

IELTS READING COURSE

Homework Collection

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Lưu ý:

- Phần key (đáp án) của các bài tập, bạn có thể xem trên hệ thống học tập của khóa học và ngoài đáp án này sẽ có video giải thích chi tiết bài tập, các bài dịch cho passage và bảng từ khóa và bài tập tương tác với từ khóa (nếu có). Do đó, bạn hãy đăng nhập vào hệ thống nhé.
- Ngoài một số bài tập ở đây, có một số trường hợp mình có thêm một số bài tập hay bài giảng nhưng không kịp cập nhật bài tập vào trong tài liệu này. Khi học trên hệ thống, mình sẽ có link để bạn tải các bài tập đó nhé. Vì khóa học luôn cập nhật nên mình sẽ không thể update liên tục vào file này được, mong bạn thông cảm.
- Tài liệu này được sử dụng và lưu hành nội bộ. Vui lòng không sử dụng cho mục đích thương mại.
- Tài liệu sử dụng nội dung từ cuốn sách IELTS Cambirdge và một số tài liệu khác.

HOME WORK

PHÂN TÍCH TỪ KHÓA

HOMework

Marie Curie's research on radioactivity

- When uranium was discovered to be radioactive, Marie Curie found that the element called 7 had the same property.
- Marie and Pierre Curie's research into the radioactivity of the mineral known as 8 led to the discovery of two new elements.
- In 1911, Marie Curie received recognition for her work on the element 9
- Marie and Irene Curie developed X-radiography which was used as a medical technique for 10
- Marie Curie saw the importance of collecting radioactive material both for research and for cases of 11
- The radioactive material stocked in Paris contributed to the discoveries in the 1930s of the 12 and of what was known as artificial radioactivity.
- During her research, Marie Curie was exposed to radiation and as a result she suffered from 13

HOME WORK

SCAN & SKIM

HOMework 01

Xác định các loại keywords trong các câu hỏi sau và xác định vị trí của chúng trong bài đọc dưới đây

Questions 7 – 10

Look at the following items (Questions 7-10) and the list of groups below.

Match each item with the group which first invented or used them.

Write the correct letter A-E in boxes 7-10 on your answer sheet.

NB You may use any letter more than once.

7 black powder

8 rocket-propelled arrows for fighting

9 rockets as war weapons

10 the rocket launcher

First invented or used by

A the Chinese

B the Indians

C the British

D the Arabs

E the Americans

The invention of rockets is linked inextricably with the invention of 'black powder'. Most historians of technology credit the Chinese with its discovery. They base their belief on studies of Chinese writings or on the notebooks of early Europeans who settled in or made long visits to China to study its history and civilisation. It is probable that, some time in the tenth century, black powder was first compounded from its basic ingredients of saltpetre, charcoal and sulphur. But this does not mean that it was immediately used to propel rockets. By the thirteenth century, powder propelled fire arrows had become rather common. The Chinese relied on this type of technological development to produce incendiary projectiles of many sorts, explosive grenades and possibly cannons to repel their enemies. One such weapon was the 'basket of fire' or, as directly translated from Chinese, the 'arrows like flying leopards'. The 0.7 metre-long arrows, each with a long tube of gunpowder attached near the point of each arrow, could be fired from a long, octagonal-shaped basket at the same time and had a range of 400 paces. Another weapon was the 'arrow as a flying sabre', which could be fired from crossbows. The rocket, placed in a similar position to other rocket-propelled arrows, was designed to increase the range. A small iron weight was

attached to the 1.5m bamboo shaft, just below the feathers, to increase the arrow's stability by moving the centre of gravity to a position below the rocket. At a similar time, the Arabs had developed the 'egg which moves and burns'. This 'egg' was apparently full of gunpowder and stabilised by a 1.5m tail. It was fired using two rockets attached to either side of this tail.

It was not until the eighteenth century that Europe became seriously interested in the possibilities of using the rocket itself as a weapon of war and not just to propel other weapons. Prior to this, rockets were used only in pyrotechnic displays. The incentive for the more aggressive use of rockets came not from within the European continent but from far-away India, whose leaders had built up a corps of rocketeers and used rockets successfully against the British in the late eighteenth century. The Indian rockets used against the British were described by a British Captain serving in India as 'an iron envelope about 200 millimetres long and 40 millimetres in diameter with sharp points at the top and a 3m-long bamboo guiding stick'. In the early nineteenth century the British began to experiment with incendiary barrage rockets. The British rocket differed from the Indian version in that it was completely encased in a stout, iron cylinder, terminating in a conical head, measuring one metre in diameter and having a stick almost five metres long and constructed in such a way that it could be firmly attached to the body of the rocket. The Americans developed a rocket, complete with its own launcher, to use against the Mexicans in the mid-nineteenth century. A long cylindrical tube was propped up by two sticks and fastened to the top of the launcher, thereby allowing the rockets to be inserted and lit from the other end. However, the results were sometimes not that impressive as the behaviour of the rockets in flight was less than predictable.

HOMework 02

Xác định các loại keywords trong các câu hỏi sau và xác định vị trí của chúng trong bài đọc dưới đây

Questions 1 and 2

Choose **TWO** letters, A-G.

Write the correct letters in boxes 1 and 2 on your answer sheet.

The list below gives some of the advantages of employing older workers.

Which **TWO** advantages are mentioned by the writer of the text?

- A They are less likely to be involved in careless accidents.
- B They can predict areas that may cause trouble in the future.
- C They are able to train younger workers.
- D They can deal with unexpected problems.
- E They are more conscientious.
- F They are prepared to work for lower salaries.
- G They are more skilled in personal relationships.

Questions 3 and 4

Choose **TWO** letters, A-F.

Write the correct letters in boxes 3 and 4 on your answer sheet.

The list below gives some of the disadvantages of employing younger workers.

Which **TWO** disadvantages are mentioned by the writer of the text?

- A They are too confident of their own skills.
- B They may injure themselves.
- C They do not stay with the same company for very long.
- D Their training has been too theoretical.
- E They are not as well educated as older workers.
- F They demand higher salaries.

Clearly, when older people do heavy physical work, their age may affect their productivity. But other skills may increase with age, including many that are crucial for good management, such as an ability to handle people diplomatically, to run a meeting or to spot a problem before it blows up. Peter Hicks, who co-ordinates OECD work on the policy implications of ageing, says that plenty of research suggests older people are paid more because they are worth more.

And the virtues of the young may be exaggerated. 'The few companies that have kept on older workers find they have good judgement and their productivity is good,' says Peter Peterson, author of a recent book on the impact of ageing. 'Besides, their education standards are much better than those of today's young high-school graduates.' Companies may say that older workers are not worth training because they are reaching the end of their working lives; in fact, young people tend to switch jobs so frequently that they offer the worst returns on training. The median age for employer-driven training is the late 40s and early 50s, and this training goes mainly to managers.

HOME WORK

GAP FILLING

HOMework 01

Questions 1-7

Complete the sentences below.

Choose **NO MORE THAN TWO WORDS** from the passage for each answer.

Write your answers in boxes 1-7 on your answer sheet.

Indoor farming

- 1 Some food plants, including _____ are already grown indoors.
- 2 Vertical farms would be located in _____ meaning that there would be less need to take them long distances to customers.
- 3 Vertical farms could use methane from plants and animals to produce _____
- 4 The consumption of _____ would be cut because agricultural vehicles would be unnecessary.
- 5 The fact that vertical farms would need _____ light is a disadvantage.
- 6 One form of vertical farming involves planting in _____ which are not fixed.
- 7 The most probable development is that food will be grown on _____ in towns and cities.

The concept of indoor farming is not new, since hothouse production of tomatoes and other produce has been in vogue for some time. What is new is the urgent need to scale up this technology to accommodate another three billion people. Many believe an entirely new approach to indoor farming is required, employing cutting-edge technologies. One such proposal is for the 'Vertical Farm'. The concept is of multi-storey buildings in which food crops are grown in environmentally controlled conditions. Situated in the heart of urban centres, they would drastically reduce the amount of transportation required to bring food to consumers. Vertical farms would need to be efficient, cheap to construct and safe to operate. If successfully implemented, proponents claim, vertical farms offer the promise of urban renewal, sustainable production of a safe and varied food supply (through year-round production of all crops), and the eventual repair of ecosystems that have been sacrificed for horizontal farming.

The supporters of vertical farming claim many potential advantages for the system. For instance, crops would be produced all year round, as they would be kept in artificially controlled, optimum growing conditions. There would be no weather-related crop failures due to droughts, floods or pests. All the food could be grown organically, eliminating the need for herbicides, pesticides and fertilisers. The system would greatly reduce the

incidence of many infectious diseases that are acquired at the agricultural interface. Although the system would consume energy, it would return energy to the grid via methane generation from composting non-edible parts of plants. It would also dramatically reduce fossil fuel use, by cutting out the need for tractors, ploughs and shipping.

A major drawback of vertical farming, however, is that the plants would require artificial light. Without it, those plants nearest the windows would be exposed to more sunlight and grow more quickly, reducing the efficiency of the system. Single-storey greenhouses have the benefit of natural overhead light; even so, many still need artificial lighting. A multi-storey facility with no natural overhead light would require far more. Generating enough light could be prohibitively expensive, unless cheap, renewable energy is available, and this appears to be rather a future aspiration than a likelihood for the near future.

One variation on vertical farming that has been developed is to grow plants in stacked trays that move on rails. Moving the trays allows the plants to get enough sunlight. This system is already in operation, and works well within a single-storey greenhouse with light reaching it from above: it is not certain, however, that it can be made to work without that overhead natural light.

Vertical farming is an attempt to address the undoubted problems that we face in producing enough food for a growing population. At the moment, though, more needs to be done to reduce the detrimental impact it would have on the environment, particularly as regards the use of energy. While it is possible that much of our food will be grown in skyscrapers in future, most experts currently believe it is far more likely that we will simply use the space available on urban rooftops.

HOMework 02

Questions 4-10

Complete the table below.

Choose **ONE WORD** from the passage for each answer. Write your answers in boxes **4 - 10** on your answer sheet.

GEO-ENGINEERING PROJECTS

Procedure	Aim
put a large number of tiny spacecraft into orbit far above Earth	to create a 4 that would reduce the amount of light reaching Earth
place 5 in the sea	to encourage 6 to form
release aerosol sprays into the stratosphere	to create 7 that would reduce the amount of light reaching Earth
fix strong 8 to Greenland ice sheets	to prevent icebergs moving into the sea
plant trees in Russian Arctic that would lose their leaves in winter	to allow the 9 to reflect radiation

change the direction of 10	to bring more cold water into ice-forming areas
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B

Geo-engineering has been shown to work, at least on a small localised scale. For decades, MayDay parades in Moscow have taken place under clear blue skies, aircraft having deposited dry ice, silver iodide and cement powder to disperse clouds. Many of the schemes now suggested look to do the opposite, and reduce the amount of sunlight reaching the planet. The most eye-catching idea of all is suggested by Professor Roger Angel of the University of Arizona. His scheme would employ up to 16 trillion minute spacecraft, each weighing about one gram, to form a transparent, sunlight-refracting sunshade in an orbit 1.5 million km above the Earth. This could, argues Angel, reduce the amount of light reaching the Earth by two per cent.

C

The majority of geo-engineering projects so far carried out – which include planting forests in deserts and depositing iron in the ocean to stimulate the growth of algae - have focused on achieving a general cooling of the Earth. But some look specifically at reversing the melting at the poles, particularly the Arctic. The reasoning is that if you replenish the ice sheets and frozen waters of the high latitudes, more light will be reflected back into space, so reducing the warming of the oceans and atmosphere.

D

The concept of releasing aerosol sprays into the stratosphere above the Arctic has been proposed by several scientists. This would involve using sulphur or hydrogen sulphide aerosols so that sulphur dioxide would form clouds, which would, in turn, lead to a global dimming. The idea is modelled on historic volcanic explosions, such as that of Mount Pinatubo in the Philippines in 1991, which led to a short-term cooling of global temperatures by 0.5 °C.

Scientists have also scrutinised whether it's possible to preserve the ice sheets of Greenland with reinforced high-tension cables, preventing icebergs from moving into the sea. Meanwhile in the Russian Arctic, geo-engineering plans include the planting of millions of birch trees. Whereas the -regions native evergreen pines shade the snow and absorb radiation, birches would shed their leaves in winter, thus enabling radiation to be reflected by the snow. Re-routing Russian rivers to increase cold water flow to ice-forming areas could also be used to slow down warming, say some climate scientists.

HOMework 03

Questions 8-11

Complete the summary below.

Choose **ONE WORD ONLY** from the passage for each answer.

Write your answers in boxes 8-11 on your answer sheet.

Jared Diamond's View

Diamond believes that the Polynesian settlers on Rapa Nui destroyed its forests, cutting down its trees for fuel and clearing land for 8 Twentieth-century discoveries of pollen prove that Rapa Nui had once been covered in palm forests, which had turned into grassland by the time the Europeans arrived on the island. When the islanders were no longer able to build the 9 they needed to go fishing, they began using the island's 10 as a food source, according to Diamond. Diamond also claims that the moai were built to show the power of the island's chieftains, and that the methods of transporting the statues needed not only a great number of people, but also a great deal of 11

B

When the Europeans arrived, Rapa Nui was grassland, with only a few scrawny trees. In the 1970s and 1980s, though, researchers found pollen preserved in lake sediments, which proved the island had been covered in lush palm forests for thousands of years. Only after the Polynesians arrived did those forests disappear. US scientist Jared Diamond believes that the Rapanui people - descendants of Polynesian settlers - wrecked their own environment. They had unfortunately settled on an extremely fragile island - dry, cool, and too remote to be properly fertilised by windblown volcanic ash. When the islanders cleared the forests for firewood and farming, the forests didn't grow back. As trees became scarce and they could no longer construct wooden canoes for fishing, they ate birds. Soil erosion decreased their crop yields. Before Europeans arrived, the Rapanui had descended into civil war and cannibalism, he maintains. The collapse of their isolated civilisation, Diamond writes, is a 'worst-case scenario for what may lie ahead of us in our own future'.

C

The moai, he thinks, accelerated the self-destruction. Diamond interprets them as power displays by rival chieftains who, trapped on a remote little island, lacked other ways of asserting their dominance. They competed by building ever bigger figures. Diamond thinks they laid the moai on wooden sledges, hauled over log rails, but that required both a lot of wood and a lot of people. To feed the people, even more land had to be cleared. When the wood was gone and civil war began, the islanders began toppling the moai. By the nineteenth century none were standing.

HOMework 04

Questions 5-7

Complete the summary using the list of words, A-H, below.

Write the correct letters, A-H, in boxes 5-7 on your answer sheet.

Art and the Brain

The discipline of neuroaesthetics aims to bring scientific objectivity to the study of art. Neurological studies of the brain, for example, demonstrate the impact which Impressionist paintings have on our **5** Alex Forsythe of the University of Liverpool believes many artists give their works the precise degree of **6** which most appeals to the viewer's brain. She also observes that pleasing works of art often contain certain repeated **7** which occur frequently in the natural world.

A. interpretation

B. complexity

C. emotions

D. movements

E. skill

F. layout

G. concern

H. images

An emerging discipline called neuroaesthetics is seeking to bring scientific objectivity to the study of art, and has already given us a better understanding of many masterpieces. The blurred imagery of Impressionist paintings seems to stimulate the brain's amygdala, for instance. Since the amygdala plays a crucial role in our feelings, that finding might explain why many people find these pieces so moving.

In another experiment, Alex Forsythe of the University of Liverpool analysed the visual intricacy of different pieces of art, and her results suggest that many artists use a key level of detail to please the brain. Too little and the work is boring, but too much results in a kind of 'perceptual overload', according to Forsythe. What's more, appealing pieces both abstract and representational, show signs of 'fractals' - repeated motifs recurring in different scales, fractals are common throughout nature, for example in the shapes of mountain peaks or the branches of trees. It is possible that our visual system, which evolved in the great outdoors, finds it easier to process such patterns.

HOMework 05

Questions 1-9

Complete the notes below.

Choose **ONE WORD ONLY** from the passage for each answer.

Write your answers in boxes 1-9 on your answer sheet.

Early silk production in China

- Around 3000 BC, according to legend:
 - silkworm cocoon fell into emperor's wife's **1**
 - emperor's wife invented a **2** to pull out silk fibres
- Only **3** were allowed to produce silk
- Only **4** were allowed to wear silk
- Silk used as a form of **5**
- e.g. farmers' taxes consisted partly of silk
- Silk used for many purposes
 - e.g. evidence found of **6** made from silk around 168 AD

Silk reaches rest of world

- Merchants use Silk Road to take silk westward and bring back **7** and precious metals
- 550 AD: **8** hide silkworm eggs in canes and take them to Constantinople
- Silk production spreads across Middle East and Europe
- 20th century: **9** and other manmade fibres cause decline in silk production

The story of silk

The history of the world's most luxurious fabric, from ancient China to the present day

Silk is a fine, smooth material produced from the cocoons - soft protective shells - that are made by mulberry silkworms (insect larvae). Legend has it that it was Lei Tzu, wife of the Yellow Emperor, ruler of China in about 3000 BC, who discovered silkworms. One account of the story goes that as she was taking a walk in her husband's gardens, she discovered that

silkworms were responsible for the destruction of several mulberry trees. She collected a number of cocoons and sat down to have a rest. It just so happened that while she was sipping some tea, one of the cocoons that she had collected landed in the hot tea and started to unravel into a fine thread. Lei Tzu found that she could wind this thread around her fingers. Subsequently, she persuaded her husband to allow her to rear silkworms on a grove of mulberry trees. She also devised a special reel to draw the fibres from the cocoon into a single thread so that they would be strong enough to be woven into fabric. While it is unknown just how much of this is true, it is certainly known that silk cultivation has existed in China for several millennia.

Originally, silkworm farming was solely restricted to women, and it was they who were responsible for the growing, harvesting and weaving. Silk quickly grew into a symbol of status, and originally, only royalty were entitled to have clothes made of silk. The rules were gradually relaxed over the years until finally during the Qing Dynasty (1644–1911 AD), even peasants, the lowest caste, were also entitled to wear silk. Sometime during the Han Dynasty (206 BC–220 AD), silk was so prized that it was also used as a unit of currency. Government officials were paid their salary in silk, and farmers paid their taxes in grain and silk. Silk was also used as diplomatic gifts by the emperor. Fishing lines, bowstrings, musical instruments and paper were all made using silk. The earliest indication of silk paper being used was discovered in the tomb of a noble who is estimated to have died around 168 AD.

Demand for this exotic fabric eventually created the lucrative trade route now known as the Silk Road, taking silk westward and bringing gold, silver and wool to the East. It was named the Silk Road after its most precious commodity, which was considered to be worth more than gold. The Silk Road stretched over 6,000 kilometres from Eastern China to the Mediterranean Sea, following the Great Wall of China, climbing the Pamir mountain range, crossing modern-day Afghanistan and going on to the Middle East, with a major trading market in Damascus. From there, the merchandise was shipped across the Mediterranean Sea. Few merchants travelled the entire route; goods were handled mostly by a series of middlemen.

With the mulberry silkworm being native to China, the country was the world's sole producer of silk for many hundreds of years. The secret of silk-making eventually reached the rest of the world via the Byzantine Empire, which ruled over the Mediterranean region of southern Europe, North Africa and the Middle East during the period 330–1453 AD. According to another legend, monks working for the Byzantine emperor Justinian smuggle silkworm eggs to Constantinople (Istanbul in modern-day Turkey) in 550 AD, concealed inside hollow bamboo walking canes. The Byzantines were as secretive as the Chinese, however, and for many centuries the weaving and trading of silk fabric was a strict imperial monopoly. Then in the seventh century, the Arabs conquered Persia, capturing their magnificent silks in the process. Silk production thus spread through Africa, Sicily and Spain as the Arabs swept, through these lands. Andalusia in southern Spain was Europe's main silk-producing centre in the tenth century. By the thirteenth century, however, Italy had become Europe's leader in silk production and export. Venetian merchants traded extensively in silk and encouraged silk growers to settle in Italy. Even now, silk processed in the province of Como in northern Italy enjoys an esteemed reputation.

The nineteenth century and industrialisation saw the downfall of the European silk industry. Cheaper Japanese silk, trade in which was greatly facilitated by the opening of the Suez Canal, was one of the many factors driving the trend. Then in the twentieth century, new manmade fibres, such as nylon, started to be used in what had traditionally been silk products, such as stockings and parachutes. The two world wars, which interrupted the supply of raw material from Japan, also stifled the European silk industry. After the Second World War, Japan's silk production was restored, with improved production and quality of raw silk. Japan was to remain the world's biggest producer of raw silk, and practically the only major exporter of raw silk, until the 1970s. However, in more recent decades, China has gradually recaptured its position as the world's biggest producer and exporter of raw silk and silk yarn. Today, around 125,000 metric tons of silk are produced in the world, and almost two thirds of that production takes place in China.

HOMework 06

Questions 10-13

Complete the summary below.

Choose **ONE WORD ONLY** from the passage for each answer.

Write your answers in boxes 10-13 on your answer sheet.

The migration of pronghorns

Pronghorns rely on their eyesight and **10** to avoid predators. One particular population's summer habitat is a national park, and their winter home is on the **11** where they go to avoid the danger presented by the snow at that time of year. However, their route between these two areas contains three **12** One problem is the construction of new homes in a narrow **13** of land on the pronghorns' route.

Human behaviour, however, is having a detrimental impact on animal migration. The pronghorn, which resembles an antelope, though they are unrelated, is the fastest land mammal of the New World. One population, which spends the summer in the mountainous Grand Teton National Park of the western USA, follows a narrow route from its summer range in the mountains, across a river, and down onto the plains. Here they wait out the frozen months, feeding mainly on sagebrush blown clear of snow. These pronghorn are notable for the invariance of their migration route and the severity of its constriction at three bottlenecks. If they can't pass through each of the three during their spring migration, they can't reach their bounty of summer grazing; if they can't pass through again in autumn, escaping south onto those windblown plains, they are likely to die trying to overwinter in the deep snow. Pronghorn, dependent on distance vision and speed to keep safe from predators, traverse high, open shoulders of land, where they can see and run. At one of the bottlenecks, forested hills rise to form a V, leaving a corridor of open ground only about 150 metres wide, filled with private homes. Increasing development is leading toward a crisis for the pronghorn, threatening to choke off their passageway.

HOMework 07

Questions 9-14

Complete the sentences below.

Choose **ONE WORD ONLY** from the passage for each answer.

Write your answers in boxes 9-14 on your answer sheet.

- 9 Some areas of both music and mathematics are suitable for someone who is a
- 10 It is sometimes possible to understand advanced mathematics using no more than a limited knowledge of
- 11 The writer intends to show that mathematics requires thinking, as well as analytical skills.
- 12 Some books written by have had to leave out the mathematics that is central to their theories.
- 13 The writer advises non-mathematical readers to perform while reading
- 14 A lawyer found that studying helped even more than other areas of mathematics in the study of law.

A

Occasionally, in some difficult musical compositions, there are beautiful, but easy parts - parts so simple a beginner could play them. So it is with mathematics as well. There are some discoveries in advanced mathematics that do not depend on specialized knowledge, not even on algebra, geometry, or trigonometry. Instead they may involve, at most, a little arithmetic, such as 'the sum of two odd numbers is even', and common sense. Each of the eight chapters in this book illustrates this phenomenon. Anyone can understand every step in the reasoning.

The thinking in each chapter uses at most only elementary arithmetic, and sometimes not even that. Thus all readers will have the chance to participate in a mathematical experience, to appreciate the beauty of mathematics, and to become familiar with its logical, yet intuitive, style of thinking.

D

Other scientists have written books to explain their fields to non-scientists, but have necessarily had to omit the mathematics, although it provides the foundation of their theories.

The reader must remain a tantalized spectator rather than an involved participant, since the appropriate language for describing the details in much of science is mathematics, whether the subject is expanding universe, subatomic particles, or chromosomes. Though the broad outline of a scientific theory can be sketched intuitively, when a part of the physical universe is finally understood, its description often looks like a page in a mathematics text.

E

Still, the non-mathematical reader can go far in understanding mathematical reasoning. This book presents the details that illustrate the mathematical style of thinking, which involves sustained, step-by-step analysis, experiments, and insights. You will turn these pages much more slowly than when reading a novel or a newspaper. It may help to have a pencil and paper ready to check claims and carry out experiments.

G

A physician wrote, the discipline of analytical thought processes [in mathematics] prepared me extremely well for medical school. In medicine one is faced with a problem which must be thoroughly analyzed before a solution can be found. The process is similar to doing mathematics.'

A lawyer made the same point, "Although I had no background in law - not even one political science course — I did well at one of the best law schools. I attribute much of my success there to having learned, through the study of mathematics, and, in particular, theorems, how to analyze complicated principles. Lawyers who have studied mathematics can master the legal principles in a way that most others cannot.'

I hope you will share my delight in watching as simple, even naive, questions lead to remarkable solutions and purely theoretical discoveries find unanticipated applications.

HOME WORK

LABELLING

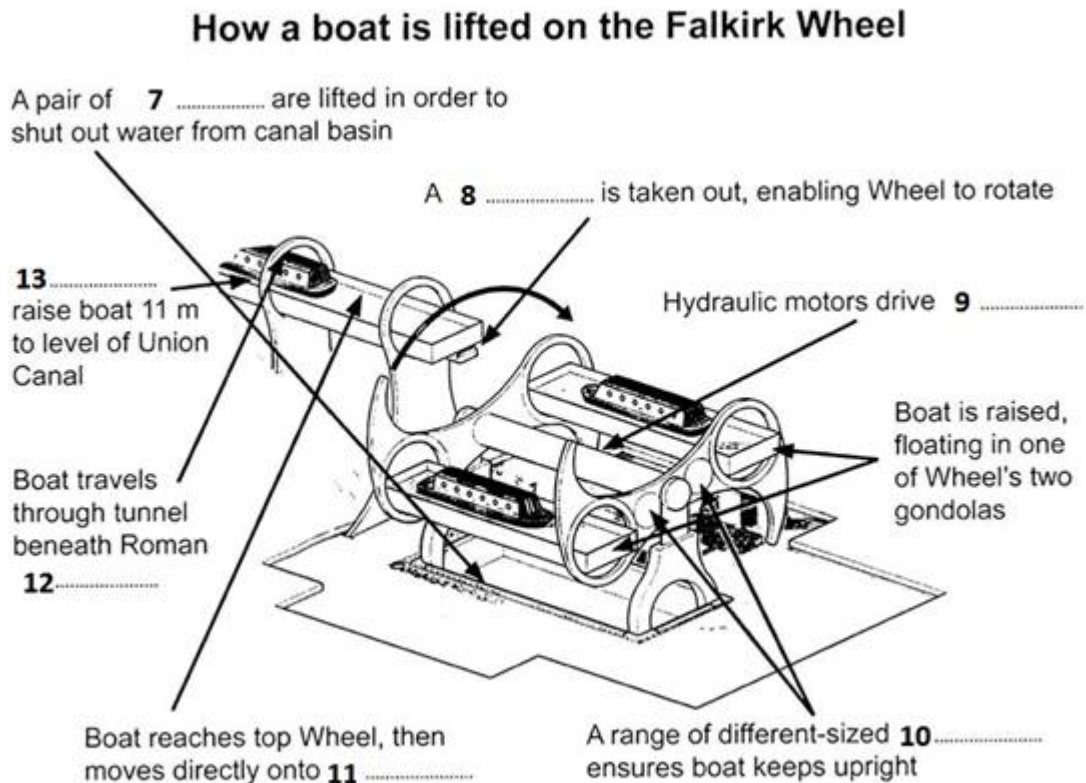
HOMEWORK 01

Questions 7-13

Label the diagram below.

Choose **ONE WORD** from the passage for each answer.

Write your answers in boxes 7-13 on your answer sheet.



Boats needing to be lifted up enter the canal basin at the level of the Forth & Clyde Canal and then enter the lower gondola of the Wheel. Two hydraulic steel gates are raised, so as to seal the gondola off from the water in the canal basin. The water between the gates is then pumped out. A hydraulic clamp, which prevents the arms of the Wheel moving while the gondola is docked, is removed, allowing the Wheel to turn. In the central machine room an array of ten hydraulic motors then begins to rotate the central axle. The axle connects to the outer arms of the Wheel, which begin to rotate at a speed of 1/8 of a revolution per minute. As the wheel rotates, the gondolas are kept in the upright position by a simple gearing system. Two eight-metre-wide cogs orbit a fixed inner cog of the same width, connected by two smaller cogs travelling in the opposite direction to the outer cogs - so ensuring that the gondolas always remain level. When the gondola reaches the top, the boat passes straight onto the aqueduct situated 24 metres above the canal basin.

The remaining 11 metres of lift needed to reach the Union Canal is achieved by means of a pair of locks. The Wheel could not be constructed to elevate boats over the full 35-metre

difference between the two canals, owing to the presence of the historically important Antonine Wall, which was built by the Romans in the second century AD. Boats travel under this wall via a tunnel, then through the locks, and finally on to the Union Canal.

HOMEWORK 02

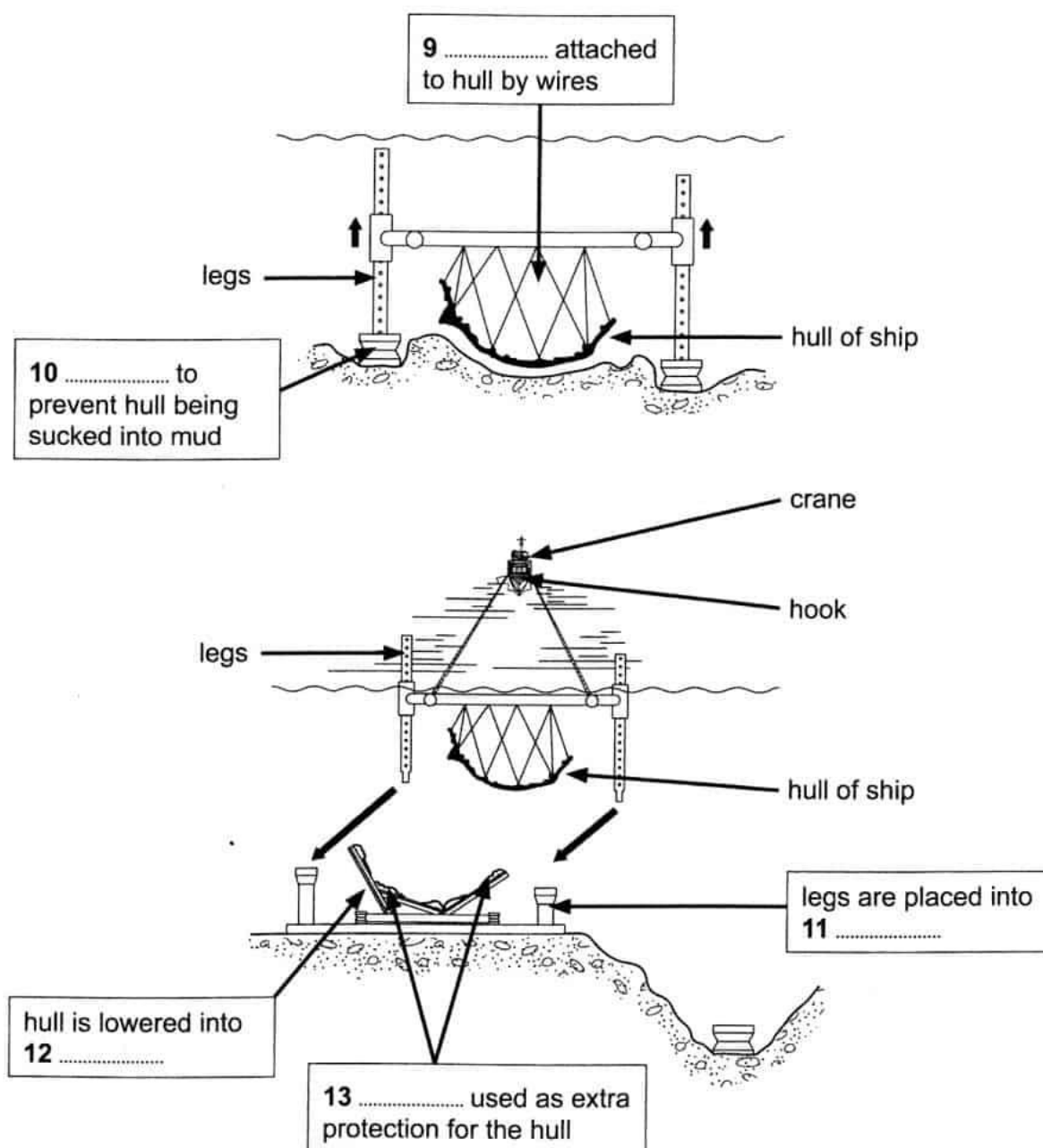
Questions 9-13

Label the diagram below.

Choose **NO MORE THAN TWO WORDS** from the passage for each answer.

Write your answers in boxes 9-13 on your answer sheet.

Raising the hull of the *Mary Rose*: Stages one and two



An important factor in trying to salvage the Mary Rose was that the remaining hull was an open shell. This led to an important decision being taken: namely to carry out the lifting operation in three very distinct stages. The hull was attached to a lifting frame via a network of bolts and lifting wires. The problem of the hull being sucked back downwards into the mud was overcome by using 12 hydraulic jacks. These raised it a few centimetres over a period of several days, as the lifting frame rose slowly up its four legs. It was only when the hull was hanging freely from the lifting frame, clear of the seabed and the suction effect of the surrounding mud, that the salvage operation progressed to the second stage. In this stage, the lifting frame was fixed to a hook attached to a crane, and the hull was lifted completely clear of the seabed and transferred underwater into the lifting cradle. This required precise positioning to locate the legs into the stabbing guides of the lifting cradle. The lifting cradle was designed to fit the hull using archaeological survey drawings, and was fitted with air bags to provide additional cushioning for the hull's delicate timber framework. The third and final stage was to lift the entire structure into the air, by which time the hull was also supported from below. Finally, on 11 October 1982, millions of people around the world held their breath as the timber skeleton of the Mary Rose was lifted clear of the water, ready to be returned home to Portsmouth.

HOME WORK

SHORT ANSWER

HOMework 01

Questions 5-7

Answer the questions below.

Choose **NO MORE THAN THREE WORDS AND/OR A NUMBER** from the passage for each answer.

Write your answers in boxes 5-7 on your answer sheet.

- 5 What is the life expectancy of Earth?
- 6 What kind of signals from other intelligent civilisations are SETI scientists searching for?
- 7 How many stars are the world's most powerful radio telescopes searching?

A

The primary reason for the search is basic curiosity - the same curiosity about the natural world that drives all pure science. We want to know whether we are alone in the Universe. We want to know whether life evolves naturally if given the right conditions, or whether there is something very special about the Earth to have fostered the variety of life forms that we see around us on the planet. The simple detection of a radio signal will be sufficient to answer this most basic of all questions. In this sense, SETI is another cog in the machinery of pure science which is continually pushing out the horizon of our knowledge. However, there are other reasons for being interested in whether life exists elsewhere. For example, we have had civilization on Earth for perhaps only a few thousand years, and the threats of nuclear war and pollution over the last few decades have told us that our survival may be tenuous. Will we last another two thousand years or will we wipe ourselves out? Since the lifetime of a planet like ours is several billion years, we can expect that, if other civilisations do survive in our galaxy, their ages will range from zero to several billion years. Thus any other civilisation that we hear from is likely to be far older, on average, than ourselves. The mere existence of such a civilisation will tell us that long-term survival is possible, and gives us some cause for optimism. It is even possible that the older civilisations may pass on the benefits of their experience in dealing with threats to survival such as nuclear war and global pollution, and other threats that we haven't yet discovered.

D

An alien civilisation could choose many different ways of sending information across the galaxy, but many of these either require too much energy, or else are severely attenuated while traversing the vast distances across the galaxy. It turns out that, for a given amount of transmitted power, radio waves in the frequency range 1000 to 3000 MHz travel the greatest distance, and so all searches to date have concentrated on looking for radio waves in this frequency range. So far there have been a number of searches by various groups around the world, including Australian searches using the radio telescope at Parkes, New South Wales. Until now there have not been any detections from the few hundred stars which have been searched. The scale of the searches has been increased dramatically since 1992, when the

US Congress voted NASA \$10 million per year for ten years to conduct a thorough search for extra-terrestrial life. Much of the money in this project is being spent on developing the special hardware needed to search many frequencies at once. The project has two parts. One part is a targeted search using the world's largest radio telescopes, the American-operated telescope in Arecibo, Puerto Rico and the French telescope in Nancy in France. This part of the project is searching the nearest 1000 likely stars with high sensitivity for signals in the frequency range 1000 to 3000 MHz. The other part of the project is an undirected search which is monitoring all of space with a lower sensitivity, using the smaller antennas of NASA's Deep Space Network.

HOMework 02

A

Hearing impairment or other auditory function deficit in young children can have a major impact on their development of speech and communication, resulting in a detrimental effect on their ability to learn at school. This is likely to have major consequences for the individual and the population as a whole. The New Zealand Ministry of Health has found from research carried out over two decades that 6-10% of children in that country are affected by hearing loss.

E

Autism is considered a neurological and genetic life-long disorder that causes discrepancies in the way information is processed. This disorder is characterised by interlinking problems with social imagination, social communication and social interaction. According to Janzen, this affects the ability to understand and relate in typical ways to people, understand events and objects in the environment, and understand or respond to sensory stimuli. Autism does not allow learning or thinking in the same ways as in children who are developing normally.

Autistic spectrum disorders often result in major difficulties in comprehending verbal information and speech processing. Those experiencing these disorders often find sounds such as crowd noise and the noise generated by machinery painful and distressing. This is difficult to scientifically quantify as such extra-sensory stimuli vary greatly from one autistic individual to another. But a child who finds any type of noise in their classroom or learning space intrusive is likely to be adversely affected in their ability to process information.

F

The attention deficit disorders are indicative of neurological and genetic disorders and are characterised by difficulties with sustaining attention, effort and persistence, organisation skills and disinhibition. Children experiencing these disorders find it difficult to screen out unimportant information, and focus on everything in the environment rather than attending to a single activity. Background noise in the classroom becomes a major distraction, which can affect their ability to concentrate.

G

Children experiencing an auditory function deficit can often find speech and communication very difficult to isolate and process when set against high levels of background noise. These levels come from outside activities that penetrate the classroom structure, from teaching activities, and other noise generated inside, which can be exacerbated by room reverberation. Strategies are needed to obtain the optimum classroom construction and perhaps a change in classroom culture and methods of teaching. In particular, the effects of noisy classrooms and activities on those experiencing disabilities in the form of auditory function deficit need thorough investigation. It is probable that many undiagnosed children exist in the education system with 'invisible' disabilities. Their needs are less likely to be met than those of children with known disabilities.

H

The New Zealand Government has developed a New Zealand Disability Strategy and has embarked on a wide-ranging consultation process. The strategy recognises that people experiencing disability face significant barriers in achieving a full quality of life in areas such as attitude, education, employment and access to services. Objective 3 of the New Zealand Disability Strategy is to 'Provide the Best Education for Disabled People' by improving education so that all children, youth learners and adult learners will have equal opportunities to learn and develop within their already existing local school. For a successful education, the learning environment is vitally significant, so any effort to improve this is likely to be of great benefit to all children, but especially to those with auditory function disabilities.

Questions 7-10

Answer the questions below.

Choose **NO MORE THAN TWO WORDS AND/OR A NUMBER** from the passage for each answer.

Write your answers in boxes 7-10 on your answer sheet.

- 7** For what period of time has hearing loss in schoolchildren been studied in New Zealand?
- 8** In addition to machinery noise, what other type of noise can upset children with autism?
- 9** What term is used to describe the hearing problems of schoolchildren which have not been diagnosed?
- 10** What part of the New Zealand Disability Strategy aims to give schoolchildren equal opportunity?

HOME WORK

MATCHING FEATURES

HOMework 01

Questions 12-14

Complete each sentence with the correct ending, A-E, below.

Write the correct letter, A-E, in boxes 12-14 on your answer sheet.

A requires both perceptual and social intelligence skills.

B focuses on how groups decide on an action.

C works in many fields, both artistic and scientific.

D leaves one open to criticism and rejection.

E involves understanding how organisations manage people.

12 Thinking like a successful iconoclast is demanding because it

13 The concept of the social brain is useful to iconoclasts because it

14 Iconoclasts are generally an asset because their way of thinking

Finally, to be successful iconoclasts, individuals must sell their ideas to other people. This is where social intelligence comes in. Social intelligence is the ability to understand and manage people in a business setting. In the last decade there has been an explosion of knowledge about the social brain and how the brain works when groups coordinate decision making. Neuroscience has revealed which brain circuits are responsible for functions like understanding what other people think, empathy, fairness, and social identity. These brain regions play key roles in whether people convince others of their ideas. Perception is important in social cognition too. The perception of someone's enthusiasm, or reputation, can make or break a deal. Understanding how perception becomes intertwined with social decision making shows why successful iconoclasts are so rare.

Iconoclasts create new opportunities in every area from artistic expression to technology to business. They supply creativity and innovation not easily accomplished by committees. Rules aren't important to them. Iconoclasts face alienation and failure, but can also be a major asset to any organization. It is crucial for success in any field to understand how the iconoclastic mind works.

HOMework 02

Questions 7-10

Look at the following findings (Questions 7-10) and the list of researchers below.

Match each finding with the correct researcher or researchers, A-E.

Write the correct letter, A-E, in boxes 7-10 on your answer sheet.

List of Researchers

A James

B Cooley

C Lewis and Brooks-Gunn

D Mead E Bronson

- 7 A sense of identity can never be formed without relationships with other people.
- 8 A child's awareness of self is related to a sense of mastery over things and people.
- 9 At a certain age, children's sense of identity leads to aggressive behaviour.
- 10 Observing their own reflection contributes to children's self awareness.

B

According to James, a child's first step on the road to self-understanding can be seen as the recognition that he or she exists. This is an aspect of the self that he labelled 'self-as-subject', and he gave it various elements. These included an awareness of one's own agency (i.e. one's power to act), and an awareness of one's distinctiveness from other people. These features gradually emerge as infants explore their world and interact with caregivers. Cooley (1902) suggested that a sense of the self-as-subject was primarily concerned with being able to exercise power. He proposed that the earliest examples of this are an infant's attempts to control physical objects, such as toys or his or her own limbs. This is followed by attempts to affect the behaviour of other people. For example, infants learn that when they cry or smile someone responds to them.

C

Another powerful source of information for infants about the effects they can have on the world around them is provided when others mimic them. Many parents spend a lot of time, particularly in the early months, copying their infant's vocalizations and expressions. In addition, young children enjoy looking in mirrors, where the movements they can see are dependent upon their own movements. This is not to say that infants recognize the reflection as their own image (a later development). However, Lewis and Brooks-Gunn (1979) suggest that infants' developing understanding that the movements they see in the

mirror are contingent on their own, leads to a growing awareness that they are distinct from other people. This is because they, and only they, can change the reflection in the mirror.

F

Cooley and other researchers suggested a close connection between a person's own understanding of their identity and other people's understanding of it. Cooley believed that people build up their sense of identity from the reactions of others to them, and from the view they believe others have of them. He called the self-as-object the 'looking-glass self', since people come to see themselves as they are reflected in others. Mead (1934) went even further, and saw the self and the social world as inextricably bound together: 'The self is essentially a social structure, and it arises in social experience ... it is impossible to conceive of a self arising outside of social experience.'

H

Finally, perhaps the most graphic expressions of self-awareness in general can be seen in the displays of rage which are most common from 18 months to 3 years of age. In a longitudinal study of groups of three or four children, Bronson (1975) found that the intensity of the frustration and anger in their disagreements increased sharply between the ages of 1 and 2 years. Often, the children's disagreements involved a struggle over a toy that none of them had played with before or after the tug-of-war: the children seemed to be disputing ownership rather than wanting to play with it. Although it may be less marked in other societies, the link between the sense of 'self' and of 'ownership' is a notable feature of childhood in Western societies.

HOMework 03

Questions 11-14

Look at the following statements (Questions 11-14) and the list of scientists below.

Match each statement with the correct scientist, A-D.

Write the correct letter, A-D, in boxes 11-14 on your answer sheet.

List of Scientists

- A** Roger Angel
- B** Phil Rasch
- C** Dan Lunt
- D** Martin Sommerkorn

- 11** The effects of geo-engineering may not be long-lasting.
- 12** Geo-engineering is a topic worth exploring.
- 13** It may be necessary to limit the effectiveness of geo-engineering projects.
- 14** Research into non-fossil-based fuels cannot be replaced by geo-engineering.

E

But will such schemes ever be implemented? Generally speaking, those who are most cautious about geo-engineering are the scientists involved in the research. Angel says that his plan is 'no substitute for developing renewable energy: the only permanent solution'.

And Dr Phil Rasch of the US-based Pacific Northwest National Laboratory is equally guarded about the role of geo-engineering: 'I think all of us agree that if we were to end geo-engineering on a given day, then the planet would return to its pre-engineered condition very rapidly, and probably within ten to twenty years. That's certainly something to worry about.'

F

The US National Center for Atmospheric Research has already suggested that the proposal to inject sulphur into the atmosphere might affect rainfall patterns across the tropics and the Southern Ocean. 'Geo-engineering plans to inject stratospheric aerosols or to seed clouds would act to cool the planet, and act to increase the extent of sea ice,' says Rasch. 'But all the models suggest some impact on the distribution of precipitation.'

G

A further risk with geo-engineering projects is that you can “overshoot” says Dr Dan Hunt, from the University of Bristol’s School of Geophysical Sciences, who has studied the likely impacts of the sunshade and aerosol schemes on the climate. ‘You may bring global temperatures back to pre-industrial levels, but the risk is that the poles will still be warmer than they should be and the tropics will be cooler than before industrialisation.’ To avoid such a scenario,” Hunt says, “Angel’s project would have to operate at half strength; all of which reinforces his view that the best option is to avoid the need for geo-engineering altogether.”

H

The main reason why geo-engineering is supported by many in the scientific community is that most researchers have little faith in the ability of politicians to agree - and then bring in – the necessary carbon cuts. Even leading conservation organisations see the value of investigating the potential of geo-engineering. According to Dr Martin Sommerkorn, climate change advisor for the World Wildlife Fund’s International Arctic Programme, ‘Human-induced climate change has brought humanity to a position where we shouldn’t exclude thinking thoroughly about this topic and its possibilities.’

HOMework 04

Questions 5-8

Look at the following statements (Questions 5-8) and the list of dates below.

Match each statement with the correct date, A-G.

Write the correct letter, A-G, in boxes 5-8 on your answer sheet.

List of Dates

A	1836	E	1971
B	1840	F	1979
C	1965	G	1982
D	1967		

- 5 A search for the Mary Rose was launched.
- 6 One person's exploration of the Mary Rose site stopped.
- 7 It was agreed that the hull of the Mary Rose should be raised.
- 8 The site of the Mary Rose was found by chance.

Then, on 16 June 1836, some fishermen in the Solent found that their equipment was caught on an underwater obstruction, which turned out to be the Mary Rose. Diver John Deane happened to be exploring another sunken ship nearby, and the fishermen approached him, asking him to free their gear. Deane dived down, and found the equipment caught on a timber protruding slightly from the seabed. Exploring further, he uncovered several other timbers and a bronze gun. Deane continued diving on the site intermittently until 1840, recovering several more guns, two bows, various timbers, part of a pump and various other small finds.

The Mary Rose then faded into obscurity for another hundred years. But in 1965, military historian and amateur diver Alexander McKee, in conjunction with the British Sub-Aqua Club, initiated a project called 'Solent Ships'. While on paper this was a plan to examine a number of known wrecks in the Solent, what McKee really hoped for was to find the Mary Rose. Ordinary search techniques proved unsatisfactory, so McKee entered into collaboration with Harold E. Edgerton, professor of electrical engineering at the Massachusetts Institute of Technology. In 1967, Edgerton's side-scan sonar systems revealed a large, unusually shaped object, which McKee believed was the Mary Rose.

Further excavations revealed stray pieces of timber and an iron gun. But the climax to the operation came when, on 5 May 1971, part of the ship's frame was uncovered. McKee and his team now knew for certain that they had found the wreck, but were as yet unaware that it

also housed a treasure trove of beautifully preserved artefacts. Interest in the project grew, and in 1979, The Mary Rose Trust was formed, with Prince Charles as its President and Dr Margaret Rule its Archaeological Director. The decision whether or not to salvage the wreck was not an easy one, although an excavation in 1978 had shown that it might be possible to raise the hull. While the original aim was to raise the hull if at all feasible, the operation was not given the go-ahead until January 1982, when all the necessary information was available.

HOME WORK

TRUE - FALSE - NOT GIVEN

YES - NO - NOT GIVEN

HOMework 01

William Henry Perkin was born on March 12, 1838, in London, England. As a boy, Perkin's curiosity prompted early interests in the arts, sciences, photography, and engineering. But it was a chance stumbling upon a run-down, yet functional, laboratory in his late grandfather's home that solidified the young man's enthusiasm for chemistry.

As a student at the City of London School, Perkin became immersed in the study of chemistry. His talent and devotion to the subject were perceived by his teacher, Thomas Hall, who encouraged him to attend a series of lectures given by the eminent scientist Michael Faraday at the Royal Institution. Those speeches fired the young chemist's enthusiasm further, and he later went on to attend the Royal College of Chemistry, which he succeeded in entering in 1853, at the age of 15.

At the time of Perkin's enrolment, the Royal College of Chemistry was headed by the noted German chemist August Wilhelm Hofmann. Perkin's scientific gifts soon caught Hofmann's attention and, within two years, he became Hofmann's youngest assistant. Not long after that, Perkin made the scientific breakthrough that would bring him both fame and fortune.

At the time, quinine was the only viable medical treatment for malaria. The drug is derived from the bark of the cinchona tree, native to South America, and by 1856 demand for the drug was surpassing the available supply. Thus, when Hofmann made some passing comments about the desirability of a synthetic substitute for quinine, it was unsurprising that his star pupil was moved to take up the challenge.

During his vacation in 1856, Perkin spent his time in the laboratory on the top floor of his family's house. He was attempting to manufacture quinine from aniline, an inexpensive and readily available coal tar waste product. Despite his best efforts, however, he did not end up with quinine. Instead, he produced a mysterious dark sludge. Luckily, Perkin's scientific training and nature prompted him to investigate the substance further. Incorporating potassium dichromate and alcohol into the aniline at various stages of the experimental process, he finally produced a deep purple solution. And, proving the truth of the famous scientist Louis Pasteur's words 'chance favours only the prepared mind', Perkin saw the potential of his unexpected find.

Questions 1-7

Do the following statements agree with the information given in Reading Passage?

In boxes 1-7 on your answer sheet, write

TRUE if the statement agrees with the information

FALSE if the statement contradicts the information

NOT GIVEN if there is no information on this

1 Michael Faraday was the first person to recognise Perkin's ability as a student of chemistry.

- 2 Michael Faraday suggested Perkin should enrol in the Royal College of Chemistry.
- 3 Perkin employed August Wilhelm Hofmann as his assistant.
- 4 Perkin was still young when he made the discovery that made him rich and famous.
- 5 The trees from which quinine is derived grow only in South America.
- 6 Perkin hoped to manufacture a drug from a coal tar waste product.
- 7 Perkin was inspired by the discoveries of the famous scientist Louis Pasteur.

HOMEWORK 02

B

For centuries, transits of Venus have drawn explorers and astronomers alike to the four corners of the globe. And you can put it all down to the extraordinary polymath Edmond Halley. In November 1677, Halley observed a transit of the innermost planet, Mercury, from the desolate island of St Helena in the South Pacific. He realised that, from different latitudes, the passage of the planet across the Sun's disc would appear to differ. By timing the transit from two widely-separated locations, teams of astronomers could calculate the parallax angle - the apparent difference in position of an astronomical body due to a difference in the observer's position. Calculating this angle would allow astronomers to measure what was then the ultimate goal: the distance of the Earth from the Sun. This distance is known as the astronomical unit' or AU.

D

Inspired by Halley's suggestion of a way to pin down the scale of the Solar System, teams of British and French astronomers set out on expeditions to places as diverse as India and Siberia. But things weren't helped by Britain and France being at war. The person who deserves most sympathy is the French astronomer Guillaume Le Gentil.

He was thwarted by the fact that the British were besieging his observation site at Pondicherry in India. Fleeing on a French warship crossing the Indian Ocean, Le Gentil saw a wonderful transit - but the ship's pitching and rolling ruled out any attempt at making accurate observations. Undaunted, he remained south of the equator, keeping himself busy by studying the islands of Mauritius and Madagascar before setting off to observe the next transit in the Philippines. Ironically after travelling nearly 50,000 kilometres, his view was clouded out at the last moment, a very dispiriting experience.

E

While the early transit timings were as precise as instruments would allow, the measurements were dogged by the 'black drop' effect. When Venus begins to cross the Sun's disc, it looks smeared not circular - which makes it difficult to establish timings. This is due to diffraction of light. The second problem is that Venus exhibits a halo of light when it is seen just outside the Sun's disc. While this showed astronomers that Venus was surrounded by a thick layer of gases refracting sunlight around it, both effects made it impossible to obtain accurate timings.

F

But astronomers laboured hard to analyse the results of these expeditions to observe Venus transits. Johann Franz Encke, Director of the Berlin Observatory, finally determined a value for the AU based on all these parallax measurements: 153,340,000 km. Reasonably accurate for the time, that is quite close to today's value of 149,597,870 km, determined by radar, which has now superseded transits and all other methods in accuracy. The AU is a cosmic measuring rod, and the basis of how we scale the Universe today. The parallax principle can

be extended to measure the distances to the stars. If we look at a star in January - when Earth is at one point in its orbit - it will seem to be in a different position from where it appears six months later. Knowing the width of Earth's orbit, the parallax shift lets astronomers calculate the distance.

Questions 9-13

Do the following statements agree with the information given in Reading Passage?

In boxes 9-13 on your answer sheet, write

TRUE if the statement agrees with the information

FALSE if the statement contradicts the information

NOT GIVEN if there is no information on this

- 9 Halley observed one transit of the planet Venus.
- 10 Le Gentil managed to observe a second Venus transit.
- 11 The shape of Venus appears distorted when it starts to pass in front of the Sun.
- 12 Early astronomers suspected that the atmosphere on Venus was toxic.
- 13 The parallax principle allows astronomers to work out how far away distant stars are from the Earth.

HOMEWORK 03

Attitudes to language

It is not easy to be systematic and objective about language study. Popular linguistic debate regularly deteriorates into invective and polemic. Language belongs to everyone, so most people feel they have a right to hold an opinion about it. And when opinions differ, emotions can run high. Arguments can start as easily over minor points of usage as over major policies of linguistic education.

Language, moreover, is a very public behaviour, so it is easy for different usages to be noted and criticised. No part of society or social behaviour is exempt: linguistic factors influence how we judge personality, intelligence, social status, educational standards, job aptitude, and many other areas of identity and social survival. As a result, it is easy to hurt, and to be hurt, when language use is unfeelingly attacked.

In its most general sense, prescriptivism is the view that one variety of language has an inherently higher value than others, and that this ought to be imposed on the whole of the speech community. The view is propounded especially in relation to grammar and vocabulary, and frequently with reference to pronunciation. The variety which is favoured, in this account, is usually a version of the 'standard' written language, especially as encountered in literature, or in the formal spoken language which most closely reflects this style. Adherents to this variety are said to speak or write 'correctly'; deviations from it are said to be 'incorrect'!

All the main languages have been studied prescriptively, especially in the 18th century approach to the writing of grammars and dictionaries. The aims of these early grammarians were threefold: (a) they wanted to codify the principles of their languages, to show that there was a system beneath the apparent chaos of usage, (b) they wanted a means of settling disputes over usage, and (c) they wanted to point out what they felt to be common errors, in order to 'improve' the language. The authoritarian nature of the approach is best characterised by its reliance on 'rules' of grammar. Some usages are 'prescribed,' to be learnt and followed accurately; others are 'proscribed,' to be avoided. In this early period, there were no half-measures: usage was either right or wrong, and it was the task of the grammarian not simply to record alternatives, but to pronounce judgement upon them.

These attitudes are still with us, and they motivate a widespread concern that linguistic standards should be maintained. Nevertheless, there is an alternative point of view that is concerned less with standards than with the facts of linguistic usage. This approach is summarised in the statement that it is the task of the grammarian to describe, not prescribe to record the facts of linguistic diversity, and not to attempt the impossible tasks of evaluating language variation or halting language change. In the second half of the 18th century, we already find advocates of this view, such as Joseph Priestley, whose *Rudiments of English Grammar* (1761) insists that 'the custom of speaking is the original and only just standard of any language! Linguistic issues, it is argued, cannot be solved by logic and legislation. And this view has become the tenet of the modern linguistic approach to grammatical analysis.

In our own time, the opposition between 'descriptivists' and 'prescriptivists' has often become extreme, with both sides painting unreal pictures of the other. Descriptive grammarians have been presented as people who do not care about standards, because of the way they see all forms of usage as equally valid. Prescriptive grammarians have been presented as blind adherents to a historical tradition. The opposition has even been presented in quasi-political terms - of radical liberalism vs elitist conservatism.

Questions 1-8

Do the following statements agree with the claims of the writer In Reading Passage?

In boxes 1-8 on your answer sheet, write

YES *if the statement agrees with the claims of the writer*

NO *if the statement contradicts the claims of the writer*

NOT GIVEN *if it is impossible to say what the writer thinks about this*

- 1** There are understandable reasons why arguments occur about language.
- 2** People feel more strongly about language education than about small differences in language usage.
- 3** Our assessment of a person's intelligence is affected by the way he or she uses language.
- 4** Prescriptive grammar books cost a lot of money to buy in the 18th century.
- 5** Prescriptivism still exists today.
- 6** According to descriptivists it is pointless to try to stop language change.
- 7** Descriptivism only appeared after the 18th century.
- 8** Both descriptivists and prescriptivists have been misrepresented.

HOMework 04

C

This all seems light years away from the down-to-earth uses Shannon originally had for his work, which began when he was a 22-year-old graduate engineering student at the prestigious Massachusetts Institute of Technology in 1939. He set out with an apparently simple aim: to pin down the precise meaning of the concept of 'information'. The most basic form of information, Shannon argued, is whether something is true or false - which can be captured in the binary unit, or 'bit', of the form 1 or 0. Having identified this fundamental unit, Shannon set about defining otherwise vague ideas about information and how to transmit it from place to place. In the process he discovered something surprising: it is always possible to guarantee information will get through random interference - 'noise' - intact.

D

Noise usually means unwanted sounds which interfere with genuine information. Information theory generalises this idea via theorems that capture the effects of noise with mathematical precision. In particular, Shannon showed that noise sets a limit on the rate at which information can pass along communication channels while remaining error-free. This rate depends on the relative strengths of the signal and noise travelling down the communication channel, and on its capacity (its 'bandwidth'). The resulting limit, given in units of bits per second, is the absolute maximum rate of error-free communication given signal strength and noise level. The trick, Shannon showed, is to find ways of packaging up - 'coding' - information to cope with the ravages of noise, while staying within the information-carrying capacity - 'bandwidth' - of the communication system being used.

E

Over the years scientists have devised many such coding methods, and they have proved crucial in many technological feats. The Voyager spacecraft transmitted data using codes which added one extra bit for every single bit of information; the result was an error rate of just one bit in 10,000 - and stunningly clear pictures of the planets. Other codes have become part of everyday life - such as the Universal Product Code, or bar code, which uses a simple error-detecting system that ensures supermarket check-out lasers can read the price even on, say, a crumpled bag of crisps. As recently as 1993, engineers made a major breakthrough by discovering so-called turbo codes - which come very close to Shannon's ultimate limit for the maximum rate that data can be transmitted reliably, and now play a key role in the mobile videophone revolution.

Questions 12-14

Do the following statements agree with the information given in Reading Passage?

In boxes 12-14 on your answer sheet, write

TRUE *if the statement agrees with the information*

FALSE *if the statement contradicts the information*

NOT GIVEN *if there is no information on this*

12 The concept of describing something as true or false was the starting point for Shannon in his attempts to send messages over distances.

13 The amount of information that can be sent in a given time period is determined with reference to the signal strength and noise level.

14 Products have now been developed which can convey more information than Shannon had anticipated as possible.

HOMEWORK 05

The life and work of Marie Curie

Marie Curie is probably the most famous woman scientist who has ever lived. Born Maria Skłodowska in Poland in 1867, she is famous for her work on radioactivity, and was twice a winner of the Nobel Prize. With her husband, Pierre Curie, and Henri Becquerel, she was awarded the 1903 Nobel Prize for Physics, and was then sole winner of the 1911 Nobel Prize for Chemistry. She was the first woman to win a Nobel Prize.

From childhood, Marie was remarkable for her prodigious memory, and at the age of 16 won a gold medal on completion of her secondary education. Because her father lost his savings through bad investment, she then had to take work as a teacher. From her earnings she was able to finance her sister Bronia's medical studies in Paris, on the understanding that Bronia would, in turn, later help her to get an education.

In 1891 this promise was fulfilled and Marie went to Paris and began to study at the Sorbonne (the University of Paris). She often worked far into the night and lived on little more than bread and butter and tea. She came first in the examination in the physical sciences in 1893, and in 1894 was placed second in the examination in mathematical sciences. It was not until the spring of that year that she was introduced to Pierre Curie.

The births of Marie's two daughters, Irène and Eve, in 1897 and 1904 failed to interrupt her scientific work. She was appointed lecturer in physics at the École Normale Supérieure for girls in Sèvres, France (1900), and introduced a method of teaching based on experimental demonstrations. In December 1904 she was appointed chief assistant in the laboratory directed by Pierre Curie.

The sudden death of her husband in 1906 was a bitter blow to Marie Curie, but was also a turning point in her career: henceforth she was to devote all her energy to completing alone the scientific work that they had undertaken. On May 13, 1906, she was appointed to the professorship that had been left vacant on her husband's death, becoming the first woman to teach at the Sorbonne. In 1911 she was awarded the Nobel Prize for Chemistry for the isolation of a pure form of radium.

In 1921, accompanied by her two daughters, Marie Curie made a triumphant journey to the United States to raise funds for research on radium. Women there presented her with a gram of radium for her campaign. Marie also gave lectures in Belgium, Brazil, Spain and Czechoslovakia and, in addition, had the satisfaction of seeing the development of the Curie Foundation in Paris, and the inauguration in 1932 in Warsaw of the Radium Institute, where her sister Bronia became director.

Questions 1-6

Do the following statements agree with the information given in Reading Passage?

In boxes 1-6 on your answer sheet, write

TRUE if the statement agrees with the information

FALSE if the statement contradicts the information

NOT GIVEN if there is no information on this

- 1 Marie Curie's husband was a joint winner of both Marie's Nobel Prizes.
- 2 Marie became interested in science when she was a child.
- 3 Marie was able to attend the Sorbonne because of her sister's financial contribution.
- 4 Marie stopped doing research for several years when her children were born.
- 5 Marie took over the teaching position her husband had held.
- 6 Marie's sister Bronia studied the medical uses of radioactivity.

HOMEWORK 06

Crop-growing skyscrapers

By the year 2050, nearly 80% of the Earth's population will live in urban centres. Applying the most conservative estimates to current demographic trends, the human population will increase by about three billion people by then. An estimated 109 hectares of new land (about 20% larger than Brazil) will be needed to grow enough food to feed them, if traditional farming methods continue as they are practised today. At present, throughout the world, over 80% of the land that is suitable for raising crops is in use. Historically, some 15% of that has been laid waste by poor management practices. What can be done to ensure enough food for the world's population to live on ?

It took humans 10,000 years to learn how to grow most of the crops we now take for granted. Along the way, we despoiled most of the land we worked, often turning verdant, natural eco-zones into semi-arid deserts. Within that same time frame, we evolved into an urban species, in which 60% of the human population now lives vertically in cities. This means that, for the majority, we humans have shelter from the elements, yet we subject our food-bearing plants to the rigours of the great outdoors and can do no more than hope for a good weather year. However, more often than not now, due to a rapidly changing climate, that is not what happens. Massive floods, long droughts, hurricanes and severe monsoons take their toll each year, destroying millions of tons of valuable crops.

The supporters of vertical farming claim many potential advantages for the system. For instance, crops would be produced all year round, as they would be kept in artificially controlled, optimum growing conditions. There would be no weather-related crop failures due to droughts, floods or pests. All the food could be grown organically, eliminating the need for herbicides, pesticides and fertilisers. The system would greatly reduce the incidence of many infectious diseases that are acquired at the agricultural interface. Although the system would consume energy, it would return energy to the grid via methane generation from composting non-edible parts of plants. It would also dramatically reduce fossil fuel use, by cutting out the need for tractors, ploughs and shipping.

Questions 8-13

Do the following statements agree with the information given in Reading Passage?

In boxes 8-13 on your answer sheet, write

TRUE if the statement agrees with the information

FALSE if the statement contradicts the information

NOT GIVEN if there is no information on this

- 8** Methods for predicting the Earth's population have recently changed.
- 9** Human beings are responsible for some of the destruction to food-producing land.
- 10** The crops produced in vertical farms will depend on the season.
- 11** Some damage to food crops is caused by climate change.
- 12** Fertilisers will be needed for certain crops in vertical farms.
- 13** Vertical farming will make plants less likely to be affected by infectious diseases.

HOMework 07

The Falkirk Wheel

A unique engineering achievement

The Falkirk Wheel in Scotland is the world's first and only rotating boat lift. Opened in 2002, it is central to the ambitious £84.5m Millennium Link project to restore navigability across Scotland by reconnecting the historic waterways of the Forth & Clyde and Union Canals.

Numerous ideas were submitted for the project, including concepts ranging from rolling eggs to tilting tanks, from giant seesaws to overhead monorails. The eventual winner was a plan for the huge rotating steel boat lift which was to become The Falkirk Wheel. The unique shape of the structure is claimed to have been inspired by various sources, both manmade and natural, most notably a Celtic double headed axe, but also the vast turning propeller of a ship, the ribcage of a whale or the spine of a fish.

The various parts of The Falkirk Wheel were all constructed and assembled, like one giant toy building set, at Butterley Engineering's Steelworks in Derbyshire, some 400 km from Falkirk. A team there carefully assembled the 1,200 tonnes of steel, painstakingly fitting the pieces together to an accuracy of just 10 mm to ensure a perfect final fit. In the summer of 2001, the structure was then dismantled and transported on 35 lorries to Falkirk, before all being bolted back together again on the ground, and finally lifted into position in five large sections by crane. The Wheel would need to withstand immense and constantly changing stresses as it rotated, so to make the structure more robust, the steel sections were bolted rather than welded together. Over 45,000 bolt holes were matched with their bolts, and each bolt was hand-tightened.

The Wheel consists of two sets of opposing axe-shaped arms, attached about 25 metres apart to a fixed central spine. Two diametrically opposed water-filled 'gondolas', each with a capacity of 360,000 litres, are fitted between the ends of the arms. These gondolas always weigh the same, whether or not they are carrying boats. This is because, according to Archimedes' principle of displacement, floating objects displace their own weight in water. So when a boat enters a gondola, the amount of water leaving the gondola weighs exactly the same as the boat. This keeps the Wheel balanced and so, despite its enormous mass, it rotates through 180° in five and a half minutes while using very little power. It takes just 1.5 kilowatt-hours (5.4 MJ) of energy to rotate the Wheel -roughly the same as boiling eight small domestic kettles of water.

The remaining 11 metres of lift needed to reach the Union Canal is achieved by means of a pair of locks. The Wheel could not be constructed to elevate boats over the full 35-metre difference between the two canals, owing to the presence of the historically important Antonine Wall, which was built by the Romans in the second century AD. Boats travel under this wall via a tunnel, then through the locks, and finally on to the Union Canal.

Questions 1-6

Do the following statements agree with the information given in Reading Passage?

in boxes 1-6 on your answer sheet, write

TRUE if the statement agrees with the information

FALSE if the statement contradicts the information

NOT GIVEN if there is no information on this

1 The Falkirk Wheel has linked the Forth & Clyde Canal with the Union Canal for the first time in their history.

2 There was some opposition to the design of the Falkirk Wheel at first.

3 The Falkirk Wheel was initially put together at the location where its components were manufactured.

4 The Falkirk Wheel is the only boat lift in the world which has steel sections bolted together by hand.

5 The weight of the gondolas varies according to the size of boat being carried.

6 The construction of the Falkirk Wheel site took into account the presence of a nearby ancient monument.

HOMEWORK 08

Raising the Mary Rose

How a sixteenth-century warship was recovered from the seabed

On 19 July 1545, English and French fleets were engaged in a sea battle off the coast of southern England in the area of water called the Solent, between Portsmouth and the Isle of Wight. Among the English vessels was a warship by the name of Mary Rose. Built in Portsmouth some 35 years earlier, she had had a long and successful fighting career, and was a favourite of King Henry VIII. Accounts of what happened to the ship vary: while witnesses agree that she was not hit by the French, some maintain that she was outdated, overladen and sailing too low in the water, others that she was mishandled by undisciplined crew. What is undisputed, however, is that the Mary Rose sank into the Solent that day, taking at least 500 men with her. After the battle, attempts were made to recover the ship, but these failed.

The Mary Rose came to rest on the seabed, lying on her starboard (right) side at an angle of approximately 60 degrees. The hull (the body of the ship) acted as a trap for the sand and mud carried by Solent currents. As a result, the starboard side filled rapidly, leaving the exposed port (left) side to be eroded by marine organisms and mechanical degradation. Because of the way the ship sank, nearly all of the starboard half survived intact. During the seventeenth and eighteenth centuries, the entire site became covered with a layer of hard grey clay, which minimised further erosion.

Further excavations revealed stray pieces of timber and an iron gun. But the climax to the operation came when, on 5 May 1971, part of the ship's frame was uncovered. McKee and his team now knew for certain that they had found the wreck, but were as yet unaware that it also housed a treasure trove of beautifully preserved artefacts. Interest in the project grew, and in 1979, The Mary Rose Trust was formed, with Prince Charles as its President and Dr Margaret Rule its Archaeological Director. The decision whether or not to salvage the wreck was not an easy one, although an excavation in 1978 had shown that it might be possible to raise the hull. While the original aim was to raise the hull if at all feasible, the operation was not given the go-ahead until January 1982, when all the necessary information was available.

Questions 1-4

Do the following statements agree with the information given in Reading Passage? In boxes 1-4 on your answer sheet, write

TRUE if the statement agrees with the information

FALSE if the statement contradicts the information

NOT GIVEN if there is no information on this

- 1 There is some doubt about what caused the Mary Rose to sink.
- 2 The Mary Rose was the only ship to sink in the battle of 19 July 1545.
- 3 Most of one side of the Mary Rose lay undamaged under the sea.
- 4 Alexander McKee knew that the wreck would contain many valuable historical objects.

HOMework 09

In another experiment, Alex Forsythe of the University of Liverpool analysed the visual intricacy of different pieces of art, and her results suggest that many artists use a key level of detail to please the brain. Too little and the work is boring, but too much results in a kind of 'perceptual overload', according to Forsythe. What's more, appealing pieces both abstract and representational, show signs of 'fractals' - repeated motifs recurring in different scales, fractals are common throughout nature, for example in the shapes of mountain peaks or the branches of trees. It is possible that our visual system, which evolved in the great outdoors, finds it easier to process such patterns.

It is also intriguing that the brain appears to process movement when we see a handwritten letter, as if we are replaying the writer's moment of creation. This has led some to wonder whether Pollock's works feel so dynamic because the brain reconstructs the energetic actions the artist used as he painted. This may be down to our brain's 'mirror neurons', which are known to mimic others' actions. The hypothesis will need to be thoroughly tested, however it might even be the case that we could use neuroaesthetic studies to understand the longevity of some pieces of artwork. While the fashions of the time might shape what is currently popular, works that are best adapted to our visual system may be the most likely to linger once the trends of previous generations have been forgotten.

It's still early days for the field of neuroaesthetics - and these studies are probably only a taste of what is to come. It would, however, be foolish to reduce art appreciation to a set of scientific laws. We shouldn't underestimate the importance of the style of a particular artist, their place in history and the artistic environment of their time. Abstract art offers both a challenge and the freedom to play with different interpretations. In some ways, it's not so different to science, where we are constantly looking for systems and decoding meaning so that we can view and appreciate the world in a new way.

Questions 8-13

Do the following statements agree with the views of the writer in Reading Passage?

In boxes 8-13 on your answer sheet, write

YES if the statement agrees with the views of the writer

NO if the statement contradicts the views of the writer

NOT GIVEN if there is no information on this

8 Forsythe's findings contradicted previous beliefs on the function of 'fractals' in art.

9 Certain ideas regarding the link between 'mirror neurons' and art appreciation require further verification.

10 People's taste in paintings depends entirely on the current artistic trends of the period.

11 Scientists should seek to define the precise rules which govern people's reactions to works of art.

- 12** Art appreciation should always involve taking into consideration the cultural context in which an artist worked.
- 13** It is easier to find meaning in the field of science than in that of art.

HOME WORK

MULTIPLE CHOICE

HOMEWORK 01

An emerging discipline called neuroaesthetics is seeking to bring scientific objectivity to the study of art, and has already given us a better understanding of many masterpieces. The blurred imagery of Impressionist paintings seems to stimulate the brain's amygdala, for instance. Since the amygdala plays a crucial role in our feelings, that finding might explain why many people find these pieces so moving.

Could the same approach also shed light on abstract twentieth-century pieces, from Mondrian's geometrical blocks of colour, to Pollock's seemingly haphazard arrangements of splashed paint on canvas? Sceptics believe that people claim to like such works simply because they are famous. We certainly do have an inclination to follow the crowd. When asked to make simple perceptual decisions such as matching a shape to its rotated image, for example, people often choose a definitively wrong answer if they see others doing the same. It is easy to imagine that this mentality would have even more impact on a fuzzy concept like art appreciation, where there is no right or wrong answer.

Angelina Hawley-Dolan, of Boston College, Massachusetts, responded to this debate by asking volunteers to view pairs of paintings - either the creations of famous abstract artists or the doodles of infants, chimps and elephants. They then had to judge which they preferred. A third of the paintings were given no captions, while many were labelled incorrectly - volunteers might think they were viewing a chimp's messy brush strokes when they were actually seeing an acclaimed masterpiece. In each set of trials, volunteers generally preferred the work of renowned artists, even when they believed it was by an animal or a child. It seems that the viewer can sense the artist's vision in paintings, even if they can't explain why.

Robert Pepperell, an artist based at Cardiff University, creates ambiguous works that are neither entirely abstract nor clearly representational. In one study, Pepperell and his collaborators asked volunteers to decide how powerful they considered an artwork to be, and whether they saw anything familiar in the piece. The longer they took to answer these questions, the more highly they rated the piece under scrutiny, and the greater their neural activity. It would seem that the brain sees these images as puzzles, and the harder it is to decipher the meaning, the more rewarding is the moment of recognition.

And what about artists such as Mondrian, whose paintings consist exclusively of horizontal and vertical lines encasing blocks of colour? Mondrian's works are deceptively simple, but eye-tracking studies confirm that they are meticulously composed, and that simply rotating

a piece radically changes the way we view it. With the originals, volunteers' eyes tended to stay longer on certain places in the image, but with the altered versions they would flit across a piece more rapidly. As a result, the volunteers considered the altered versions less pleasurable when they later rated the work.

Questions 1-4

*Choose the correct letter, **A, B, C or D.***

Write the correct letter in boxes 1-4 on your answer sheet.

1. In the second paragraph, the writer refers to a shape-matching test in order to illustrate
 - A** the subjective nature of art appreciation.
 - B** the reliance of modern art on abstract forms.
 - C** our tendency to be influenced by the opinions of others.
 - D** a common problem encountered when processing visual data.

2. Angelina Hawley-Dolan's findings indicate that people
 - A** mostly favour works of art which they know well.
 - B** hold fixed ideas about what makes a good work of art.
 - C** are often misled by their initial expectations of a work of art.
 - D** have the ability to perceive the intention behind works of art.

3. Results of studies involving Robert Pepperell's pieces suggest that people
 - A** can appreciate a painting without fully understanding it.
 - B** find it satisfying to work out what a painting represents.
 - C** vary widely in the time they spend looking at paintings.
 - D** generally prefer representational art to abstract art.

4. What do the experiments described in the fifth paragraph suggest about the paintings of Mondrian?
 - A** They are more carefully put together than they appear.
 - B** They can be interpreted in a number of different ways.

- C** They challenge our assumptions about shape and colour.
- D** They are easier to appreciate than many other abstract works.

HOMework 02

D

The researchers allowed various prey spiders to spin webs in the laboratory and then introduced Portia spiders. To simulate the shaking effect of a breeze the zoologists used either a model aircraft propeller or attached a tiny magnet to the centre of the web which could be vibrated by applying a varying electrical field. The researchers noticed that the stalking Portia spiders moved more when the webs were shaking than when they were still and they were more likely to capture their prey during tests in which the webs were periodically shaken than in those where the webs were undisturbed. If the spiders were placed onto unoccupied webs, they would make no attempt to change their movements.

E

It is the Portia spider's tactic of making its victims' webs shake that has most intrigued the researchers. They noticed that the spiders would sometimes shake their quarry's web violently, then creep forwards up to five millimeters before the vibrations died down. 'They'd make a big pluck with one of their hind legs,' says Wilcox. These twangs were much more powerful than the gentler vibrations Portia spiders use to mimic a trapped insect, and the researchers were initially surprised that the prey spiders did not respond to them in any way. But they have since discovered that the violent twanging produces a pattern of vibrations that match those caused by a twig falling onto the web.

F

Other predators make use of natural 'smokescreens' or disguise to hide from their prey: lions hunting at night, for example, move in on their prey when clouds obscure the moon. 'But this is the first example of an animal making its own smokescreen that we know of,' says Wilcox. 'Portia spiders are clearly intelligent and they often learn from their prey as they are trying to capture it. They do this by making different signals on the web of their prey until the prey spider makes a movement. In general, Portia spiders adjust their stalking strategy according to their prey and what the prey is doing. Thus, Portia spiders use trial-and-error learning in stalking. Sometimes they will even take an indirect route to reach a prey spider they can see from a distance. This can sometimes take one to two hours following a predetermined route. When it does this, the Portia spider is actually solving problems and thinking ahead about its actions.'

Questions 10-13

Choose the correct letter, A, B, C or D and write in your answer sheet.

10 In their laboratory experiments, the researchers found that the Portia spiders moved most when the web was

- A vibrating.
- B motionless.
- C undisturbed.
- D unoccupied.

11 What discovery did the researchers make about Portia spiders?

- A They make very strong vibrations with one leg.
- B They move 5 mm at a time on a still web.
- C They move slowly when vibrations stop.
- D They use energetic vibrations to mimic a trapped insect.

12 Portia spiders are the only known animal to

- A use the weather to disguise themselves.
- B mimic other prey-eating animals.
- C create their own smokescreen.
- D stalk using 'trial and error'.

13 The Portia spider demonstrates 'thinking ahead' when it

- A chooses prey that is a short distance away.
- B takes a longer route to reach its prey.
- C reaches its prey in a short time.
- D solves the problem of locating its prey.

HOMework 03

B.

In fact, this 'new' pen was not new after all, and was just the latest development in a long search for the best way to deliver ink to paper. In 1884 Lewis Waterman had patented the fountain pen, giving him the sole rights to manufacture it. This marked a significant leap forward in writing technology, but fountain pens soon became notorious for leaking. In 1888, a leather tanner named John Loud devised and patented the first "rolling-pointed marker pen" for marking leather. Loud's design contained a reservoir of ink in a cartridge and a rotating ball point that was constantly bathed on one side with ink. Loud's pen was never manufactured, however, and over the next five decades, 350 additional patents were issued for similar ball-type pens, though none advanced beyond the design stage. Each had their own faults, but the major difficulty was the ink: if the ink was thin, the pens leaked, and if it was too thick, they clogged. Depending on the climate or air temperature, sometimes the pens would do both.

C.

Almost fifty years later, Ladislav and Georg Biro, two Hungarian brothers, came up with a solution to this problem. In 1935 Ladislav Biro was working as a journalist, editing a small newspaper. He found himself becoming more and more frustrated by the amount of time he wasted filling fountain pens with ink and cleaning up ink smudges. What's more, the sharp tip of his fountain pen often scratched or tore through the thin newsprint paper. Ladislav and Georg (a chemist) set about making models of new pen designs and creating better inks to use in them. Ladislav had observed that the type of ink used in newspaper printing dried rapidly, leaving the paper dry and smudge-free. He was determined to construct a pen using the same type of ink. However, the thicker ink would not flow from a regular pen nib so he had to develop a new type of point. Biro came up with the idea of fitting his pen with a tiny ball bearing in its tip. As the pen moved along the paper, the ball bearing rotated and picked up ink from the ink cartridge which it delivered to the paper.

D.

The first Biro pen, like the designs that had gone before it, relied on gravity for the ink to flow to the ball bearing at the tip. This meant that the pens only worked when they were held straight up, and even then the ink flow was sometimes too heavy, leaving big smudges of ink on the paper. The Biro brothers had a rethink and eventually devised a new design, which relied on capillary action rather than gravity to feed the ink. This meant that the ink could flow more smoothly to the tip and the pen could be held at an angle rather than straight up. In 1938, as World War II broke out, the Biro brothers fled to Argentina, where they applied for a patent for their pen and established their first factory.

F.

Meanwhile, in June 1945 an American named Milton Reynolds stumbled upon the Biro pen while on vacation in Buenos Aires. Immediately seeing its commercial potential, he bought several pens and returned to Chicago, where he discovered that Loud's original 1888 patent

had long since expired. This meant that the ballpoint was now in the public domain, and he, therefore, wasted no time making a copy based on the Biro design. Establishing his pen company with just \$26,000, Reynolds quickly set up a factory with 300 workers who began production on 6th October 1945, stamping out pens from precious scraps of aluminum that hadn't been used during the war for military equipment or weapons. Just 23 days later, it was Reynolds' ballpoint pen that caused the stampede at Gimbels Department Store. Following the ballpoint's debut in New York City, Eversharp challenged Reynolds in the law courts, but lost the case because the Biro brothers had failed to secure a U.S. patent on their invention.

Questions 7-9

Choose the correct answer, A, B, C or D and write in your answer sheet from 7-9

7. The problem with the ballpoint pens invented between 1888 and 1935 was that

- A. they cost a great deal of money to manufacture.
- B. the technology to manufacture them did not exist.
- C. they could not write on ordinary paper:
- D. they were affected by weather conditions.

8. The design of the Biro brothers' first pen

- A. was similar to previous pens.
- B. was based on capillary action,
- C. worked with heavy or light inks.
- D. worked when slanted slightly.

9. Milton Reynolds was able to copy the Biro brothers' design because

- A. the Biro brothers' original patent was out of date.
- B. it was legal to copy other designs at the time.
- C. they did not have a patent for North America.
- D. the Biro brothers gave him permission.

HOME WORK

MULTIPLE CHOICE

(2 or more answers)

HOMework

C

The moai, he thinks, accelerated the self-destruction. Diamond interprets them as power displays by rival chieftains who, trapped on a remote little island, lacked other ways of asserting their dominance. They competed by building ever bigger figures. Diamond thinks they laid the moai on wooden sledges, hauled over log rails, but that required both a lot of wood and a lot of people. To feed the people, even more land had to be cleared. When the wood was gone and civil war began, the islanders began toppling the moai. By the nineteenth century none were standing.

D

Archaeologists Terry Hunt of the University of Hawaii and Carl Lipo of California State University agree that Easter Island lost its lush forests and that it was an 'ecological catastrophe' - but they believe the islanders themselves weren't to blame. And the moai certainly weren't. Archaeological excavations indicate that the Rapanui went to heroic efforts to protect the resources of their wind-lashed, infertile fields. They built thousands of circular stone windbreaks and gardened inside them, and used broken volcanic rocks to keep the soil moist. In short, Hunt and Lipo argue, the prehistoric Rapanui were pioneers of sustainable farming.

E

Hunt and Lipo contend that moai-building was an activity that helped keep the peace between islanders. They also believe that moving the moai required few people and no wood, because they were walked upright. On that issue, Hunt and Lipo say, archaeological evidence backs up Rapanui folklore. Recent experiments indicate that as few as 18 people could, with three strong ropes and a bit of practice, easily manoeuvre a 1,000 kg moai replica a few hundred metres. The figures' fat bellies tilted them forward, and a D-shaped base allowed handlers to roll and rock them side to side.

F

Moreover, Hunt and Lipo are convinced that the settlers were not wholly responsible for the loss of the island's trees. Archaeological finds of nuts from the extinct Easter Island palm show tiny grooves, made by the teeth of Polynesian rats. The rats arrived along with the settlers, and in just a few years, Hunt and Lipo calculate, they would have overrun the island. They would have prevented the reseedling of the slow-growing palm trees and thereby doomed Rapa Nui's forest, even without the settlers' campaign of deforestation. No doubt the rats ate birds' eggs too. Hunt and Lipo also see no evidence that Rapanui civilisation collapsed when the palm forest did. They think its population grew rapidly and then remained more or less stable until the arrival of the Europeans, who introduced deadly diseases to which islanders had no immunity. Then in the nineteenth century slave traders decimated the population, which shrivelled to 111 people by 1877.

Questions 12-13

Choose **TWO** letters, A-E.

Write the correct letters in boxes 12-13 on your answer sheet.

On what points do Hunt and Lipo disagree with Diamond?

- A the period when the moai were created
- B how the moai were transported
- C the impact of the moai on Rapanui society
- D how the moai were carved
- E the origins of the people who made the moai

HOME WORK

MATCHING INFORMATION

HOMework 01

A

Operating on the same principle as wind turbines, the power in sea turbines comes from tidal currents which turn blades similar to ships' propellers, but, unlike wind, the tides are predictable and the power input is constant. The technology raises the prospect of Britain becoming self-sufficient in renewable energy and drastically reducing its carbon dioxide emissions. If tide, wind and wave power are all developed, Britain would be able to close gas, coal and nuclear power plants and export renewable power to other parts of Europe. Unlike wind power, which Britain originally developed and then abandoned for 20 years allowing the Dutch to make it a major industry, undersea turbines could become a big export earner to island nations such as Japan and New Zealand.

C

Work on designs for the new turbine blades and sites are well advanced at the University of Southampton's sustainable energy research group. The first station is expected to be installed off Lynmouth in Devon shortly to test the technology in a venture jointly funded by the department of Trade and Industry and the European Union. AbuBakr Bahaj, in charge of the Southampton research, said: The prospects for energy from tidal currents are far better than from wind because the flows of water are predictable and constant. The technology for dealing with the hostile saline environment under the sea has been developed in the North Sea oil industry and much is already known about turbine blade design, because of wind power and ship propellers. There are a few technical difficulties, but I believe in the next five to ten years we will be installing commercial marine turbine farms.' Southampton has been awarded £215,000 over three years to develop the turbines and is working with Marine Current Turbines, a subsidiary of IT power, on the Lynmouth project. EU research has now identified 106 potential sites for tidal power, 80% round the coasts of Britain. The best sites are between islands or around heavily indented coasts where there are strong tidal currents.

D

A marine turbine blade needs to be only one third of the size of a wind generator to produce three times as much power. The blades will be about 20 metres in diameter, so around 30 metres of water is required. Unlike wind power, there are unlikely to be environmental objections. Fish and other creatures are thought unlikely to be at risk from the relatively slow-turning blades. Each turbine will be mounted on a tower which will connect to the national power supply grid via underwater cables. The towers will stick out of the water and be lit, to warn shipping, and also be designed to be lifted out of the water for maintenance and to clean seaweed from the blades.

E

Dr Bahaj has done most work on the Alderney site, where there are powerful currents. The single undersea turbine farm would produce far more power than needed for the Channel Islands and most would be fed into the French Grid and be re-imported into Britain via the cable under the Channel.

Questions 1-4

Reading Passage has six paragraphs, A-F.

Which paragraph contains the following information?

Write the correct letter, A-F, in boxes 1-4 on your answer sheet.

NB *You may use any letter more than once.*

- 1** the location of the first test site
- 2** a way of bringing the power produced on one site back into Britain
- 3** a reference to a previous attempt by Britain to find an alternative source of energy
- 4** mention of the possibility of applying technology from another industry

HOMework 02

A

In April 2002 an event took place which demonstrated one of the many applications of information theory. The space probe, Voyager I, launched in 1977, had sent back spectacular images of Jupiter and Saturn and then soared out of the Solar System on a one-way mission to the stars. After 25 years of exposure to the freezing temperatures of deep space, the probe was beginning to show its age. Sensors and circuits were on the brink of failing and NASA experts realised that they had to do something or lose contact with their probe forever. The solution was to get a message to Voyager I to instruct it to use spares to change the failing parts. With the probe 12 billion kilometres from Earth, this was not an easy task. By means of a radio dish belonging to NASA's Deep Space Network, the message was sent out into the depths of space. Even travelling at the speed of light, it took over 11 hours to reach its target, far beyond the orbit of Pluto. Yet, incredibly, the little probe managed to hear the faint call from its home planet, and successfully made the switchover.

B

It was the longest-distance repair job in history, and a triumph for the NASA engineers. But it also highlighted the astonishing power of the techniques developed by American communications engineer Claude Shannon, who had died just a year earlier. Born in 1916 in Petoskey, Michigan, Shannon showed an early talent for maths and for building gadgets, and made breakthroughs in the foundations of computer technology when still a student. While at Bell Laboratories, Shannon developed information theory, but shunned the resulting acclaim. In the 1940s, he single-handedly created an entire science of communication which has since inveigled its way into a host of applications, from DVDs to satellite communications to bar codes - any area, in short, where data has to be conveyed rapidly yet accurately.

C

This all seems light years away from the down-to-earth uses Shannon originally had for his work, which began when he was a 22-year-old graduate engineering student at the prestigious Massachusetts Institute of Technology in 1939. He set out with an apparently simple aim: to pin down the precise meaning of the concept of 'information'. The most basic form of information, Shannon argued, is whether something is true or false - which can be captured in the binary unit, or 'bit', of the form 1 or 0. Having identified this fundamental unit, Shannon set about defining otherwise vague ideas about information and how to transmit it from place to place. In the process he discovered something surprising: it is always possible to guarantee information will get through random interference - 'noise' - intact.

D

Noise usually means unwanted sounds which interfere with genuine information. Information theory generalises this idea via theorems that capture the effects of noise with mathematical precision. In particular, Shannon showed that noise sets a limit on the rate at which information can pass along communication channels while remaining error-free. This

rate depends on the relative strengths of the signal and noise travelling down the communication channel, and on its capacity (its 'bandwidth'). The resulting limit, given in units of bits per second, is the absolute maximum rate of error-free communication given signal strength and noise level. The trick, Shannon showed, is to find ways of packaging up - 'coding' - information to cope with the ravages of noise, while staying within the information-carrying capacity - 'bandwidth' - of the communication system being used.

E

Over the years scientists have devised many such coding methods, and they have proved crucial in many technological feats. The Voyager spacecraft transmitted data using codes which added one extra bit for every single bit of information; the result was an error rate of just one bit in 10,000 - and stunningly clear pictures of the planets. Other codes have become part of everyday life - such as the Universal Product Code, or bar code, which uses a simple error-detecting system that ensures supermarket check-out lasers can read the price even on, say, a crumpled bag of crisps. As recently as 1993, engineers made a major breakthrough by discovering so-called turbo codes - which come very close to Shannon's ultimate limit for the maximum rate that data can be transmitted reliably, and now play a key role in the mobile videophone revolution.

F

Shannon also laid the foundations of more efficient ways of storing information, by stripping out superfluous ('redundant') bits from data which contributed little real information. As mobile phone text messages like 'I CN C U' show, it is often possible to leave out a lot of data without losing much meaning. As with error correction, however, there's a limit beyond which messages become too ambiguous. Shannon showed how to calculate this limit, opening the way to the design of compression methods that cram maximum information into the minimum space.

Questions 1-6

Reading Passage has six paragraphs, A-F.

Which paragraph contains the following information?

Write the correct letter, A-F, in boxes 1-6 on your answer sheet.

- 1 an explanation of the factors affecting the transmission of information
- 2 an example of how unnecessary information can be omitted
- 3 a reference to Shannon's attitude to fame
- 4 details of a machine capable of interpreting incomplete information
- 5 a detailed account of an incident involving information theory
- 6 a reference to what Shannon initially intended to achieve in his research

HOMework 03

C

Another powerful source of information for infants about the effects they can have on the world around them is provided when others mimic them. Many parents spend a lot of time, particularly in the early months, copying their infant's vocalizations and expressions. In addition, young children enjoy looking in mirrors, where the movements they can see are dependent upon their own movements. This is not to say that infants recognize the reflection as their own image (a later development). However, Lewis and Brooks-Gunn (1979) suggest that infants' developing understanding that the movements they see in the mirror are contingent on their own, leads to a growing awareness that they are distinct from other people. This is because they, and only they, can change the reflection in the mirror.

D

This understanding that children gain of themselves as active agents continues to develop in their attempts to co-operate with others in play. Dunn (1988) points out that it is in such day-to-day relationships and interactions that the child's understanding of his- or herself emerges. Empirical investigations of the self-as-subject in young children are, however, rather scarce because of difficulties of communication: even if young infants can reflect on their experience, they certainly cannot express this aspect of the self directly.

E

Once children have acquired a certain level of self-awareness, they begin to place themselves in a whole series of categories, which together play such an important part in defining them uniquely as 'themselves'. This second step in the development of a full sense of self is what James called the 'self-as-object'. This has been seen by many to be the aspect of the self which is most influenced by social elements, since it is made up of social roles (such as student, brother, colleague) and characteristics which derive their meaning from comparison or interaction with other people (such as trustworthiness, shyness, sporting ability).

F

Cooley and other researchers suggested a close connection between a person's own understanding of their identity and other people's understanding of it. Cooley believed that people build up their sense of identity from the reactions of others to them, and from the view they believe others have of them. He called the self-as-object the 'looking-glass self', since people come to see themselves as they are reflected in others. Mead (1934) went even further, and saw the self and the social world as inextricably bound together: 'The self is essentially a social structure, and it arises in social experience ... it is impossible to conceive of a self arising outside of social experience.'

G

Lewis and Brooks-Gunn argued that an important developmental milestone is reached when children become able to recognize themselves visually without the support of seeing

contingent movement. This recognition occurs around their second birthday. In one experiment, Lewis and Brooks-Gunn (1979) dabbed some red powder on the noses of children who were playing in front of a mirror, and then observed how often they touched their noses. The psychologists reasoned that if the children knew what they usually looked like, they would be surprised by the unusual red mark and would start touching it. On the other hand, they found that children of 15 to 18 months are generally not able to recognize themselves unless other cues such as movement are present.

H

Finally, perhaps the most graphic expressions of self-awareness in general can be seen in the displays of rage which are most common from 18 months to 3 years of age. In a longitudinal study of groups of three or four children, Bronson (1975) found that the intensity of the frustration and anger in their disagreements increased sharply between the ages of 1 and 2 years. Often, the children's disagreements involved a struggle over a toy that none of them had played with before or after the tug-of-war: the children seemed to be disputing ownership rather than wanting to play with it. Although it may be less marked in other societies, the link between the sense of 'self' and of 'ownership' is a notable feature of childhood in Western societies.

Questions 1-6

Reading Passage has eight paragraphs, A-H.

Which paragraph contains the following information?

Write the correct letter, A-H, in boxes 1-6 on your answer sheet.

NB *You may use any letter more than once.*

- 1 an account of the method used by researchers in a particular study
- 2 the role of imitation in developing a sense of identity
- 3 the age at which children can usually identify a static image of themselves
- 4 a reason for the limitations of scientific research into 'self-as-subject'
- 5 reference to a possible link between culture and a particular form of behaviour
- 6 examples of the wide range of features that contribute to the sense of 'self-as-object'

HOMEWORK 04

Reducing the Effects of Climate Change

A

Such is our dependence on fossil fuels, and such is the volume of carbon dioxide already released into the atmosphere, that many experts agree that significant global warming is now inevitable. They believe that the best we can do is keep it at a reasonable level, and at present the only serious option for doing this is cutting back on our carbon emissions. But while a few countries are making major strides in this regard, the majority are having great difficulty even stemming the rate of increase, let alone reversing it. Consequently, an increasing number of scientists are beginning to explore the alternative of geo-engineering – a term which generally refers to the intentional large-scale manipulation of the environment. According to its proponents, geo-engineering is the equivalent of a backup generator: if Plan A - reducing our dependency on fossil fuels - fails, we require a Plan B, employing grand schemes to slow down or reverse the process of global warming.

B

Geo-engineering has been shown to work, at least on a small localised scale. For decades, MayDay parades in Moscow have taken place under clear blue skies, aircraft having deposited dry ice, silver iodide and cement powder to disperse clouds. Many of the schemes now suggested look to do the opposite, and reduce the amount of sunlight reaching the planet. The most eye-catching idea of all is suggested by Professor Roger Angel of the University of Arizona. His scheme would employ up to 16 trillion minute spacecraft, each weighing about one gram, to form a transparent, sunlight-refracting sunshade in an orbit 1.5 million km above the Earth. This could, argues Angel, reduce the amount of light reaching the Earth by two per cent.

C

The majority of geo-engineering projects so far carried out – which include planting forests in deserts and depositing iron in the ocean to stimulate the growth of algae - have focused on achieving a general cooling of the Earth. But some look specifically at reversing the melting at the poles, particularly the Arctic. The reasoning is that if you replenish the ice sheets and frozen waters of the high latitudes, more light will be reflected back into space, so reducing the warming of the oceans and atmosphere.

D

The concept of releasing aerosol sprays into the stratosphere above the Arctic has been proposed by several scientists. This would involve using sulphur or hydrogen sulphide aerosols so that sulphur dioxide would form clouds, which would, in turn, lead to a global dimming. The idea is modelled on historic volcanic explosions, such as that of Mount Pinatubo in the Philippines in 1991, which led to a short-term cooling of global temperatures by 0.5 °C. Scientists have also scrutinised whether it's possible to preserve the ice sheets of Greenland with reinforced high-tension cables, preventing icebergs from moving into the

sea. Meanwhile in the Russian Arctic, geo-engineering plans include the planting of millions of birch trees. Whereas the -regions native evergreen pines shade the snow and absorb radiation, birches would shed their leaves in winter, thus enabling radiation to be reflected by the snow. Re-routing Russian rivers to increase cold water flow to ice-forming areas could also be used to slow down warming, say some climate scientists.

Questions 1-3

Reading Passage has eight paragraphs A-H

Which paragraph contains the following information?

Write the correct letter, A-H, in boxes 1-3 on your answer sheet.

- 1** mention of a geo-engineering project based on an earlier natural phenomenon
- 2** an example of a successful use of geo-engineering
- 3** a common definition of geo-engineering

HOMEWORK

MATCHING HEADINGS

HOMEWORK 01

Questions 1-7

Reading Passage has seven paragraphs, A-G.

Choose the correct heading for each paragraph from the list of headings below.

Write the correct number, i-ix, in boxes 1-7 on your answer sheet.

List of Headings

- i** Evidence of innovative environment management practices
- ii** An undisputed answer to a question about the moai
- iii** The future of the moai statues
- iv** A theory which supports a local belief
- v** The future of Easter Island
- vi** Two opposing views about the Rapanui people
- vii** Destruction outside the inhabitants' control
- viii** How the statues made a situation worse
- ix** Diminishing food resources

- 1** Paragraph A
- 2** Paragraph B
- 3** Paragraph C
- 4** Paragraph D
- 5** Paragraph E
- 6** Paragraph F
- 7** Paragraph G

What destroyed the civilisation of Easter Island?

A

Easter Island, or Rapa Nui as it is known locally, is home to several hundred ancient human statues - the moai. After this remote Pacific island was settled by the Polynesians, it remained isolated for centuries. All the energy and resources that went into the moai - some of which are ten metres tall and weigh over 7,000 kilos - came from the island itself. Yet when Dutch explorers landed in 1722, they met a Stone Age culture. The moai were carved with stone tools, then transported for many kilometres, without the use of animals or wheels, to massive stone platforms. The identity of the moai builders was in doubt until well into the twentieth century. Thor Heyerdahl, the Norwegian ethnographer and adventurer, thought the statues had been created by pre-Inca peoples from Peru. Bestselling Swiss author Erich von Daniken believed they were built by stranded extraterrestrials. Modern science - linguistic, archaeological and genetic evidence - has definitively proved the moai builders were Polynesians, but not how they moved their creations. Local folklore maintains that the statues walked, while researchers have tended to assume the ancestors dragged the statues somehow, using ropes and logs.

B

When the Europeans arrived, Rapa Nui was grassland, with only a few scrawny trees. In the 1970s and 1980s, though, researchers found pollen preserved in lake sediments, which proved the island had been covered in lush palm forests for thousands of years. Only after the Polynesians arrived did those forests disappear. US scientist Jared Diamond believes that the Rapanui people - descendants of Polynesian settlers - wrecked their own environment. They had unfortunately settled on an extremely fragile island - dry, cool, and too remote to be properly fertilised by windblown volcanic ash. When the islanders cleared the forests for firewood and farming, the forests didn't grow back. As trees became scarce and they could no longer construct wooden canoes for fishing, they ate birds. Soil erosion decreased their crop yields. Before Europeans arrived, the Rapanui had descended into civil war and cannibalism, he maintains. The collapse of their isolated civilisation, Diamond writes, is a 'worst-case scenario for what may lie ahead of us in our own future'.

C

The moai, he thinks, accelerated the self-destruction. Diamond interprets them as power displays by rival chieftains who, trapped on a remote little island, lacked other ways of asserting their dominance. They competed by building ever bigger figures. Diamond thinks they laid the moai on wooden sledges, hauled over log rails, but that required both a lot of wood and a lot of people. To feed the people, even more land had to be cleared. When the wood was gone and civil war began, the islanders began toppling the moai. By the nineteenth century none were standing.

D

Archaeologists Terry Hunt of the University of Hawaii and Carl Lipo of California State University agree that Easter Island lost its lush forests and that it was an 'ecological

catastrophe' - but they believe the islanders themselves weren't to blame. And the moai certainly weren't. Archaeological excavations indicate that the Rapanui went to heroic efforts to protect the resources of their wind-lashed, infertile fields. They built thousands of circular stone windbreaks and gardened inside them, and used broken volcanic rocks to keep the soil moist. In short, Hunt and Lipo argue, the prehistoric Rapanui were pioneers of sustainable farming.

E

Hunt and Lipo contend that moai-building was an activity that helped keep the peace between islanders. They also believe that moving the moai required few people and no wood, because they were walked upright. On that issue, Hunt and Lipo say, archaeological evidence backs up Rapanui folklore. Recent experiments indicate that as few as 18 people could, with three strong ropes and a bit of practice, easily manoeuvre a 1,000 kg moai replica a few hundred metres. The figures' fat bellies tilted them forward, and a D-shaped base allowed handlers to roll and rock them side to side.

F

Moreover, Hunt and Lipo are convinced that the settlers were not wholly responsible for the loss of the island's trees. Archaeological finds of nuts from the extinct Easter Island palm show tiny grooves, made by the teeth of Polynesian rats. The rats arrived along with the settlers, and in just a few years, Hunt and Lipo calculate, they would have overrun the island. They would have prevented the reseedling of the slow-growing palm trees and thereby doomed Rapa Nui's forest, even without the settlers' campaign of deforestation. No doubt the rats ate birds' eggs too. Hunt and Lipo also see no evidence that Rapanui civilisation collapsed when the palm forest did. They think its population grew rapidly and then remained more or less stable until the arrival of the Europeans, who introduced deadly diseases to which islanders had no immunity. Then in the nineteenth century slave traders decimated the population, which shrivelled to 111 people by 1877.

G

Hunt and Lipo's vision, therefore, is one of an island populated by peaceful and ingenious moai builders and careful stewards of the land, rather than by reckless destroyers ruining their own environment and society. 'Rather than a case of abject failure, Rapa Nui is an unlikely story of success', they claim. Whichever is the case, there are surely some valuable lessons which the world at large can learn from the story of Rapa Nui.

HOMework 02

Questions 1-6

The reading passage has six paragraphs A-F.

Choose the most suitable heading for each paragraph from the list of headings below.

Write the correct number i-ix in your answer sheet.

List of Headings

- i. Fountain pens are history.
- ii. Fame at last for the Biro brothers.
- iii. A holiday helps bring the biro to America.
- iv. A second design and a new country.
- v. War halts progress.
- vi. Dissatisfaction leads to a new invention.
- vii. Big claims bring big crowds.
- viii. A government request brings a change of ownership.
- ix. Many patents and many problems.

- 1 Paragraph A
- 2 Paragraph B
- 3 Paragraph C
- 4 Paragraph D
- 5 Paragraph E
- 6 Paragraph F

The history of the biro

A.

One chilly autumn morning in 1945, five thousand shoppers crowded the pavements outside Gimbels Department Store in New York City. The day before, Gimbels had taken out a full-page newspaper advertisement in the New York Times, announcing the sale of the first ballpoint pens in the United States. The new writing instrument was heralded as "fantastic ... miraculous ... guaranteed to write for two years without refilling!" Within six hours, Gimbels had sold its entire stock of ten thousand ballpoints at \$12.50 each - approximately \$130 at today's prices.

B.

In fact, this 'new' pen was not new after all, and was just the latest development in a long search for the best way to deliver ink to paper. In 1884 Lewis Waterman had patented the fountain pen, giving him the sole rights to manufacture it. This marked a significant leap forward in writing technology, but fountain pens soon became notorious for leaking. In 1888, a leather tanner named John Loud devised and patented the first "rolling-pointed marker pen" for marking leather. Loud's design contained a reservoir of ink in a cartridge and a rotating ball point that was constantly bathed on one side with ink. Loud's pen was never manufactured, however, and over the next five decades, 350 additional patents were issued for similar ball-type pens, though none advanced beyond the design stage. Each had their own faults, but the major difficulty was the ink: if the ink was thin, the pens leaked, and if it was too thick, they clogged. Depending on the climate or air temperature, sometimes the pens would do both.

C.

Almost fifty years later, Ladislav and Georg Biro, two Hungarian brothers, came up with a solution to this problem. In 1935 Ladislav Biro was working as a journalist, editing a small newspaper. He found himself becoming more and more frustrated by the amount of time he wasted filling fountain pens with ink and cleaning up ink smudges. What's more, the sharp tip of his fountain pen often scratched or tore through the thin newsprint paper. Ladislav and Georg (a chemist) set about making models of new pen designs and creating better inks to use in them. Ladislav had observed that the type of ink used in newspaper printing dried rapidly, leaving the paper dry and smudge-free. He was determined to construct a pen using the same type of ink. However, the thicker ink would not flow from a regular pen nib so he had to develop a new type of point. Biro came up with the idea of fitting his pen with a tiny ball bearing in its tip. As the pen moved along the paper, the ball bearing rotated and picked up ink from the ink cartridge which it delivered to the paper.

D.

The first Biro pen, like the designs that had gone before it, relied on gravity for the ink to flow to the ball bearing at the tip. This meant that the pens only worked when they were held straight up, and even then the ink flow was sometimes too heavy, leaving big smudges of ink on the paper. The Biro brothers had a rethink and eventually devised a new design, which

relied on capillary action rather than gravity to feed the ink. This meant that the ink could flow more smoothly to the tip and the pen could be held at an angle rather than straight up. In 1938, as World War II broke out, the Biro brothers fled to Argentina, where they applied for a patent for their pen and established their first factory.

E.

The Birus' pen soon came to the attention of American fighter pilots, who needed a new kind of pen to use at high altitudes. Apparently, it was ideal for pilots as it did not leak like the fountain pen and did not have to be refilled frequently. The United States Department of War contacted several American companies, asking them to manufacture a similar writing instrument in the U.S. Thus fortune smiled on the Biro brothers in May 1945, when the American company 'Eversharp' paid them \$500,000 for the exclusive manufacturing and marketing rights of the Biro ballpoint for the North American market. Eversharp were slow to put their pen into production, however, and this delay ultimately cost them their competitive advantage.

F.

Meanwhile, in June 1945 an American named Milton Reynolds stumbled upon the Biro pen while on vacation in Buenos Aires. Immediately seeing its commercial potential, he bought several pens and returned to Chicago, where he discovered that Biro's original 1888 patent had long since expired. This meant that the ballpoint was now in the public domain, and he, therefore, wasted no time making a copy based on the Biro design. Establishing his pen company with just \$26,000, Reynolds quickly set up a factory with 300 workers who began production on 6th October 1945, stamping out pens from precious scraps of aluminum that hadn't been used during the war for military equipment or weapons. Just 23 days later, it was Reynolds' ballpoint pen that caused the stampede at Gimbel's Department Store. Following the ballpoint's debut in New York City, Eversharp challenged Reynolds in the law courts, but lost the case because the Biro brothers had failed to secure a U.S. patent on their invention.