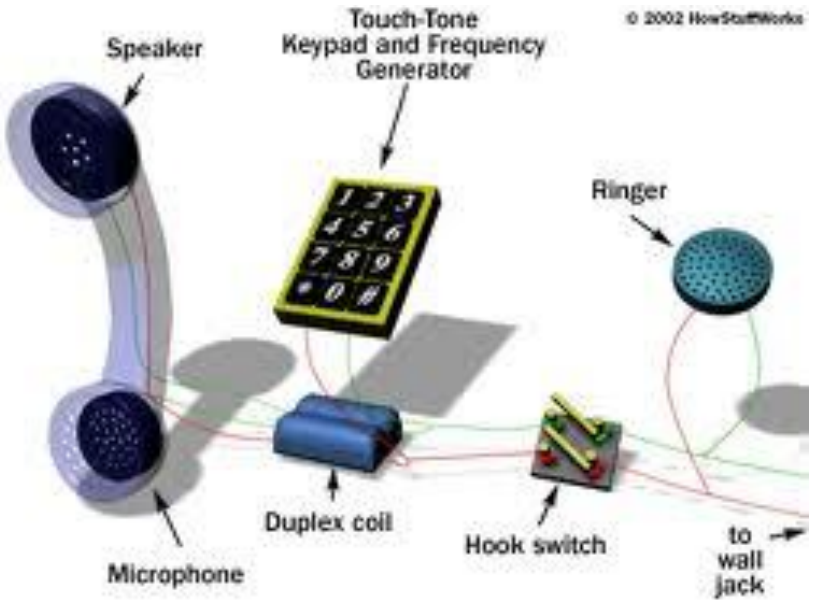
How Things Work - Finals

- 20 questions (QMS interfered)
- 1 Theme round
- “Part points da macha…” – Not happening

Question 1

- Every telephone has an essential component called the Duplex coil (marked in the figure). What is its purpose?



Answer

Answer

- To prevent the sound of one’s own voice from reaching one’s ears through the speaker.

Question 2

How is the guy's hand not getting burnt by the molten lead?

Answer

Answer

- His hand is dipped in moisture. This vaporises and forms a layer of insulation around his fingers, protecting them from the heat.

Question 3

- Why are infrasound signals of a particular frequency (~18 Hz) being increasingly proposed as the most probable reason for some locations having a haunting feel?

Answer

Answer

- There are two main reasons.
- The resonant frequency of the eye, as given by NASA, is 18 Hz. When a signal of such a frequency is around, our eyeballs start resonating to it and this results in apparitions.
- The roar of the tiger also has components of a similar frequency, and this creates an instinctive feeling of apprehension and dread.

Question 4

This is a SpeechJammer. It apparently shuts people up when they are chattering. How does it do it? Note the directed microphone and speaker on top.

Answer

Answer

When he pulls the trigger, the directional microphone with a 0.2-second delay is switched on, giving them a delayed feedback of their own voice.

Question 5

Probably because slow-motion cameras weren't around until recently, the fact that cats and dogs have different techniques of drinking water is a surprisingly recent discovery. What is the difference?

Answer

Answer

- A dog drinks by forming a backward cup with its tongue and holding water in it.
- A cat drinks by touching the surface of water with the sticky tip of its tongue and pulling water up. They have to pull their tongue back at the exact correct time, because too early would mean not enough water gets stuck and too late would mean the water falls back due to gravity.

Question 6

- Why is fast walking less comfortable than jogging?

Answer

Answer

- By recording the movement of the medial gastrocnemius muscle in the calf during walking and jogging, these researchers have discovered a mechanism which greatly increases efficiency while running. The medial gastrocnemius is the muscle which helps the all-important Achilles tendon function, working opposite the tendon as ballast. As the stride is initiated, the muscle contracts, locking the Achilles tendon in place at the top causing the tendon to stretch as the leg moves forward. A stretched tendon contains potential energy, which is released as the stride finishes, pushing the person forward. Now consider the speed of gait in a power walk as compared to a jog. Power walking requires a much faster gait than running, where the stride is much larger, reducing the speed of the gait. This elevated walking gait causes the medical gastrocnemius to contract faster and change its length more quickly, resulting in less power and less efficient muscle use. When switching to a jogging gait (usually around 2 meters per second), the muscle returns to a slower contraction, storing more energy in the tendon and resulting in a more efficient stride.

Question 7

- Would a penny dropped from the top of the Empire State Building onto a pedestrian's head kill him? If not, can you make a reasonable estimation of the minimum height from which a dropped penny would kill a person? (The Empire State building is 1454 feet tall.)

Answer

Answer

- There is no such height. The penny can attain a maximum (terminal) velocity of around 30-50 miles per hour, and the height ceases to be a factor beyond that. This is nowhere near close enough to kill a person.

Question 8

- Watch the video carefully. The predator, the tentacled sea snake, always seems to know in which direction the fish is going to move. The fish seems to run right into the snake's waiting jaws. How?

Answer

Answer

- The fish has an evolutionary mechanism, by which it involuntarily flees the moment it senses a disturbance, away from the direction the disturbance came from. The snake has got wise to this and causes a vibration with its midsection. It knows the fish will definitely move in the exact opposite direction and moves its mouth there.

Question 9

- A common argument against the theory of evolution is that it appears to violate the Second Law of Thermodynamics, since evolution by and large leads to creation of more complex systems which involve less randomness and more order. This seems to reduce entropy.
- What is the glaring flaw in this argument?

Answer

Answer

- Only the entropy of *closed systems* can be said to increase with certainty. The earth is not a closed system – it receives energy from the sun all the time.

Question 10

- The pictures on the previous slides are called Oxidation paintings made using _____ to “paint” on a surface coated with Copper paint.
- Fill in the blank.

Answer

Answer

- Urine

Theme Round

6 Responses to “why did the chicken cross the road?”. ID the scientists

Chickens at rest tend to stay at rest. Chickens in motion tend to cross roads.

Some say it was a sixth sense that led the chicken to cross the road. I say it was a sixth power.

The chicken doesn’t cross the road. Rather, it exists simultaneously on both sides…..just don’t peek.

Interesting, it always seems to flap its wings an integral number of times before it comes back.

It appears to be a white chicken. Sorry, I deal only with black bodies.

There was this good-looking rooster on the other side of the road, and he figured he'd skip all the games and just get to the point. So he asked the chicken if she'd like to come over to his side, and she said sure.

Answers

- Isaac Newton
- Van der Waals
- Erwin Schrodinger
- Louis de Broglie
- Max Planck
- Richard Feynman

Question 11

- In the recent neutrino experiment, the OPERA team said they had found a problem in the optical fiber connection between the GPS signal and the experiment's main clock - quite simply, a cable not quite fully plugged in. This however effect would increase the neutrinos' apparent speed. What is the alternative possibility which could explain the anomalous results of the experiment?

Answer

Answer

- The team said there is a problem in the "oscillator" that provides a ticking clock to the experiment in the intervals between the synchronizations of GPS equipment. This is used to provide start and stop times for the measurement as well as precise distance information. That problem would increase the measured time of the neutrinos' flight, in turn reducing the surprising faster-than-light effect.

Question 12

- The Federal Aviation Commission of the United States has a ban on the use of cellphones in aeroplanes, even though it is largely speculative, and not even one accident has been proven to have been caused by electronic interference. However, the Federal Communication Commission recently came up with its own ban. Why?

Answer

Answer

- A cellphones automatically locate the nearest tower, and it allocates some channel for that user’s communication. However, at high altitudes many towers are at roughly equal distances, and this leads to redundant allocation, slowing it down for other users.

Question 13

- MIPS helmets sandwich a layer of low-friction material between the outer shell and the inner liner. How does this help?

Answer

Answer

- The human brain is surrounded by cerebrospinal fluid, which allows it to slide around inside the skull upon head impact and protect it from direct impact.
- Similarly, this material allows the shell to move around in relation to the liner, thereby limiting the forces passed straight through to your head. The same way your brain "floats" in the cerebrospinal fluid, your head floats inside the helmet.

Question 14

- Why are piezoelectric devices not more popular in harnessing energy?

Answer

Answer

- Piezoelectric harvesters typically operate in a linear fashion, in that they can only be tuned to a particular frequency of vibration. While that may work well in the lab, where the same vibration can be produced over and over again, the real world tends to be a lot more random. Duke engineer Brian Mann decided that in order to generate a practical amount of electricity, the devices would need to be able to take advantage of a wider range of frequencies - essentially, they would need to be *non*linear.

Question 15

- The new Apple iPad's retina display has 4 times the number of pixels. But at such small scales, the capacitive coupling between signal wires (cross talk) becomes significant and distorts images. How did they overcome this?

Answer

Answer

- To overcome the issue, Apple separated the actual pixels from the signal wires with a thin resin layer. By putting an acrylic film just 3 micrometers thick in between the pixels and the wires, it eliminates cross-talk and also has the benefit of increasing the screen's "aperture ratio" — the amount of screen space that light actually passes through (if you look close enough at an LCD screen, you'll see lines between the pixels which contain components that drive the pixels).

Question 16

- Brain fingerprinting is a technique that uses the well known fact that an electrical signal known as P300 is emitted from an individual's brain beginning approximately 300 milliseconds after it is confronted with a stimulus of special significance. Because it is based on EEG signals, the system does not require the subject to issue verbal responses to questions or stimuli. But, this still cannot be used to conclusively prove if a person is guilty of a crime or not. Why?

Answer

Answer

- Brain fingerprinting detects information-processing brain responses that reveal what information is stored in the subject's brain. It does not detect how that information got there. In a case where a suspect claims not to have been at the crime scene and has no legitimate reason for knowing the details of the crime, and investigators have information that has not been released to the public, brain fingerprinting can determine objectively whether or not the subject possesses that information. In such a case, brain fingerprinting could provide useful evidence. If, however, the suspect knows everything that the investigators know about the crime for some legitimate reason, then the test cannot be applied.

Question 17

- In Westinghouse's 1869 version of the air brake, the straight or direct air brake used air hoses to connect the cars. When the engineer turned on the brakes, air pressure turned the brakes on in each car of the train.
- However with air brake 2.0, Westinghouse turned things around. Air pressure kept the brakes off. The engineer reduced pressure to put the brakes on. Why was this done?

Answer

Answer

- This built-in safeguard meant a loss of pressure would stop the train automatically. That applied to leakage and to the situation where cars came unhitched: Loose cars would brake to a stop. The system went into use in 1872 on the Pennsylvania Railroad.

Question 18

- In the Tata Megapixel, a concept car unveiled recently Zero Turn technology replaces the Infinitely Variable Transmission (IVT) from the Pixel has been replaced by the electric motors in the wheels. It has an exceptional turning radius of 2.8m. How does it achieve it?

Answer

The electric motors rotate the rear wheels in opposite directions, while the front wheels are turned at an acute angle, enabling the short 2.8 metre turning radius

Question 19

- In wind mills, the tri-blade turbine tower is a prevalent design. It's not exactly trouble-free though and there are those who do not look upon these monsters favorably, most often complaining about the noise and the not so picturesque view.
- There is another design for harnessing wind energy though. Pic in next slide. How does it work?

Answer

Answer

- The system is based on reciprocating motion - as the wind catches a horizontal airfoil (like the ones you might find on aircraft), it's raised until it reaches a certain point, then the angle of the blade alters and it's forced downward, and the process repeats. Unlike the more familiar wind turbine designs where the tip of the blade moves at a different speed to a more central point, all the points on the airfoils of the Wind Harvester would move at the same velocity. This is said to make the unit capable of generating power at low wind speed, as well as continuing through to the kind of higher wind speeds that may result in other systems ceasing operation to prevent damage.

Question 20

- We all know a helicopter stays up because the rotor generates a lift, but how does it move forward and backward without an engine?

Answer

Answer

- A swash plate tilts the rotor according to the pilot's instructions, increasing the blade speed on one side.