

There are 8 essays in this test. The essays 1-6 each contain a text followed by questions.
Please answer these questions BRIEFLY according to the text.

1. If scientists' hunch proves correct, the mystery 'killer flu' that has killed more than 50 people in Asia and beyond is an infection like none seen before. Suspicions are growing that the culprit is an unassuming virus called a coronavirus. Many labs have found a version of it in most patients' lungs and blood; some sufferers also have antibodies that show they were infected. But the coronavirus might have a partner in crime: a virus that was discovered last week. This pathogen, one of the paramyxoviruses that cause respiratory infections, has also turned up in some swabs. "It could well be that a combination is important," says virologist Albert Osterhaus of Erasmus University Hospital in Rotterdam, the Netherlands. The coronavirus may weaken patients' immune defenses, leaving them vulnerable to the second bug. Alternatively, it could be acting alone, and the presence of the paramyxovirus - which is common in winter months - may be a fluke. Either way, there is little in the pharmacy to fight a coronavirus as it's not been a high-priority virus. The US Department of Defense is already screening anti-viral medicines against the suspect coronavirus to find one that curbs its growth. Meanwhile, most affected countries are containing the disease by isolating patients. There are fears that this process is not watertight in Hong Kong and China, where the worldwide outbreak is thought to have started. Health officials' concern over the mystery disease - known as severe acute respiratory syndrome (SARS) - is heightening by the day. The global tally of probable cases leapt from nearly 500 to 1,323 this week.

The coronavirus cause around a third of common colds - but have rarely killed. It could well be that a combination of viruses is important. But coronaviruses are prone to transformation. They have an unusually large amount of genetic material, as well as enzymes that enable them to shuffle it. A new, more virulent mutant could easily result. The virus might also be a strain that only recently made the jump into humans from animals. Investigators are trying to work out whether the bug has an animal counterpart by reading its genetic sequence.

Q: a) According to this article, what are the possible causes for SARS? (8%)

b) What's the best way to treat SARS and to prevent its spreading? (4%)

2. Researchers have found a molecular switch that enables the immune system's cells to function without oxygen. Jamming the switch stops inflammation, suggesting a new way to treat arthritis and other diseases in which the body turns on itself. The switch is in white blood cells, the immune system's special forces. These cells rush into ailing tissues, and form the first line of defence against incoming infection, eating invading bacteria.

(背面仍有題目,請繼續作答)

This influx is one of the causes of inflammation. Randall Johnson of the University of California, San Diego, and his colleagues have found that a molecule called HIF-1 alters white blood cells so that they survive without oxygen - a trick that is essential to their defensive role, as damaged tissues are often low in the gas. The team genetically engineered mice to lack HIF-1 in their white blood cells. The modified cells stay away from low-oxygen environments, and destroy few bacteria. "It's as if they can't manage the energetic burst needed to kill bacteria," says Johnson. The animals' skin does not redden in response to irritating chemicals, and their joints do not develop arthritis when injected with a substance that normally causes swelling.

HIF-1 was known to switch on genes that trigger the production of red blood cells or the growth of blood vessels. Cancer researchers are already looking for drugs that block HIF-1 - which they hope will starve tumours of oxygen. Such drugs might also help to treat arthritis, says Johnson. But without HIF-1, a mouse's immune system is also much weaker. The molecule's many jobs will make it difficult to disable without adverse side-effects.

Q: a) How does inflammation occur and what problems it may cause? (8%)

b) What are the strong and weak points of treatment targeting HIF ? (8%)

3. Changes to the genome that don't affect DNA sequence may help to explain differences between genetically identical twins. Marie and Jo are twins, genetically identical and raised in a happy home. Growing up, both enjoyed sport and art, were equally good at school, and appeared similar in almost every respect. But as adults, their lives and personalities diverged: in her early twenties, following episodes of hallucinations and delusions, Marie was diagnosed with schizophrenia. Such examples have long baffled geneticists. Despite sharing the same DNA and often the same environment, 'identical' twins can sometimes show striking differences. Now some researchers are beginning to investigate whether subtle modifications to the genome that don't alter its DNA sequence, known as epigenetic changes, may provide the answer. In doing so, they hope to shed light on the mysterious roots of common diseases — such as schizophrenia and diabetes — that burden society as a whole. The idea that epigenetics underpins many of the world's health scourges is still highly speculative. Most geneticists believe that the essence of all human disease is related to DNA-sequence variation. But with the genomics revolution having yet to yield the hoped-for avalanche of genes that confer susceptibility to common diseases, Some believe that it's time to revisit the problem under the spotlight of epigenetics.

Each of our cells carries the genes for making all the building blocks of the body, but only some of them are active. Epigenetic modifications act like switches, helping to control gene activity so that only those that are required in a particular cell are actually turned on. They constitute a 'memory' of gene activity that can be passed on each time a cell divides, ensuring that liver cells beget more liver cells, and so on.

Q: a) How do you define epigenetics? (5%)

b) What evidence support epigenetics as mechanisms for diseases? (5%)

4. The guidance molecule netrin-1 is famous for its role in telling axons — the long extensions sent out by nerve cells — where they should and shouldn't go in the nervous system. Recently, Karpagam Srinivasan *et al.* extend the repertoire of netrin-1 activities to non-neuronal tissues, showing that it also acts to keep cells stuck together during the development of mammary glands. It was already known that netrins are secreted by many cells outside the nervous system, but until now no one had really worked out what they were doing. Srinivasan *et al.* looked more closely at where netrin-1 occurs in the developing mammary glands of mice, and found that it surrounds the cap cells — the single layer of cells that caps the developing gland, or bud — in a pattern that is complementary to one of its receptors, neogenin. Extrapolating from netrin-1's function in the nervous system, it might be predicted that it provides a positional cue to guide moving cells within the mammary gland. Surprisingly, the authors found that, instead, netrin-1 prevents cap-cell movement. Loss of either netrin-1 or neogenin disrupted adhesion between the cap-cell layer and adjacent cells, and resulted in cap cells moving into regions where they would not normally go. Furthermore, addition of netrin-1 to isolated neogenin-producing cells caused them to aggregate. So it seems that netrin-1 may be required in the developing mammary gland simply to make sure that cells stick together.

Q: a) Why are the findings in this study interesting? (8%)

b) What are the possible consequences for losing netrin-1 during mammary gland development? (4%)

5. Previous studies have linked lead exposure in men with high blood pressure. But the new research is the first to suggest that thinning bones can release lead acquired from decades-earlier exposure and cause health problems. Lead exposure from paint, water, air pollution and other environmental sources elevates blood-lead levels and in large doses can cause poisoning, especially in children. The metallic chemical ultimately accumulates in bones, and in low-level exposure may remain there for decades without serious effects. But when aging bones start to thin, lead can leak back into the blood, where it is more

(背面仍有題目,請繼續作答)

likely to cause damage, the researchers said. Loss of bone at menopause can essentially result in a latent or re-exposure to lead. About one-fourth of the study participants had the highest blood-lead levels -- averaging 6.4 micrograms per deciliter. They were 40 percent more likely to have high blood pressure than those with the lowest blood-lead levels, 1 microgram per deciliter on average. That suggests that lead in the blood has a damaging effect on blood pressure even when it's below the government's "level of concern" for childhood lead exposure, 10 micrograms per deciliter. The federal limit for occupational exposure is 40 micrograms per deciliter.

Q: Please tell me how lead might affect blood pressure when you get old! (10%)

6. Because of its reputation as a risk factor for heart disease, people tend to think of cholesterol only in negative terms. But cholesterol is an important component of cell membranes and vital to the structure and function of all of your body's cells. Cholesterol also is a building block in the formation of certain types of hormones. Still, about half of American adults have blood cholesterol levels that are higher than desirable (hypercholesterolemia). If you're one of these people with this largely preventable condition, you may be on the way to heart disease. When the levels of cholesterol and triglycerides, another blood fat, in your bloodstream become too high, your likelihood of developing cholesterol-containing fatty deposits (plaques) in your blood vessels increases. Over time, plaques lead to narrowing of arteries, impeding blood flow and creating a condition called atherosclerosis. Narrowing of the arteries around your heart (coronary artery disease) can prevent your heart from getting as much oxygen-rich blood as it needs. This means an increased risk of a heart attack. Likewise, decreased blood flow to your brain can cause a stroke, and less blood flowing to your lower limbs may result in exercise-related pain or even gangrene.

Q: Please tell me the good side and bad side of the cholesterol! (10%)

7. What do you know about cloning in life sciences (hint: Dolly sheep died couple weeks ago)? Please describe it by using less than 300 words! Do you think it is worth spending huge money in cloning scientific research just for elongating human life? (15%)

8. A new study proves that human male sperm will swim toward chemical attractants to find the female egg for fertilization, the researchers who made the discovery say that this finding can lead to new ways to treat infertility or to new contraceptives that do not use hormones. Why do the researchers say so? (15%)