編號：E 58　系所：地球科學系甲組　　科目：科學英文

本試題是否可以使用計算機：□可使用，☑不可使用　（請命題老師勾選）

Please note that the written style (i.e. organization and grammar) will be taken into account in the rating of your paper, no matter in English or in Chinese.

1) This article is about the implication of scientific instrument in forensic science which is the science dealing with the application of scientific knowledge to legal problem. This article was released in July, 2004. After read through the article, please answer the following questions. The answer can be written in Chinese or in English.

Japanese police arrested three people on Wednesday in connection with the 1995 shooting of the country's top police official. The police identified the suspects using the massive SPring-8 synchrotron, a powerful X-ray beam that can reveal the chemical makeup of tiny samples. The three are all former members of the Aum Shinrikyo cult (a terrorist organization), which on 20 March 1995 released sarin nerve gas (沙林神經毒氣) on the Tokyo subway, killing 12 people. Ten days later Takaji Kunimatsu, then head of the National Police Agency and leader of the investigation into the attack, was shot and critically injured.

The key new evidence is reported to have come from analysis of metal traces found on one suspect's clothing. Impurities in this metal are believed to match those in the gun used to shoot Kunimatsu. The police have refused to make any statements, and the name of the scientist leading the new investigation is being withheld to protect his or her safety.

The police wouldn't have a case without SPring-8, says Akito Kakizaki, a physicist at the University of Tokyo. SPring-8, the world's most powerful synchrotron (同步輻射), can analyze samples weighing only trillionths of a gram - which, in criminal evidence, is often all that is available.

This is not SPring-8's first contribution to forensic science. In December 1998, evidence from the synchroton helped convict a woman suspected of killing four people at a festival by putting arsenic in a curry. Ten milligrams of arsenic found at the suspect's home matched the chemical added to the curry. The synchrotron revealed matching bismuth and antimony impurities in the two samples. "Conventional methods of analysis would need much more [arsenic]," says the scientist behind that analysis, Izumi Nakai, an analytic chemist at Tokyo University of Science and a member of the American Academy of Forensic Sciences, who is not involved in the current investigation. He thinks the police will use the method more in the future. Also, synchrotron radiation leaves the sample intact. "We can repeat the experiment many times," says Nakai. "This is extremely important for investigating crimes. Nakai became involved in the poisoning case through his study of arsenic in hair samples. He is now pushing for synchrotrons to become a staple of forensic science.

So far his efforts to get a dedicated synchrotron for forensic science have failed, but he is hopeful. "All countries will begin to use synchrotron energy for forensics," he says. Only two other synchrotrons could handle samples as small as those in the shooting case: the US Advanced Photon

(背面仍有題目,請繼續作答)

Source at Argonne National Laboratory, Illinois, and the European Synchrotron Radiation Facility in Grenoble France. "With a machine any less powerful it would be difficult," says Kakizaki.

Q1: Which scientific method or technique described in this article has been employed in forensic science? What is its advantage? (6%)
Q2: How many police case(s) has(have) been reported in this article? Please describe the case(s) in short. (8%)
Q3: How many of the facilities in the world can conduct such experiments described in the article? Where are these facilities located? (6%)

2) Please translate the following paragraphs into Chinese.

a) The first seismometers capable of measuring ground vibrations with periods of several seconds were installed in the early 20th century. Since then, the devices have recorded a continuous seismic hum (*), called "ocean microseisms." This hum is not the result of tectonic forces, but rather the response of the solid Earth to ocean wave-wave interactions, which have an annual global cumulative seismic energy comparable to that from earthquakes. (*hum:哼聲). (15%)

b) Mantle plumes are columns of hot, solid material that originate deep in the mantle, probably at the core–mantle boundary. Laboratory and numerical models replicating conditions appropriate to the mantle show that mantle plumes have a regular and predictable shape that allows a number of testable predictions to be made. New mantle plumes are predicted to consist of a large head, 1000 km in diameter, followed by a narrower tail. Initial eruption of basalt from a plume head should be preceded by ~1000 m of domal uplift. High-temperature magmas are expected to dominate the first eruptive products of a new plume and should be concentrated near the centre of the volcanic province. All of these predictions are confirmed by observations. (15%)

3) This article, "Every body's fault", tries to highlight the urgent need for Pakistan and India to put aside their differences and build stronger scientific ties from the earthquake event in Kashmiri. Please read through it and write a short summary (In Chinese or in English). (20%)

Everybody's fault

In the past 15 years, the dispute between India and Pakistan over the military 'line of control' that divides Kashmir may have cost between 40,000 and 60,000 lives. But even that formidable death toll was surpassed in a few moments last autumn, when the boundary between the Indian and Eurasian tectonic plates shook, killing an estimated 75,000 people. The earthquake of magnitude 7.6 left many more homeless on both sides of the border.

The mayhem (*) was made worse by the failure of either Pakistan or India to adequately address their well-established earthquake vulnerabilities. There is now a movement among Pakistan's geologists to deal with earthquakes. But so far, there has been no real move towards closer collaboration with researchers in neighbouring India.

Such collaboration has the potential to significantly strengthen the two nations' earthquake defences, potentially saving thousands of lives. Kashmir is home to some of the subcontinent's poorest people. They cannot afford reinforced concrete or 'seismic isolation', but they can make simple modifications to house designs — such as integrating a roof into a house's frame — that will greatly improve their chances of surviving future earthquakes. Government facilities such as schools, bridges and hospitals could also be built at relatively low cost with earthquakes in mind, dramatically strengthening future disaster response in the region.

Real change will still require substantial public investment, however. Better scientific cooperation could help both nations set priorities for such investment. By mapping and studying the many faults that run through the line of control, Pakistani and Indian seismologists could build a better understanding of which towns are at greatest earthquake risk. Together they could devise building regulations that would be sensitive to the region's limited resources while ensuring that more of their citizens would survive. They could also provide insight into how relief could be most efficiently distributed to the region in the aftermath of a major earthquake.

Both countries have recently tried to de-escalate the conflict over the disputed province of Kashmir. Collaboration in all fields of civil society, including science, has a role to play here too. There are finally some promising signs: in the past few years, scientific leaders from the nations have met, and joint efforts are now under way in fields such as agricultural biotechnology.

(背面仍有題目，請繼續作答)

But when it comes to seismology in Kashmir, the two nations are still barely talking. They are both paranoid about ceding military advantage in the disputed region — with the result that geologists bearing maps or GPS receivers are banned from entry. Consorting with 'enemy' researchers is also viewed with deep suspicion.

In May, however, geologists from both sides of the border will attend a 'science for peace' workshop in Lahore, Pakistan, where they will discuss topics such as remote sensing, geophysics and seismology, as well as the idea of turning the hotly contested Nanga Parbat glacier into a scientific peace park. The meeting's US coordinators hope that it can serve as a starting point for scientific exchange in geology.

Both nations' scientists should take advantage of this gathering to begin serious and sustained collaboration. Their governments should make provisions to allow scientific exchange and the open dissemination of data of the sort that is needed for such work. Indian and Pakistani scientists based abroad, who often work side-by-side in Western laboratories, can help by acting as go-betweens for researchers in the region who currently share no direct contact.

If India and Pakistan are to get to grips with earthquakes, they must overcome enormous technical, social and economic challenges. The task is formidable and requires the two nations to put their manifest political differences to one side and work together. By allowing their scientists to collaborate openly, governments in both countries can gain an understanding of the risks their citizens face, and help them prepare for the future.

(*mayhem: chaos)

4) The questions have been described in Chinese. Please read through them and write your answer or essay in English as required.

a) 你必須繳上你的期中報告，其中一部分是有關未知礦物之密度測量，在實驗中你已測量 10 次，但有二個數值落在不合理的範圍(一個偏高，一個偏低)，所以你就用其餘 8 個測量值去取平均值(d)及其誤差(Δd)。請你將如何整理及處理數據的這一段報告用英文寫出。(15%)

b) 你與 A 班同學到澎湖出野外，澎湖是玄武岩爲主的島群，現在你們一群同學到達其中一個小島嶼，觀察到一個柱狀玄武岩 (columnar joints) 的露頭。請你用英文描述柱狀玄武岩的形狀及解釋其成因。(15%)