullet train and a circuit breaker work on the magnetic effect of a current?

BULLET TRAIN:

Bullet trains work with the help of powerful electromagnets which make them high speed trains. Electromagnets are attached to metal lining of track. Large magnets are present inside the train. They work on the principle that like poles repel and unlike poles attract.

CIRCUIT BREAKERS:

It is a device which cuts the power when there is too much current flowing through the circuits, they are also called fuses. They work with the help of electromagnet to cut the circuit and rejoin.

Q Why wheat flour is usually passed near a magnet before being packed?

A lot of food is passed through metal detectors/magnetic fields to ensure that no metal has ended up in there during the manufacturing process. Wheat flour is passed near a magnet because tiny silvers of metal could have been ground off the milling equipment and made their way into the flour. If they otherwise ended up in the finished product, we would end up eating them and it can be harmful to our health.

Q Why does a steel ship become magnetized as it is constructed.

The ship building process involves huge metal work and welding. Ships are built in various stages.

- First stage is called fabrication of panels. Here plates and stiffeners are welded together and panels are formed.
- Groups of panels are then combined together by welding and forming assemblies.
- Groups of assemblies are welded together to form blocks.
- Groups of blocks are welded together to form mega blocks.
- Mega blocks are joined together by welding to form ship hull.

All through this process of ship building, there is a massive amount of welding. Typically the hull construction takes about an year. During this process, to weld steel, high current in the range $100A - 250A$ also flows in the form of loop from the machine, through the arc to the metal body which is ship's steel hull structure.

Assume a scenario where if 50 welders are welding at various locations on a ship structure, approximately $1000+$ amperes of current may be flowing through the ship structure at that point of time.

This continuous and ON/OFF flow of high ampere current over very long periods of time during ship construction realigns the molecules

and makes the ship structure slightly magnetic as during this period millions of amperes of current would have passed through the ship hull structure

Q What happens to density as speed increases?

As the speed of any object increases, its atoms are known to increase the amount of electromagnetic attraction, to hold themselves together more, as their electrons struggle harder to keep up with the nucleus.

The atom then becomes more contracted, smaller and more tightly bound. All the other atoms at the new speed are doing the same so the object itself gets denser as a unit.

Q Will a person see his reflection in a mirror if moving with speed of light?

Yes, According to principle of relativity.

This is precisely the sort of thought experiment Albert Einstein started out with. It turns out, yes, a person will be able to see his reflection in mirror if moving close to the speed of light. The person will also not notice anything strange about that image, or anything strange about things that are moving with him in his local reference frame.

However from a different reference frame, it might seem strange in the sense that (inertial reference frame "at rest")

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the rays of light will appear to take a much longer time to reach the mirror, and a much shorter time to be reflected back to the ~~moving~~ person.

Q Does a compressed spring have more mass than a relaxed one \rightarrow (confusion)

In terms of weight, a compressed spring will weigh more on whatever object is underneath it. Its weight corresponds to its gravity plus the compressive force acting on the spring

In terms of mass, both a compressed and uncompressed spring have the same mass.

Q Why does the existence of cut-off frequency \rightarrow (Threshold frequency) favour a particle theory for light rather than a wave theory?

Cut-off Frequency: A frequency level above or below where a device fails to operate.

Ans:

Wave Theory of light has several problems when trying to explain the photoelectric effect:

1. The intensity of the light would effect the energy of the electrons emitted, this is not observed ~~in the~~ to be the case
2. If the light was intense enough, any frequency would be able to cause electron

emission. Again, this is not observed to be the case as there is a threshold frequency

3. We would expect an even distribution of electron emission as the wavefront equally strikes the surface. Instead, electrons are emitted seemingly random

Q What postulate of Bohr is justified by De-Broglie

Bohr assumed quantization of angular momentum of electron revolving round in a specific orbit. De-Broglie explained "why angular momentum is quantized" using the wave-particle duality. De-Broglie assumed that the wavelength associated with the electron, is an integral ~~multiple~~^{number} of wavelengths must fit in the circumference of an orbit and derived the expression for angular momentum.

Starting from the idea that the circumference of the circular orbit must be an integral multiple of wavelengths

$$2\pi r = n\lambda$$

Taking wavelength to be De-Broglie wavelength ($\lambda = \frac{h}{p}$)

$$2\pi r = n \frac{h}{p}$$

$$2\pi r = \frac{nh}{mv}$$

$$\therefore mvr = \frac{nh}{2\pi}$$