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There are 7 essays in this test. Each essay contains a text followed by questions. Please answer these questions BRIEFLY according to the text.

Essay 1 (12%)

Does the prospect of public speaking make you panic? Do you run for the hills at the mere mention of spiders? Help could be at hand: researchers have come up with a way to ease the crippling symptoms of phobia.

The treatment could one day help sufferers to face their fear simply by popping a pill before facing a stressful situation. The researchers hope that it may even have permanent effects, by helping phobics deal with the daunting prospect of undergoing therapy in which they come face to face with their fears. The remedy contains a human hormone called cortisol, which the body produces naturally in times of stress or fear to help subdue the panic response. Previous studies have shown that increased levels of cortisol help us to blank out painful memories and emotions, allowing us to deal more effectively with stressful situations.

Researchers led by Dominique de Quervain of the University of Zurich studied whether artificially increasing levels of cortisol can help phobics overcome the paralysing fear that they feel when faced with the source of their anxiety. They tested 40 people with social phobia and 20 with a fear of spiders. They gave half of them cortisol and then, an hour later, forced the volunteers to give a presentation and undergo an impromptu maths test, or to view a picture of a large spider. Participants who took cortisol reported significantly less fear, on a scale of 0 to 10, than those given a placebo. The next step will be to repeat the trial using a larger group of people, says de Quervain, and to combine it with behavioural techniques.

Traditionally, severe phobias are treated using behavioural therapy, in which a patient gradually embraces their fear. An arachnophobe, for example, might begin by looking at pictures of spiders, before graduating to seeing or handling the real thing.

Cortisol, which has a wide range of effects on both brain and body, is already used to treat chronic conditions such as arthritis. Side effects of daily use include changes in blood pressure and metabolism, and the risk of diabetes. There are also fears that extended exposure to increased cortisol levels can affect long-term memory.

Q 1-1: What is phobia? (5%, two sentences at most)

Q1-2: Is it a good idea to use cortisol daily to treat phobia and why? (7%)

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Essay 2 (13%)

It isn't news that eating fatty foods and smoking can shorten your life expectancy through heart attacks and cancer. But now a study shows that a lifetime of these unhealthy habits can directly 'age' DNA by years. Strings of DNA are often capped by highly repetitive sequences known as telomeres. Like the plastic tips on the ends of shoelaces, telomeres help to protect genes against wear and tear. But each time a cell divides, the proteins involved in replicating our DNA fail to copy the telomeres completely. So these sections get shorter as the years pass.

Tim Spector, director of the twin research unit at St Thomas' Hospital in London, and his team have shown that telomeres shrink dramatically in patients who are obese or heavy smokers. Researchers already knew that smoking and obesity could cause a kind of stress in cells that produces reactive chemicals, which in turn are known to wear away telomeres. Spector's large study looks directly at this effect to quantify just how much a cigarette can age you. Spector's team collected information and blood samples from more than 1,100 women aged between 18 and 76 years. Within this group, 11% had a body mass index greater than 30, which classified them as clinically obese. About 18% were active smokers.

The researchers sequenced the DNA of the women's white blood cells to find the length of their telomeres. Overall, they found that a woman's telomeres shorten by about 27 base pairs a year; a base pair being a single letter of DNA in your genetic sequence. But heavy smokers wore an additional 200 base pairs off their telomeres after 40 years of puffing. And obese participants' telomeres were, on average, 240 base pairs shorter than those of their lean counterparts. This ageing effect might help to explain why these women are at a greater risk of age-related health problems such as heart disease. But, Spector adds, it is important to note that the whole body ages faster under this kind of stress, not just the heart.

Q2-1: How is aging measured in this study? (5%)

Q2-2: According to this study, how many years older are obese women and heavy smokers, respectively, compared to others? (8%)

Essay 3 (13%)

Tony Blair may want to stay calm during the British elections: a study of people with cardiac troubles suggests that bursts of anger precede the most dangerous flutters of the heart. Although Prime Minister Blair has no current heart troubles, he had a procedure to correct an irregular heartbeat in October 2004. The results may also hold true for those with healthy hearts, the researchers say.

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To explore how feelings affect heartbeats, Matthew Stopper of the Yale University School of Medicine and his colleagues asked 24 patients with implanted defibrillator devices to keep a diary of their emotions. The patients all had conditions that can disrupt electrical signals to the heart, causing an unhealthy quivering of the muscles. This in turn can lead to a cardiac arrest. Their implanted defibrillators are designed to detect these abnormalities and deliver a life-saving electric shock to put their hearts back in the right rhythm.

After receiving such a shock, participants in the study rated how angry they had felt beforehand on a scale of 1 to 5. The medical team then retrieved information from the defibrillator devices to see how their hearts had gone wrong. Out of the 56 shocks recorded during the study, the researchers found that in 100% of cases where people reported anger levels above 2, the arrhythmias were initiated by a series of rapid, premature heart contractions. This type of contraction is known to put an individual at greater risk of sudden arrest. In contrast, only 68% of arrhythmias not preceded by angry feeling had this characteristic.

Q3-1: What does electric shock do to these patients? (3%)

Q3-2: What are the major findings (7%) and the implications (3%) of this study?

Essay 4 (16%)

A new discovery seems to settle the question of how pigeons (*Columba livia*) have such an impressive 'nose for north'. Some experts had previously suggested that the birds rely on different odour cues in the atmosphere to work out where they are. But the latest findings suggest that they are using magnetic cues.

The idea that pigeons' beaks contain tiny particles of an iron oxide called magnetite is not a new one, says Cordula Mora, who led the latest study at the University of Auckland, New Zealand. But the particles themselves are likely to be only a few micrometres across, and no one has ever seen them under the microscope. Mora's behavioural experiments therefore give the best indication yet that pigeons are aware of Earth's magnetic field. She and her colleagues taught the pigeons to discriminate between magnetic fields by placing them in a wooden tunnel with a feeder platform at either end and coils of wire around the outside.

The pigeons were trained to go to one end of the tunnel if the coils were switched on, generating a magnetic field, and to the other if they were switched off, leaving Earth's natural field unperturbed. "I was pleasantly surprised. The pigeons were very fast learners," says Mora. Their skills were impaired, however, when the researchers attached magnets to

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their upper beaks, and also when the upper beak was anaesthetized. This suggests that their ability is down to the presence of magnetically sensitive material in this area. The team then set about seeing how these magnetic signals might be transmitted to the birds' brains. When they severed the ophthalmic branch of the trigeminal nerve, which leads from the upper beak to the brain, the birds were unable to distinguish between natural and perturbed magnetic fields. But when the olfactory nerve, which carries smell signals, was cut instead, the birds performed fine, dealing a seemingly fatal blow to the idea that they navigate by relying on odours.

The results sit well with previous studies of another impressive navigator, the rainbow trout. The species both seem to have a system in which signals from magnetite particles are carried from the nose to the brain by the trigeminal nerve, says Mora. This is not surprising, she says, as iron-containing materials are common in many animals' bodies.

Q4-1: Which evidence demonstrates that magnetic particle is responsible for pigeons' homing activity? (10%)

Q4-2: What are common between pigeons and rainbow trout? (6%)

Essay 5 (15%)

Bacteria often develop resistance to antibiotics by, for example, mutating the part of them that the drug is targeting or gaining the gene for an enzyme to neutralize the drug. Whereas treatment kills off most of the cells, any resistant organisms quickly flourish and become dominant.

The most common way for resistance genes to spread is on small loops of DNA called plasmids, which are separate from the organism's genome and can spread quickly from one cell to another. Because the majority of useful antibiotics are variations on just three ways of killing bacteria, a plasmid containing one or more resistance genes can render a whole class of drugs useless.

Paul Hergenrother, a chemist at the University of Illinois, Urbana-Champaign, has found a way to evict plasmids from antibiotic-resistant bacteria, leaving the microbes open to attack from conventional drugs. His team used a molecule called apramycin, which mimics a short section of RNA. This molecule interrupts the plasmid's replication by sticking to RNA strands that carry its genetic information. This 'blocks' the strands, at which point the host bacterium categorizes the plasmid as a foreign body and ejects it. The team tested its chemical weapon on *Escherichia coli* bacteria that harboured a plasmid that made them resistant to the antibiotic ampicillin. The researchers found that the bacteria lost their

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protective plasmid and were quickly killed off by ampicillin.

Q5-1: What is the best title for this article? (5%)

Q5-2: How does apramycin overcome drug resistance of bacteria? (10%)

Essay 6 (18%)

A simple blood check that can detect some rare but devastating disorders is being trialled in New York state as a screening test for newborns. The test is for progressive, genetic diseases known as 'lysosomal storage disorders'. These conditions can cause symptoms from gross enlargement of the liver to mental retardation. Some 40-50 of the disorders are known, and in total they affect 1 in 5,000 people. Gaucher disease, one of the more common afflictions, affects a little more than 1 in 1,000 Ashkenazi Jews.

Lysosomes are small compartments within cells that help to recycle waste cellular material within the body. Enzymes within the lysosomes do this job by breaking up waste materials into smaller pieces. If one of these enzymes is not functioning, usually because of a problem in the gene that codes for it, then the breakdown stops and half-digested matter clogs up the cell with disastrous consequences. Newborn babies with these diseases can be healthy, because there has been little time for this material to build up. Blood tests are available for cases where lysosomal diseases are suspected. But doctors are keen to find a way to diagnose the disorders before problems begin, so that treatment, if it exists for the specific condition, can start early.

A tiny bit of blood taken from a routine heel-prick is treated so that the enzymes pop out of the cell membranes, then is presented with doses of the kinds of molecules the enzymes were born to cleave. The result is run through a mass spectrometer in tandem with a mixture of molecules of known sizes. A healthy baby's blood should produce a clean set of twin peaks, one for the enzyme product and one for a matching molecule of known similar size. If a twin peak is missing, the baby is probably lacking an enzyme.

The methodology isn't very complicated and should be quite cheap: the group estimates that a single machine should be able to process 85,000 screenings a year. This would be enough to cover the state of Washington, for example. A screening, which could look for up to 20 different enzymes at a time, should cost as little as five cents after the purchase of a suitable mass spectrometer, they say.

Q6-1: Why are doctors eager to make early diagnosis for lysosomal storage disorders? (8%)

Q6-2: How does this method detect an abnormal enzyme? (5%)

Q6-3: What are the advantages of this new test other than early diagnosis,? (5%)

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Essay 7 (13%)

Most people understand that the proverb 'The grass is always greener on the other side' has a deeper, more general meaning: someone else's situation always looks more attractive than your own. But people with defects in a small area of the cerebral cortex called the left angular gyrus take such sentences literally, US researchers have found. They say that the walnut-sized area, located above and behind the left ear, is needed to understand the deeper meaning behind proverbs and metaphors.

Although the area is not the only part of the brain involved in processing metaphors, "it's the main player of the orchestra", says Vilayanur Ramachandran of the University of California, San Diego. Ramachandran and his colleagues studied four patients who had a defect in the left angular gyrus as a result of a stroke or tumour, but were otherwise normal. They asked them to explain the deeper meaning behind 20 proverbs and metaphors. The patients took most of the phrases literally, whereas three patients with lesions in different brain areas correctly interpreted the deeper meaning.

When asked, for example, about the meaning behind 'All that glitters is not gold', one person with a deficient left angular gyrus said, "The deep meaning is that we have to be very careful when buying jewellery."

Ramachandran says it makes sense that the gyrus is involved in understanding metaphors. It is located next to areas of the cortex that process hearing, vision and touch, making it a good candidate for integrating completely different sensations and extracting a common, abstract meaning from them. To test this prediction, Ramachandran's team tested the patients' ability to translate one kind of sensory information into another, such as shapes into sounds. They found that the patients couldn't associate an image of sawtooths with the sound 'rrrrrrr' or an image of speckled dots with the sound 'shhhhhh'. Normal people can make the connection between the sensations, even though they have nothing more in common than the abstract concept of jaggedness or fuzziness.

This suggests that the left angular gyrus helps humans to think in abstract terms. The area is much larger in humans than in other primates, says Ramachandran. "Any monkey or ape can reach for a peanut," he says, "but only humans can reach for the stars, or even understand what that means."

Q7-1: How does the left angular gyrus function? (10%)

Q7-2: Where is the left angular gyrus located? (3%)