muon detector

第1题

What is the lecture mainly about?

A Misconceptions about muon detectors in Archaeology

B An excavation of an ancient structure using a muon detector

C The collaboration between physicists and archaeologists in the development of the muon detector

D Benefits that archaeologists can obtain from muon detectors

第2题

What feature of the muons benefit archaeologists?

A Their ability to carry information from outer space

B Their ability to break down cosmic rays into smaller particles

C Their ability to pass through solid material

D Their ability to travel at the speed of light

第3题

According to the professor, what information can a muon detector provide about the Mayan pyramid?

A The temperature inside of the structure

B The location of rooms within the structure

C The age range of the structure

D The types of material used to build the structure

第4题

Why does the professor discuss damages to archaeological sites?

A To describe a benefit of using muon detectors in archaeological study

B To explain an accident with a muon detector during a pyramid exploration

C To indicate how useful detectors are in restoring damaged sites

D To explain why muon detectors were rarely used in the past

第5题

In what ways are modern muon detectors different from muon detectors used in 1967?

A They are more economical.

B They use less energy.

C They are not as large.

D They take less time to produce an image.

E They can scan in more than one direction.

第6题

What is the professor’s opinion about the newer muon detectors?

A She appreciates the help they provide even though it takes much time to produce images.

B She is afraid that many archaeologists will be unwilling to learn to use them.

C She thinks that they have greater potential in areas of science other than archaeology.

D They provide more accurate information about the age of objects than older detectors did.

【L1-5】 Listen to part of a lecture in an Archaeology class.

P: Talking about one popular myth in Archaeology, some people simply think excavation is digging the site until something valuable is found. Well, while there is an element of luck involved, we have an array of high tech devices to help us figure out where to put our efforts. You know, we can’t just dig up the site randomly looking for an ancient structure. There is one of the newer tools actually created by a different field of study. The machine relies on particle physics. Um... interdisciplinary跨学科 I’d say. And it is called a muon detector, or counter.

Muon is a charged elementary particle similar to electron. Okay, let me start over. On Earth, most naturally occurring muons are created by cosmic rays, which consist mostly of protons, many arriving from deep space at very high energy. When these charged particles of cosmic rays collide with molecules in the upper atmosphere, they break up into smaller particles, muons. Traveling at the speed of light, muons can penetrate tens of meters into rocks and other matter on Earth's surface. In fact, they can pass through solid matter, so they can transmit deep into the surface. Thus, this property of muon is perfect for archaeologists to take advantage of.

Let me explain. Over the course of several months, one detector can build up a picture showing the shadows of structures they’re studying - like the Mayan pyramid in Central America, for example. We're interested in finding out if there are buried chambers or other rooms inside. Well, a muon detector can track a great number of muon passing through the less dense space inside the pyramid. Yes, you have your hand up?

S: I don't think I get how this device works exactly.

P: Okay, well, when muons pass through... uh... say... stone walls of a pyramid, dense material, they lose energy. So, in the case of empty space, more muons can pass through because they lose less energy. The muon detector can identify the area by measuring the amount of muons in each place. We can see darker colors in empty spaces, so we wind up with a sort of.... picture of the site and its internal structure.

S: Picture?

P: Yes, in the same way that CT scans produce a 3-D picture of your body using x-rays. It literally is like tomography in the medical sense.

S: Okay, so if darker areas show up inside the pyramid, we assume it’s an empty space with more muons.

P: You got it. This technology enables us to see what's inside of the structure before we dig up the site. So, now we

know exactly where to excavate, and we can minimize the damage. You know, even a little damage could result in losing crucial information forever.

Now, it was when archaeologists began to use muon detectors that they improved. Four decades ago, In 1967, a physicist buried these detectors in the ground, surrounding the Egyptian pyramids. He was looking for buried chambers. However, he saw no surprises in that experiment. But he did demonstrate that the technique worked. One of the problems was that the machine he used was about the size of a water heater. It was so big that many archaeologists doubted its practicality. Then, there was another issue of range. With the detector used in 1967, we could only scan from muon directly above it but not from the sides. So, it actually had to be placed underneath the pyramid first, so we could look up into the inside of the ancient structure. It would be nice, for instance, to have a system that didn't take six months to produce an image. I believe that’s way better than the year it took for the 1967 study to get the results, but still...

Well, there's good reason to believe that with better equipment, we’re going to use muons in much more diverse manners. Muon detectors can also be used in other areas of science. For instance, to scope our nuclear waste sites or even look for the underground.

{"1": ["D"], "2": ["C"], "3": ["B"], "4": ["A"], "5": ["C", "D", "E"], "6": ["A"]}