



IELTS SPIRIT

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With all the best wishes

Tarik Hasan

Founder and CEO

IELTS SPIRIT

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LIST OF HEADING

List of heading

Tip: more than one heading may seem to match a paragraph at first.

After reading the paragraph, read each heading and decide which one best sums up the main point of the paragraph.

Example:

Here is a part of a text about the scientific system for naming species of animals and plant. You have to choose the correct heading for each paragraph.

List of heading

- I. example of the system in use
- II. reaction to Linnaeus's work
- III. the origin of the system
- IV. which animals are lions and tigers related to ?

- A. The scientific conventions for naming living organisms were established by the 18th century Swedish botanist ,physician and zoologist Carl Linnaeus, who developed binominal nomenclature , a two word system for naming every species of animal and plant. The first word indentifies the genus and the second word is the specific name.
- B. As an illustration, lions belong to the genus *Panthera*. And their specific name is *Leo*. Here the species is specified as panthera leo. Their relation the tiger, on the other hand, is named panthera tigers. The two-word names indicate the relationship in a way that lion and tiger dot.

Explanation: paragraph A explains how the system began. So the correct heading for **A** is heading **iii**. Although the paragraph refers to Linnaeus work. It isn't about reactions to it, so heading **ii** is wrong.

In paragraph **B** two example of animal name are given using the system so the correct answer is **i**. although the paragraph refers to to animals they are related to so heading **iv** is wrong.

You should read the heading before the text to focus your mind on the ideas you need to look for.

IS THERE ANYBODY OUT THERE'

The Search for Extra-terrestrial Intelligence

The question of whether we are alone in the Universe has haunted humanity for centuries, but we may now stand poised on the brink of the answer to that question, as we search for radio signals from other intelligent civilisations. This search, often known by the acronym SETI (search for extra-terrestrial intelligence), is a difficult one. Although groups around the world have been searching intermittently for three decades, it is only now that we have reached the level of technology where we can make a determined attempt to search all nearby stars for any sign of life.

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 civilisation 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 civilisation 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.

B

In discussing whether we are alone, most SETI scientists adopt two ground rules. First, UFOs (Unidentified Flying Objects) are generally ignored since most scientists don't consider the evidence for them to be strong enough to bear serious consideration (although it is also important to keep an open mind in case any really convincing evidence emerges in the future). Second, we make a very conservative assumption that we are looking for a life form that is pretty well like us, since if it differs radically from us we may well not recognise it as a life form, quite apart from whether we are able to communicate with it. In other words, the life form we are looking for may well have two green heads and seven fingers, but it will nevertheless resemble us in that it should communicate with its fellows, be interested in the Universe, live on a planet orbiting a star like our Sun, and perhaps most restrictively, have a chemistry, like us, based on carbon and water.

C

Even when we make these assumptions, our understanding of other life forms is still severely limited. We do not even know, for example, how many stars have planets, and we certainly do not know how likely it is that life will arise naturally, given the right conditions. However, when we look at the 100 billion stars in our galaxy (the Milky Way), and 100 billion galaxies in the observable Universe, it seems inconceivable that at least one of these planets does not have a life form on it; in fact, the best educated guess we can make, using the little that we do know about the conditions for carbon-based life, leads us to estimate that perhaps one in 100,000 stars might have a life-bearing planet orbiting it. That means that our nearest neighbours are perhaps 100 light years away, which is almost next door in astronomical terms.

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.

E

There is considerable debate over how we should react if we detect a signal from an alien civilisation. Everybody agrees that we should not reply immediately. Quite apart from the impracticality of sending a reply over such large distances at short notice, it raises a host of ethical questions that would have to be addressed by the global community before any reply could be sent. Would the human race face the culture shock if faced with a superior and much older civilisation? Luckily, there is no urgency about this. The stars being searched are hundreds of light years away, so it takes hundreds of years for their signal to reach us, and a further few hundred years for our reply to reach them. It's not important, then, if there's a delay of a few years, or decades, while the human race debates the question of whether to reply, and perhaps carefully drafts a reply.

Reading Passage 1 has five paragraphs, A-E.

Choose the correct heading for paragraphs B-E from the list of headings below.

Write the correct number, i-vii, in boxes 1-4 on your answer sheet.

List of Headings

- i Seeking the transmission of radio signals from planets
- ii Appropriate responses to signals from other civilisations
- iii Vast distances to Earth's closest neighbours
- iv Assumptions underlying the search for extra-terrestrial intelligence
- v Reasons for the search for extra-terrestrial intelligence
- vi Knowledge of extra-terrestrial life forms
- vii Likelihood of life on other planets

1 Paragraph B

2 Paragraph C

3 Paragraph D

4 Paragraph E

<i>Example</i>	<i>Answer</i>
Paragraph A	V

READING PASSAGE 2

The Development of Museums

A

The conviction that historical relics provide infallible testimony about the past is rooted in the nineteenth and early twentieth centuries, when science was regarded as objective and value free. As one writer observes: 'Although it is now evident that artefacts are as easily altered as chronicles, public faith in their veracity endures: a tangible relic seems ipso facto real.' Such conviction was, until recently, reflected in museum displays. Museums used to look - and some still do - much like storage rooms of objects packed together in showcases: good for scholars who wanted to study the subtle differences in design, but not for the ordinary visitor, to whom it all looked alike. Similarly, the information accompanying the objects often made little sense to the lay visitor. The content and format of explanations dated back to a time when the museum was the exclusive domain of the scientific researcher.

B

Recently, however, attitudes towards history and the way it should be presented have altered. The key word in heritage display is now 'experience', the more exciting the better and, if possible, involving all the senses. Good examples of this approach in the UK are the Jorvik Centre in York; the National Museum of Photography, Film and Television in Bradford; and the Imperial War Museum in London. In the US the trend emerged much earlier: Williamsburg has been a prototype for many heritage developments in other parts of the world. No one can predict where the process will end. On so-called heritage sites the re-enactment of historical events is increasingly popular, and computers will soon provide virtual reality experiences, which will present visitors with a vivid image of the period of their choice, in which they themselves can act as if part of the historical environment. Such developments have been criticised as an intolerable vulgarisation, but the success of many historical theme parks and similar locations suggests that the majority of the public does not share this opinion.

C

In a related development, the sharp distinction between museum and heritage sites on the one hand, and theme parks on the other, is gradually evaporating. They already borrow ideas and concepts from one another. For example, museums have adopted story lines for exhibitions, sites have accepted 'theming' as a relevant tool, and theme parks are moving towards more authenticity and research-based presentations. In zoos, animals are no longer kept in cages, but in great spaces, either in the open air or in enormous greenhouses, such as the jungle and desert environments in Burgers' Zoo in Holland. This particular trend is regarded as one of the major developments in the presentation of natural history in the twentieth century.

D

Theme parks are undergoing other changes, too, as they try to present more serious social and cultural issues, and move away from fantasy. This development is a response to market forces and, although museums and heritage sites have a special, rather distinct, role to fulfil, they are also operating in a very competitive environment, where visitors make choices on how and where to spend their free time. Heritage and museum experts do not have to invent stories and recreate historical environments to attract their visitors: their assets are already in place. However, exhibits must be both based on artefacts and facts as we know them, and attractively presented. Those who are professionally engaged in the art of interpreting history are thus in a difficult position, as they must steer a narrow course between the demands of 'evidence' and 'attractiveness', especially given the increasing need in the heritage industry for income-generating activities.

E

It could be claimed that in order to make everything in heritage more 'real', historical accuracy must be increasingly altered. For example, *Pithecanthropus erectus* is depicted in an Indonesian museum

with Malay facial features, because this corresponds to public perceptions. Similarly, in the Museum of Natural History in Washington, Neanderthal man is shown making a dominant gesture to his wife. Such presentations tell us more about contemporary perceptions of the world than about our ancestors. There is one compensation, however, for the professionals who make these interpretations: if they did not provide the interpretation, visitors would do it for themselves, based on their own ideas, misconceptions and prejudices. And no matter how exciting the result, it would contain a lot more bias than the presentations provided by experts.

F

Human bias is inevitable, but another source of bias in the representation of history has to do with the transitory nature of the materials themselves. The simple fact is that not everything from history survives the historical process. Castles, palaces and cathedrals have a longer lifespan than the dwellings of ordinary people. The same applies to the furnishings and other contents of the premises. In a town like Leyden in Holland, which in the seventeenth century was occupied by approximately the same number of inhabitants as today, people lived within the walled town, an area more than five times smaller than modern Leyden. In most of the houses several families lived together in circumstances beyond our imagination. Yet in museums, fine period rooms give only an image of the lifestyle of the upper class of that era. No wonder that people who stroll around exhibitions are filled with nostalgia; the evidence in museums indicates that life was so much better in the past. This notion is induced by the bias in its representation in museums and heritage centres.

Questions 6-9

Write the correct number, **i-vii**, in boxes 6-9 on your answer sheet.

6 Paragraph B

7 Paragraph C

8 Paragraph D

9 Paragraph E

<i>Example</i>	<i>Answer</i>
Paragraph A	V

List of Headings

- i** *Commercial pressures on people in charge*
- ii** *Mixed views on current changes to museums*
- iii** *Interpreting the facts to meet visitor expectations*
- iv** *The international dimension*
- v** *Collections of factual evidence*
- vi** *Fewer differences between public attractions*
- vii** *Current reviews and suggestion*

READING PASSAGE 3

AIR TRAFFIC CONTROL IN THE USA

A

An accident that occurred in the skies over the Grand Canyon in 1956 resulted in the establishment of the Federal Aviation Administration (FAA) to regulate and oversee the operation of aircraft in the skies over the United States, which were becoming quite congested. The resulting structure of air traffic control has greatly increased the safety of flight in the United States, and similar air traffic control procedures are also in place over much of the rest of the world.

B

Rudimentary air traffic control (ATC) existed well before the Grand Canyon disaster. As early as the 1920s, the earliest air traffic controllers manually guided aircraft in the vicinity of the airports, using lights and flags, while beacons and flashing lights were placed along cross-country routes to establish the earliest airways. However, this purely visual system was useless in bad weather, and, by the 1930s, radio communication was coming into use for ATC. The first region to have something approximating today's ATC was New York City, with other major metropolitan areas following soon after.

C

In the 1940s, ATC centres could and did take advantage of the newly developed radar and improved radio communication brought about by the Second World War, but the system remained rudimentary. It was only after the creation of the FAA that full-scale regulation of America's airspace took place, and this was fortuitous, for the advent of the jet engine suddenly resulted in a large number of very fast planes, reducing pilots' margin of error and practically demanding some set of rules to keep everyone well separated and operating safely in the air.

D

Many people think that ATC consists of a row of controllers sitting in front of their radar screens at the nation's airports, telling arriving and departing traffic what to do. This is a very incomplete part of the picture. The FAA realised that the airspace over the United States would at any time have many different kinds of planes, flying for many different purposes, in a variety of weather conditions, and the same kind of structure was needed to accommodate all of them.

E

To meet this challenge, the following elements were put into effect. First, ATC extends over virtually the entire United States. In general, from 365m above the ground and higher, the entire country is blanketed by controlled airspace. In certain areas, mainly near airports, controlled airspace extends down to 215m above the ground, and, in the immediate vicinity of an airport, all the way down to the surface. Controlled airspace is that airspace in which FAA regulations apply. Elsewhere, in uncontrolled airspace, pilots are bound by fewer regulations. In this way, the recreational pilot who simply wishes to go flying for a while without all the restrictions imposed by the FAA has only to stay in uncontrolled airspace, below 365m, while the pilot who does want the protection afforded by ATC can easily enter the controlled airspace.

F

The FAA then recognised two types of operating environments. In good meteorological conditions, flying would be permitted under Visual Flight Rules (VFR), which suggests a strong reliance on visual cues to maintain an acceptable level of safety. Poor visibility necessitated a set of Instrumental Flight Rules (IFR), under which the pilot relied on altitude and navigational information provided by the plane's instrument panel to fly safely. On a clear day, a pilot in controlled airspace can choose a VFR or IFR flight plan, and the FAA regulations were devised in a way which accommodates both VFR and IFR operations in the same airspace. However, a pilot can only choose to fly IFR if they possess an instrument rating which is above and beyond the basic pilot's license that must also be held.

G

Controlled airspace is divided into several different types, designated by letters of the alphabet. Uncontrolled airspace is designated Class F, while controlled airspace below 5,490m above sea level and not in the vicinity of an airport is Class E. All airspace above 5,490m is designated Class A. The reason for the division of Class E and Class A airspace stems from the type of planes operating in them. Generally, Class E airspace is where one finds general aviation aircraft (few of which can climb above 5,490m anyway), and commercial turboprop aircraft. Above 5,490m is the realm of the heavy jets, since jet engines operate more efficiently at higher altitudes. The difference between Class E and A airspace is that in Class A, all operations are IFR, and pilots must be instrument-rated, that is, skilled and licensed in aircraft instrumentation. This is because ATC control of the entire space is essential. Three other types of airspace, Classes D, C and B, govern the vicinity of airports. These correspond roughly to small municipal, medium-sized metropolitan and major metropolitan airports respectively, and encompass an increasingly rigorous set of regulations. For example, all a VFR pilot has to do to enter Class C airspace is establish two-way radio contact with ATC. No explicit permission from ATC to enter is needed, although the pilot must continue to obey all regulations governing VFR flight. To enter Class B airspace, such as on approach to a major metropolitan airport, an explicit ATC clearance is required. The private pilot who cruises without permission into this airspace risks losing their license.

Questions 9.a-14

Write the correct number, **i-vii**, in boxes 9.a-14 on your answer sheet.

9.a. Paragraph A

10 Paragraph C

11 Paragraph D

12 Paragraph E

13 Paragraph F

14 Paragraph G

<i>Example</i>	<i>Answer</i>
Paragraph B	X

List of Headings

- i** Disobeying FAA regulations
- ii** Aviation disaster prompts action
- iii** Two coincidental developments
- iv** Setting altitude zones
- v** An oversimplified view
- vi** Controlling pilots' licences
- vii** Defining airspace categories
- viii** Setting rules to weather conditions
- ix** Taking off safely
- x** First steps towards ATC

READING PASSAGE 4

THE LITTLE ICE AGE

A

This book will provide a detailed examination of the Little Ice Age and other climatic shifts, but, before I embark on that, let me provide a historical context. We tend to think of climate - as opposed to weather - as something unchanging, yet humanity has been at the mercy of climate change for its entire existence, with at least eight glacial episodes in the past 730,000 years. Our ancestors adapted to the universal but irregular global warming since the end of the last great Ice Age, around 10,000 years ago, with dazzling opportunism. They developed strategies for surviving harsh drought cycles, decades of heavy rainfall or unaccustomed cold; adopted agriculture and stock-raising, which revolutionised human life; and founded the world's first pre-industrial civilisations in Egypt, Mesopotamia and the Americas. But the price of sudden climate change, in famine, disease and suffering, was often high.

B

The Little Ice Age lasted from roughly 1300 until the middle of the nineteenth century. Only two centuries ago, Europe experienced a cycle of bitterly cold winters; mountain glaciers in the Swiss Alps were the lowest in recorded memory, and pack ice surrounded Iceland for much of the year. The climatic events of the Little Ice Age did more than help shape the modern world. They are the deeply important context for the current unprecedented global warming. The Little Ice Age was far from a deep freeze, however; rather an irregular seesaw of rapid climatic shifts, few lasting more than a quarter-century, driven by complex and still little understood interactions between the atmosphere and the ocean. The seesaw brought cycles of intensely cold winters and easterly winds, then switched abruptly to years of heavy spring and early summer rains, mild winters, and frequent Atlantic storms, or to periods of droughts, light northeasterly winds, and summer heat waves.

C

Reconstructing the climate changes of the past is extremely difficult, because systematic weather observations began only a few centuries ago, in Europe and North America. Records from India and tropical Africa are even more recent. For the time before records began, we have only 'proxy records' reconstructed largely from tree rings and ice cores, supplemented by a few incomplete written accounts. We now have hundreds of tree-ring records from throughout the northern hemisphere, and many from south of the equator, too, amplified with a growing body of temperature data from ice cores drilled in Antarctica, Greenland, the Peruvian Andes, and other locations. We are close to a knowledge of annual summer and winter temperature variations over much of the northern hemisphere going back 600 years.

D

This book is a narrative history of climatic shifts during the past ten centuries, and some of the ways in which people in Europe adapted to them. Part One describes the Medieval Warm Period, roughly 900 to 1200. During these three centuries, Norse voyagers from Northern Europe explored northern seas, settled Greenland, and visited North America. It was not a time of uniform warmth, for then, as always since the Great Ice Age, there were constant shifts in rainfall and temperature. Mean European temperatures were about the same as today, perhaps slightly cooler.

E

It is known that the Little Ice Age cooling began in Greenland and the Arctic in about 1200. As the Arctic ice pack spread southward, Norse voyages to the west were rerouted into the open Atlantic, then ended altogether. Storminess increased in the North Atlantic and North Sea. Colder, much wetter weather descended on Europe between 1315 and 1319, when thousands perished in a continent-wide famine. By 1400, the weather had become decidedly more unpredictable and stormier, with sudden shifts and lower temperatures that culminated in the cold decades of the late sixteenth century. Fish were a vital commodity in growing towns and cities, where food supplies were a constant concern. Dried cod and herring were already the staples of the European fish trade, but changes in water temperatures forced fishing fleets to work further offshore. The Basques, Dutch, and English developed the first offshore fishing boats adapted to a colder and stormier Atlantic. A gradual agricultural revolution in northern Europe stemmed from concerns over food supplies at a time of rising populations. The revolution involved intensive commercial farming and the growing of animal fodder on

land not previously used for crops. The increased productivity from farmland made some countries self-sufficient in grain and livestock and offered effective protection against famine.

F

Global temperatures began to rise slowly after 1850, with the beginning of the Modern Warm Period. There was a vast migration from Europe by land-hungry farmers and others, to which the famine caused by the Irish potato blight contributed, to North America, Australia, New Zealand, and southern Africa. Millions of hectares of forest and woodland fell before the newcomers' axes between 1850 and 1890, as intensive European farming methods expanded across the world. The unprecedented land clearance released vast quantities of carbon dioxide into the atmosphere, triggering for the first time humanly caused global warming. Temperatures climbed more rapidly in the twentieth century as the use of fossil fuels proliferated and greenhouse gas levels continued to soar. The rise has been even steeper since the early 1980s. The Little Ice Age has given way to a new climatic regime, marked by prolonged and steady warming. At the same time, extreme weather events like Category 5 hurricanes are becoming more frequent.

Questions 14-17

Write the correct number, **i-ix**, in boxes 14-17 on your answer sheet.

16 Paragraph B

17 Paragraph D

18 Paragraph E

19 Paragraph F

<i>Example</i>	<i>Answer</i>
Paragraph A	viii

<i>Example</i>	<i>Answer</i>
Paragraph C	v

List of Headings

i Predicting climatic changes

ii The relevance of the Little Ice Age today

iii How cities contribute to climate change

iv Human impact on the climate

v How past climatic conditions can be determined

vi A growing need for weather records

vii A study covering a thousand years

viii People have always responded to climate change

ix Enough food at last

READING PASSAGE 5

The meaning and power of smell

The sense of smell, or olfaction, is powerful. Odours affect us on a physical, psychological and social level. For the most part, however, we breathe in the aromas which surround us without being consciously aware of their importance to us. It is only when the faculty of smell is impaired for some reason that we begin to realise the essential role the sense of smell plays in our sense of well-being

A

A survey conducted by Anthony Synott at Montreal's Concordia University asked participants to comment on how important smell was to them in their lives. It became apparent that smell can evoke strong emotional responses. A scent associated with a good experience can bring a rush of joy, while a foul odour or one associated with a bad memory may make us grimace with disgust. Respondents to the survey noted that many of their olfactory likes and dislikes were based on emotional associations. Such associations can be powerful enough so that odours that we would generally label unpleasant become agreeable, and those that we would generally consider fragrant become disagreeable for particular individuals. The perception of smell, therefore, consists not only of the sensation of the odours themselves, but of the experiences and emotions associated with them.

B

Odours are also essential cues in social bonding. One respondent to the survey believed that there is no true emotional bonding without touching and smelling a loved one. In fact, infants recognise the odours of their mothers soon after birth and adults can often identify their children or spouses by scent. In one well-known test, women and men were able to distinguish by smell alone clothing worn by their marriage partners from similar clothing worn by other people. Most of the subjects would probably never have given much thought to odour as a cue for identifying family members before being involved in the test, but as the experiment revealed, even when not consciously considered, smells register.

C

In spite of its importance to our emotional and sensory lives, smell is probably the most undervalued sense in many cultures. The reason often given for the low regard in which smell is held is that, in comparison with its importance among animals, the human sense of smell is feeble and undeveloped. While it is true that the olfactory powers of humans are nothing like as fine as those possessed by certain animals, they are still remarkably acute. Our noses are able to recognise thousands of smells, and to perceive odours which are present only in extremely small quantities.

D

Smell, however, is a highly elusive phenomenon. Odours, unlike colours, for instance, cannot be named in many languages because the specific vocabulary simply doesn't exist. 'It smells like . . .', we have to say when describing an odour, struggling to express our olfactory experience. Nor can odours be recorded: there is no effective way to either capture or store them over time. In the realm of olfaction, we must make do with descriptions and recollections. This has implications for olfactory research.

E

Most of the research on smell undertaken to date has been of a physical scientific nature. Significant advances have been made in the understanding of the biological and chemical nature of olfaction, but many fundamental questions have yet to be answered. Researchers have still to decide whether smell is one sense or two - one responding to odours proper and the other registering odourless chemicals in the air. Other unanswered questions are whether the nose is the only part of the body affected by odours, and how smells can be measured objectively given the nonphysical components. Questions like these mean that interest in the psychology of smell is inevitably set to play an increasingly important role for researchers.

F

However, smell is not simply a biological and psychological phenomenon. Smell is cultural, hence it is a social and historical phenomenon. Odours are invested with cultural values: smells that are considered to be offensive in some cultures may be perfectly acceptable in others. Therefore, our sense of smell is a means of, and model for, interacting with the world. Different smells can provide us with intimate and emotionally charged experiences and the value that we attach to these experiences is interiorised by the members of society in a

deeply personal way. Importantly, our commonly held feelings about smells can help distinguish us from other cultures. The study of the cultural history of smell is, therefore, in a very real sense, an investigation into the essence of human culture.

Questions 27-32

Write the correct number, i-viii, in boxes 27-32 on your answer sheet. 20 Paragraph A

21 Paragraph B

22 Paragraph C

23 Paragraph D

24 Paragraph E

25 Paragraph F

List of Headings

- i** The difficulties of talking about smells
- ii** The role of smell in personal relationships
- iii** Future studies into smell
- iv** The relationship between the brain and the nose
- v** The interpretation of smells as a factor in defining groups
- vi** Why our sense of smell is not appreciated
- vii** Smell is our superior sense
- viii** The relationship between smell and feelings

READING PASSAGE 6

HOW DOES THE BIOLOGICAL CLOCK TICK?

A

Our life span is restricted. Everyone accepts this as 'biologically' obvious. 'Nothing lives for ever!' However, in this statement we think of artificially produced, technical objects, products which are subjected to natural wear and tear during use. This leads to the result that at some time or other the object stops working and is unusable ('death' in the biological sense). But are the wear and tear and loss of function of technical objects and the death of living organisms really similar or comparable?

B

Our 'dead' products are 'static', closed systems. It is always the basic material which constitutes the object and which, in the natural course of things, is worn down and becomes 'older'. Ageing in this case must occur according to the laws of physical chemistry and of thermodynamics. Although the same law holds for a living organism, the result of this law is not inexorable in the same way. At least as long as a biological system has the ability to renew itself it could actually become older without ageing; an organism is an open, dynamic system through which new material continuously flows. Destruction of old material and formation of new material are thus in permanent dynamic equilibrium. The material of which the organism is formed changes continuously. Thus our bodies continuously exchange old substance for new, just like a spring which more or less maintains its form and movement, but in which the water molecules are always different.

C

Thus ageing and death should not be seen as inevitable, particularly as the organism possesses many mechanisms for repair. It is not, in principle, necessary for a biological system to age and die. Nevertheless, a restricted life span, ageing, and then death are basic characteristics of life. The reason for this is easy to recognise: in nature, the existent organisms either adapt or are regularly replaced by new types. Because of changes in the genetic material (mutations) these have new characteristics and in the course of their individual lives they are tested for optimal or better adaptation to the environmental conditions. Immortality would disturb this system - it needs room for new and better life. This is the basic problem of evolution.

D

Every organism has a life span which is highly characteristic. There are striking differences in life span between different species, but within one species the parameter is relatively constant. For example, the average duration of human life has hardly changed in thousands of years. Although more and more people attain an advanced age as a result of developments in medical care and better nutrition, the characteristic upper limit for most remains 80 years. A further argument against the simple wear and tear theory is the observation that the time within which organisms age lies between a few days (even a few hours for unicellular organisms) and several thousand years, as with mammoth trees.

E

If a life span is a genetically determined biological characteristic, it is logically necessary to propose the existence of an internal clock, which in some way measures and controls the ageing process and which finally determines death as the last step in a fixed programme. Like the life span, the metabolic rate has for different organisms a fixed mathematical relationship to the body mass. In comparison to the life span this relationship is 'inverted': the larger the organism the lower its metabolic rate. Again this relationship is valid not only for birds, but also, similarly on average within the systematic unit, for all other organisms (plants, animals, unicellular organisms).

F

Animals which behave 'frugally' with energy become particularly old, for example, crocodiles and tortoises. Parrots and birds of prey are often held chained up. Thus they are not able to 'experience life' and so they attain a high life span in captivity. Animals which save energy by hibernation or lethargy (e.g. bats or hedgehogs) live much longer than those which are always active. The metabolic rate of mice can be reduced by a very low consumption of food (hunger diet). They then may live twice as long as their well fed

comrades. Women become distinctly (about 10 per cent) older than men. If you examine the metabolic rates of the two sexes you establish that the higher male metabolic rate roughly accounts for the lower male life span. That means that they live life 'energetically' - more intensively, but not for as long.

G

It follows from the above that sparing use of energy reserves should tend to extend life. Extreme high performance sports may lead to optimal cardiovascular performance, but they quite certainly do not prolong life. Relaxation lowers metabolic rate, as does adequate sleep and in general an equable and balanced personality. Each of us can develop his or her own 'energy saving programme' with a little self-observation, critical self-control and, above all, logical consistency. Experience will show that to live in this way not only increases the life span but is also very healthy. This final aspect should not be forgotten.

Questions 25-30

Write the correct number, **i-x**, in boxes 25-30 on your answer sheet.

25 Paragraph B

26 Paragraph C

27 Paragraph D

28 Paragraph E

29 Paragraph F

30 Paragraph G

<i>Example</i>	<i>Answer</i>
Paragraph A	V

List of Headings

- i** The biological clock
- ii** Why dying is beneficial
- iii** The ageing process of men and women
- iv** Prolonging your life
- v** Limitations of life span
- vi** Modes of development of different species
- vii** A stable life span despite improvements
- viii** Energy consumption
- ix** Fundamental differences in ageing of objects and organisms
- x** Repair of genetic material

READING PASSAGE 7

LAND OF THE RISING SUN

A

Japan has a significantly better record in terms of average mathematical attainment than England and Wales. Large sample international comparisons of pupils' attainments since the 1960s have established that not only did Japanese pupils at age 13 have better scores of average attainment, but there was also a larger proportion of 'low' attainers in England, where, incidentally, the variation in attainment scores was much greater. The percentage of Gross National Product spent on education is reasonably similar in the two countries, so how is this higher and more consistent attainment in maths achieved?

B

Lower secondary schools in Japan cover three school years, from the seventh grade (age 13) to the ninth grade (age 15). Virtually all pupils at this stage attend state schools: only 3 per cent are in the private sector. Schools are usually modern in design, set well back from the road and spacious inside. Classrooms are large and pupils sit at single desks in rows. Lessons last for a standardised 50 minutes and are always followed by a 10-minute break, which gives the pupils a chance to let off steam. Teachers begin with a formal address and mutual bowing, and then concentrate on whole-class teaching.

Classes are large - usually about 40 - and are unstreamed. Pupils stay in the same class for all lessons throughout the school and develop considerable class identity and loyalty. Pupils attend the school in their own neighbourhood, which in theory removes ranking by school. In practice in Tokyo, because of the relative concentration of schools, there is some competition to get into the 'better' school in a particular area.

C

Traditional ways of teaching form the basis of the lesson and the remarkably quiet classes take their own notes of the points made and the examples demonstrated. Everyone has their own copy of the textbook supplied by the central education authority, Monbusho, as part of the concept of free compulsory education up to the age of 15. These textbooks are, on the whole, small, presumably inexpensive to produce, but well set out and logically developed. (One teacher was particularly keen to introduce colour and pictures into maths textbooks: he felt this would make them more accessible to pupils brought up in a cartoon culture.) Besides approving textbooks, Monbusho also decides the highly centralised national curriculum and how it is to be delivered.

D

Lessons all follow the same pattern. At the beginning, the pupils put solutions to the homework on the board, then the teachers comment, correct or elaborate as necessary. Pupils mark their own homework: this is an important principle in Japanese schooling as it enables pupils to see where and why they made a mistake, so that these can be avoided in future. No one minds mistakes or ignorance as long as you are prepared to learn from them.

After the homework has been discussed, the teacher explains the topic of the lesson, slowly and with a lot of repetition and elaboration. Examples are demonstrated on the board; questions from the textbook are worked through first with the class, and then the class is set questions from the textbook to do individually. Only rarely are supplementary worksheets distributed in a maths class. The impression is that the logical nature of the textbooks and their comprehensive coverage of different types of examples, combined with the relative homogeneity of the class, renders work sheets unnecessary. At this point, the teacher would circulate and make sure that all the pupils were coping well.

E

It is remarkable that large, mixed-ability classes could be kept together for maths throughout all their compulsory schooling from 6 to 15. Teachers say that they give individual help at the end of a lesson

or after school, setting extra work if necessary. In observed lessons, any strugglers would be assisted by the teacher or quietly seek help from their neighbour. Carefully fostered class identity makes pupils keen to help each other - anyway, it is in their interests since the class progresses together.

This scarcely seems adequate help to enable slow learners to keep up. However, the Japanese attitude towards education runs along the lines of 'if you work hard enough, you can do almost anything'. Parents are kept closely informed of their children's progress and will play a part in helping their children to keep up with class, sending them to 'Juku' (private evening tuition) if extra help is needed and encouraging them to work harder. It seems to work, at least for 95 per cent of the school population.

F

So what are the major contributing factors in the success of maths teaching? Clearly, attitudes are important. Education is valued greatly in Japanese culture; maths is recognised as an important compulsory subject throughout schooling; and the emphasis is on hard work coupled with a focus on accuracy.

Other relevant points relate to the supportive attitude of a class towards slower pupils, the lack of competition within a class, and the positive emphasis on learning for oneself and improving one's own standard. And the view of repetitively boring lessons and learning the facts by heart, which is sometimes quoted in relation to Japanese classes, may be unfair and unjustified. No poor maths lessons were observed. They were mainly good and one or two were inspirational.

Questions 31-35

The Passage has six sections, A-F.

31 Section B

32 Section C

33 Section D

34 Section E

35 Section F

<i>Example</i>	<i>Answer</i>
Section A	iv

List of Headings

i The influence of Monbusho

ii Helping less successful students

iii The success of compulsory education

iv Research findings concerning
achievements in maths

v The typical format of a maths lesson

vi Comparative expenditure on maths
education

vii Background to middle-years education in
Japan

viii The key to Japanese successes in
maths education

ix The role of homework correction

READING PASSAGE 8

EUROPEAN TRANSPORT SYSTEMS 1990-2010

What have been the trends and what are the prospects for European transport systems?

A It is difficult to conceive of vigorous economic growth without an efficient transport system. Although modern information technologies can reduce the demand for physical transport by facilitating teleworking and teleservices, the requirement for transport continues to increase. There are two key factors behind this trend. For passenger transport, the determining factor is the spectacular growth in car use. The number of cars on European Union (EU) roads saw an increase of three million cars each year from 1990 to 2010, and in the next decade the EU will see a further substantial increase in its fleet.

B As far as goods transport is concerned, growth is due to a large extent to changes in the European economy and its system of production. In the last 20 years, as internal frontiers have been abolished, the EU has moved from a "stock" economy to a "flow" economy. This phenomenon has been emphasised by the relocation of some industries, particularly those which are labourintensive, to reduce production costs, even though the production site is hundreds or even thousands of kilometres away from the final assembly plant or away from users.

C The strong economic growth expected in countries which are candidates for entry to the EU will also increase transport flows, in particular road haulage traffic. In 1998, some of these countries already exported more than twice their 1990 volumes and imported more than five times their 1990 volumes. And although many candidate countries inherited a transport system which encourages rail, the distribution between modes has tipped sharply in favour of road transport since the 1990s. Between 1990 and 1998, road haulage increased by 19.4%, while during the same period rail haulage decreased by 43.5%, although – and this could benefit the enlarged EU – it is still on average at a much higher level than in existing member states.

D However, a new imperative-sustainable development – offers an opportunity for adapting the EU, s common transport policy. This objective, agreed by the Gothenburg European Council, has to be achieved by integrating environmental considerations into Community policies, and shifting the balance between modes of transport lies at the heart of its strategy. The ambitious objective can only be fully achieved by 2020, but proposed measures are nonetheless a first essential step towards a sustainable transport system which will ideally be in place in 30 years" time, that is by 2040.

E In 1998, energy consumption in the transport sector was to blame for 28% of emissions of CO₂, the leading greenhouse gas. According to the latest estimates, if nothing is done to reverse the traffic growth trend, CO₂ emissions from transport can be expected to increase by around 50% to 1,113 billion tonnes by 2020, compared with the 739 billion tonnes recorded in 1990. Once again, road transport is the main culprit since it alone accounts for 84% of the CO₂ emissions attributable to transport. Using alternative fuels and improving energy efficiency is thus both an ecological necessity and a technological challenge.

F At the same time greater efforts must be made to achieve a modal shift. Such a change cannot be achieved overnight, all the less so after over half a century of constant deterioration in favour of road. This has reached such a pitch that today rail freight services are facing marginalisation, with just 8% of market share, and with international goods trains struggling along at an average speed of 18km/h. Three possible options have emerged.

G The first approach would consist of focusing on road transport solely through pricing. This option would not be accompanied by complementary measures in the other modes of transport. In the short term it might curb the growth in road transport through the better loading ratio of goods vehicles and occupancy rates of passenger vehicles expected as a result of the increase in the price of transport. However, the lack of measures available to revitalise other modes of transport would make it impossible for more sustainable modes of transport to take up the baton.

H The second approach also concentrates on road transport pricing but is accompanied by measures to increase the efficiency of the other modes (better quality of services, logistics, technology). However, this approach does not include investment in new infrastructure, nor does it guarantee better regional cohesion. It could help to achieve greater uncoupling than the first approach, but road transport would keep the lion's share of the market and continue to concentrate on saturated arteries, despite being the most polluting of the modes. It is therefore not enough to guarantee the necessary shift of the balance.

I The third approach, which is not new, comprises a series of measures ranging from pricing to revitalising alternative modes of transport and targeting investment in the trans-European network. This integrated approach would allow the market shares of the other modes to return to their 1998 levels and thus make a shift of balance. It is far more ambitious than it looks, bearing in mind the historical imbalance in favour of roads for the last fifty years, but would achieve a marked break in the link between road transport growth and economic growth, without placing restrictions on the mobility of people and goods.

Questions 37-44

The Passage has nine paragraphs, A-I.

37 Paragraph A

38 Paragraph B

39 Paragraph C

40 Paragraph D

41 Paragraph E

42 Paragraph G

43 Paragraph H

44 Paragraph

List of Headings

i A fresh and important long-term goal

ii Charging for roads and improving other transport methods

iii Changes affecting the distances goods may be transported

iv Taking all the steps necessary to change transport patterns

v The environmental costs of road transport

vi The escalating cost of rail transport

vii The need to achieve transport rebalance

viii The rapid growth of private transport

ix Plans to develop major road networks

x Restricting road use through charging policies alone

xi Transport trends in countries awaiting EU admission

READING PASSAGE 9

Tea and the Industrial Revolution

A Cambridge professor says that a change in drinking habits was the reason for the Industrial Revolution in Britain. Anjana Abuja reports

A Alan Macfarlane, professor of anthropological science at King's College, Cambridge has, like other historians, spent decades wrestling with the enigma of the Industrial Revolution. Why did this particular Big Bang – the world-changing birth of industry-happen in Britain? And why did it strike at the end of the 18th century?

B Macfarlane compares the puzzle to a combination lock. 'There are about 20 different factors and all of them need to be present before the revolution can happen,' he says. For industry to take off, there needs to be the technology and power to drive factories, large urban populations to provide cheap labour, easy transport to move goods around, an affluent middle-class willing to buy mass-produced objects, a market-driven economy and a political system that allows this to happen. While this was the case for England, other nations, such as Japan, the Netherlands and France also met some of these criteria but were not industrialising. All these factors must have been necessary. But not sufficient to cause the revolution, says Macfarlane. 'After all, Holland had everything except coal while China also had many of these factors. Most historians are convinced there are one or two missing factors that you need to open the lock.'

C The missing factors, he proposes, are to be found in almost even kitchen cupboard. Tea and beer, two of the nation's favourite drinks, fuelled the revolution. The antiseptic properties of tannin, the active ingredient in tea, and of hops in beer – plus the fact that both are made with boiled water – allowed urban communities to flourish at close quarters without succumbing to water-borne diseases such as dysentery. The theory sounds eccentric but once he starts to explain the detective work that went into his deduction, the scepticism gives way to wary admiration. Macfarlane's case has been strengthened by support from notable quarters – Roy Porter, the distinguished medical historian, recently wrote a favourable appraisal of his research.

D Macfarlane had wondered for a long time how the Industrial Revolution came about. Historians had alighted on one interesting factor around the mid-18th century that required explanation. Between about 1650 and 1740, the population in Britain was static. But then there was a burst in population growth. Macfarlane says: 'The infant mortality rate halved in the space of 20 years, and this happened in both rural areas and cities, and across all classes. People suggested four possible causes. Was there a sudden change in the viruses and bacteria around? Unlikely. Was there a revolution in medical science? But this was a century before Lister's revolution*. Was there a change in environmental conditions? There were improvements in agriculture that wiped out malaria, but these were small gains. Sanitation did not become widespread until the 19th century. The only option left is food. But the height and weight statistics show a decline. So the food must have got worse. Efforts to explain this sudden reduction in child deaths appeared to draw a blank.'

E This population burst seemed to happen at just the right time to provide labour for the Industrial Revolution. 'When you start moving towards an industrial revolution, it is economically efficient to have people living close together,' says Macfarlane. 'But then you get disease, particularly from human waste.' Some digging around in historical records revealed that there was a change in the incidence of water-borne disease at that time, especially dysentery. Macfarlane deduced that whatever the British were drinking must have been important in regulating disease. He says, 'We drank beer. For a long time, the English were protected by the strong antibacterial agent in hops, which were added to help preserve the beer. But in the late 17th century a tax was

introduced on malt, the basic ingredient of beer. The poor turned to water and gin and in the 1720s the mortality rate began to rise again. Then it suddenly dropped again. What caused this?

F Macfarlane looked to Japan, which was also developing large cities about the same time, and also had no sanitation. Water-borne diseases had a much looser grip on the Japanese population than those in Britain. Could it be the prevalence of tea in their culture? Macfarlane then noted that the history of tea in Britain provided an extraordinary coincidence of dates. Tea was relatively expensive until Britain started a direct dipper trade with China in the early 18th century. By the 1740s, about the time that infant mortality was dipping, the drink was common. Macfarlane guessed that the fact that water had to be boiled, together with the stomach-purifying properties of tea meant that the breast milk provided by mothers was healthier than it had ever been. No other European nation sipped tea like the British, which, by Macfarlanes logic, pushed these other countries out of contention for the revolution.

G But, if tea is a factor in the combination lock, why didn't Japan forge ahead in a tea-soaked industrial revolution of its own? Macfarlane notes that even though 17th-century Japan had large cities, high literacy rates, even a futures market, it had turned its back on the essence of any work-based revolution by giving up labour-saving devices such as animals, afraid that they would put people out of work. So, the nation that we now think of as one of the most technologically advanced entered the 19th century having 'abandoned the wheel'

Questions 45-51

Write the correct number, i-ix, in boxes 45-51 on your answer sheet

- | | |
|-----------------------|-----------------------|
| 45 Paragraph A | 49 Paragraph E |
| 46 Paragraph B | 50 Paragraph F |
| 47 Paragraph C | 51 Paragraph G |
| 48 Paragraph D | |

List of Headings

- i** The search for the reasons for an increase in population
- ii** Industrialisation and the fear of unemployment
- iii** The development of cities in Japan 4 The time and place of the Industrial Revolution
- iv** The time and place of the Industrial Revolution
- v** The cases of Holland, France and China
- vi** Changes in drinking habits in Britain
- vii** Two keys to Britain's industrial revolution
- viii** Conditions required for industrialisation
- ix** Comparisons with Japan lead to the answer

READING PASSAGE 10

The Context, Meaning and Scope of Tourism

A Travel has existed since the beginning of time, when primitive man set out, often traversing great distances in search of game, which provided the food and clothing necessary for his survival. Throughout the course of history, people have travelled for purposes of trade, religious conviction, economic gain, war, migration and other equally compelling motivations. In the Roman era, wealthy aristocrats and high government officials also travelled for pleasure. Seaside resorts located at Pompeii and Herculaneum afforded citizens the opportunity to escape to their vacation villas in order to avoid the summer heat of Rome. Travel, except during the Dark Ages, has continued to grow and, throughout recorded history, has played a vital role in the development of civilisations and their economies.

B Tourism in the mass form as we know it today is a distinctly twentieth-century phenomenon. Historians suggest that the advent of mass tourism began in England during the industrial revolution with the rise of the middle class and the availability of relatively inexpensive transportation. The creation of the commercial airline industry following the Second World War and the subsequent development of the jet aircraft in the 1950s signalled the rapid growth and expansion of international travel. This growth led to the development of a major new industry: tourism. In turn, international tourism became the concern of a number of world governments since it not only provided new employment opportunities but also produced a means of earning foreign exchange.

C Tourism today has grown significantly in both economic and social importance. In most industrialised countries over the past few years the fastest growth has been seen in the area of services. One of the largest segments of the service industry, although largely unrecognised as an entity in some of these countries, is travel and tourism. According to the World Travel and Tourism Council (1992), Travel and tourism is the largest industry in the world on virtually any economic measure including value-added capital investment, employment and tax contributions. In 1992 the industry's gross output was estimated to be \$3.5 trillion, over 12 per cent of all consumer spending. The travel and tourism industry is the world's largest employer the almost 130 million jobs, or almost 7 per cent of all employees. This industry is the world's leading industrial contributor, producing over 6 per cent of the world's national product and accounting for capital investment in excess of \$422 billion in direct indirect and personal taxes each year. Thus, tourism has a profound impact both on the world economy and, because of the educative effect of travel and the effects on employment, on society itself.

D However, the major problems of the travel and tourism industry that have hidden, or obscured, its economic impact are the diversity and fragmentation of the industry itself. The travel industry includes: hotels, motels and other types of accommodation; restaurants and other food services; transportation services and facilities; amusements, attractions and other leisure facilities; gift shops and a large number of other enterprises. Since many of these businesses also serve local residents, the impact of spending by visitors can easily be overlooked or underestimated. In addition, Meis (1992) points out that the tourism industry involves concepts that have remained amorphous to both analysts and decision makers. Moreover, in all nations this problem has made it difficult for the industry to develop any type of reliable or credible tourism information base in order to estimate the contribution it makes to regional, national and global economies. However, the nature of this very diversity makes travel and tourism ideal vehicles for economic development in a wide variety of countries, regions or communities.

E Once the exclusive province of the wealthy, travel and tourism have become an institutionalised way of life for most of the population. In fact, McIntosh and Goeldner (1990) suggest

that tourism has become the largest commodity in international trade for many nations and, for a significant number of other countries, it ranks second or third. For example, tourism is the major source of income in Bermuda, Greece, Italy, Spain, Switzerland and most Caribbean countries. In addition, Hawkins and Ritchie, quoting from data published by the American Express Company, suggest that the travel and tourism industry is the number one ranked employer in the Bahamas, Brazil, Canada, France, (the former) West Germany, Hong Kong, Italy, Jamaica, Japan, Singapore, the United Kingdom and the United States. However, because of problems of definition, which directly affect statistical measurement, it is not possible with any degree of certainty to provide precise, valid or reliable data about the extent of world-wide tourism participation or its economic impact. In many cases, similar difficulties arise when attempts are made to measure domestic tourism.

Questions 52-55

The Passage has five paragraphs, A-E.

52 Paragraph B

53 Paragraph C

54 Paragraph D

55 Paragraph E

Example	Answer
Paragraph A	viii

List of Headings

- i. Economic and social significance of tourism
- ii. The development of mass tourism
- iii. Travel for the wealthy
- iv. Earning foreign exchange through tourism
- v. Difficulty in recognising the economic effects of tourism
- vi. The contribution of air travel to tourism
- vii. The world impact of tourism
- viii. The history of travel

TRUE, FALS, NOT GIVEN

True vs false

Tip. Remember that the statements will not be expressed in exactly the same as in the text , so look for key words in the statements and find similar words or phrases in the text

Example:

Here is a part of a text about the history of Greenland and some of the questions.

The ancestor of the Inuit people of Greenland are thought to have lived in Siberia – the vast eastern region of modern Russia . Until 7,000 or 8,000 years ago. There is evidence that they then travelled by boat in to Alaska. settling in the northerly part on North America . from there ,some migrated to Greenland around 5,000 years ago. And evidence has been found of their existence around the northern tip of the island.

Question :

Do the following statements agree with the information given in the passage?

1. The Inuit people are provably descended from inhabitant of Siberia . **true**
2. The Inuit people's ancestor migrated to North America about 5,000 years ago. **False**
3. The north of Greenland was the most attractive area of the island for the earliest people. **Not given**

Explanation: The key words in the questions are underlined, and so are words in the text that they refer to. 1. Has the same meaning as the first highlighted section. 2 the text says that they are thought to have lived in Siberia until 7000 or 8000 years ago . 5000 ago is when some moved from north America to Greenland. 3 no reason is given for migrating to northern Greenland. There is nothing in the text that 'most attractive' refers to, So the statement may or may not be true.

READING PASSAGE 1

William Henry Perkin

The man who invented synthetic dyes

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.

Historically, textile dyes were made from such natural sources as plants and animal excretions. Some of these, such as the glandular mucus of snails, were difficult to obtain and outrageously expensive. Indeed, the purple colour extracted from a snail was once so costly that in society at the time only the rich could afford it. Further, natural dyes tended to be muddy in hue and fade quickly. It was against this backdrop that Perkin's discovery was made.

Perkin quickly grasped that his purple solution could be used to colour fabric, thus making it the world's first synthetic dye. Realising the importance of this breakthrough, he lost no time in patenting it. But perhaps the most fascinating of all Perkin's reactions to his find was his nearly instant recognition that the new dye had commercial possibilities.

Perkin originally named his dye Tyrian Purple, but it later became commonly known as mauve (from the French for the plant used to make the colour violet). He asked advice of Scottish dye works owner Robert Pullar, who assured him that manufacturing the dye would be well worth it if the colour remained fast (i.e. would not fade) and the cost was relatively low. So, over the fierce objections of his mentor Hofmann, he left college to give birth to the modern chemical industry.

With the help of his father and brother, Perkin set up a factory not far from London. Utilising the cheap and plentiful coal tar that was an almost unlimited by product of London's gas street lighting, the dye works began producing the world's first synthetically dyed material in 1857. The company received a commercial boost from the Empress Eugenie of France, when she decided the new colour flattered her. Very soon, mauve was the necessary shade for all the fashionable ladies in that country.

Not to be outdone, England's Queen Victoria also appeared in public wearing a mauve gown, thus making it all the rage in England as well. The dye was bold and fast, and the public clamoured for more. Perkin went back to the drawing board.

Although Perkin's fame was achieved and fortune assured by his first discovery, the chemist continued his research. Among other dyes he developed and introduced were aniline red (1859) and aniline black (1863) and, in the late 1860s, Perkin's green. It is important to note that Perkin's synthetic dye discoveries had outcomes far beyond the merely decorative. The dyes also became vital to medical research in many ways. For instance, they were used to stain previously invisible microbes and bacteria, allowing researchers to identify such bacilli as tuberculosis, cholera, and anthrax. Artificial dyes continue to play a crucial role today. And, in what would have been particularly pleasing to Perkin, their current use is in the search for a vaccine against malaria.

Questions 1-7

Do the following statements agree with the information given in Reading Passage 1?

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.

READING PASSAGE 2

The history of the tortoise

If you go back far enough, everything lived in the sea. At various points in evolutionary history, enterprising individuals within many different animal groups moved out onto the land, sometimes even to the most parched deserts, taking their own private seawater with them in blood and cellular fluids. In addition to the reptiles, birds, mammals and insects which we see all around us, other groups that have succeeded out of water include scorpions, snails, crustaceans such as woodlice and land crabs, millipedes and centipedes, spiders and various worms. And we mustn't forget the plants, without whose prior invasion of the land none of the other migrations could have happened.

Moving from water to land involved a major redesign of every aspect of life, including breathing and reproduction. Nevertheless, a good number of thoroughgoing land animals later turned around, abandoned their hard-earned terrestrial re-tooling, and returned to the water again. Seals have only gone part way back. They show us what the intermediates might have been like, on the way to extreme cases such as whales and dugongs. Whales (including the small whales we call dolphins) and dugongs, with their close cousins the manatees, ceased to be land creatures altogether and reverted to the full marine habits of their remote ancestors. They don't even come ashore to breed. They do, however, still breathe air, having never developed anything equivalent to the gills of their earlier marine incarnation. Turtles went back to the sea a very long time ago and, like all vertebrate returnees to the water, they breathe air. However, they are, in one respect, less fully given back to the water than whales or dugongs, for turtles still lay their eggs on beaches.

There is evidence that all modern turtles are descended from a terrestrial ancestor which lived before most of the dinosaurs. There are two key fossils called *Proganochelys quenstedti* and *Palaeochersis talampayensis* dating from early dinosaur times, which appear to be close to the ancestry of all modern turtles and tortoises. You might wonder how we can tell whether fossil animals lived on land or in water, especially if only fragments are found. Sometimes it's obvious. Ichthyosaurs were reptilian contemporaries of the dinosaurs, with fins and streamlined bodies. The fossils look like dolphins and they surely lived like dolphins, in the water. With turtles it is a little less obvious. One way to tell is by measuring the bones of their forelimbs.

Walter Joyce and Jacques Gauthier, at Yale University, obtained three measurements in these particular bones

of 71 species of living turtles and tortoises. They used a kind of triangular graph paper to plot the three measurements against one another. All the land tortoise species formed a tight cluster of points in the upper part of the triangle; all the water turtles cluster in the lower part of the triangular graph. There was no overlap, except when they added some species that spend time both in water and on land. Sure enough, these amphibious species show up on the triangular graph approximately half way between the 'wet cluster' of sea turtles and the 'dry cluster' of land tortoises. The next step was to determine where the fossils fell. The bones of *P. quenstedti* and *JR talampayensis* leave us in no doubt. Their points on the graph are right in the thick of the dry cluster. Both these fossils were dry-land tortoises. They come from the era before our turtles returned to the water.

You might think, therefore, that modern land tortoises have probably stayed on land ever since those early terrestrial times, as most mammals did after a few of them went back to the sea. But apparently not. If you draw out the family tree of all modern turtles and tortoises, nearly all the branches are aquatic. Today's land tortoises constitute a single branch, deeply nested among branches consisting of aquatic turtles. This suggests that modern land tortoises have not stayed on land continuously since the time of *P. quenstedti* and *P.*

talampayensis. Rather, their ancestors were among those who went back to the water, and they then re-emerged back onto the land in (relatively) more recent times.

Tortoises therefore represent a remarkable double return. In common with all mammals, reptiles and birds, their remote ancestors were marine fish and before that various more or less worm-like creatures stretching back, still in the sea, to the primeval bacteria. Later ancestors lived on land and stayed there for a very large number of generations. Later ancestors still evolved back into the water and became sea turtles. And finally they returned yet again to the land as tortoises, some of which now live in the driest of deserts.

Questions 8-10

Do the following statements agree with the information given in Reading Passage 3?

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 Turtles were among the first group of animals to migrate back to the sea.
- 9 It is always difficult to determine where an animal lived when its fossilised remains are incomplete.
- 10 The habitat of ichthyosaurs can be determined by the appearance of their fossilised remains.

READING PASSAGE 3

Venus in transit

June 2004 saw the first passage, known as a 'transit', of the planet Venus across the face of the Sun in 122 years. Transits have helped shape our view of the whole Universe, as Heather Cooper and Nigel Henbest explain

A

On 8 June 2004, more than half the population of the world were treated to a rare astronomical event. For over six hours, the planet Venus steadily inched its way over the surface of the Sun. This 'transit' of Venus was the first since 6 December 1882. On that occasion, the American astronomer Professor Simon Newcomb led a party to South Africa to observe the event. They were based at a girls' school, where - it is alleged - the combined forces of three schoolmistresses outperformed the professionals with the accuracy of their observations.

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.

C

Halley was aware that the AU was one of the most fundamental of all astronomical measurements. Johannes Kepler, in the early 17th century, had shown that the distances of the planets from the Sun governed their orbital speeds, which were easily measurable. But no-one had found a way to calculate accurate distances to the planets from the Earth. The goal was to measure the AU; then, knowing the orbital speeds of all the other planets round the Sun, the scale of the Solar System would fall into place. However, Halley realised that Mercury was so far away that its parallax angle would be very difficult to determine. As Venus was closer to the Earth, its parallax angle would be larger, and Halley worked out that by using Venus it would be possible to measure the Sun's distance to 1 part in 500. But there was a problem: transits of Venus, unlike those of Mercury, are rare, occurring in pairs roughly eight years apart every hundred or so years. Nevertheless, he accurately predicted that Venus would cross the face of the Sun in both 1761 and 1769 - though he didn't survive to see either.

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.

G

June 2004's transit of Venus was thus more of an astronomical spectacle than a scientifically important event. But such transits have paved the way for what might prove to be one of the most vital breakthroughs in the cosmos - detecting Earth-sized planets orbiting other stars.

Questions 22-26

Do the following statements agree with the information given in Reading Passage 2?

In boxes 22-26 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*

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

READING PASSAGE 4.

Information theory - the big idea

Information theory lies at the heart of everything - from DVD players and the genetic code of DNA to the physics of the universe at its most fundamental. It has been central to the development of the science of communication, which enables data to be sent electronically and has therefore had a major impact on our lives

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 17-19

Do the following statements agree with the information given in Reading Passage 3?

TRUE *if the statement agrees with the information*

FALSE *if the statement contradicts the information*

NOT GIVEN *if there is no information on this*

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

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

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

READING PASSAGE 5

The life and work of Marie Curie

Marie Curie is probably the most famous woman scientist who has ever lived. Born Maria Sklodowska 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.

Their marriage in 1895 marked the start of a partnership that was soon to achieve results of world significance. Following Henri Becquerel's discovery in 1896 of a new phenomenon, which Marie later called 'radioactivity', Marie Curie decided to find out if the radioactivity discovered in uranium was to be found in other elements. She discovered that this was true for thorium.

Turning her attention to minerals, she found her interest drawn to pitchblende, a mineral whose radioactivity, superior to that of pure uranium, could be explained only by the presence in the ore of small quantities of an unknown substance of very high activity. Pierre Curie joined her in the work that she had undertaken to resolve this problem, and that led to the discovery of the new elements, polonium and radium. While Pierre Curie devoted himself chiefly to the physical study of the new radiations, Marie Curie struggled to obtain pure radium in the metallic state. This was achieved with the help of the chemist André-Louis Debierne, one of Pierre Curie's pupils. Based on the results of this research, Marie Curie received her Doctorate of Science, and in 1903 Marie and Pierre shared with Becquerel the Nobel Prize for Physics for the discovery of radioactivity.

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.

During World War I, Marie Curie, with the help of her daughter Irène, devoted herself to the development of the use of X-radiography, including the mobile units which came to be known as 'Little Curies', used for the treatment of wounded soldiers. In 1918 the Radium Institute, whose staff Irène had joined, began to operate in earnest, and became a centre for nuclear physics and chemistry. Marie Curie, now at the highest point of her

fame and, from 1922, a member of the Academy of Medicine, researched the chemistry of radioactive substances and their medical applications.

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.

One of Marie Curie's outstanding achievements was to have understood the need to accumulate intense radioactive sources, not only to treat illness but also to maintain an abundant supply for research. The existence in Paris at the Radium Institute of a stock of 1.5 grams of radium made a decisive contribution to the success of the experiments undertaken in the years around 1930. This work prepared the way for the discovery of the neutron by Sir James Chadwick and, above all, for the discovery in 1934 by Irène and Frédéric Joliot-Curie of artificial radioactivity. A few months after this discovery, Marie Curie died as a result of leukaemia caused by exposure to radiation. She had often carried test tubes containing radioactive isotopes in her pocket, remarking on the pretty blue-green light they gave off.

Her contribution to physics had been immense, not only in her own work, the importance of which had been demonstrated by her two Nobel Prizes, but because of her influence on subsequent generations of nuclear physicists and chemists.

Questions 20-25

Do the following statements agree with the information given in Reading Passage 1?

TRUE if the statement agrees with the information

FALSE if the statement contradicts the information

NOT GIVEN if there is no information on this

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

READING PASSAGE 6

The Development of Museums

A

The conviction that historical relics provide infallible testimony about the past is rooted in the nineteenth and early twentieth centuries, when science was regarded as objective and value free. As one writer observes: 'Although it is now evident that artefacts are as easily altered as chronicles, public faith in their veracity endures: a tangible relic seems ipso facto real.' Such conviction was, until recently, reflected in museum displays. Museums used to look - and some still do - much like storage rooms of objects packed together in showcases: good for scholars who wanted to study the subtle differences in design, but not for the ordinary visitor, to whom it all looked alike. Similarly, the information accompanying the objects often made little sense to the lay visitor. The content and format of explanations dated back to a time when the museum was the exclusive domain of the scientific researcher.

B

Recently, however, attitudes towards history and the way it should be presented have altered. The key word in heritage display is now 'experience', the more exciting the better and, if possible, involving all the senses. Good examples of this approach in the UK are the Jorvik Centre in York; the National Museum of Photography, Film and Television in Bradford; and the Imperial War Museum in London. In the US the trend emerged much earlier: Williamsburg has been a prototype for many heritage developments in other parts of the world. No one can predict where the process will end. On so-called heritage sites the re-enactment of historical events is increasingly popular, and computers will soon provide virtual reality experiences, which will present visitors with a vivid image of the period of their choice, in which they themselves can act as if part of the historical environment. Such developments have been criticised as an intolerable vulgarisation, but the success of many historical theme parks and similar locations suggests that the majority of the public does not share this opinion.

C

In a related development, the sharp distinction between museum and heritage sites on the one hand, and theme parks on the other, is gradually evaporating. They already borrow ideas and concepts from one another. For example, museums have adopted story lines for exhibitions, sites have accepted 'theming' as a relevant tool, and theme parks are moving towards more authenticity and research-based presentations. In zoos, animals are no longer kept in cages, but in great spaces, either in the open air or in enormous greenhouses, such as the jungle and desert environments in Burgers' Zoo in Holland. This particular trend is regarded as one of the major developments in the presentation of natural history in the twentieth century.

D

Theme parks are undergoing other changes, too, as they try to present more serious social and cultural issues, and move away from fantasy. This development is a response to market forces and, although museums and heritage sites have a special, rather distinct, role to fulfil, they are also operating in a very competitive environment, where visitors make choices on how and where to spend their free time. Heritage and museum experts do not have to invent stories and recreate historical environments to attract their visitors: their assets are already in place. However, exhibits must be both based on artefacts and facts as we know them, and attractively presented. Those who are professionally engaged in the art of interpreting history are thus in a difficult position, as they must steer a narrow course between the demands of 'evidence' and 'attractiveness', especially given the increasing need in the heritage industry for income-generating activities.

E

It could be claimed that in order to make everything in heritage more 'real', historical accuracy must be increasingly altered. For example, *Pithecanthropus erectus* is depicted in an Indonesian museum with Malay facial features, because this corresponds to public perceptions. Similarly, in the Museum of Natural History in Washington, Neanderthal man is shown making a dominant gesture to his wife. Such presentations tell us

more about contemporary perceptions of the world than about our ancestors. There is one compensation, however, for the professionals who make these interpretations: if they did not provide the interpretation, visitors would do it for themselves, based on their own ideas, misconceptions and prejudices. And no matter how exciting the result, it would contain a lot more bias than the presentations provided by experts.

F

Human bias is inevitable, but another source of bias in the representation of history has to do with the transitory nature of the materials themselves. The simple fact is that not everything from history survives the historical process. Castles, palaces and cathedrals have a longer lifespan than the dwellings of ordinary people. The same applies to the furnishings and other contents of the premises. In a town like Leyden in Holland, which in the seventeenth century was occupied by approximately the same number of inhabitants as today, people lived within the walled town, an area more than five times smaller than modern Leyden. In most of the houses several families lived together in circumstances beyond our imagination. Yet in museums, fine period rooms give only an image of the lifestyle of the upper class of that era. No wonder that people who stroll around exhibitions are filled with nostalgia; the evidence in museums indicates that life was so much better in the past. This notion is induced by the bias in its representation in museums and heritage centres.

Questions 37-40

Do the following statements agree with the information given in Reading Passage 3?

TRUE if the statement agrees with the information

FALSE if the statement contradicts the information

NOT GIVEN if there is no information on this

26 Consumers prefer theme parks which avoid serious issues.

27 More people visit museums than theme parks.

28 The boundaries of Leyden have changed little since the seventeenth century.

29 Museums can give a false impression of how life used to be.

READING PASSAGE 7

AIR TRAFFIC CONTROL IN THE USA

A

An accident that occurred in the skies over the Grand Canyon in 1956 resulted in the establishment of the Federal Aviation Administration (FAA) to regulate and oversee the operation of aircraft in the skies over the United States, which were becoming quite congested. The resulting structure of air traffic control has greatly increased the safety of flight in the United States, and similar air traffic control procedures are also in place over much of the rest of the world.

B

Rudimentary air traffic control (ATC) existed well before the Grand Canyon disaster. As early as the 1920s, the earliest air traffic controllers manually guided aircraft in the vicinity of the airports, using lights and flags, while beacons and flashing lights were placed along cross-country routes to establish the earliest airways. However, this purely visual system was useless in bad weather, and, by the 1930s, radio communication was coming into use for ATC. The first region to have something approximating today's ATC was New York City, with other major metropolitan areas following soon after.

C

In the 1940s, ATC centres could and did take advantage of the newly developed radar and improved radio communication brought about by the Second World War, but the system remained rudimentary. It was only after the creation of the FAA that full-scale regulation of America's airspace took place, and this was fortuitous, for the advent of the jet engine suddenly resulted in a large number of very fast planes, reducing pilots' margin of error and practically demanding some set of rules to keep everyone well separated and operating safely in the air.

D

Many people think that ATC consists of a row of controllers sitting in front of their radar screens at the nation's airports, telling arriving and departing traffic what to do. This is a very incomplete part of the picture. The FAA realised that the airspace over the United States would at any time have many different kinds of planes, flying for many different purposes, in a variety of weather conditions, and the same kind of structure was needed to accommodate all of them.

E

To meet this challenge, the following elements were put into effect. First, ATC extends over virtually the entire United States. In general, from 365m above the ground and higher, the entire country is blanketed by controlled airspace. In certain areas, mainly near airports, controlled airspace extends down to 215m above the ground, and, in the immediate vicinity of an airport, all the way down to the surface. Controlled airspace is that airspace in which FAA regulations apply. Elsewhere, in uncontrolled airspace, pilots are bound by fewer regulations. In this way, the recreational pilot who simply wishes to go flying for a while without all the restrictions imposed by the FAA has only to stay in uncontrolled airspace, below 365m, while the pilot who does want the protection afforded by ATC can easily enter the controlled airspace.

F

The FAA then recognised two types of operating environments. In good meteorological conditions, flying would be permitted under Visual Flight Rules (VFR), which suggests a strong reliance on visual cues to maintain an acceptable level of safety. Poor visibility necessitated a set of Instrumental Flight Rules (IFR), under which the pilot relied on altitude and navigational information provided by the plane's instrument panel to fly safely. On a clear day, a pilot in controlled airspace can choose a VFR or IFR flight plan, and the FAA regulations were devised in a way which accommodates both VFR and IFR operations in the same airspace. However, a pilot can only

choose to fly IFR if they possess an instrument rating which is above and beyond the basic pilot's license that must also be held.

G

Controlled airspace is divided into several different types, designated by letters of the alphabet. Uncontrolled airspace is designated Class F, while controlled airspace below 5,490m above sea level and not in the vicinity of an airport is Class E. All airspace above 5,490m is designated Class A. The reason for the division of Class E and Class A airspace stems from the type of planes operating in them. Generally, Class E airspace is where one finds general aviation aircraft (few of which can climb above 5,490m anyway), and commercial turboprop aircraft. Above 5,490m is the realm of the heavy jets, since jet engines operate more efficiently at higher altitudes. The difference between Class E and A airspace is that in Class A, all operations are IFR, and pilots must be instrument-rated, that is, skilled and licensed in aircraft instrumentation. This is because ATC control of the entire space is essential. Three other types of airspace, Classes D, C and B, govern the vicinity of airports. These correspond roughly to small municipal, medium-sized metropolitan and major metropolitan airports respectively, and encompass an increasingly rigorous set of regulations. For example, all a VFR pilot has to do to enter Class C airspace is establish two-way radio contact with ATC. No explicit permission from ATC to enter is needed, although the pilot must continue to obey all regulations governing VFR flight. To enter Class B airspace, such as on approach to a major metropolitan airport, an explicit ATC clearance is required. The private pilot who cruises without permission into this airspace risks losing their license.

Questions 30-37

*Do the following statements agree with the information given in Reading Passage 2?
In boxes 20-26 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*

- 30** The FAA was created as a result of the introduction of the jet engine.
- 31** Air Traffic Control started after the Grand Canyon crash in 1956.
- 32** Beacons and flashing lights are still used by ATC today.
- 33** Some improvements were made in radio communication during World War II.
- 34** Class F airspace is airspace which is below 365m and not near airports.
- 35** All aircraft in Class E airspace must use IFR.
- 36** A pilot entering Class C airspace is flying over an average-sized city.

READING PASSAGE 8

Sheet glass manufacture: the float process

Glass, which has been made since the time of the Mesopotamians and Egyptians, is little more than a mixture of sand, soda ash and lime. When heated to about 1500 degrees Celsius (°C) this becomes a molten mass that hardens when slowly cooled. The first successful method for making clear, flat glass involved spinning. This method was very effective as the glass had not touched any surfaces between being soft and becoming hard, so it stayed perfectly unblemished, with a 'fire finish'. However, the process took a long time and was labour intensive.

Nevertheless, demand for flat glass was very high and glassmakers across the world were looking for a method of making it continuously. The first continuous ribbon process involved squeezing molten glass through two hot rollers, similar to an old mangle. This allowed glass of virtually any thickness to be made non-stop, but the rollers would leave both sides of the glass marked, and these would then need to be ground and polished. This part of the process rubbed away around 20 per cent of the glass, and the machines were very expensive.

The float process for making flat glass was invented by Alistair Pilkington. This process allows the manufacture of clear, tinted and coated glass for buildings, and clear and tinted glass for vehicles. Pilkington had been experimenting with improving the melting process, and in 1952 he had the idea of using a bed of molten metal to form the flat glass, eliminating altogether the need for rollers within the float bath. The metal had to melt at a temperature less than the hardening point of glass (about 600°C), but could not boil at a temperature below the temperature of the molten glass (about 1500°C). The best metal for the job was tin.

The rest of the concept relied on gravity, which guaranteed that the surface of the molten metal was perfectly flat and horizontal. Consequently, when pouring molten glass onto the molten tin, the underside of the glass would also be perfectly flat. If the glass were kept hot enough, it would flow over the molten tin until the top surface was also flat, horizontal and perfectly parallel to the bottom surface. Once the glass cooled to 604°C or less it was too hard to mark and could be transported out of the cooling zone by rollers. The glass settled to a thickness of six millimetres because of surface tension interactions between the glass and the tin. By fortunate coincidence, 60 per cent of the flat glass market at that time was for six-millimetre glass.

Pilkington built a pilot plant in 1953 and by 1955 he had convinced his company to build a full-scale plant. However, it took 14 months of non-stop production, costing the company £100,000 a month, before the plant produced any usable glass. Furthermore, once they succeeded in making marketable flat glass, the machine was turned off for a service to prepare it for years of continuous production. When it started up again it took another four months to get the process right again. They finally succeeded in 1959 and there are now float plants all over the world, with each able to produce around 1000 tons of glass every day, non-stop for around 15 years.

Float plants today make glass of near optical quality. Several processes - melting, refining, homogenising - take place simultaneously in the 2000 tonnes of molten glass in the furnace. They occur in separate zones in a complex glass flow driven by high temperatures. It adds up to a continuous melting process, lasting as long as 50 hours, that delivers glass smoothly and continuously to the float bath, and from there to a coating zone and finally a heat treatment zone, where stresses formed during cooling are relieved.

The principle of float glass is unchanged since the 1950s. However, the product has changed dramatically, from a single thickness of 6.8 mm to a range from sub-millimetre to 25 mm, from a ribbon frequently marred by inclusions and bubbles to almost optical perfection. To ensure the highest quality, inspection takes place at every stage. Occasionally, a bubble is not removed during refining, a sand grain refuses to melt, a tremor in the tin puts ripples into the glass ribbon. Automated on-line inspection does two things. Firstly, it reveals process faults upstream that can be corrected. Inspection technology allows more than 100 million measurements a second to be made across the ribbon, locating flaws the unaided eye would be unable to see. Secondly, it enables computers downstream to steer cutters around flaws.

Float glass is sold by the square metre, and at the final stage computers translate customer requirements into patterns of cuts designed to minimise waste.

Questions 9-13

*Do the following statements agree with the information given in Reading Passage 1?
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*

- 37 The metal used in the float process had to have specific properties.
- 38 Pilkington invested some of his own money in his float plant.
- 39 Pilkington's first full-scale plant was an instant commercial success.
- 40 The process invented by Pilkington has now been improved.
- 41 Computers are better than humans at detecting faults in glass.

READING PASSAGE 9

The Nature of Genius

There has always been an interest in geniuses and prodigies. The word 'genius', from the Latin gens (= family) and the term 'genius', meaning 'begetter', comes from the early Roman cult of a divinity as the head of the family. In its earliest form, genius was concerned with the ability of the head of the family, the paterfamilias, to perpetuate himself. Gradually, genius came to represent a person's characteristics and thence an individual's highest attributes derived from his 'genius' or guiding spirit. Today, people still look to stars or genes, astrology or genetics, in the hope of finding the source of exceptional abilities or personal characteristics.

The concept of genius and of gifts has become part of our folk culture, and attitudes are ambivalent towards them. We envy the gifted and mistrust them. In the mythology of giftedness, it is popularly believed that if people are talented in one area, they must be defective in another, that intellectuals are impractical, that prodigies burn too brightly too soon and burn out, that gifted people are eccentric, that they are physical weaklings, that there's a thin line between genius and madness, that genius runs in families, that the gifted are so clever they don't need special help, that giftedness is the same as having a high IQ, that some races are more intelligent or musical or mathematical than others, that genius goes unrecognised and unrewarded, that adversity makes men wise or that people with gifts have a responsibility to use them. Language has been enriched with such terms as 'highbrow', 'egghead', 'blue-stocking', 'wiseacre', 'know-all', 'boffin' and, for many, 'intellectual' is a term of denigration.

The nineteenth century saw considerable interest in the nature of genius, and produced not a few studies of famous prodigies. Perhaps for us today, two of the most significant aspects of most of these studies of genius are the frequency with which early encouragement and teaching by parents and tutors had beneficial effects on the intellectual, artistic or musical development of the children but caused great difficulties of adjustment later in their lives, and the frequency with which abilities went unrecognised by teachers and schools. However, the difficulty with the evidence produced by these studies, fascinating as they are in collecting together anecdotes and apparent similarities and exceptions, is that they are not what we would today call norm-referenced. In other words, when, for instance, information is collated about early illnesses, methods of upbringing, schooling, etc., we must also take into account information from other historical sources about how common or exceptional these were at the time. For instance, infant mortality was high and life expectancy much shorter than today, home tutoring was common in the families of the nobility and wealthy, bullying and corporal punishment were common at the best independent schools and, for the most part, the cases studied were members of the privileged classes. It was only with the growth of paediatrics and psychology in the twentieth century that studies could be carried out on a more objective, if still not always very scientific, basis.

Geniuses, however they are defined, are but the peaks which stand out through the mist of history and are visible to the particular observer from his or her particular vantage point. Change the observers and the vantage points, clear away some of the mist, and a different lot of peaks appear. Genius is a term we apply to those whom we recognise for their outstanding achievements and who stand near the end of the continuum of human abilities which reaches back through the mundane and mediocre to the incapable. There is still much truth in Dr Samuel Johnson's observation, 'The true genius is a mind of large general powers, accidentally determined to some particular direction'. We may disagree with the 'general', for we doubt if all musicians of genius could have become scientists of genius or vice versa, but there is no doubting the accidental determination which nurtured or triggered their gifts into those channels into which they have poured their powers so successfully. Along the continuum of abilities are hundreds of thousands of gifted men and women, boys and girls.

What we appreciate, enjoy or marvel at in the works of genius or the achievements of prodigies are the manifestations of skills or abilities which are similar to, but so much superior to, our own. But that their minds are not different from our own is demonstrated by the fact that the hard-won discoveries of scientists like Kepler or Einstein become the commonplace knowledge of schoolchildren and the once outrageous shapes and colours of an artist like Paul Klee so soon appear on the fabrics we wear. This does not minimise the supremacy of their achievements, which outstrip our own as the sub-four-minute milers outstrip our jogging.

To think of geniuses and the gifted as having uniquely different brains is only reasonable. If we accept that each human brain is uniquely different. The purpose of instruction is to make us even more different from one another, and in the process of being educated we can learn from the achievements of those more gifted than ourselves. But before we try to emulate geniuses or encourage our children to do so we should note that some of the things we learn from them may prove unpalatable. We may envy their achievements and fame, but we should also recognise the price they may have paid in terms of perseverance, single-mindedness, dedication, restrictions on their personal lives, the demands upon their energies and time, and how often they had to display great courage to preserve their integrity or to make their way to the top.

Genius and giftedness are relative descriptive terms of no real substance. We may, at best, give them some precision by defining them and placing them in a context but, whatever we do, we should never delude ourselves into believing that gifted children or geniuses are different from the rest of humanity, save in the degree to which they have developed the performance of their abilities.

Questions 19-26

TRUE if the statement agrees with the information

FALSE if the statement contradicts the information

NOT GIVEN if there is no information on this

42. Nineteenth-century studies of the nature of genius failed to take into account the uniqueness of the person's upbringing.
43. Nineteenth-century studies of genius lacked both objectivity and a proper scientific approach.
44. A true genius has general powers capable of excellence in any area.
45. The skills of ordinary individuals are in essence the same as the skills of prodigies.
46. The ease with which truly great ideas are accepted and taken for granted fails to lessen their significance.
47. Giftedness and genius deserve proper scientific research into their true nature so that all talent may be retained for the human race.
48. Geniuses often pay a high price to achieve greatness.
49. To be a genius is worth the high personal cost.

READING PASSAGE 10

Collecting Ant Specimens

Collecting ants can be as simple as picking up stray ones and placing them in a glass jar, or as complicated as completing an exhaustive survey of all species present in an area and estimating their relative abundances. The exact method used will depend on the final purpose of the collections. For taxonomy, or classification, long series, from a single nest, which contain all castes (workers, including majors and minors, and, if present, queens and males) are desirable, to allow the determination of variation within species. For ecological studies, the most important factor is collecting identifiable samples of as many of the different species present as possible. Unfortunately, these methods are not always compatible. The taxonomist sometimes overlooks whole species in favour of those groups currently under study, while the ecologist often collects only a limited number of specimens of each species, thus reducing their value for taxonomic investigations.

To collect as wide a range of species as possible, several methods must be used. These include hand collecting, using baits to attract the ants, ground litter sampling, and the use of pitfall traps. Hand collecting consists of searching for ants everywhere they are likely to occur. This includes on the ground, under rocks, logs or other objects on the ground, in rotten wood on the ground or on trees, in vegetation, on tree trunks and under bark. When possible, collections should be made from nests or foraging columns and at least 20 to 25 individuals collected. This will ensure that all individuals are of the same species, and so increase their value for detailed studies. Since some species are largely nocturnal, collecting should not be confined to daytime. Specimens are collected using an aspirator (often called a pooter), forceps, a fine, moistened paint brush, or fingers, if the ants are known not to sting. Individual insects are placed in plastic or glass tubes (1.5-3-0 ml capacity for small ants, 5-8 ml for larger ants) containing 75% to 95% ethanol. Plastic tubes with secure tops are better than glass because they are lighter, and do not break as easily if mishandled.

Baits can be used to attract and concentrate foragers. This often increases the number of individuals collected and attracts species that are otherwise elusive. Sugars and meats or oils will attract different species and a range should be utilised. These baits can be placed either on the ground or on the trunks of trees or large shrubs. When placed on the ground, baits should be situated on small paper cards or other flat, light-coloured surfaces, or in test-tubes or vials. This makes it easier to spot ants and to capture them before they can escape into the surrounding leaf litter.

Many ants are small and forage primarily in the layer of leaves and other debris on the ground. Collecting these species by hand can be difficult. One of the most successful ways to collect them is to gather the leaf litter in which they are foraging and extract the ants from it. This is most commonly done by placing leaf litter on a screen over a large funnel, often under some heat. As the leaf litter dries from above, ants (and other animals) move downward and eventually fall out the bottom and are collected in alcohol placed below the funnel. This method works especially well in rain forests and marshy areas. A method of improving the catch when using a funnel is to sift the leaf litter through a coarse screen before placing it above the funnel. This will concentrate the litter and remove larger leaves and twigs. It will also allow more litter to be sampled when using a limited number of funnels.

The pitfall trap is another commonly used tool for collecting ants. A pitfall trap can be any small container placed in the ground with the top level with the surrounding surface and filled with a preservative. Ants are collected when they fall into the trap while foraging.

The diameter of the traps can vary from about 18 mm to 10 cm and the number used can vary from a few to several hundred. The size of the traps used is influenced largely by personal preference (although larger sizes are generally better), while the number will be determined by the study being undertaken. The preservative

used is usually ethylene glycol or propylene glycol, as alcohol will evaporate quickly and the traps will dry out.

One advantage of pitfall traps is that they can be used to collect over a period of time with minimal maintenance and intervention. One disadvantage is that some species are not collected as they either avoid the traps or do not commonly encounter them while foraging.

Questions 50-53

TRUE *if the statement agrees with the information*

FALSE *if the statement contradicts the information*

NOT GIVEN *if there is no information on this*

50 Taxonomic research involves comparing members of one group of ants.

51 New species of ant are frequently identified by taxonomists.

52 Range is the key criterion for ecological collections.

53 A single collection of ants can generally be used for both taxonomic and ecological purposes.

Stepwells

A millennium ago, stepwells were fundamental to life in the driest parts of India. Although many have been neglected, recent restoration has returned them to their former glory. Richard Cox travelled to north-western India to document these spectacular monuments from a bygone era.

During the sixth and seventh centuries, the inhabitants of the modern-day states of Gujarat and Rajasthan in North-western India developed a method of gaining access to clean, fresh groundwater during the dry season for drinking, bathing, watering animals and irrigation. However, the significance of this invention – the stepwell – goes beyond its utilitarian application.

Unique to the region, stepwells are often architecturally complex and vary widely in size and shape. During their heyday, they were places of gathering, of leisure, of relaxation and of worship for villagers of all but the lowest castes. Most stepwells are found dotted around the desert areas of Gujarat (where they are called vav) and Rajasthan (where they are known as baori), while a few also survive in Delhi. Some were located in or near villages as public spaces for the community; others were positioned beside roads as resting places for travellers.

As their name suggests, stepwells comprise a series of stone steps descending from ground level to the water source (normally an underground aquifer) as it recedes following the rains. When the water level was high, the user needed only to descend a few steps to reach it; when it was low, several levels would have to be negotiated.

Some wells are vast, open craters with hundreds of steps paving each sloping side, often in tiers. Others are more elaborate, with long stepped passages leading to the water via several storeys built from stone and supported by pillars, they also included pavilions that sheltered visitors from the relentless heat. But perhaps the most impressive features are the intricate decorative sculptures that embellish many stepwells, showing activities from fighting and dancing to everyday acts such as women combing their hair and churning butter.

Down the centuries, thousands of wells were constructed throughout northwestern India, but the majority have now fallen into disuse; many are derelict and dry, as groundwater has been diverted for industrial use and the wells no longer reach the water table. Their condition hasn't been helped by recent dry spells: southern Rajasthan suffered an eight-year drought between 1996 and 2004.

However, some important sites in Gujarat have recently undergone major restoration, and the state government announced in June last year that it plans to restore the stepwells throughout the state.

In Patan, the state's ancient capital, the stepwell of Rani Ki Vav (Queen's Stepwell) is perhaps the finest current example. It was built by Queen Udayamati during the late 11th century, but became silted up following a flood during the 13th century. But the Archaeological Survey of India began restoring it in the 1960s, and today it's in pristine condition. At 65 metres long, 20 metres wide and 27 metres deep, Rani Ki Vav features 500 distinct sculptures carved into niches throughout the monument, depicting gods such as Vishnu and Parvati in various incarnations. Incredibly, in January 2001, this ancient structure survived a devastating earthquake that measured 7.6 on the Richter scale.

Another example is the Surya Kund in Modhera, northern Gujarat, next to the Sun Temple, built by King Bhima I in 1026 to honour the sun god Surya. It's actually a tank (kund means reservoir or pond) rather than a well, but displays the hallmarks of stepwell architecture, including four sides of steps that descend to the bottom in a stunning geometrical formation. The terraces house 108 small, intricately carved shrines between the sets of steps.

Rajasthan also has a wealth of wells. The ancient city of Bundi, 200 kilometres south of Jaipur, is renowned for its architecture, including its stepwells. One of the larger examples is Rani Ki Baori, which was built by the queen of the region, Nathavatji, in 1699. At 46 metres deep, 20 metres wide and 40 metres long, the intricately carved monument is one of 21 baoris commissioned in the Bundi area by Nathavatji.

In the old ruined town of Abhaneri, about 95 kilometres east of Jaipur, is Chand Baori, one of India's oldest and deepest wells; aesthetically, it's perhaps one of the most dramatic. Built in around 850 AD next to the temple of Harshat Mata, the baori comprises hundreds of zigzagging steps that run along three of its sides, steeply descending 11 storeys, resulting in a striking geometric pattern when seen from afar. On the fourth side, covered verandas supported by ornate pillars overlook the steps.

Still in public use is Neemrana Ki Baori, located just off the Jaipur–Dehli highway. Constructed in around 1700, it's nine storeys deep, with the last two levels underwater. At ground level, there are 86 colonnaded openings from where the visitor descends 170 steps to the deepest water source.

Today, following years of neglect, many of these monuments to medieval engineering have been saved by the Archaeological Survey of India, which has recognised the importance of preserving them as part of the country's rich history. Tourists flock to wells in far-flung corners of northwestern India to gaze in wonder at these architectural marvels from 1,000 years ago, which serve as a reminder of both the ingenuity and artistry of ancient civilisations and of the value of water to human existence

Questions 1–5

TRUE if the statement agrees with the information

FALSE if the statement contradicts the information

NOT GIVEN if there is no information on this

- 54 Examples of ancient stepwells can be found all over the world.
- 55 Stepwells had a range of functions, in addition to those related to water collection.
- 56 The few existing stepwells in Delhi are more attractive than those found elsewhere.
- 57 It took workers many years to build the stone steps characteristic of stepwells.
- 58 The number of steps above the water level in a stepwell altered during the course of a year.

READING PASSAGE 12

EUROPEAN TRANSPORT SYSTEMS 1990-2010

What have been the trends and what are the prospects for European transport systems?

A

It is difficult to conceive of vigorous economic growth without an efficient transport system. Although modern information technologies can reduce the demand for physical transport by facilitating teleworking and teleservices, the requirement for transport continues to increase. There are two key factors behind this trend. For passenger transport, the determining factor is the spectacular growth in car use. The number of cars on European Union (EU) roads saw an increase of three million cars each year from 1990 to 2010, and in the next decade the EU will see a further substantial increase in its fleet.

B

As far as goods transport is concerned, growth is due to a large extent to changes in the European economy and its system of production. In the last 20 years, as internal frontiers have been abolished, the EU has moved from a "stock" economy to a "flow" economy. This phenomenon has been emphasised by the relocation of some industries, particularly those which are labourintensive, to reduce production costs, even though the production site is hundreds or even thousands of kilometres away from the final assembly plant or away from users.

C

The strong economic growth expected in countries which are candidates for entry to the EU will also increase transport flows, in particular road haulage traffic. In 1998, some of these countries already exported more than twice their 1990 volumes and imported more than five times their 1990 volumes. And although many candidate countries inherited a transport system which encourages rail, the distribution between modes has tipped sharply in favour of road transport since the 1990s. Between 1990 and 1998, road haulage increased by 19.4%, while during the same period rail haulage decreased by 43.5%, although – and this could benefit the enlarged EU – it is still on average at a much higher level than in existing member states.

D

However, a new imperative-sustainable development – offers an opportunity for adapting the EU, s common transport policy. This objective, agreed by the Gothenburg European Council, has to be achieved by integrating environmental considerations into Community policies, and shifting the balance between modes of transport lies at the heart of its strategy. The ambitious objective can only be fully achieved by 2020, but proposed measures are nonetheless a first essential step towards a sustainable transport system which will ideally be in place in 30 years" time, that is by 2040.

E

In 1998, energy consumption in the transport sector was to blame for 28% of emissions of CO₂, the leading greenhouse gas. According to the latest estimates, if nothing is done to reverse the traffic growth trend, CO₂ emissions from transport can be expected to increase by around 50% to 1,113 billion tonnes by 2020, compared with the 739 billion tonnes recorded in 1990. Once again, road transport is the main culprit since it alone accounts for 84% of the CO₂ emissions attributable to transport. Using alternative fuels and improving energy efficiency is thus both an ecological necessity and a technological challenge.

F

At the same time greater efforts must be made to achieve a modal shift. Such a change cannot be achieved overnight, all the less so after over half a century of constant deterioration in favour of road. This has reached such a pitch that today rail freight services are facing marginalisation, with just 8% of market share, and with international goods trains struggling along at an average speed of 18km/h. Three possible options have emerged.

G

The first approach would consist of focusing on road transport solely through pricing. This option would not be accompanied by complementary measures in the other modes of transport. In the short term it might curb the growth in road transport through the better loading ratio of goods vehicles and occupancy rates of passenger vehicles expected as a result of the increase in the price of transport. However, the lack of measures available to revitalise other modes of transport would make it impossible for more sustainable modes of transport to take up the baton.

H

The second approach also concentrates on road transport pricing but is accompanied by measures to increase the efficiency of the other modes (better quality of services, logistics, technology). However, this approach does not include investment in new infrastructure, nor does it guarantee better regional cohesion. It could help to achieve greater uncoupling than the first approach, but road transport would keep the lion's share of the market and continue to concentrate on saturated arteries, despite being the most polluting of the modes. It is therefore not enough to guarantee the necessary shift of the balance.

I

The third approach, which is not new, comprises a series of measures ranging from pricing to revitalising alternative modes of transport and targeting investment in the trans-European network. This integrated approach would allow the market shares of the other modes to return to their 1998 levels and thus make a shift of balance. It is far more ambitious than it looks, bearing in mind the historical imbalance in favour of roads for the last fifty years, but would achieve a marked break in the link between road transport growth and economic growth, without placing restrictions on the mobility of people and goods.

Questions 59-63

TRUE *if the statement agrees with the information*

FALSE *if the statement contradicts the information*

NOT GIVEN *if there is no information on this*

- 59** The need for transport is growing, despite technological developments.
- 60** To reduce production costs, some industries have been moved closer to their relevant consumers.
- 61** Cars are prohibitively expensive in some EU candidate countries.
- 62** The Gothenburg European Council was set up 30 years ago.
- 63** By the end of this decade, CO₂ emissions from transport are predicted to reach 739 billion tonnes.

READING PASSAGE 13

Tea and the Industrial Revolution

A Cambridge professor says that a change in drinking habits was the reason for the Industrial Revolution in Britain. Anjana Abuja reports

A Alan Macfarlane, professor of anthropological science at King's College, Cambridge has, like other historians, spent decades wrestling with the enigma of the Industrial Revolution. Why did this particular Big Bang – the world-changing birth of industry-happen in Britain? And why did it strike at the end of the 18th century?

B Macfarlane compares the puzzle to a combination lock. 'There are about 20 different factors and all of them need to be present before the revolution can happen,' he says. For industry to take off, there needs to be the technology and power to drive factories, large urban populations to provide cheap labour, easy transport to move goods around, an affluent middle-class willing to buy mass-produced objects, a market-driven economy and a political system that allows this to happen. While this was the case for England, other nations, such as Japan, the Netherlands and France also met some of these criteria but were not industrialising. All these factors must have been necessary. But not sufficient to cause the revolution, says Macfarlane. 'After all, Holland had everything except coal while China also had many of these factors. Most historians are convinced there are one or two missing factors that you need to open the lock.'

C The missing factors, he proposes, are to be found in almost even kitchen cupboard. Tea and beer, two of the nation's favourite drinks, fuelled the revolution. The antiseptic properties of tannin, the active ingredient in tea, and of hops in beer – plus the fact that both are made with boiled water – allowed urban communities to flourish at close quarters without succumbing to water-borne diseases such as dysentery. The theory sounds eccentric but once he starts to explain the detective work that went into his deduction, the scepticism gives way to wary admiration. Macfarlane's case has been strengthened by support from notable quarters – Roy Porter, the distinguished medical historian, recently wrote a favourable appraisal of his research.

D Macfarlane had wondered for a long time how the Industrial Revolution came about. Historians had alighted on one interesting factor around the mid-18th century that required explanation. Between about 1650 and 1740, the population in Britain was static. But then there was a burst in population growth. Macfarlane says: 'The infant mortality rate halved in the space of 20 years, and this happened in both rural areas and cities, and across all classes. People suggested four possible causes. Was there a sudden change in the viruses and bacteria around? Unlikely. Was there a revolution in medical science? But this was a century before Lister's revolution*. Was there a change in environmental conditions? There were improvements in agriculture that wiped out malaria, but these were small gains. Sanitation did not become widespread until the 19th century. The only option left is food. But the height and weight statistics show a decline. So the food must have got worse. Efforts to explain this sudden reduction in child deaths appeared to draw a blank.'

E This population burst seemed to happen at just the right time to provide labour for the Industrial Revolution. 'When you start moving towards an industrial revolution, it is economically efficient to have people living close together,' says Macfarlane. 'But then you get disease, particularly from human waste.' Some digging around in historical records revealed that there was a change in the incidence of water-borne disease at that time, especially dysentery. Macfarlane deduced that whatever the British were drinking must have been important in regulating disease. He says, 'We drank beer. For a long time, the English were protected by the strong antibacterial agent in hops, which were added to help preserve the beer. But in the late 17th century a tax was introduced on malt, the basic ingredient of beer. The poor turned to water and gin and in the 1720s the mortality rate began to rise again. Then it suddenly dropped again. What caused this?'

F Macfarlane looked to Japan, which was also developing large cities about the same time, and also had no sanitation. Water-borne diseases had a much looser grip on the Japanese population than those in Britain.

Could it be the prevalence of tea in their culture? Macfarlane then noted that the history of tea in Britain provided an extraordinary coincidence of dates. Tea was relatively expensive until Britain started a direct dipper trade with China in the early 18th century. By the 1740s, about the time that infant mortality was dipping, the drink was common. Macfarlane guessed that the fact that water had to be boiled, together with the stomach-purifying properties of tea meant that the breast milk provided by mothers was healthier than it had ever been. No other European nation sipped tea like the British, which, by Macfarlanes logic, pushed these other countries out of contention for the revolution.

G But, if tea is a factor in the combination lock, why didn't Japan forge ahead in a tea-soaked industrial revolution of its own? Macfarlane notes that even though 17th-century Japan had large cities, high literacy rates, even a futures market, it had turned its back on the essence of any work-based revolution by giving up labour-saving devices such as animals, afraid that they would put people out of work. So, the nation that we now think of as one of the most technologically advanced entered the 19th century having 'abandoned the wheel'

Questions 8-13

TRUE if the statement agrees with the information

FALSE if the statement contradicts the information

NOT GIVEN if there is no information on this

- 64 China's transport system was not suitable for industry in the 18th century.
- 65 Tea and beer both helped to prevent dysentery in Britain.
- 66 Roy Porter disagrees with Professor Macfarlane's findings.
- 67 After 1740, there was a reduction in population in Britain.
- 68 People in Britain used to make beer at home.
- 69 The tax on malt indirectly caused a rise in the death rate.

The Context, Meaning and Scope of Tourism

A Travel has existed since the beginning of time, when primitive man set out, often traversing great distances in search of game, which provided the food and clothing necessary for his survival. Throughout the course of history, people have travelled for purposes of trade, religious conviction, economic gain, war, migration and other equally compelling motivations. In the Roman era, wealthy aristocrats and high government officials also travelled for pleasure. Seaside resorts located at Pompeii and Herculaneum afforded citizens the opportunity to escape to their vacation villas in order to avoid the summer heat of Rome. Travel, except during the Dark Ages, has continued to grow and, throughout recorded history, has played a vital role in the development of civilisations and their economies.

B Tourism in the mass form as we know it today is a distinctly twentieth-century phenomenon. Historians suggest that the advent of mass tourism began in England during the industrial revolution with the rise of the middle class and the availability of relatively inexpensive transportation. The creation of the commercial airline industry following the Second World War and the subsequent development of the jet aircraft in the 1950s signalled the rapid growth and expansion of international travel. This growth led to the development of a major new industry: tourism. In turn, international tourism became the concern of a number of world governments since it not only provided new employment opportunities but also produced a means of earning foreign exchange.

C Tourism today has grown significantly in both economic and social importance. In most industrialised countries over the past few years the fastest growth has been seen in the area of services. One of the largest segments of the service industry, although largely unrecognised as an entity in some of these countries, is travel and tourism. According to the World Travel and Tourism Council (1992), Travel and tourism is the largest industry in the world on virtually any economic measure including value-added capital investment, employment and tax contributions. In 1992, the industry's gross output was estimated to be \$3.5 trillion, over 12 per cent of all consumer spending. The travel and tourism industry is the world's largest employer the almost 130 million jobs, or almost 7 per cent of all employees. This industry is the world's leading industrial contributor, producing over 6 per cent of the world's national product and accounting for capital investment in excess of \$422 billion in direct indirect and personal taxes each year. Thus, tourism has a profound impact both on the world economy and, because of the educative effect of travel and the effects on employment, on society itself.

D However, the major problems of the travel and tourism industry that have hidden, or obscured, its economic impact are the diversity and fragmentation of the industry itself. The travel industry includes: hotels, motels and other types of accommodation; restaurants and other food services; transportation services and facilities; amusements, attractions and other leisure facilities; gift shops and a large number of other enterprises. Since many of these businesses also serve local residents, the impact of spending by visitors can easily be overlooked or underestimated. In addition, Meis (1992) points out that the tourism industry involves concepts that have remained amorphous to both analysts and decision makers. Moreover, in all nations this problem has made it difficult for the industry to develop any type of reliable or credible tourism information base in order to estimate the contribution it makes to regional, national and global economies. However, the nature of this very diversity makes travel and tourism ideal vehicles for economic development in a wide variety of countries, regions or communities.

E Once the exclusive province of the wealthy, travel and tourism have become an institutionalised way of life for most of the population. In fact, McIntosh and Goeldner (1990) suggest that tourism has become the largest commodity in international trade for many nations and, for a significant number of other countries, it ranks second or third. For example, tourism is the major source of income in Bermuda, Greece, Italy, Spain,

Switzerland and most Caribbean countries. In addition, Hawkins and Ritchie, quoting from data published by the American Express Company, suggest that the travel and tourism industry is the number one ranked employer in the Bahamas, Brazil, Canada, France, (the former) West Germany, Hong Kong, Italy, Jamaica, Japan, Singapore, the United Kingdom and the United States. However, because of problems of definition, which directly affect statistical measurement, it is not possible with any degree of certainty to provide precise, valid or reliable data about the extent of world-wide tourism participation or its economic impact. In many cases, similar difficulties arise when attempts are made to measure domestic tourism.

Questions 70-75

*Do the following statements agree with the information given in Reading Passage 1?
In boxes 70-75 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

- 70** The largest employment figures in the world are found in the travel and tourism industry.
- 71** Tourism contributes over six per cent of the Australian gross national product.
- 72** Tourism has a social impact because it promotes recreation.
- 73** Two main features of the travel and tourism industry make its economic significance difficult to ascertain.
- 74** Visitor spending is always greater than the spending of residents in tourist areas.
- 75** It is easy to show statistically how tourism affects individual economies.

READING PASSAGE 15

Autumn leaves

Canadian writer Jay Ingram investigates the mystery of why leaves turn red in the fall

A

One of the most captivating natural events of the year in many areas throughout North America is the turning of the leaves in the fall. The colours are magnificent, but the question of exactly why some trees turn yellow or orange, and others red or purple, is something which has long puzzled scientists.

B

Summer leaves are green because they are full of chlorophyll, the molecule that captures sunlight converts that energy into new building materials for the tree. As fall approaches in the northern hemisphere, the amount of solar energy available declines considerably. For many trees – evergreen conifers being an exception – the best strategy is to abandon photosynthesis* until the spring. So rather than maintaining the now redundant leaves throughout the winter, the tree saves its precious resources and discards them. But before letting its leaves go, the tree dismantles their chlorophyll molecules and ships their valuable nitrogen back into the twigs. As chlorophyll is depleted, other colours that have been dominated by it throughout the summer begin to be revealed. This unmasking explains the autumn colours of yellow and orange, but not the brilliant reds and purples of trees such as the maple or sumac.

C

The source of the red is widely known: it is created by anthocyanins, water-soluble plant pigments reflecting the red to blue range of the visible spectrum. They belong to a class of sugar-based chemical compounds also known as flavonoids. What's puzzling is that anthocyanins are actually newly minted, made in the leaves at the same time as the tree is preparing to drop them. But it is hard to make sense of the manufacture of anthocyanins – why should a tree bother making new chemicals in its leaves when it's already scrambling to withdraw and preserve the ones already there?

D

Some theories about anthocyanins have argued that they might act as a chemical defence against attacks by insects or fungi, or that they might attract fruit-eating birds or increase a leaf's tolerance to freezing. However there are problems with each of these theories, including the fact that leaves are red for such a relatively short period that the expense of energy needed to manufacture the anthocyanins would outweigh any anti-fungal or anti-herbivore activity achieved.* photosynthesis: the production of new material from sunlight, water and carbon dioxide.

E

It has also been proposed that trees may produce vivid red colours to convince herbivorous insects that they are healthy and robust and would be easily able to mount chemical defences against infestation. If insects paid attention to such advertisements, they might be prompted to lay their eggs on a duller, and presumably less resistant host. The flaw in this theory lies in the lack of proof to support it. No one has as yet ascertained whether more robust trees sport the brightest leaves, or whether insects make choices according to colour intensity.

F

Perhaps the most plausible suggestion as to why leaves would go to the trouble of making anthocyanins when they're busy packing up for the winter is the theory known as the 'light screen' hypothesis. It sounds paradoxical, because the idea behind this hypothesis is that the red pigment is made in autumn leaves to protect chlorophyll, the light-absorbing chemical, from too much light. Why does chlorophyll need protection when it is the natural world's supreme light absorber? Why protect chlorophyll at a time when the tree is breaking it down to salvage as much of it as possible?

G

Chlorophyll, although exquisitely evolved to capture the energy of sunlight, can sometimes be overwhelmed by it, especially in situations of drought, low temperatures, or nutrient deficiency. Moreover, the problem of oversensitivity to light is even more acute in the fall, when the leaf is busy preparing for winter by dismantling

its internal machinery. The energy absorbed by the chlorophyll molecules of the unstable autumn leaf is not immediately channelled into useful products and processes, as it would be in an intact summer leaf. The weakened fall leaf then becomes vulnerable to the highly destructive effects of the oxygen created by the excited chlorophyll molecules.

H

Even if you had never suspected that this is what was going on when leaves turn red, there are clues out there. One is straightforward: on many trees, the leaves that are the reddest are those on the side of the tree which gets most sun. Not only that, but the red is brighter on the upper side of the leaf. It has also been recognised for decades that the best conditions for intense red colours are dry, sunny days and cool nights, conditions that nicely match those that make leaves susceptible to excess light. And finally, trees such as maples usually get much redder the more north you travel in the northern hemisphere. It's colder there, they're more stressed, their chlorophyll is more sensitive and it needs more sunblock.

I

What is still not fully understood, however, is why some trees resort to producing red pigments while others don't bother, and simply reveal their orange or yellow hues. Do these trees have other means at their disposal to prevent overexposure to light in autumn? Their story, though not as spectacular to the eye, will surely turn out to be as subtle and as complex.

Questions 76-78

TRUE if the statement agrees with the information

FALSE if the statement contradicts the information

NOT GIVEN if there is no information on this

- 76** It is likely that the red pigments help to protect the leaf from freezing temperatures.
- 77** The 'light screen' hypothesis would initially seem to contradict what is known about chlorophyll.
- 78** Leaves which turn colours other than red are more likely to be damaged by sunlight.

READING PASSAGE 16

The megafires of California

Drought, housing expansion, and oversupply of tinder make for bigger, hotter fires in the western United States

Wildfires are becoming an increasing menace in the western United States, with Southern California being the hardest hit area. There's a reason fire squads battling more frequent blazes in Southern California are having such difficulty containing the flames, despite better preparedness than ever and decades of experience fighting fires fanned by the 'Santa Ana Winds'. The wildfires themselves, experts say, are generally hotter, faster, and spread more erratically than in the past.

Megafires, also called 'siege fires', are the increasingly frequent blazes that burn 500,000 acres or more - 10 times the size of the average forest fire of 20 years ago. Some recent wildfires are among the biggest ever in California in terms of acreage burned, according to state figures and news reports.

One explanation for the trend to more superhot fires is that the region, which usually has dry summers, has had significantly below normal precipitation in many recent years. Another reason, experts say, is related to the century-long policy of the US Forest Service to stop wildfires as quickly as possible.

The unintentional consequence has been to halt the natural eradication of underbrush, now the primary fuel for megafires.

Three other factors contribute to the trend, they add. First is climate change, marked by a 1-degree Fahrenheit rise in average yearly temperature across the western states. Second is fire seasons that on average are 78 days longer than they were 20 years ago. Third is increased construction of homes in wooded areas.

'We are increasingly building our homes in fire-prone ecosystems,' says Dominik Kulakowski, adjunct professor of biology at Clark University Graduate School of Geography in Worcester, Massachusetts. 'Doing that in many of the forests of the western US is like building homes on the side of an active volcano.'

In California, where population growth has averaged more than 600,000 a year for at least a decade, more residential housing is being built. 'What once was open space is now residential homes providing fuel to make fires burn with greater intensity,' says Terry McHale of the California Department of Forestry firefighters' union. 'With so much dryness, so many communities to catch fire, so many fronts to fight, it becomes an almost incredible job.'

That said, many experts give California high marks for making progress on preparedness in recent years, after some of the largest fires in state history scorched thousands of acres, burned thousands of homes, and killed numerous people. Stung in the past by criticism of bungling that allowed fires to spread when they might have been contained, personnel are meeting the peculiar challenges of neighborhood - and canyon - hopping fires better than previously, observers say.

State promises to provide more up-to-date engines, planes, and helicopters to fight fires have been fulfilled. Firefighters' unions that in the past complained of dilapidated equipment, old fire engines, and insufficient blueprints for fire safety are now praising the state's commitment, noting that funding for firefighting has increased, despite huge cuts in many other programs. 'We are pleased that the current state administration has been very proactive in its support of us, and [has] come through with budgetary support of the infrastructure needs we have long sought,' says Mr. McHale of the firefighters' union.

Besides providing money to upgrade the fire engines that must traverse the mammoth state and wind along serpentine canyon roads, the state has invested in better command-and-control facilities as well as in the

strategies to run them. 'In the fire sieges of earlier years, we found that other jurisdictions and states were willing to offer mutual-aid help, but we were not able to communicate adequately with them,' says Kim Zagaris, chief of the state's Office of Emergency Services Fire and Rescue Branch.

After a commission examined and revamped communications procedures, the statewide response 'has become far more professional and responsive,' he says. There is a sense among both government officials and residents that the speed, dedication, and coordination of firefighters from several states and jurisdictions are resulting in greater efficiency than in past 'siege fire' situations.

In recent years, the Southern California region has improved building codes, evacuation procedures, and procurement of new technology. 'I am extraordinarily impressed by the improvements we have witnessed,' says Randy Jacobs, a Southern California-based lawyer who has had to evacuate both his home and business to escape wildfires. 'Notwithstanding all the damage that will continue to be caused by wildfires, we will no longer suffer the loss of life endured in the past because of the fire prevention and firefighting measures that have been put in place,' he says.

Questions 7-13

***TRUE** if the statement agrees with the information*
***FALSE** if the statement contradicts the information*
***NOT GIVEN** if there is no information on this*

- 79 The amount of open space in California has diminished over the last ten years.
- 80 Many experts believe California has made little progress in readying itself to fight fires.
- 81 Personnel in the past have been criticised for mishandling fire containment.
- 82 California has replaced a range of firefighting tools.
- 83 More firefighters have been hired to improve fire-fighting capacity.
- 84 Citizens and government groups disapprove of the efforts of different states and agencies working together.
- 85 Randy Jacobs believes that loss of life from fires will continue at the same levels, despite changes made.

YES, NO, NOT GIVEN

No vs yes

Tips: Remember that 'no' means the statement contradicts the writer's opinion. So it can't be right. 'Not given' means that there is no information about the writer's opinion in the text, so that statement may or may not be true.

Example

Here is part of a text about an art installation (or sculpture)

At first glance , Cornelia Parker's 1991 installation cold dark matter. An exploded view would seem to be the outcome of a destructive drive in the artist personality. On the contrary , she is fascinated by the way that change even change a violence nature , is a new beginning. An opportunity for something very different to emerge . cold dark matter consists of a garden shed which parker filled with objects, then asked the army to blow up. She suspended the resulting fragments in a room and lit them with a single bulb. Throwing sinister shadow on the walls. The title is central to understanding the work, alluding to the cold dark matter which in one version of the 'big bang' theory . led to the creation of the universe.

Question:

Do the following statements agree with the writer's views?

1. The impulse for the work is the artist's physiological need to destroy. *No*
2. The way in which the shade was destroyed adds to the meaning of the work. *Not given*

Explanation:

The highlighted part of the text shows you where you can find the information which gives you the answers. 1 can't be the writer's view because it contradicts ('on the contrary'). 2 although there is information about how the shed was destroyed , there is no information about how this adds to the meaning of the work, so statement 2 may or may not be true.

READING PASSAGE 1

IS THERE ANYBODY OUT THERE'

The Search for Extra-terrestrial Intelligence

The question of whether we are alone in the Universe has haunted humanity for centuries, but we may now stand poised on the brink of the answer to that question, as we search for radio signals from other intelligent civilisations. This search, often known by the acronym SETI (search for extra-terrestrial intelligence], is a difficult one. Although groups around the world have been searching intermittently for three decades, it is only now that we have reached the level of technology where we can make a determined attempt to search all nearby stars for any sign of life.

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 civilisation 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 civilisation 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.

B

In discussing whether we are alone, most SETI scientists adopt two ground rules. First, UFOs (Unidentified Flying Objects) are generally ignored since most scientists don't consider the evidence for them to be strong enough to bear serious consideration (although it is also important to keep an open mind in case any really convincing evidence emerges in the future). Second, we make a very conservative assumption that we are looking for a life form that is pretty well like us, since if it differs radically from us we may well not recognise it as a life form, quite apart from whether we are able to communicate with it. In other words, the life form we are looking for may well have two green heads and seven fingers, but it will nevertheless resemble us in that it should communicate with its fellows, be interested in the Universe, live on a planet orbiting a star like our Sun, and perhaps most restrictively, have a chemistry, like us, based on carbon and water.

C

Even when we make these assumptions, our understanding of other life forms is still severely limited. We do not even know, for example, how many stars have planets, and we certainly do not know how likely it is that life will arise naturally, given the right conditions. However, when we look at the 100 billion stars in our galaxy (the Milky Way), and 100 billion galaxies in the observable Universe, it seems inconceivable that at least one of these planets does not have a life form on it; in fact, the best educated guess we can make, using the little that we do know about the conditions for carbon-based life, leads us to estimate that perhaps one in 100,000 stars might have a life-bearing planet orbiting it. That means that our nearest neighbours are perhaps 100 light years away, which is almost next door in astronomical terms.

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.

E

There is considerable debate over how we should react if we detect a signal from an alien civilisation. Everybody agrees that we should not reply immediately. Quite apart from the impracticality of sending a reply over such large distances at short notice, it raises a host of ethical questions that would have to be addressed by the global community before any reply could be sent. Would the human race face the culture shock if faced with a superior and much older civilisation? Luckily, there is no urgency about this. The stars being searched are hundreds of light years away, so it takes hundreds of years for their signal to reach us, and a further few hundred years for our reply to reach them. It's not important, then, if there's a delay of a few years, or decades, while the human race debates the question of whether to reply, and perhaps carefully drafts a reply.

Questions 8-13

YES NO.....NOT GIVEN

- 1** Alien civilisations may be able to help the human race to overcome serious problems.
- 2** SETI scientists are trying to find a life form that resembles humans in many ways.
- 3** The Americans and Australians have co-operated on joint research projects.
- 4** So far SETI scientists have picked up radio signals from several stars.
- 5** The NASA project attracted criticism from some members of Congress.
- 6** If a signal from outer space is received, it will be important to respond promptly.

READING PASSAGE 2

A neuroscientist reveals how to think differently

In the last decade a revolution has occurred In the way that scientists think about the brain.

We now know that the decisions humans make can be traced to the firing patterns of neurons in specific parts of the brain. These discoveries have led to the field known as neuroeconomics, which studies the brain's secrets to success in an economic environment that demands innovation and being able to do things differently from competitors. A brain that can do this is an iconoclastic one. Briefly, an iconoclast is a person who does something that others say can't be done.

This definition implies that iconoclasts are different from other people, but more precisely, it is their brains that are different in three distinct ways: perception, fear response, and social intelligence. Each of these three functions utilizes a different circuit in the brain. Naysayers might suggest that the brain is irrelevant, that thinking in an original, even revolutionary, way is more a matter of personality than brain function. But the field of neuroeconomics was born out of the realization that the physical workings of the brain place limitations on the way we make decisions. By understanding these constraints, we begin to understand why some people march to a different drumbeat.

The first thing to realize is that the brain suffers from limited resources. It has a fixed energy budget, about the same as a 40 watt light bulb, so it has evolved to work as efficiently as possible. This is where most people are impeded from being an iconoclast. For example, when confronted with information streaming from the eyes, the brain will interpret this information in the quickest way possible. Thus it will draw on both past experience and any other source of information, such as what other people say, to make sense of what it is seeing. This happens all the time. The brain takes shortcuts that work so well we are hardly ever aware of them.

We think our perceptions of the world are real, but they are only biological and electrical rumblings. Perception is not simply a product of what your eyes or ears transmit to your brain. More than the physical reality of photons or sound waves, perception is a product of the brain. Perception is central to iconoclasm. Iconoclasts see things differently to other people. Their brains do not fall into efficiency pitfalls as much as the average person's brain. Iconoclasts, either because they were born that way or through learning, have found ways to work around the perceptual shortcuts that plague most people. Perception is not something that is hardwired into the brain. It is a learned process, which is both a curse and an opportunity for change. The brain faces the fundamental problem of interpreting physical stimuli from the senses. Everything the brain sees, hears, or touches has multiple interpretations. The one that is ultimately chosen is simply the brain's best theory. In technical terms, these conjectures have their basis in the statistical likelihood of one interpretation over another and are heavily influenced by past experience and, importantly for potential iconoclasts, what other people say.

The best way to see things differently to other people is to bombard the brain with things it has never encountered before. Novelty releases the perceptual process from the chains of past experience and forces the brain to make new judgments. Successful iconoclasts have an extraordinary willingness to be exposed to what is fresh and different. Observation of iconoclasts shows that they embrace novelty while most people avoid things that are different.

The problem with novelty, however, is that it tends to trigger the brain's fear system. Fear is a major impediment to thinking like an iconoclast and stops the average person in his tracks. There are many types of fear, but the two that inhibit iconoclastic thinking and people generally find difficult to deal with are fear of uncertainty and fear of public ridicule. These may seem like trivial phobias. But fear of public speaking, which everyone must do from time to time, afflicts one-third of the population. This makes it too common to be

considered a mental disorder. It is simply a common variant of human nature, one which iconoclasts do not let inhibit their reactions.

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.

Questions 32-37

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*

- 7 Exposure to different events forces the brain to think differently.
- 8 Iconoclasts are unusually receptive to new experiences.
- 9 Most people are too shy to try different things.
- 10 If you think in an iconoclastic way, you can easily overcome fear.
- 11 When concern about embarrassment matters less, other fears become irrelevant.
- 12 Fear of public speaking is a psychological illness.

READING PASSAGE 3

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 13-20

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*

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

READING PASSAGE 4

Striking Back at Lightning With Lasers

Seldom is the weather more dramatic than when thunderstorms strike. Their electrical fury inflicts death or serious injury on around 500 people each year in the United States alone. As the clouds roll in, a leisurely round of golf can become a terrifying dice with death - out in the open, a lone golfer may be a lightning bolt's most inviting target. And there is damage to property too. Lightning damage costs American power companies more than \$100 million a year.

But researchers in the United States and Japan are planning to hit back. Already in laboratory trials they have tested strategies for neutralising the power of thunderstorms, and this winter they will brave real storms, equipped with an armoury of lasers that they will be pointing towards the heavens to discharge thunderclouds before lightning can strike.

The idea of forcing storm clouds to discharge their lightning on command is not new. In the early 1960s, researchers tried firing rockets trailing wires into thunderclouds to set up an easy discharge path for the huge electric charges that these clouds generate. The technique survives to this day at a test site in Florida run by the University of Florida, with support from the Electrical Power Research Institute (EPRI), based in California. EPRI, which is funded by power companies, is looking at ways to protect the United States' power grid from lightning strikes. 'We can cause the lightning to strike where we want it to using rockets,' says Ralph Bernstein, manager of lightning projects at EPRI. The rocket site is providing precise measurements of lightning voltages and allowing engineers to check how electrical equipment bears up.

Bad behaviour

But while rockets are fine for research, they cannot provide the protection from lightning strikes that everyone is looking for. The rockets cost around \$1,200 each, can only be fired at a limited frequency and their failure rate is about 40 per cent. And even when they do trigger lightning, things still do not always go according to plan. 'Lightning is not perfectly well behaved,' says Bernstein. 'Occasionally, it will take a branch and go someplace it wasn't supposed to go.'

And anyway, who would want to fire streams of rockets in a populated area? 'What goes up must come down,' points out Jean-Claude Diels of the University of New Mexico. Diels is leading a project, which is backed by EPRI, to try to use lasers to discharge lightning safely- and safety is a basic requirement since no one wants to put themselves or their expensive equipment at risk. With around \$500,000 invested so far, a promising system is just emerging from the laboratory.

The idea began some 20 years ago, when high-powered lasers were revealing their ability to extract electrons out of atoms and create ions. If a laser could generate a line of ionisation in the air all the way up to a storm cloud, this conducting path could be used to guide lightning to Earth, before the electric field becomes strong enough to break down the air in an uncontrollable surge. To stop the laser itself being struck, it would not be pointed straight at the clouds. Instead it would be directed at a mirror, and from there into the sky. The mirror would be protected by placing lightning conductors close by. Ideally, the cloud-zapper (gun) would be cheap enough to be installed around all key power installations, and portable enough to be taken to international sporting events to beam up at brewing storm clouds.

A stumbling block

However, there is still a big stumbling block. The laser is no nifty portable: it's a monster that takes up a whole room. Diels is trying to cut down the size and says that a laser around the size of a small table is in the offing. He plans to test this more manageable system on live thunderclouds next summer. Bernstein says that Diels's system is attracting lots of interest from the power companies.

But they have not yet come up with the \$5 million that EPRI says will be needed to develop a commercial system, by making the lasers yet smaller and cheaper. 'I cannot say I have money yet, but I'm working on it,' says Bernstein. He reckons that the forthcoming field tests will be the turning point - and he's hoping for good news. Bernstein predicts 'an avalanche of interest and support' if all goes well. He expects to see cloud-zappers eventually costing \$50,000 to \$100,000 each.

Other scientists could also benefit. With a lightning 'switch' at their fingertips, materials scientists could find out what happens when mighty currents meet matter. Diels also hopes to see the birth of 'interactive meteorology' - not just forecasting the weather but controlling it. 'If we could discharge clouds, we might affect the weather,' he says.

And perhaps, says Diels, we'll be able to confront some other meteorological menaces. 'We think we could prevent hail by inducing lightning,' he says. Thunder, the shock wave that comes from a lightning flash, is thought to be the trigger for the torrential rain that is typical of storms. A laser thunder factory could shake the moisture out of clouds, perhaps preventing the formation of the giant hailstones that threaten crops. With luck, as the storm clouds gather this winter, laser-toting researchers could, for the first time, strike back.

Questions 21-23

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*

- 21** Power companies have given Diels enough money to develop his laser.
- 22** Obtaining money to improve the lasers will depend on tests in real storms.
- 23** Weather forecasters are intensely interested in Diels's system.

READING PASSAGE 4

HOW DOES THE BIOLOGICAL CLOCK TICK?

A

Our life span is restricted. Everyone accepts this as 'biologically' obvious. 'Nothing lives for ever!' However, in this statement we think of artificially produced, technical objects, products which are subjected to natural wear and tear during use. This leads to the result that at some time or other the object stops working and is unusable ('death' in the biological sense). But are the wear and tear and loss of function of technical objects and the death of living organisms really similar or comparable?

B

Our 'dead' products are 'static', closed systems. It is always the basic material which constitutes the object and which, in the natural course of things, is worn down and becomes 'older'. Ageing in this case must occur according to the laws of physical chemistry and of thermodynamics. Although the same law holds for a living organism, the result of this law is not inexorable in the same way. At least as long as a biological system has the ability to renew itself it could actually become older without ageing; an organism is an open, dynamic system through which new material continuously flows. Destruction of old material and formation of new material are thus in permanent dynamic equilibrium. The material of which the organism is formed changes continuously. Thus our bodies continuously exchange old substance for new, just like a spring which more or less maintains its form and movement, but in which the water molecules are always different.

C

Thus ageing and death should not be seen as inevitable, particularly as the organism possesses many mechanisms for repair. It is not, in principle, necessary for a biological system to age and die. Nevertheless, a restricted life span, ageing, and then death are basic characteristics of life. The reason for this is easy to recognise: in nature, the existent organisms either adapt or are regularly replaced by new types. Because of changes in the genetic material (mutations) these have new characteristics and in the course of their individual lives they are tested for optimal or better adaptation to the environmental conditions. Immortality would disturb this system - it needs room for new and better life. This is the basic problem of evolution.

D

Every organism has a life span which is highly characteristic. There are striking differences in life span between different species, but within one species the parameter is relatively constant. For example, the average duration of human life has hardly changed in thousands of years. Although more and more people attain an advanced age as a result of developments in medical care and better nutrition, the characteristic upper limit for most remains 80 years. A further argument against the simple wear and tear theory is the observation that the time within which organisms age lies between a few days (even a few hours for unicellular organisms) and several thousand years, as with mammoth trees.

E

If a life span is a genetically determined biological characteristic, it is logically necessary to propose the existence of an internal clock, which in some way measures and controls the ageing process and which finally determines death as the last step in a fixed programme. Like the life span, the metabolic rate has for different organisms a fixed mathematical relationship to the body mass. In comparison to the life span this relationship is 'inverted': the larger the organism the lower its metabolic rate. Again this relationship is valid not only for birds, but also, similarly on average within the systematic unit, for all other organisms (plants, animals, unicellular organisms).

F

Animals which behave 'frugally' with energy become particularly old, for example, crocodiles and tortoises. Parrots and birds of prey are often held chained up. Thus they are not able to 'experience life' and so they attain a high life span in captivity. Animals which save energy by hibernation or lethargy (e.g. bats or hedgehogs) live much longer than those which are always active. The metabolic rate of mice can be reduced by a very low consumption of food (hunger diet). They then may live twice as long as their well fed

comrades. Women become distinctly (about 10 per cent) older than men. If you examine the metabolic rates of the two sexes you establish that the higher male metabolic rate roughly accounts for the lower male life span. That means that they live life 'energetically' - more intensively, but not for as long.

G

It follows from the above that sparing use of energy reserves should tend to extend life. Extreme high performance sports may lead to optimal cardiovascular performance, but they quite certainly do not prolong life. Relaxation lowers metabolic rate, as does adequate sleep and in general an equable and balanced personality. Each of us can develop his or her own 'energy saving programme' with a little self-observation, critical self-control and, above all, logical consistency. Experience will show that to live in this way not only increases the life span but is also very healthy. This final aspect should not be forgotten.

Questions 37-40

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

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

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

- 24** The wear and tear theory applies to both artificial objects and biological systems.
- 25** In principle, it is possible for a biological system to become older without ageing.
- 26** Within seven years, about 90 per cent of a human body is replaced as new.
- 27** Conserving energy may help to extend a human's life.

LAND OF THE RISING SUN

A

Japan has a significantly better record in terms of average mathematical attainment than England and Wales. Large sample international comparisons of pupils' attainments since the 1960s have established that not only did Japanese pupils at age 13 have better scores of average attainment, but there was also a larger proportion of 'low' attainers in England, where, incidentally, the variation in attainment scores was much greater. The percentage of Gross National Product spent on education is reasonably similar in the two countries, so how is this higher and more consistent attainment in maths achieved?

B

Lower secondary schools in Japan cover three school years, from the seventh grade (age 13) to the ninth grade (age 15). Virtually all pupils at this stage attend state schools: only 3 per cent are in the private sector. Schools are usually modern in design, set well back from the road and spacious inside. Classrooms are large and pupils sit at single desks in rows. Lessons last for a standardised 50 minutes and are always followed by a 10-minute break, which gives the pupils a chance to let off steam. Teachers begin with a formal address and mutual bowing, and then concentrate on whole-class teaching. Classes are large - usually about 40 - and are unstreamed. Pupils stay in the same class for all lessons throughout the school and develop considerable class identity and loyalty. Pupils attend the school in their own neighbourhood, which in theory removes ranking by school. In practice in Tokyo, because of the relative concentration of schools, there is some competition to get into the 'better' school in a particular area.

C

Traditional ways of teaching form the basis of the lesson and the remarkably quiet classes take their own notes of the points made and the examples demonstrated. Everyone has their own copy of the textbook supplied by the central education authority, Monbusho, as part of the concept of free compulsory education up to the age of 15. These textbooks are, on the whole, small, presumably inexpensive to produce, but well set out and logically developed. (One teacher was particularly keen to introduce colour and pictures into maths textbooks: he felt this would make them more accessible to pupils brought up in a cartoon culture.) Besides approving textbooks, Monbusho also decides the highly centralised national curriculum and how it is to be delivered.

D

Lessons all follow the same pattern. At the beginning, the pupils put solutions to the homework on the board, then the teachers comment, correct or elaborate as necessary. Pupils mark their own homework: this is an important principle in Japanese schooling as it enables pupils to see where and why they made a mistake, so that these can be avoided in future. No one minds mistakes or ignorance as long as you are prepared to learn from them.

After the homework has been discussed, the teacher explains the topic of the lesson, slowly and with a lot of repetition and elaboration. Examples are demonstrated on the board; questions from the textbook are worked through first with the class, and then the class is set questions from the textbook to do individually. Only rarely are supplementary worksheets distributed in a maths class. The impression is that the logical nature of the textbooks and their comprehensive coverage of different types of examples, combined with the relative homogeneity of the class, renders work sheets unnecessary. At this point, the teacher would circulate and make sure that all the pupils were coping well.

E

It is remarkable that large, mixed-ability classes could be kept together for maths throughout all their compulsory schooling from 6 to 15. Teachers say that they give individual help at the end of a lesson or after school, setting extra work if necessary. In observed lessons, any strugglers would be assisted by the teacher or quietly seek help from their neighbour. Carefully fostered class identity makes pupils keen to help each other - anyway, it is in their interests since the class progresses together.

This scarcely seems adequate help to enable slow learners to keep up. However, the Japanese attitude towards education runs along the lines of 'if you work hard enough, you can do almost anything'. Parents are kept closely informed of their children's progress and will play a part in helping their

children to keep up with class, sending them to 'Juku' (private evening tuition) if extra help is needed and encouraging them to work harder. It seems to work, at least for 95 per cent of the school population.

F

So what are the major contributing factors in the success of maths teaching? Clearly, attitudes are important. Education is valued greatly in Japanese culture; maths is recognised as an important compulsory subject throughout schooling; and the emphasis is on hard work coupled with a focus on accuracy.

Other relevant points relate to the supportive attitude of a class towards slower pupils, the lack of competition within a class, and the positive emphasis on learning for oneself and improving one's own standard. And the view of repetitively boring lessons and learning the facts by heart, which is sometimes quoted in relation to Japanese classes, may be unfair and unjustified. No poor maths lessons were observed. They were mainly good and one or two were inspirational.

Questions 6-9

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*

28 There is a wider range of achievement amongst English pupils studying maths than amongst their Japanese counterparts.

29 The percentage of Gross National Product spent on education generally reflects the level of attainment in mathematics.

30 Private schools in Japan are more modern and spacious than state-run lower secondary schools.

31 Teachers mark homework in Japanese schools.

READING PASSAGE 6

.Biological control of pests

The continuous and reckless use of synthetic chemicals for the control of pests which pose a threat to agricultural crops and human health is proving to be counter-productive. Apart from engendering widespread ecological disorders, pesticides have contributed to the emergence of a new breed of chemical-resistant, highly lethal superbugs.

According to a recent study by the Food and Agriculture Organisation (FAO), more than 300 species of agricultural pests have developed resistance to a wide range of potent chemicals. Not to be left behind are the disease-spreading pests, about 100 species of which have become immune to a variety of insecticides now in use.

One glaring disadvantage of pesticides' application is that, while destroying harmful pests, they also wipe out many useful non-targeted organisms, which keep the growth of the pest population in check. This results in what agroecologists call the 'treadmill syndrome'. Because of their tremendous breeding potential and genetic diversity, many pests are known to withstand synthetic chemicals and bear offspring with a built-in resistance to pesticides.

The havoc that the 'treadmill syndrome' can bring about is well illustrated by what happened to cotton farmers in Central America. In the early 1940s, basking in the glory of chemical-based intensive agriculture, the farmers avidly took to pesticides as a sure measure to boost crop yield. The insecticide was applied eight times a year in the mid-1940s, rising to 28 in a season in the mid-1950s, following the sudden proliferation of three new varieties of chemical-resistant pests.

By the mid-1960s, the situation took an alarming turn with the outbreak of four more new pests, necessitating pesticide spraying to such an extent that 50% of the financial outlay on cotton production was accounted for by pesticides. In the early 1970s, the spraying frequently reached 70 times a season as the farmers were pushed to the wall by the invasion of genetically stronger insect species.

Most of the pesticides in the market today remain inadequately tested for properties that cause cancer and mutations as well as for other adverse effects on health, says a study by United States environmental agencies. The United States National Resource Defense Council has found that DDT was the most popular of a long list of dangerous chemicals in use.

In the face of the escalating perils from indiscriminate applications of pesticides, a more effective and ecologically sound strategy of biological control, involving the selective use of natural enemies of the pest population, is fast gaining popularity - though, as yet, it is a new field with limited potential. The advantage of biological control in contrast to other methods is that it provides a relatively low-cost, perpetual control system with a minimum of detrimental side-effects. When handled by experts, bio-control is safe, non-polluting and self-dispersing.

The Commonwealth Institute of Biological Control (CIBC) in Bangalore, with its global network of research laboratories and field stations, is one of the most active, non-commercial research agencies engaged in pest control by setting natural predators against parasites. CIBC also serves as a clearing-house for the export and import of biological agents for pest control world-wide.

CIBC successfully used a seed-feeding weevil, native to Mexico, to control the obnoxious parthenium weed, known to exert devious influence on agriculture and human health in both India and Australia. Similarly the Hyderabad-based Regional Research Laboratory (RRL), supported by CIBC, is now trying out an Argentinian weevil for the eradication of water hyacinth, another dangerous weed, which has become a nuisance in many parts of the world. According to Mrs Kaiser Jamil of RRL, 'The Argentinian weevil does not attack any other

plant and a pair of adult bugs could destroy the weed in 4-5 days.' CIBC is also perfecting the technique for breeding parasites that prey on 'disapene scale' insects - notorious defoliant of fruit trees in the US and India.

How effectively biological control can be pressed into service is proved by the following examples. In the late 1960s, when Sri Lanka's flourishing coconut groves were plagued by leaf-mining hispid, a larval parasite imported from Singapore brought the pest under control. A natural predator indigenous to India, *Neodumetia sangawani*, was found useful in controlling the Rhodes grass-scale insect that was devouring forage grass in many parts of the US. By using *Neochetina bruci*, a beetle native to Brazil, scientists at Kerala Agricultural University freed a 12-kilometre-long canal from the clutches of the weed *Salvinia molesta*, popularly called 'African Payal' in Kerala. About 30,000 hectares of rice fields in Kerala are infested by this weed.

Questions 32-35

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*

- 32** Disease-spreading pests respond more quickly to pesticides than agricultural pests do.
- 33** A number of pests are now born with an innate immunity to some pesticides.
- 34** Biological control entails using synthetic chemicals to try and change the genetic make-up of the pests' offspring.
- 35** Bio-control is free from danger under certain circumstances.

READING PASSAGE 7

The psychology of innovation

Why are so few companies truly innovative?

Innovation is key to business survival, and companies put substantial resources into inspiring employees to develop new ideas. There are, nevertheless, people working in luxurious, state-of-the-art centres designed to stimulate innovation who find that their environment doesn't make them feel at all creative. And there are those who don't have a budget, or much space, but who innovate successfully.

For Robert B. Cialdini, Professor of Psychology at Arizona State University, one reason that companies don't succeed as often as they should is that innovation starts with recruitment. Research shows that the fit between an employee's values and a company's values makes a difference to what contribution they make and whether, two years after they join, they're still at the company. Studies at Harvard Business School show that, although some individuals may be more creative than others, almost every individual can be creative in the right circumstances.

One of the most famous photographs in the story of rock'n'roll emphasises Cialdini's views. The 1956 picture of singers Elvis Presley, Carl Perkins, Johnny Cash and Jerry Lee Lewis jamming at a piano in Sun Studios in Memphis tells a hidden story. Sun's 'million-dollar quartet' could have been a quintet. Missing from the picture is Roy Orbison, a greater natural singer than Lewis, Perkins or Cash. Sam Phillips, who owned Sun, wanted to revolutionise popular music with songs that fused black and white music, and country and blues. Presley, Cash, Perkins and Lewis instinctively understood Phillips's ambition and believed in it. Orbison wasn't inspired by the goal, and only ever achieved one hit with the Sun label.

The value fit matters, says Cialdini, because innovation is, in part, a process of change, and under that pressure we, as a species, behave differently, 'When things change, we are hard-wired to play it safe.' Managers should therefore adopt an approach that appears counterintuitive -they should explain what stands to be lost if the company fails to seize a particular opportunity. Studies show that we invariably take more gambles when threatened with a loss than when offered a reward.

Managing innovation is a delicate art. It's easy for a company to be pulled in conflicting directions as the marketing, product development, and finance departments each get different feedback from different sets of people. And without a system which ensures collaborative exchanges within the company, it's also easy for small 'pockets of innovation' to disappear. Innovation is a contact sport. You can't brief people just by saying, 'We're going in this direction and I'm going to take you with me.'

Cialdini believes that this 'follow-the-leader syndrome, is dangerous, not least because it encourages bosses to go it alone. 'It's been scientifically proven that three people will be better than one at solving problems, even if that one person is the smartest person in the field.' To prove his point, Cialdini cites an interview with molecular biologist James Watson. Watson, together with Francis Crick, discovered the structure of DNA, the genetic information carrier of all living organisms. 'When asked how they had cracked the code ahead of an array of highly accomplished rival investigators, he said something that stunned me. He said "he and Crick had succeeded because they were aware that they weren't the most intelligent of the scientists pursuing the answer. The smartest scientist was called Rosalind Franklin who, Watson said, "was so intelligent she rarely sought advice".'

Teamwork taps into one of the basic drivers of human behaviour. 'The principle of social proof is so pervasive that we don't even recognise it,' says Cialdini. 'If your project is being resisted, for example, by a group of veteran employees, ask another old-timer to speak up for it.' Cialdini is not alone in advocating this strategy. Research shows that peer power, used horizontally not vertically, is much more powerful than any boss's speech.

Writing, visualising and prototyping can stimulate the flow of new ideas. Cialdini cites scores of research papers and historical events that prove that even something as simple as writing deepens every individual's engagement in the project. It is, he says, the reason why all those competitions on breakfast cereal packets encouraged us to write in saying, in no more than 10 words: 'I like Kellogg's Corn Flakes because...' The very act of writing makes us more likely to believe it.

Authority doesn't have to inhibit innovation but it often does. The wrong kind of leadership will lead to what Cialdini calls "captainitis, the regrettable tendency of team members to opt out of team responsibilities that are properly their'. He calls it captainitis because, he says, "crew members of multipilot aircraft exhibit a sometimes deadly passivity when the flight captain makes a clearly wrong-headed decision". This behaviour is not, he says, unique to air travel, but can happen in any workplace where the leader is overbearing.

At the other end of the scale is the 1980s Memphis design collective, a group of young designers for whom "the only rule was that there were no rule". This environment encouraged a free interchange of ideas, which led to more creativity with form, function, colour and materials that revolutionised attitudes to furniture design.

Many theorists believe the ideal boss should lead from behind, taking pride in collective accomplishment and giving credit where it is due. Cialdini says: "Leaders should encourage everyone to contribute and simultaneously assure all concerned that every recommendation is important to making the right decision and will be given full attention" The frustrating thing about innovation is that there are many approaches, but no magic formula. However, a manager who wants to create a truly innovative culture can make their job a lot easier by recognising these psychological realities.

Questions 36-40

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.

36 The physical surroundings in which a person works play a key role in determining their creativity.

37 Most people have the potential to be creative.

38 Teams work best when their members are of equally matched intelligence.

39 It is easier for smaller companies to be innovative.

40 A manager's approval of an idea is more persuasive than that of a colleague.

READING PASSAGE 8

Museums of fine art and their public

The fact that people go to the Louvre museum in Paris to see the original painting Mona Lisa when they can see a reproduction anywhere leads us to question some assumptions about the role of museums of fine art in today's world

One of the most famous works of art in the world is Leonardo da Vinci's Mona Lisa. Nearly everyone who goes to see the original will already be familiar with it from reproductions, but they accept that fine art is more rewardingly viewed in its original form.

However, if Mona Lisa was a famous novel, few people would bother to go to a museum to read the writer's actual manuscript rather than a printed reproduction. This might be explained by the fact that the novel has evolved precisely because of technological developments that made it possible to print out huge numbers of texts, whereas oil paintings have always been produced as unique objects. In addition, it could be argued that the practice of interpreting or 'reading' each medium follows different conventions. With novels, the reader attends mainly to the meaning of words rather than the way they are printed on the page, whereas the 'reader' of a painting must attend just as closely to the material form of marks and shapes in the picture as to any ideas they may signify.

Yet it has always been possible to make very accurate facsimiles of pretty well any fine art work. The seven surviving versions of Mona Lisa bear witness to the fact that in the 16th century, artists seemed perfectly content to assign the reproduction of their creations to their workshop apprentices as regular 'bread and butter' work. And today the task of reproducing pictures is incomparably more simple and reliable, with reprographic techniques that allow the production of high-quality prints made exactly to the original scale, with faithful colour values, and even with duplication of the surface relief of the painting.

But despite an implicit recognition that the spread of good reproductions can be culturally valuable, museums continue to promote the special status of original work.

Unfortunately, this seems to place severe limitations on the kind of experience offered to visitors.

One limitation is related to the way the museum presents its exhibits. As repositories of unique historical objects, art museums are often called 'treasure houses'. We are reminded of this even before we view a collection by the presence of security guards, attendants, ropes and display cases to keep us away from the exhibits. In many cases, the architectural style of the building further reinforces that notion. In addition, a major collection like that of London's National Gallery is housed in numerous rooms, each with dozens of works, any one of which is likely to be worth more than all the average visitor possesses. In a society that judges the personal status of the individual so much by their material worth, it is therefore difficult not to be impressed by one's own relative 'worthlessness' in such an environment.

Furthermore, consideration of the 'value' of the original work in its treasure house setting impresses upon the viewer that, since these works were originally produced, they have been assigned a huge monetary value by some person or institution more powerful than themselves. Evidently, nothing the viewer thinks about the work is going to alter that value, and so today's viewer is deterred from trying to extend that spontaneous, immediate, self-reliant kind of reading which would originally have met the work.

The visitor may then be struck by the strangeness of seeing such diverse paintings, drawings and sculptures brought together in an environment for which they were not originally created. This 'displacement effect' is further heightened by the sheer volume of exhibits. In the case of a major collection, there are probably more works on display than we could realistically view in weeks or even months.

This is particularly distressing because time seems to be a vital factor in the appreciation of all art forms. A fundamental difference between paintings and other art forms is that there is no prescribed time over which a painting is viewed. By contrast, the audience encourage an opera or a play over a specific time, which is the duration of the performance. Similarly novels and poems are read in a prescribed temporal sequence, whereas a picture has no clear place at which to start viewing, or at which to finish. Thus art works themselves encourage us to view them superficially, without appreciating the richness of detail and labour that is involved.

Consequently, the dominant critical approach becomes that of the art historian, a specialised academic approach devoted to 'discovering the meaning' of art within the cultural context of its time. This is in perfect harmony with the museum's function, since the approach is dedicated to seeking out and conserving 'authentic', original, readings of the exhibits. Again, this seems to put paid to that spontaneous, participatory criticism which can be found in abundance in criticism of classic works of literature, but is absent from most art history.

The displays of art museums serve as a warning of what critical practices can emerge when spontaneous criticism is suppressed. The museum public, like any other audience, experience art more rewardingly when given the confidence to express their views. If appropriate works of fine art could be rendered permanently accessible to the public by means of high-fidelity reproductions, as literature and music already are, the public may feel somewhat less in awe of them. Unfortunately, that may be too much to ask from those who seek to maintain and control the art establishment.

Questions 41-45

YES if the statement agrees with the views of the writer

NO if the statement contradicts the views of the writer

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

- 41 Art history should focus on discovering the meaning of art using a range of media.
- 42 The approach of art historians conflicts with that of art museums.
- 43 People should be encouraged to give their opinions openly on works of art.
- 44 Reproductions of fine art should only be sold to the public if they are of high quality.
- 45 In the future, those with power are likely to encourage more people to enjoy art.

READING PASSAGE 9

Beyond the blue horizon

Ancient voyagers who settled the far-flung islands of the Pacific Ocean

(1)

An important archaeological discovery on the island of Efate in the Pacific archipelago of Vanuatu has revealed traces of an ancient seafaring people, the distant ancestors of today's Polynesians. The site came to light only by chance. An agricultural worker, digging in the grounds of a derelict plantation, scraped open a grave – the first of dozens in a burial ground some 3,000 years old. It is the oldest cemetery ever found in the Pacific islands, and it harbors the remains of an ancient people archaeologists call the Lapita.

(2)

They were daring blue-water adventurers who used basic canoes to rove across the ocean. But they were not just explorers. They were also pioneers who carried with them everything they would need to build new lives – their livestock, taro seedlings and stone tools. Within the span of several centuries, the Lapita stretched the boundaries of their world from the jungle-clad volcanoes of Papua New Guinea to the loneliest coral outliers of Tonga.

(3)

The Lapita left precious few clues about themselves, but Efate expands the volume of data available to researchers dramatically. The remains of 62 individuals have been uncovered so far, and archaeologists were also thrilled to find six complete Lapita pots. Other items included a Lapita burial urn with modeled birds arranged on the rim as though peering down at the human remains sealed inside. 'It's an important discovery,' says Matthew Spriggs, professor of archaeology at the Australian National University and head of the international team digging up the site, 'for it conclusively identifies the remains as Lapita.'

(4)

DNA teased from these human remains may help answer one of the most puzzling questions in Pacific anthropology: did all Pacific islanders spring from one source or many? Was there only one outward migration from a single point in Asia, or several from different points? 'This represents the best opportunity we've had yet,' says Spriggs, 'to find out who the Lapita actually were, where they came from, and who their closest descendants are today.'

(5)

There is one stubborn question for which archaeology has yet to provide any answers: how did the Lapita accomplish the ancient equivalent of a moon landing, many times over? No-one has found one of their canoes or any rigging, which could reveal how the canoes were sailed. Nor do the oral histories and traditions of later Polynesians offer any insights, for they turn into myths long before they reach as far back in time as the Lapita.

(6)

'All we can say for certain is that the Lapita had canoes that were capable of ocean voyages, and they had the ability to sail them,' says Geoff Irwin, a professor of archaeology at the University of Auckland. Those sailing skills, he says, were developed and passed down over thousands of years by earlier mariners who worked their way through the archipelagoes of the western Pacific, making short crossings to nearby islands. The real adventure didn't begin, however, until their Lapita descendants sailed out of sight of land, with empty horizons on every side. This must have been as difficult for them as landing on the moon is for us today. Certainly it distinguished them from their ancestors, but what gave them the courage to launch out on such risky voyages?

(7)

The Lapita was thrust into the Pacific as eastward, against the prevailing trade winds, Irwin notes. Those nagging headwinds, he argues, may have been the key to their success. 'They could sail out for days into the unknown and assess the area, secure in the knowledge that if they didn't find anything, they could turn about and catch a swift ride back on the trade winds. This is what would have made the whole thing work.' Once out there, skilled seafarers would have detected abundant leads to follow to land: seabirds, coconuts and twigs carried out to sea by the tides, and the afternoon pile-up of clouds on the horizon which often indicates an island in the distance.

(8)

For returning explorers, successful or not, the geography of their own archipelagoes would have provided a safety net. Without this to go by, overshooting their home ports, getting lost and sailing off into eternity would have been all too easy. Vanuatu, for example, stretches more than 500 miles in a northwest-southeast trend, its scores of innumerable islands forming a backstop for mariners riding the trade winds home.

(9)

All this presupposes one essential detail, says Atholl Anderson, professor of prehistory at the Australian National University: the Lapita had mastered the advanced art of sailing against the wind. 'And there's no proof they could do any such thing,' Anderson says. 'There has been this assumption they did, and people have built canoes to re-create those early voyages based on that assumption. But nobody has any idea what their canoes looked like or how they were rigged.'

(10)

Rather than give all the credit to human skill, Anderson invokes the winds of chance. El Nino, the same climate disruption that affects the Pacific today, may have helped scatter the Lapita, Anderson suggests. He points out that climate data obtained from slow-growing corals around the Pacific indicate a series of unusually frequent El Ninos around the time of the Lapita expansion. By reversing the regular east-to-west flow of the trade winds for weeks at a time, these super El Ninos might have taken the Lapita on long unplanned voyages.

(11)

However they did it, the Lapita spread themselves a third of the way across the Pacific, then called it quits for reasons known only to them. Ahead lay the vast emptiness of the central Pacific and perhaps they were too thinly stretched to venture farther. They probably never numbered more than a few thousand in total, and in their rapid migration eastward they encountered hundreds of islands – more than 300 in Fiji alone.

Questions 36-40

TRUE if the statement agrees with the information

FALSE if the statement contradicts the information

NOT GIVEN if there is no information on this

- 46 It is now clear that the Lapita could sail into a prevailing wind.
- 47 Extreme climate conditions may have played a role in Lapita migration.
- 48 The Lapita learnt to predict the duration of El Ninos.
- 48 It remains unclear why the Lapita halted their expansion across the Pacific.
- 49 It is likely that the majority of Lapita settled on Fiji.

When evolution runs backwards

Evolution isn't supposed to run backwards - yet an increasing number of examples show that it does and that it can sometimes represent the future of a species.

The description of any animal as an 'evolutionary throwback' is controversial. For the better part of a century, most biologists have been reluctant to use those words, mindful of a principle of evolution that says 'evolution cannot run backwards. But as more and more examples come to light and modern genetics enters the scene, that principle is having to be rewritten. Not only are evolutionary throwbacks possible, they sometimes play an important role in the forward march of evolution.

The technical term for an evolutionary throwback is an 'atavism', from the Latin atavus, meaning forefather. The word has ugly connotations thanks largely to Cesare Lombroso, a 19th-century Italian medic who argued that criminals were born not made and could be identified by certain physical features that were throwbacks to a primitive, sub-human state.

While Lombroso was measuring criminals, a Belgian palaeontologist called Louis Dollo was studying fossil records and coming to the opposite conclusion. In 1890 he proposed that evolution was irreversible: that 'an organism is unable to return, even partially, to a previous stage already realised in the ranks of its ancestors. Early 20th-century biologists came to a similar conclusion, though they qualified it in terms of probability, stating that there is no reason why evolution cannot run backwards -it is just very unlikely. And so the idea of irreversibility in evolution stuck and came to be known as 'Dollo's law.

If Dollo's law is right, atavisms should occur only very rarely, if at all. Yet almost since the idea took root, exceptions have been cropping up. In 1919, for example, a humpback whale with a pair of leglike appendages over a metre long, complete with a full set of limb bones, was caught off Vancouver Island in Canada. Explorer Roy Chapman Andrews argued at the time that the whale must be a throwback to a land-living ancestor. 'I can see no other explanation, he wrote in 1921.

Since then, so many other examples have been discovered that it no longer makes sense to say that evolution is as good as irreversible. And this poses a puzzle: how can characteristics that disappeared millions of years ago suddenly reappear?

In 1994, Rudolf Raff and colleagues at Indiana University in the USA decided to use genetics to put a number on the probability of evolution going into reverse. They reasoned that while some evolutionary changes involve the loss of genes and are therefore irreversible, others may be the result of genes being switched off. If these silent genes are somehow switched back on, they argued, longlost traits could reappear.

Raff's team went on to calculate the likelihood of it happening. Silent genes accumulate random mutations, they reasoned, eventually rendering them useless. So how long can a gene survive in a species if it is no longer used? The team calculated that there is a good chance of silent genes surviving for up to 6 million years in at least a few individuals in a population, and that some might survive as long as 10 million years. In other words, throwbacks are possible, but only to the relatively recent evolutionary past.

As a possible example, the team pointed to the mole salamanders of Mexico and California. Like most amphibians these begin life in a juvenile 'tadpole' state, then metamorphose into the adult form – except for one species, the axolotl, which famously lives its entire life as a juvenile. The simplest explanation for this is that the axolotl lineage alone lost the ability to metamorphose, while others retained it. From a detailed analysis of the salamanders' family tree, however, it is clear that the other lineages evolved from an ancestor that itself had lost the ability to metamorphose. In other words, metamorphosis in mole salamanders is an atavism. The salamander example fits with Raff's 10million-year time frame.

More recently, however, examples have been reported that break the time limit, suggesting that silent genes may not be the whole story. In a paper published last year, biologist Gunter Wagner of Yale University reported some work on the evolutionary history of a group of South American lizards called *Bachia*. Many of these have minuscule limbs; some look more like snakes than lizards and a few have completely lost the toes on their hind limbs. Other species, however, sport up to four toes on their hind legs. The simplest explanation is that the toed lineages never lost their toes, but Wagner begs to differ. According to his analysis of the *Bachia* family tree, the toed species re-evolved toes from toeless ancestors and, what is more, digit loss and gain has occurred on more than one occasion over tens of millions of years.

So what's going on? One possibility is that these traits are lost and then simply reappear, in much the same way that similar structures can independently arise in unrelated species, such as the dorsal fins of sharks and killer whales. Another more intriguing possibility is that the genetic information needed to make toes somehow survived for tens or perhaps hundreds of millions of years in the lizards and was reactivated. These atavistic traits provided an advantage and spread through the population, effectively reversing evolution.

But if silent genes degrade within 6 to million years, how can long-lost traits be reactivated over longer timescales? The answer may lie in the womb. Early embryos of many species develop ancestral features. Snake embryos, for example, sprout hind limb buds. Later in development these features disappear thanks to developmental programs that say 'lose the leg'. If for any reason this does not happen, the ancestral feature may not disappear, leading to an atavism.

Questions 50-54

YES	<i>if the statement agrees with the claims of the writer</i>
NO	<i>if the statement contradicts the claims of the writer</i>
NOT GIVEN	<i>if it is impossible to say what the writer thinks about this</i>

- 51 Wagner was the first person to do research on South American lizards.
- 52 Wagner believes that *Bachia* lizards with toes had toeless ancestors.
- 53 The temporary occurrence of longlost traits in embryos is rare.
- 54 Evolutionary throwbacks might be caused by developmental problems in the womb.

F ILL IN THE GAP

Summary completion

Tip: don't always expect words or phrases in the box to be the same as in the text . they may be words with similar meaning or the same word in a different form , so read both the text and the summary carefully.

Example

Here is a part of a text about innovation in business.

Success, for many companies, **depends on** their ability to innovate, to create new products and services. Ask anyone which business sectors are the most **creative**. And the music industry will come fairly high up the list, but creativity is also the lifeblood of other, less obvious fields: the pharmaceutical industry, for instance, relies almost entirely on ideas and inventions that can be developed into new drugs. Just like land buildings machinery, ideas can be a valuable assets to a business , but while the former are **tangible** assets , with a physical existence , idea has been developed , whether into a new medical treatment or a new brand of clothing, it become intellectual **property** , and can be legally owned. It is then **protected** against competitor benefiting by imitating the new product without having had **to fund** its development.

 **Complete the summary using the box below.**

Innovation is 1.....f.....for business in many sectors, from the most obviously 2.....d....., such as the music industry ,to ones that are less self-evidently so, like the pharmaceutical industry like 3.....h.....assets, new ideas may be very valuable, and so, like those they need to be treated as 4.....b.....to the business they therefore require legal 5.....g.....to to prevent competitors from benefiting from the company's 6.....i.....

- A. Intellectual
- B. Belonging
- C. Developing

- D. creative
- E. intangible
- F. essential

- G. protection
- H. tangible
- I. investment

Explanation: the highlighted words in the text show you where you can find the words which match the options. 1 “is essential for” means the same as “depends on” 4 ‘belonging to the businesses means the same as property. 6 investments refer to “to fund”.

READING PASSAGE 1

The history of the tortoise

If you go back far enough, everything lived in the sea. At various points in evolutionary history, enterprising individuals within many different animal groups moved out onto the land, sometimes even to the most parched deserts, taking their own private seawater with them in blood and cellular fluids. In addition to the reptiles, birds, mammals and insects which we see all around us, other groups that have succeeded out of water include scorpions, snails, crustaceans such as woodlice and land crabs, millipedes and centipedes, spiders and various worms. And we mustn't forget the plants, without whose prior invasion of the land none of the other migrations could have happened.

Moving from water to land involved a major redesign of every aspect of life, including breathing and reproduction. Nevertheless, a good number of thoroughgoing land animals later turned around, abandoned their hard-earned terrestrial re-tooling, and returned to the water again. Seals have only gone part way back. They show us what the intermediates might have been like, on the way to extreme cases such as whales and dugongs. Whales (including the small whales we call dolphins) and dugongs, with their close cousins the manatees, ceased to be land creatures altogether and reverted to the full marine habits of their remote ancestors. They don't even come ashore to breed. They do, however, still breathe air, having never developed anything equivalent to the gills of their earlier marine incarnation. Turtles went back to the sea a very long time ago and, like all vertebrate returnees to the water, they breathe air. However, they are, in one respect, less fully given back to the water than whales or dugongs, for turtles still lay their eggs on beaches.

There is evidence that all modern turtles are descended from a terrestrial ancestor which lived before most of the dinosaurs. There are two key fossils called *Proganochelys quenstedti* and *Palaeochersis talampayensis* dating from early dinosaur times, which appear to be close to the ancestry of all modern turtles and tortoises. You might wonder how we can tell whether fossil animals lived on land or in water, especially if only fragments are found. Sometimes it's obvious. Ichthyosaurs were reptilian contemporaries of the dinosaurs, with fins and streamlined bodies. The fossils look like dolphins and they surely lived like dolphins, in the water. With turtles it is a little less obvious. One way to tell is by measuring the bones of their forelimbs.

Walter Joyce and Jacques Gauthier, at Yale University, obtained three measurements in these particular bones

of 71 species of living turtles and tortoises. They used a kind of triangular graph paper to plot the three measurements against one another. All the land tortoise species formed a tight cluster of points in the upper part of the triangle; all the water turtles cluster in the lower part of the triangular graph. There was no overlap, except when they added some species that spend time both in water and on land. Sure enough, these amphibious species show up on the triangular graph approximately half way between the 'wet cluster' of sea turtles and the 'dry cluster' of land tortoises. The next step was to determine where the fossils fell. The bones of *P. quenstedti* and *JR talampayensis* leave us in no doubt. Their points on the graph are right in the thick of the dry cluster. Both these fossils were dry-land tortoises. They come from the era before our turtles returned to the water.

You might think, therefore, that modern land tortoises have probably stayed on land ever since those early terrestrial times, as most mammals did after a few of them went back to the sea. But apparently not. If you draw out the family tree of all modern turtles and tortoises, nearly all the branches are aquatic. Today's land tortoises constitute a single branch, deeply nested among branches consisting of aquatic turtles. This suggests that modern land tortoises have not stayed on land continuously since the time of *P. quenstedti* and *P. talampayensis*. Rather, their ancestors were among those who went back to the water, and they then re-emerged back onto the land in (relatively) more recent times.

Tortoises therefore represent a remarkable double return. In common with all mammals, reptiles and birds, their remote ancestors were marine fish and before that various more or less worm-like creatures stretching back, still in the sea, to the primeval bacteria. Later ancestors lived on land and stayed there for a very large number of generations. Later ancestors still evolved back into the water and became sea turtles. And finally they returned yet again to the land as tortoises, some of which now live in the driest of deserts.

Questions 1-6

Complete the flow-chart below.

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

Method of determining where the ancestors of turtles and tortoises come from

Step 1

71 species of living turtles and tortoises were examined and a total of **1**.....were taken from the bones of their forelimbs.



Step 2

The data was recorded on a **2**.....necessary for comparing the information).

Outcome: Land tortoises were represented by a dense **3**.....of points towards the top.

Sea turtles were grouped together in the bottom part.



Step 3

The same data was collected from some living **4**..... species and added to the other results.

Outcome: The points for these species turned out to be positioned about **5**.....up the triangle between the land tortoises and the sea turtles.



Step 4

Bones of *P. quenstedti* and *P. talampayensis* were examined in a similar way and the results added.

Outcome: The position of the points indicated that both these ancient creatures were **6**.....

READING PASSAGE 2

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 7-10

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

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

The language debate

According to **7**..... there is only one correct form of language. Linguists who take this approach to language place great importance on grammatical **8**..... Conversely, the view of **9**..... such as Joseph Priestley, is that grammar should be based on **10**.....

A	descriptivists	B	language experts	C	popular speech
D	formal language	E	evaluation	F	rules
G	modern linguists	H	prescriptivists	I	change

READING PASSAGE 3

Tidal Power

Undersea turbines which produce electricity from the tides are set to become an important source of renewable energy for Britain. It is still too early to predict the extent of the impact they may have, but all the signs are that they will play a significant role in the future

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.

B

Tidal sites have already been identified that will produce one sixth or more of the UK's power - and at prices competitive with modern gas turbines and undercutting those of the already ailing nuclear industry. One site alone, the Pentland Firth, between Orkney and mainland Scotland, could produce 10% of the country's electricity with banks of turbines under the sea, and another at Alderney in the Channel Islands three times the 1,200 megawatts of Britain's largest and newest nuclear plant, Sizewell B, in Suffolk. Other sites identified include the Bristol Channel and the west coast of Scotland, particularly the channel between Campbeltown and Northern Ireland.

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.

F

One technical difficulty is cavitation, where low pressure behind a turning blade causes air bubbles. These can cause vibration and damage the blades of the turbines. Dr Bahaj said: ‘We have to test a number of blade types to avoid this happening or at least make sure it does not damage the turbines or reduce performance. Another slight concern is submerged debris floating into the blades. So far we do not know how much of a problem it might be. We will have to make the turbines robust because the sea is a hostile environment, but all the signs that we can do it are good.’

Questions 11-14

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

An Undersea Turbine

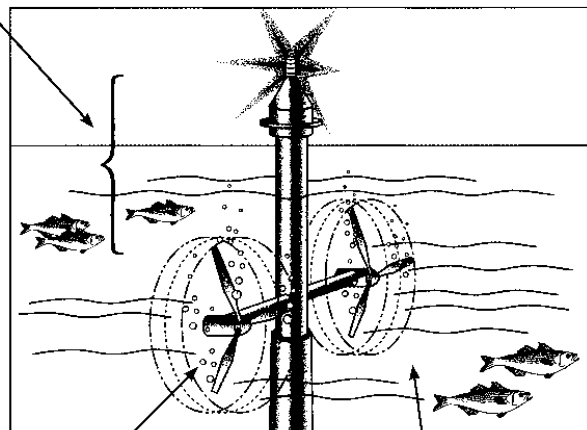
Whole tower can be raised
for 23 and the extraction
of seaweed from the blades

11.....

12.....

13.....

14.....



Air bubbles result from
the 25 behind blades.
This is known as 26

Sea life not in danger due to the
fact that blades are comparatively
24

READING PASSAGE 4

Information theory - the big idea

Information theory lies at the heart of everything - from DVD players and the genetic code of DNA to the physics of the universe at its most fundamental. It has been central to the development of the science of communication, which enables data to be sent electronically and has therefore had a major impact on our lives

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 16-20

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

The Voyager 1 Space Probe

- The probe transmitted pictures of both 16..... then left the 17.....
- The freezing temperatures were found to have a negative effect on parts of the space probe.
- Scientists feared that both the 18were about to stop working.
- The only hope was to tell the probe to replace them with 19.....- but distance made communication with the probe difficult.
- A 20.....was used to transmit the message at the speed of light.
- The message was picked up by the probe and the switchover took place.

READING PASSAGE 5

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.

Their marriage in 1895 marked the start of a partnership that was soon to achieve results of world significance. Following Henri Becquerel's discovery in 1896 of a new phenomenon, which Marie later called 'radioactivity', Marie Curie decided to find out if the radioactivity discovered in uranium was to be found in other elements. She discovered that this was true for thorium.

Turning her attention to minerals, she found her interest drawn to pitchblende, a mineral whose radioactivity, superior to that of pure uranium, could be explained only by the presence in the ore of small quantities of an unknown substance of very high activity. Pierre Curie joined her in the work that she had undertaken to resolve this problem, and that led to the discovery of the new elements, polonium and radium. While Pierre Curie devoted himself chiefly to the physical study of the new radiations, Marie Curie struggled to obtain pure radium in the metallic state. This was achieved with the help of the chemist André-Louis Debierne, one of Pierre Curie's pupils. Based on the results of this research, Marie Curie received her Doctorate of Science, and in 1903 Marie and Pierre shared with Becquerel the Nobel Prize for Physics for the discovery of radioactivity.

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.

During World War I, Marie Curie, with the help of her daughter Irène, devoted herself to the development of the use of X-radiography, including the mobile units which came to be known as 'Little Curies', used for the treatment of wounded soldiers. In 1918 the Radium Institute, whose staff

Irène had joined, began to operate in earnest, and became a centre for nuclear physics and chemistry. Marie Curie, now at the highest point of her fame and, from 1922, a member of the Academy of Medicine, researched the chemistry of radioactive substances and their medical applications.

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.

One of Marie Curie's outstanding achievements was to have understood the need to accumulate intense radioactive sources, not only to treat illness but also to maintain an abundant supply for research. The existence in Paris at the Radium Institute of a stock of 1.5 grams of radium made a decisive contribution to the success of the experiments undertaken in the years around 1930. This work prepared the way for the discovery of the neutron by Sir James Chadwick and, above all, for the discovery in 1934 by Irène and Frédéric Joliot-Curie of artificial radioactivity. A few months after this discovery, Marie Curie died as a result of leukaemia caused by exposure to radiation. She had often carried test tubes containing radioactive isotopes in her pocket, remarking on the pretty blue-green light they gave off.

Her contribution to physics had been immense, not only in her own work, the importance of which had been demonstrated by her two Nobel Prizes, but because of her influence on subsequent generations of nuclear physicists and chemists.

Questions 21-24

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

Marie Curie's research on radioactivity

- When uranium was discovered to be radioactive, Marie Curie found that the element called **21**..... had the same property.
- Marie and Pierre Curie's research into the radioactivity of the mineral known as **22**..... led to the discovery of two new elements.
- In 1911, Marie Curie received recognition for her work on the element **23**.....
- Marie and Irene Curie developed X-radiography which was used as a medical technique for **24**.....
- Marie Curie saw the importance of collecting radioactive material both for research and for cases of **25**.....
- The radioactive material stocked in Paris contributed to the discoveries in the 1930s of the **26**..... and of what was known as artificial radioactivity.
- During her research, Marie Curie was exposed to radiation and as a result she suffered from **27**.....

READING PASSAGE 6

Young children's sense of identity

A

A sense of self develops in young children by degrees. The process can usefully be thought of in terms of the gradual emergence of two somewhat separate features: the self as a subject, and the self as an object. William James introduced the distinction in 1892, and contemporaries of his, such as Charles Cooley, added to the developing debate. Ever since then psychologists have continued building on the theory.

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.

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 28-30

Complete the summary below.

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

How children acquire a sense of identity

First, children come to realise that they can have an effect on the world around them, for example by handling objects, or causing the image to move when they face a **28** This aspect of self-awareness is difficult to research directly, because of **29**..... problems.

Secondly, children start to become aware of how they are viewed by others. One important stage in this process is the visual recognition of themselves which usually occurs when they reach the age of two. In Western societies at least, the development of self awareness is often linked to a sense of **30**....., and can lead to disputes.

READING PASSAGE 7

A Chronicle of Timekeeping

Our conception of time depends on the way we measure it

A

According to archaeological evidence, at least 5,000 years ago, and long before the advent of the Roman Empire, the Babylonians began to measure time, introducing calendars to co-ordinate communal activities, to plan the shipment of goods and, in particular, to regulate planting and harvesting. They based their calendars on three natural cycles: the solar day, marked by the successive periods of light and darkness as the earth rotates on its axis; the lunar month, following the phases of the moon as it orbits the earth; and the solar year, defined by the changing seasons that accompany our planet's revolution around the sun.

B

Before the invention of artificial light, the moon had greater social impact. And, for those living near the equator in particular, its waxing and waning was more conspicuous than the passing of the seasons. Hence, the calendars that were developed at the lower latitudes were influenced more by the lunar cycle than by the solar year. In more northern climes, however, where seasonal agriculture was practised, the solar year became more crucial. As the Roman Empire expanded northward, it organised its activity chart for the most part around the solar year.

C

Centuries before the Roman Empire, the Egyptians had formulated a municipal calendar having 12 months of 30 days, with five days added to approximate the solar year. Each period of ten days was marked by the appearance of special groups of stars called decans. At the rise of the star Sirius just before sunrise, which occurred around the all-important annual flooding of the Nile, 12 decans could be seen spanning the heavens. The cosmic significance the Egyptians placed in the 12 decans led them to develop a system in which each interval of darkness (and later, each interval of daylight) was divided into a dozen equal parts. These periods became known as temporal hours because their duration varied according to the changing length of days and nights with the passing of the seasons. Summer hours were long, winter ones short; only at the spring and autumn equinoxes were the hours of daylight and darkness equal. Temporal hours, which were first adopted by the Greeks and then the Romans, who disseminated them through Europe, remained in use for more than 2,500 years.

D

In order to track temporal hours during the day, inventors created sundials, which indicate time by the length or direction of the sun's shadow. The sundial's counterpart, the water clock, was designed to measure temporal hours at night. One of the first water clocks was a basin with a small hole near the bottom through which the water dripped out. The falling water level denoted the passing hour as it dipped below hour lines inscribed on the inner surface. Although these devices performed satisfactorily around the Mediterranean, they could not always be depended on in the cloudy and often freezing weather of northern Europe.

E

The advent of the mechanical clock meant that although it could be adjusted to maintain temporal hours, it was naturally suited to keeping equal ones. With these, however, arose the question of when to begin counting, and so, in the early 14th century, a number of systems evolved. The schemes that divided the day into 24 equal parts varied according to the start of the count: Italian hours began at sunset, Babylonian hours at sunrise, astronomical hours at midday and 'great clock' hours, used for some large public clocks in Germany, at midnight. Eventually these were superseded by 'small clock', or French, hours, which split the day into two 12-hour periods commencing at midnight.

F

The earliest recorded weight-driven mechanical clock was built in 1283 in Bedfordshire in England. The revolutionary aspect of this new timekeeper was neither the descending weight that provided its motive force nor the gear wheels (which had been around for at least 1,300 years) that transferred the power; It was the part called the escapement. In the early 1400s came the invention of the coiled spring or fusee which maintained constant force to the gear wheels of the timekeeper despite the changing tension of its mainspring. By the 16th century, a pendulum clock had been devised, but the pendulum swung in a large arc and thus was not very efficient.

G

To address this, a variation on the original escapement was invented in 1670, in England. It was called the anchor escapement, which was a lever-based device shaped like a ship's anchor. The motion of a pendulum rocks this device so that it catches and then releases each tooth of the escape wheel, in turn allowing it to turn a precise amount. Unlike the original form used in early pendulum clocks, the anchor escapement permitted the pendulum to travel in a very small arc. Moreover, this invention allowed the use of a long pendulum which could beat once a second and thus led to the development of a new floorstanding case design, which became known as the grandfather clock.

H

Today, highly accurate timekeeping instruments set the beat for most electronic devices. Nearly all computers contain a quartz-crystal clock to regulate their operation. Moreover, not only do time signals beamed down from Global Positioning System satellites calibrate the functions of precision navigation equipment, they do so as well for mobile phones, instant stock-trading systems and nationwide power-distribution grids. So integral have these time-based technologies become to day-to-day existence that our dependency on them is recognised only when they fail to work.

Questions 31-35

Label the diagram below.

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

How the 1670 lever-based device worke

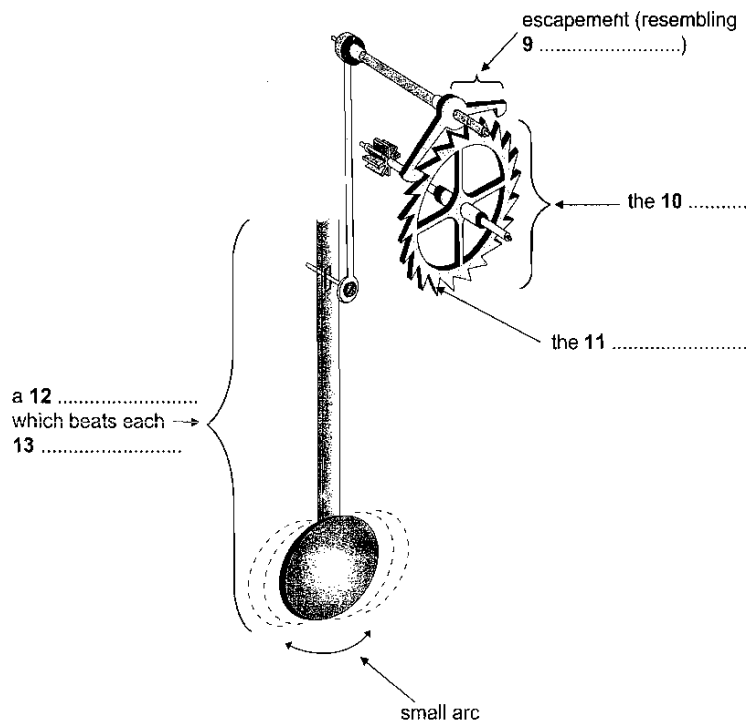
31.....

32.....

33.....

34.....

35.....



READING PASSAGE 8

Telepathy

Can human beings communicate by thought alone? For more than a century the issue of telepathy has divided the scientific community, and even today it still sparks bitter controversy among top academics

Since the 1970s, parapsychologists at leading universities and research institutes around the world have risked the derision of sceptical colleagues by putting the various claims for telepathy to the test in dozens of rigorous scientific studies. The results and their implications are dividing even the researchers who uncovered them.

Some researchers say the results constitute compelling evidence that telepathy is genuine. Other parapsychologists believe the field is on the brink of collapse, having tried to produce definitive scientific proof and failed. Sceptics and advocates alike do concur on one issue, however: that the most impressive evidence so far has come from the so-called 'ganzfeld' experiments, a German term that means 'whole field'. Reports of telepathic experiences had by people during meditation led parapsychologists to suspect that telepathy might involve 'signals' passing between people that were so faint that they were usually swamped by normal brain activity. In this case, such signals might be more easily detected by those experiencing meditation-like tranquillity in a relaxing 'whole field' of light, sound and warmth.

The ganzfeld experiment tries to recreate these conditions with participants sitting in soft reclining chairs in a sealed room, listening to relaxing sounds while their eyes are covered with special filters letting in only soft pink light. In early ganzfeld experiments, the telepathy test involved identification of a picture chosen from a random selection of four taken from a large image bank. The idea was that a person acting as a 'sender' would attempt to beam the image over to the 'receiver' relaxing in the sealed room.

Once the session was over, this person was asked to identify which of the four images had been used. Random guessing would give a hit-rate of 25 per cent; if telepathy is real, however, the hit-rate would be higher. In 1982, the results from the first ganzfeld studies were analysed by one of its pioneers, the American parapsychologist Charles Honorton. They pointed to typical hit-rates of better than 30 per cent - a small effect, but one which statistical tests suggested could not be put down to chance.

The implication was that the ganzfeld method had revealed real evidence for telepathy. But there was a crucial flaw in this argument - one routinely overlooked in more conventional areas of science. Just because chance had been ruled out as an explanation did not prove telepathy must exist; there were many other ways of getting positive results. These ranged from 'sensory leakage' - where clues about the pictures accidentally reach the receiver - to outright fraud. In response, the researchers issued a review of all the ganzfeld studies done up to 1985 to show that 80 per cent had found statistically significant evidence. However, they also agreed that there were still too many problems in the experiments which could lead to positive results, and they drew up a list demanding new standards for future research.

After this, many researchers switched to autoganzfeld tests - an automated variant of the technique which used computers to perform many of the key tasks such as the random selection of images. By minimising human involvement, the idea was to minimise the risk of flawed results. In 1987, results from hundreds of autoganzfeld tests were studied by Honorton in a 'meta-analysis', a statistical technique for finding the overall results from a set of studies. Though less compelling than before, the outcome was still impressive.

Yet some parapsychologists remain disturbed by the lack of consistency between individual ganzfeld studies. Defenders of telepathy point out that demanding impressive evidence from every study ignores one basic statistical fact: it takes large samples to detect small effects. If, as current results suggest, telepathy produces hit-rates only marginally above the 25 per cent expected by chance, it's unlikely to be detected by a typical ganzfeld study involving around 40 people: the group is just not big enough. Only when many studies are combined in a meta-analysis will the faint signal of telepathy really become apparent. And that is what researchers do seem to be finding.

What they are certainly not finding, however, is any change in attitude of mainstream scientists: most still totally reject the very idea of telepathy. The problem stems at least in part from the lack of any plausible mechanism for telepathy.

Various theories have been put forward, many focusing on esoteric ideas from theoretical physics. They include 'quantum entanglement', in which events affecting one group of atoms instantly affect another group, no matter how far apart they may be. While physicists have demonstrated entanglement with specially prepared atoms, no-one knows if it also exists between atoms making up human minds. Answering such questions would transform parapsychology. This has prompted some researchers to argue that the future lies not in collecting more evidence for telepathy, but in probing possible mechanisms. Some work has begun already, with researchers trying to identify people who are particularly successful in autoganzfeld trials. Early results show that creative and artistic people do much better than average: in one study at the University of Edinburgh, musicians achieved a hit-rate of 56 per cent. Perhaps more tests like these will eventually give the researchers the evidence they are seeking and strengthen the case for the existence of telepathy.

Questions 36-45

Complete the table below.

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

Telepathy Experiments			
Name/Date	Description	Result	Flaw
Ganzfeld studies 1982	Involved a person acting as a 36 who picked out one 37from a random selection of four, and a 38, who then tried to identify it.	Hit-rates were higher than with random guessing.	Positive results could be produced by factors such as 39 or 40
Autoganzfeld studies 1987	41 were used for key tasks to limit the amount of 42 in carrying out the tests.	The results were then subjected to a 43	The 44 between different test results was put down to the fact that sample groups were not 45 (as with most ganzfeld studies).

READING PASSAGE 9

Sheet glass manufacture: the float process

Glass, which has been made since the time of the Mesopotamians and Egyptians, is little more than a mixture of sand, soda ash and lime. When heated to about 1500 degrees Celsius (°C) this becomes a molten mass that hardens when slowly cooled. The first successful method for making clear, flat glass involved spinning. This method was very effective as the glass had not touched any surfaces between being soft and becoming hard, so it stayed perfectly unblemished, with a 'fire finish'. However, the process took a long time and was labour intensive.

Nevertheless, demand for flat glass was very high and glassmakers across the world were looking for a method of making it continuously. The first continuous ribbon process involved squeezing molten glass through two hot rollers, similar to an old mangle. This allowed glass of virtually any thickness to be made non-stop, but the rollers would leave both sides of the glass marked, and these would then need to be ground and polished. This part of the process rubbed away around 20 per cent of the glass, and the machines were very expensive.

The float process for making flat glass was invented by Alistair Pilkington. This process allows the manufacture of clear, tinted and coated glass for buildings, and clear and tinted glass for vehicles. Pilkington had been experimenting with improving the melting process, and in 1952 he had the idea of using a bed of molten metal to form the flat glass, eliminating altogether the need for rollers within the float bath. The metal had to melt at a temperature less than the hardening point of glass (about 600°C), but could not boil at a temperature below the temperature of the molten glass (about 1500°C). The best metal for the job was tin.

The rest of the concept relied on gravity, which guaranteed that the surface of the molten metal was perfectly flat and horizontal. Consequently, when pouring molten glass onto the molten tin, the underside of the glass would also be perfectly flat. If the glass were kept hot enough, it would flow over the molten tin until the top surface was also flat, horizontal and perfectly parallel to the bottom surface. Once the glass cooled to 604°C or less it was too hard to mark and could be transported out of the cooling zone by rollers. The glass settled to a thickness of six millimetres because of surface tension interactions between the glass and the tin. By fortunate coincidence, 60 per cent of the flat glass market at that time was for six-millimetre glass.

Pilkington built a pilot plant in 1953 and by 1955 he had convinced his company to build a full-scale plant. However, it took 14 months of non-stop production, costing the company £100,000 a month, before the plant produced any usable glass. Furthermore, once they succeeded in making marketable flat glass, the machine was turned off for a service to prepare it for years of continuous production. When it started up again it took another four months to get the process right again. They finally succeeded in 1959 and there are now float plants all over the world, with each able to produce around 1000 tons of glass every day, non-stop for around 15 years.

Float plants today make glass of near optical quality. Several processes - melting, refining, homogenising - take place simultaneously in the 2000 tonnes of molten glass in the furnace. They occur in separate zones in a complex glass flow driven by high temperatures. It adds up to a continuous melting process, lasting as long as 50 hours, that delivers glass smoothly and continuously to the float bath, and from there to a coating zone and finally a heat treatment zone, where stresses formed during cooling are relieved.

The principle of float glass is unchanged since the 1950s. However, the product has changed dramatically, from a single thickness of 6.8 mm to a range from sub-millimetre to 25 mm, from a ribbon frequently marred by inclusions and bubbles to almost optical perfection. To ensure the highest quality, inspection takes place at every stage. Occasionally, a bubble is not removed during refining, a sand grain refuses to melt, a tremor in the tin puts ripples into the glass ribbon. Automated on-line inspection does two things. Firstly, it reveals process faults upstream that can be corrected. Inspection technology allows more than

100 million measurements a second to be made across the ribbon, locating flaws the unaided eye would be unable to see. Secondly, it enables computers downstream to steer cutters around flaws.

Float glass is sold by the square metre, and at the final stage computers translate customer requirements into patterns of cuts designed to minimise waste.

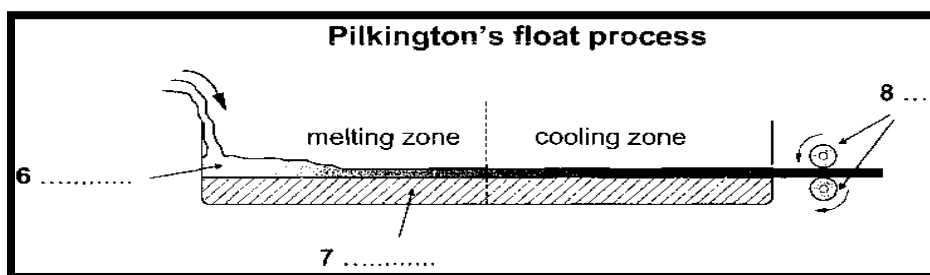
Questions 46-53

Complete the table and diagram below.

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

Early methods of producing flat glass

Method	Advantages	Disadvantages
46.....	<ul style="list-style-type: none"> • Glass remained 47.....	<ul style="list-style-type: none"> • Slow 48.....
Ribbon	<ul style="list-style-type: none"> • Could produce glass sheets of varying 49..... • Non-stop process 	<ul style="list-style-type: none"> • Glass was 50..... • 20% of glass rubbed away • Machines were expensive



51.....

53.....

52.....

THE LITTLE ICE AGE

A

This book will provide a detailed examination of the Little Ice Age and other climatic shifts, but, before I embark on that, let me provide a historical context. We tend to think of climate - as opposed to weather - as something unchanging, yet humanity has been at the mercy of climate change for its entire existence, with at least eight glacial episodes in the past 730,000 years. Our ancestors adapted to the universal but irregular global warming since the end of the last great Ice Age, around 10,000 years ago, with dazzling opportunism. They developed strategies for surviving harsh drought cycles, decades of heavy rainfall or unaccustomed cold; adopted agriculture and stock-raising, which revolutionised human life; and founded the world's first pre-industrial civilisations in Egypt, Mesopotamia and the Americas. But the price of sudden climate change, in famine, disease and suffering, was often high.

B

The Little Ice Age lasted from roughly 1300 until the middle of the nineteenth century. Only two centuries ago, Europe experienced a cycle of bitterly cold winters; mountain glaciers in the Swiss Alps were the lowest in recorded memory, and pack ice surrounded Iceland for much of the year. The climatic events of the Little Ice Age did more than help shape the modern world. They are the deeply important context for the current unprecedented global warming. The Little Ice Age was far from a deep freeze, however; rather an irregular seesaw of rapid climatic shifts, few lasting more than a quarter-century, driven by complex and still little understood interactions between the atmosphere and the ocean. The seesaw brought cycles of intensely cold winters and easterly winds, then switched abruptly to years of heavy spring and early summer rains, mild winters, and frequent Atlantic storms, or to periods of droughts, light northeasterly winds, and summer heat waves.

C

Reconstructing the climate changes of the past is extremely difficult, because systematic weather observations began only a few centuries ago, in Europe and North America. Records from India and tropical Africa are even more recent. For the time before records began, we have only 'proxy records' reconstructed largely from tree rings and ice cores, supplemented by a few incomplete written accounts. We now have hundreds of tree-ring records from throughout the northern hemisphere, and many from south of the equator, too, amplified with a growing body of temperature data from ice cores drilled in Antarctica, Greenland, the Peruvian Andes, and other locations. We are close to a knowledge of annual summer and winter temperature variations over much of the northern hemisphere going back 600 years.

D

This book is a narrative history of climatic shifts during the past ten centuries, and some of the ways in which people in Europe adapted to them. Part One describes the Medieval Warm Period, roughly 900 to 1200. During these three centuries, Norse voyagers from Northern Europe explored northern seas, settled Greenland, and visited North America. It was not a time of uniform warmth, for then, as always since the Great Ice Age, there were constant shifts in rainfall and temperature. Mean European temperatures were about the same as today, perhaps slightly cooler.

E

It is known that the Little Ice Age cooling began in Greenland and the Arctic in about 1200. As the Arctic ice pack spread southward, Norse voyages to the west were rerouted into the open Atlantic, then ended altogether. Storminess increased in the North Atlantic and North Sea. Colder, much wetter weather descended on Europe between 1315 and 1319, when thousands perished in a continent-wide famine. By 1400, the weather had become decidedly more unpredictable and stormier, with sudden shifts and lower temperatures that culminated in the cold decades of the late sixteenth century. Fish were a vital commodity in growing towns and cities, where food supplies were a constant concern. Dried cod and herring were already the staples of the European fish trade, but changes in water temperatures forced fishing fleets to work further offshore. The Basques, Dutch, and English developed the first offshore fishing boats adapted to a colder and stormier Atlantic. A gradual agricultural revolution in northern Europe stemmed from concerns over food supplies at a time of rising populations. The revolution involved intensive commercial farming and the growing of animal fodder on

land not previously used for crops. The increased productivity from farmland made some countries self-sufficient in grain and livestock and offered effective protection against famine.

F

Global temperatures began to rise slowly after 1850, with the beginning of the Modern Warm Period. There was a vast migration from Europe by land-hungry farmers and others, to which the famine caused by the Irish potato blight contributed, to North America, Australia, New Zealand, and southern Africa. Millions of hectares of forest and woodland fell before the newcomers' axes between 1850 and 1890, as intensive European farming methods expanded across the world. The unprecedented land clearance released vast quantities of carbon dioxide into the atmosphere, triggering for the first time humanly caused global warming. Temperatures climbed more rapidly in the twentieth century as the use of fossil fuels proliferated and greenhouse gas levels continued to soar. The rise has been even steeper since the early 1980s. The Little Ice Age has given way to a new climatic regime, marked by prolonged and steady warming. At the same time, extreme weather events like Category 5 hurricanes are becoming more frequent.

Questions 54-58

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

Weather during the Little Ice Age

Documentation of past weather conditions is limited: our main sources of knowledge of conditions in the distant past are **54**..... and **55**..... We can deduce that the Little Ice Age was a time of **56**..... rather than of consistent freezing. Within it there were some periods of very cold winters, others of **57**..... and heavy rain, and yet others that saw **58**.....with no rain at all.

- | | | |
|--------------------------|-----------------------|-------------------------------|
| A climatic shifts | F ice cores | C tree rings |
| D glaciers | F interactions | F weather observations |
| G heat waves | F storms | I written accounts |

READING PASSAGE 11

The meaning and power of smell

The sense of smell, or olfaction, is powerful. Odours affect us on a physical, psychological and social level. For the most part, however, we breathe in the aromas which surround us without being consciously aware of their importance to us. It is only when the faculty of smell is impaired for some reason that we begin to realise the essential role the sense of smell plays in our sense of well-being

A

A survey conducted by Anthony Synott at Montreal's Concordia University asked participants to comment on how important smell was to them in their lives. It became apparent that smell can evoke strong emotional responses. A scent associated with a good experience can bring a rush of joy, while a foul odour or one associated with a bad memory may make us grimace with disgust. Respondents to the survey noted that many of their olfactory likes and dislikes were based on emotional associations. Such associations can be powerful enough so that odours that we would generally label unpleasant become agreeable, and those that we would generally consider fragrant become disagreeable for particular individuals. The perception of smell, therefore, consists not only of the sensation of the odours themselves, but of the experiences and emotions associated with them.

B

Odours are also essential cues in social bonding. One respondent to the survey believed that there is no true emotional bonding without touching and smelling a loved one. In fact, infants recognise the odours of their mothers soon after birth and adults can often identify their children or spouses by scent. In one well-known test, women and men were able to distinguish by smell alone clothing worn by their marriage partners from similar clothing worn by other people. Most of the subjects would probably never have given much thought to odour as a cue for identifying family members before being involved in the test, but as the experiment revealed, even when not consciously considered, smells register.

C

In spite of its importance to our emotional and sensory lives, smell is probably the most undervalued sense in many cultures. The reason often given for the low regard in which smell is held is that, in comparison with its importance among animals, the human sense of smell is feeble and undeveloped. While it is true that the olfactory powers of humans are nothing like as fine as those possessed by certain animals, they are still remarkably acute. Our noses are able to recognise thousands of smells, and to perceive odours which are present only in extremely small quantities.

D

Smell, however, is a highly elusive phenomenon. Odours, unlike colours, for instance, cannot be named in many languages because the specific vocabulary simply doesn't exist. 'It smells like . . .', we have to say when describing an odour, struggling to express our olfactory experience. Nor can odours be recorded: there is no effective way to either capture or store them over time. In the realm of olfaction, we must make do with descriptions and recollections. This has implications for olfactory research.

E

Most of the research on smell undertaken to date has been of a physical scientific nature. Significant advances have been made in the understanding of the biological and chemical nature of olfaction, but many fundamental questions have yet to be answered. Researchers have still to decide whether smell is one sense or two - one responding to odours proper and the other registering odourless chemicals in the air. Other unanswered questions are whether the nose is the only part of the body affected by odours, and how smells can be measured objectively given the nonphysical components. Questions like these mean that interest in the psychology of smell is inevitably set to play an increasingly important role for researchers.

F

However, smell is not simply a biological and psychological phenomenon. Smell is cultural, hence it is a social and historical phenomenon. Odours are invested with cultural values: smells that are considered to be offensive in some cultures may be perfectly acceptable in others. Therefore, our sense of smell is a means of, and model for, interacting with the world. Different smells can provide us with intimate and emotionally charged experiences and the value that we attach to these experiences is interiorised by the members of society in a

deeply personal way. Importantly, our commonly held feelings about smells can help distinguish us from other cultures. The study of the cultural history of smell is, therefore, in a very real sense, an investigation into the essence of human culture.

Questions 59-62

Complete the sentences below.

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

59 Tests have shown that odours can help people recognise the..... belonging to their husbands and wives.

60 Certain linguistic groups may have difficulty describing smell because they lack the appropriate.....

61 The sense of smell may involve response to.....which do not smell, in addition to obvious odours.

62 Odours regarded as unpleasant in certain.....are not regarded as unpleasant in others.

READING PASSAGE 12

Striking Back at Lightning With Lasers

Seldom is the weather more dramatic than when thunderstorms strike. Their electrical fury inflicts death or serious injury on around 500 people each year in the United States alone. As the clouds roll in, a leisurely round of golf can become a terrifying dice with death - out in the open, a lone golfer may be a lightning bolt's most inviting target. And there is damage to property too. Lightning damage costs American power companies more than \$100 million a year.

But researchers in the United States and Japan are planning to hit back. Already in laboratory trials they have tested strategies for neutralising the power of thunderstorms, and this winter they will brave real storms, equipped with an armoury of lasers that they will be pointing towards the heavens to discharge thunderclouds before lightning can strike.

The idea of forcing storm clouds to discharge their lightning on command is not new. In the early 1960s, researchers tried firing rockets trailing wires into thunderclouds to set up an easy discharge path for the huge electric charges that these clouds generate. The technique survives to this day at a test site in Florida run by the University of Florida, with support from the Electrical Power Research Institute (EPRI), based in California. EPRI, which is funded by power companies, is looking at ways to protect the United States' power grid from lightning strikes. 'We can cause the lightning to strike where we want it to using rockets,' says Ralph Bernstein, manager of lightning projects at EPRI. The rocket site is providing precise measurements of lightning voltages and allowing engineers to check how electrical equipment bears up.

Bad behaviour

But while rockets are fine for research, they cannot provide the protection from lightning strikes that everyone is looking for. The rockets cost around \$1,200 each, can only be fired at a limited frequency and their failure rate is about 40 per cent. And even when they do trigger lightning, things still do not always go according to plan. 'Lightning is not perfectly well behaved,' says Bernstein. 'Occasionally, it will take a branch and go someplace it wasn't supposed to go.'

And anyway, who would want to fire streams of rockets in a populated area? 'What goes up must come down,' points out Jean-Claude Diels of the University of New Mexico. Diels is leading a project, which is backed by EPRI, to try to use lasers to discharge lightning safely- and safety is a basic requirement since no one wants to put themselves or their expensive equipment at risk. With around \$500,000 invested so far, a promising system is just emerging from the laboratory.

The idea began some 20 years ago, when high-powered lasers were revealing their ability to extract electrons out of atoms and create ions. If a laser could generate a line of ionisation in the air all the way up to a storm cloud, this conducting path could be used to guide lightning to Earth, before the electric field becomes strong enough to break down the air in an uncontrollable surge. To stop the laser itself being struck, it would not be pointed straight at the clouds. Instead it would be directed at a mirror, and from there into the sky. The mirror would be protected by placing lightning conductors close by. Ideally, the cloud-zapper (gun) would be cheap enough to be installed around all key power installations, and portable enough to be taken to international sporting events to beam up at brewing storm clouds.

A stumbling block

However, there is still a big stumbling block. The laser is no nifty portable: it's a monster that takes up a whole room. Diels is trying to cut down the size and says that a laser around the size of a small table is in the offing.

He plans to test this more manageable system on live thunderclouds next summer. Bernstein says that Diels's system is attracting lots of interest from the power companies.

But they have not yet come up with the \$5 million that EPRI says will be needed to develop a commercial system, by making the lasers yet smaller and cheaper. 'I cannot say I have money yet, but I'm working on it,' says Bernstein. He reckons that the forthcoming field tests will be the turning point - and he's hoping for good news. Bernstein predicts 'an avalanche of interest and support' if all goes well. He expects to see cloud-zappers eventually costing \$50,000 to \$100,000 each.

Other scientists could also benefit. With a lightning 'switch' at their fingertips, materials scientists could find out what happens when mighty currents meet matter. Diels also hopes to see the birth of 'interactive meteorology' - not just forecasting the weather but controlling it. 'If we could discharge clouds, we might affect the weather,' he says.

And perhaps, says Diels, we'll be able to confront some other meteorological menaces. 'We think we could prevent hail by inducing lightning,' he says. Thunder, the shock wave that comes from a lightning flash, is thought to be the trigger for the torrential rain that is typical of storms. A laser thunder factory could shake the moisture out of clouds, perhaps preventing the formation of the giant hailstones that threaten crops. With luck, as the storm clouds gather this winter, laser-toting researchers could, for the first time, strike back.

Questions 63-65

Complete the sentences below.

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

- 63 EPRI receives financial support from.....
- 64 The advantage of the technique being developed by Diels is that it can be used.....
- 65 The main difficulty associated with using the laser equipment is related to its.....

Questions 66-69

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

In this method, a laser is used to create a line of ionisation by removing electrons from **66**..... This laser is then directed at **67**..... in order to control electrical charges, a method which is less dangerous than using **68**..... As a protection for the lasers, the beams are aimed firstly at **69**.....

- | | | |
|------------------------|---------------------|-----------------------|
| A cloud-zappers | B atoms | C storm clouds |
| D mirrors | E technique | F ions |
| G rockets | H conductors | I thunder |

Collecting Ant Specimens

Collecting ants can be as simple as picking up stray ones and placing them in a glass jar, or as complicated as completing an exhaustive survey of all species present in an area and estimating their relative abundances. The exact method used will depend on the final purpose of the collections. For taxonomy, or classification, long series, from a single nest, which contain all castes (workers, including majors and minors, and, if present, queens and males) are desirable, to allow the determination of variation within species. For ecological studies, the most important factor is collecting identifiable samples of as many of the different species present as possible. Unfortunately, these methods are not always compatible. The taxonomist sometimes overlooks whole species in favour of those groups currently under study, while the ecologist often collects only a limited number of specimens of each species, thus reducing their value for taxonomic investigations.

To collect as wide a range of species as possible, several methods must be used. These include hand collecting, using baits to attract the ants, ground litter sampling, and the use of pitfall traps. Hand collecting consists of searching for ants everywhere they are likely to occur. This includes on the ground, under rocks, logs or other objects on the ground, in rotten wood on the ground or on trees, in vegetation, on tree trunks and under bark. When possible, collections should be made from nests or foraging columns and at least 20 to 25 individuals collected. This will ensure that all individuals are of the same species, and so increase their value for detailed studies. Since some species are largely nocturnal, collecting should not be confined to daytime. Specimens are collected using an aspirator (often called a pooter), forceps, a fine, moistened paint brush, or fingers, if the ants are known not to sting. Individual insects are placed in plastic or glass tubes (1.5-3-0 ml capacity for small ants, 5-8 ml for larger ants) containing 75% to 95% ethanol. Plastic tubes with secure tops are better than glass because they are lighter, and do not break as easily if mishandled.

Baits can be used to attract and concentrate foragers. This often increases the number of individuals collected and attracts species that are otherwise elusive. Sugars and meats or oils will attract different species and a range should be utilised. These baits can be placed either on the ground or on the trunks of trees or large shrubs. When placed on the ground, baits should be situated on small paper cards or other flat, light-coloured surfaces, or in test-tubes or vials. This makes it easier to spot ants and to capture them before they can escape into the surrounding leaf litter.

Many ants are small and forage primarily in the layer of leaves and other debris on the ground. Collecting these species by hand can be difficult. One of the most successful ways to collect them is to gather the leaf litter in which they are foraging and extract the ants from it. This is most commonly done by placing leaf litter on a screen over a large funnel, often under some heat. As the leaf litter dries from above, ants (and other animals) move downward and eventually fall out the bottom and are collected in alcohol placed below the funnel. This method works especially well in rain forests and marshy areas. A method of improving the catch when using a funnel is to sift the leaf litter through a coarse screen before placing it above the funnel. This will concentrate the litter and remove larger leaves and twigs. It will also allow more litter to be sampled when using a limited number of funnels.

The pitfall trap is another commonly used tool for collecting ants. A pitfall trap can be any small container placed in the ground with the top level with the surrounding surface and filled with a preservative. Ants are collected when they fall into the trap while foraging.

The diameter of the traps can vary from about 18 mm to 10 cm and the number used can vary from a few to several hundred. The size of the traps used is influenced largely by personal preference (although larger sizes are generally better), while the number will be determined by the study being undertaken. The preservative used is usually ethylene glycol or propylene glycol, as alcohol will evaporate quickly and the traps will dry out.

One advantage of pitfall traps is that they can be used to collect over a period of time with minimal maintenance and intervention. One disadvantage is that some species are not collected as they either avoid the traps or do not commonly encounter them while foraging.

Questions 37-40

Label the diagram below.

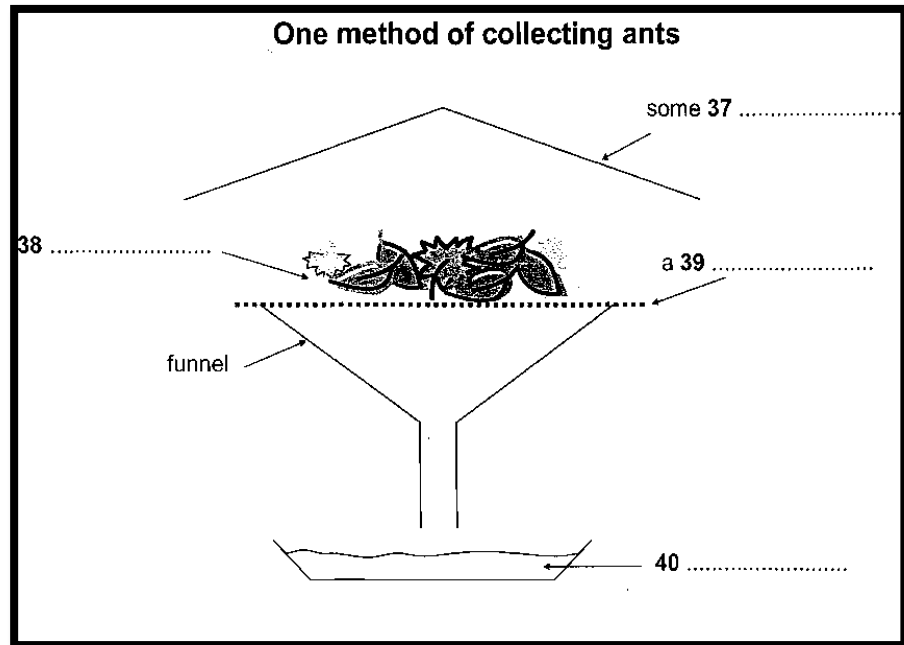
Choose **NO MORE THAN TWO WORDS** from the passage for each answer.

70.....

71.....

72.....

73.....



READING PASSAGE 14

. Stepwells

A millennium ago, stepwells were fundamental to life in the driest parts of India. Although many have been neglected, recent restoration has returned them to their former glory. Richard Cox travelled to north-western India to document these spectacular monuments from a bygone era.

During the sixth and seventh centuries, the inhabitants of the modern-day states of Gujarat and Rajasthan in North-western India developed a method of gaining access to clean, fresh groundwater during the dry season for drinking, bathing, watering animals and irrigation. However, the significance of this invention – the stepwell – goes beyond its utilitarian application.

Unique to the region, stepwells are often architecturally complex and vary widely in size and shape. During their heyday, they were places of gathering, of leisure, of relaxation and of worship for villagers of all but the lowest castes. Most stepwells are found dotted around the desert areas of Gujarat (where they are called vav) and Rajasthan (where they are known as baori), while a few also survive in Delhi. Some were located in or near villages as public spaces for the community; others were positioned beside roads as resting places for travellers.

As their name suggests, stepwells comprise a series of stone steps descending from ground level to the water source (normally an underground aquifer) as it recedes following the rains. When the water level was high, the user needed only to descend a few steps to reach it; when it was low, several levels would have to be negotiated.

Some wells are vast, open craters with hundreds of steps paving each sloping side, often in tiers. Others are more elaborate, with long stepped passages leading to the water via several storeys built from stone and supported by pillars, they also included pavilions that sheltered visitors from the relentless heat. But perhaps the most impressive features are the intricate decorative sculptures that embellish many stepwells, showing activities from fighting and dancing to everyday acts such as women combing their hair and churning butter.

Down the centuries, thousands of wells were constructed throughout northwestern India, but the majority have now fallen into disuse; many are derelict and dry, as groundwater has been diverted for industrial use and the wells no longer reach the water table. Their condition hasn't been helped by recent dry spells: southern Rajasthan suffered an eight-year drought between 1996 and 2004.

However, some important sites in Gujarat have recently undergone major restoration, and the state government announced in June last year that it plans to restore the stepwells throughout the state.

In Patan, the state's ancient capital, the stepwell of Rani Ki Vav (Queen's Stepwell) is perhaps the finest current example. It was built by Queen Udayamati during the late 11th century, but became silted up following a flood during the 13th century. But the Archaeological Survey of India began restoring it in the 1960s, and today it's in pristine condition. At 65 metres long, 20 metres wide and 27 metres deep, Rani Ki Vav features 500 distinct sculptures carved into niches throughout the monument, depicting gods such as Vishnu and Parvati in various incarnations. Incredibly, in January 2001, this ancient structure survived a devastating earthquake that measured 7.6 on the Richter scale.

Another example is the Surya Kund in Modhera, northern Gujarat, next to the Sun Temple, built by King Bhima I in 1026 to honour the sun god Surya. It's actually a tank (kund means reservoir or pond) rather than a well, but displays the hallmarks of stepwell architecture, including four sides of steps that descend to the

bottom in a stunning geometrical formation. The terraces house 108 small, intricately carved shrines between the sets of steps.

Rajasthan also has a wealth of wells. The ancient city of Bundi, 200 kilometres south of Jaipur, is renowned for its architecture, including its stepwells. One of the larger examples is Rani Ki Baori, which was built by the queen of the region, Nathavatji, in 1699. At 46 metres deep, 20 metres wide and 40 metres long, the intricately carved monument is one of 21 baoris commissioned in the Bundi area by Nathavatji.

In the old ruined town of Abhaneri, about 95 kilometres east of Jaipur, is Chand Baori, one of India's oldest and deepest wells; aesthetically, it's perhaps one of the most dramatic. Built in around 850 AD next to the temple of Harshat Mata, the baori comprises hundreds of zigzagging steps that run along three of its sides, steeply descending 11 storeys, resulting in a striking geometric pattern when seen from afar. On the fourth side, covered verandas supported by ornate pillars overlook the steps.

Still in public use is Neemrana Ki Baori, located just off the Jaipur–Dehli highway. Constructed in around 1700, it's nine storeys deep, with the last two levels underwater. At ground level, there are 86 colonnaded openings from where the visitor descends 170 steps to the deepest water source.

Today, following years of neglect, many of these monuments to medieval engineering have been saved by the Archaeological Survey of India, which has recognised the importance of preserving them as part of the country's rich history. Tourists flock to wells in far-flung corners of northwestern India to gaze in wonder at these architectural marvels from 1,000 years ago, which serve as a reminder of both the ingenuity and artistry of ancient civilisations and of the value of water to human existence

Question 74-78

Complete the table below

*Choose **ONE WORD AND /OR A NUMBER** from the passage for each answer.*

Stepwells	Date	Features	Other notes
Rani Ki Vav	Late 11th century	As many as 500 sculptures decorate the monument	Restored in the 1990s Excellent condition, despite the 74.....of 2001.
Surya Kund	1026	Steps on the 75..... produce a geometric pattern Carved shrines.	looks more like a 76..... then a well.
Rani Ki Baori	1699	Intricately carved monument	One of 21 baoris in the area commissioned by Queen Nathavatji
Chand Baori	850 AD	Steps take you down 11 storeys to the bottom	Old, deep and very dramatic Has 77.....which provide a view to the steps.
Neemrana Ki Baori	1700	Has two 78.....levels.	Used by public today

READING PASSAGE 15

Gifted children and learning

A Internationally, 'giftedness' is most frequently determined by a score on a general intelligence test, known as an IQ test, which is above a chosen cutoff point, usually at around the top 2-5%. Children's educational environment contributes to the IQ score and the way intelligence is used. For example, a very close positive relationship was found when children's IQ scores were compared with their home educational provision (Freeman, 2010). The higher the children's IQ scores, especially over IQ 130, the better the quality of their educational backup, measured in terms of reported verbal interactions with parents, number of books and activities in their home etc. Because IQ tests are decidedly influenced by what the child has learned, they are to some extent measures of current achievement based on age-norms; that is, how well the children have learned to manipulate their knowledge and know-how within the terms of the test. The vocabulary aspect, for example, is dependent on having heard those words. But IQ tests can neither identify the processes of learning and thinking nor predict creativity.

B Excellence does not emerge without appropriate help. To reach an exceptionally high standard in any area very able children need the means to learn, which includes material to work with and focused challenging tuition -and the encouragement to follow their dream. There appears to be a qualitative difference in the way the intellectually highly able think, compared with more average-ability or older pupils, for whom external regulation by the teacher often compensates for lack of internal regulation. To be at their most effective in their self-regulation, all children can be helped to identify their own ways of learning – metacognition – which will include strategies of planning, monitoring, evaluation, and choice of what to learn. Emotional awareness is also part of metacognition, so children should be helped to be aware of their feelings around the area to be learned, feelings of curiosity or confidence, for example.

C High achievers have been found to use self-regulatory learning strategies more often and more effectively than lower achievers, and are better able to transfer these strategies to deal with unfamiliar tasks. This happens to such a high degree in some children that they appear to be demonstrating talent in particular areas. Overlooking research on the thinking process of highly able children, (Shore and Kanevsky, 1993) put the instructor's problem succinctly: 'If they [the gifted] merely think more quickly, then we need only teach more quickly. If they merely make fewer errors, then we can shorten the practice'. But of course, this is not entirely the case; adjustments have to be made in methods of learning and teaching, to take account of the many ways individuals think.

D Yet in order to learn by themselves, the gifted do need some support from their teachers. Conversely, teachers who have a tendency to 'overdirect' can diminish their gifted pupils' learning autonomy. Although 'spoon-feeding' can produce extremely high examination results, these are not always followed by equally impressive life successes. Too much dependence on the teachers risks loss of autonomy and motivation to discover. However, when teachers o pupils to reflect on their own learning and thinking activities, they increase their pupils' self-regulation. For a young child, it may be just the simple question 'What have you learned today?' which helps them to recognise what they are doing. Given that a fundamental goal of education is to transfer the control of learning from teachers to pupils, improving pupils' learning to learn techniques should be a major outcome of the school experience, especially for the highly competent. There are quite a number of new methods which can help, such as child- initiated learning, ability-peer tutoring, etc. Such practices have been found to be particularly useful for bright children from deprived areas.

E But scientific progress is not all theoretical, knowledge is a so vital to outstanding performance: individuals who know a great deal about a specific domain will achieve at a higher level than those who do not (Elshout, 1995). Research with creative scientists by Simonton (1988) brought him to the conclusion that above a certain high level, characteristics such as independence seemed to contribute more to reaching the highest levels of expertise than intellectual skills, due to the great demands of effort and time needed for learning and

practice. Creativity in all forms can be seen as expertise se mixed with a high level of motivation (Weisberg, 1993).

F To sum up, learning is affected by emotions of both the individual and significant others. Positive emotions facilitate the creative aspects of earning and negative emotions inhibit it. Fear, for example, can limit the development of curiosity, which is a strong force in scientific advance, because it motivates problem-solving behaviour. In Boekaerts' (1991) review of emotion the learning of very high IQ and highly achieving children, she found emotional forces in harness. They were not only curious, but often had a strong desire to control their environment, improve their learning efficiency and increase their own learning resources.

Questions 79-82

*Complete the sentences below. Choose **NO MORE THAN THREE WORDS** from the passage for each answer.*

- One study found a strong connection between children's IQ and the availability of **79**.....**and**..... at home.
- Children of average ability seem to need more direction from teachers because they do not have **80**.....
- Meta-cognition involves children understanding their own learning strategies, as well as developing **81**.....
- Teachers who rely on what is known as **82**..... often produce sets of impressive grades in class tests.

READING PASSAGE 16

Museums of fine art and their public

The fact that people go to the Louvre museum in Paris to see the original painting Mona Lisa when they can see a reproduction anywhere leads us to question some assumptions about the role of museums of fine art in today's world

One of the most famous works of art in the world is Leonardo da Vinci's Mona Lisa. Nearly everyone who goes to see the original will already be familiar with it from reproductions, but they accept that fine art is more rewardingly viewed in its original form.

However, if Mona Lisa was a famous novel, few people would bother to go to a museum to read the writer's actual manuscript rather than a printed reproduction. This might be explained by the fact that the novel has evolved precisely because of technological developments that made it possible to print out huge numbers of texts, whereas oil paintings have always been produced as unique objects. In addition, it could be argued that the practice of interpreting or 'reading' each medium follows different conventions. With novels, the reader attends mainly to the meaning of words rather than the way they are printed on the page, whereas the 'reader' of a painting must attend just as closely to the material form of marks and shapes in the picture as to any ideas they may signify.

Yet it has always been possible to make very accurate facsimiles of pretty well any fine art work. The seven surviving versions of Mona Lisa bear witness to the fact that in the 16th century, artists seemed perfectly content to assign the reproduction of their creations to their workshop apprentices as regular 'bread and butter' work. And today the task of reproducing pictures is incomparably more simple and reliable, with reprographic techniques that allow the production of high-quality prints made exactly to the original scale, with faithful colour values, and even with duplication of the surface relief of the painting.

But despite an implicit recognition that the spread of good reproductions can be culturally valuable, museums continue to promote the special status of original work.

Unfortunately, this seems to place severe limitations on the kind of experience offered to visitors.

One limitation is related to the way the museum presents its exhibits. As repositories of unique historical objects, art museums are often called 'treasure houses'. We are reminded of this even before we view a collection by the presence of security guards, attendants, ropes and display cases to keep us away from the exhibits. In many cases, the architectural style of the building further reinforces that notion. In addition, a major collection like that of London's National Gallery is housed in numerous rooms, each with dozens of works, any one of which is likely to be worth more than all the average visitor possesses. In a society that judges the personal status of the individual so much by their material worth, it is therefore difficult not to be impressed by one's own relative 'worthlessness' in such an environment.

Furthermore, consideration of the 'value' of the original work in its treasure house setting impresses upon the viewer that, since these works were originally produced, they have been assigned a huge monetary value by some person or institution more powerful than themselves. Evidently, nothing the viewer thinks about the work is going to alter that value, and so today's viewer is deterred from trying to extend that spontaneous, immediate, self-reliant kind of reading which would originally have met the work.

The visitor may then be struck by the strangeness of seeing such diverse paintings, drawings and sculptures brought together in an environment for which they were not originally created. This 'displacement effect' is further heightened by the sheer volume of exhibits. In the case of a major collection, there are probably more works on display than we could realistically view in weeks or even months.

This is particularly distressing because time seems to be a vital factor in the appreciation of all art forms. A fundamental difference between paintings and other art forms is that there is no prescribed time over which a painting is viewed. By contrast, the audience encourage an opera or a play over a specific time, which is the duration of the performance. Similarly novels and poems are read in a prescribed temporal sequence, whereas a picture has no clear place at which to start viewing, or at which to finish. Thus art works themselves encourage us to view them superficially, without appreciating the richness of detail and labour that is involved.

Consequently, the dominant critical approach becomes that of the art historian, a specialised academic approach devoted to 'discovering the meaning' of art within the cultural context of its time. This is in perfect harmony with the museum's function, since the approach is dedicated to seeking out and conserving 'authentic', original, readings of the exhibits. Again, this seems to put paid to that spontaneous, participatory criticism which can be found in abundance in criticism of classic works of literature, but is absent from most art history.

The displays of art museums serve as a warning of what critical practices can emerge when spontaneous criticism is suppressed. The museum public, like any other audience, experience art more rewardingly when given the confidence to express their views. If appropriate works of fine art could be rendered permanently accessible to the public by means of high-fidelity reproductions, as literature and music already are, the public may feel somewhat less in awe of them. Unfortunately, that may be too much to ask from those who seek to maintain and control the art establishment.

Questions 83-87

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

The value attached to original works of art

People go to art museums because they accept the value of seeing an original work of art. But they do not go to museums to read original manuscripts of novels, perhaps because the availability of novels has depended on **83**..... for so long, and also because with novels, the **84**..... are the most important thing.

However, in historical times artists such as Leonardo were happy to instruct **85**..... to produce copies of their work and these days new methods of reproduction allow excellent replication of surface relief features as well as colour and **86**..... It is regrettable that museums still promote the superiority of original works of art, since this may not be in the interests of the **87**.....

A institution

B mass production

C mechanical processes

D public

E paints

F artist

G size

H underlying ideas

I basic technology

J readers

K picture frames

L assistants

Autumn leaves

Canadian writer Jay Ingram investigates the mystery of why leaves turn red in the fall

A One of the most captivating natural events of the year in many areas throughout North America is the turning of the leaves in the fall. The colours are magnificent, but the question of exactly why some trees turn yellow or orange, and others red or purple, is something which has long puzzled scientists.

B Summer leaves are green because they are full of chlorophyll, the molecule that captures sunlight converts that energy into new building materials for the tree. As fall approaches in the northern hemisphere, the amount of solar energy available declines considerably. For many trees – evergreen conifers being an exception – the best strategy is to abandon photosynthesis* until the spring. So rather than maintaining the now redundant leaves throughout the winter, the tree saves its precious resources and discards them. But before letting its leaves go, the tree dismantles their chlorophyll molecules and ships their valuable nitrogen back into the twigs. As chlorophyll is depleted, other colours that have been dominated by it throughout the summer begin to be revealed. This unmasking explains the autumn colours of yellow and orange, but not the brilliant reds and purples of trees such as the maple or sumac.

C The source of the red is widely known: it is created by anthocyanins, water-soluble plant pigments reflecting the red to blue range of the visible spectrum. They belong to a class of sugar-based chemical compounds also known as flavonoids. What's puzzling is that anthocyanins are actually newly minted, made in the leaves at the same time as the tree is preparing to drop them. But it is hard to make sense of the manufacture of anthocyanins – why should a tree bother making new chemicals in its leaves when it's already scrambling to withdraw and preserve the ones already there?

D Some theories about anthocyanins have argued that they might act as a chemical defence against attacks by insects or fungi, or that they might attract fruit-eating birds or increase a leaf's tolerance to freezing. However there are problems with each of these theories, including the fact that leaves are red for such a relatively short period that the expense of energy needed to manufacture the anthocyanins would outweigh any anti-fungal or anti-herbivore activity achieved.* photosynthesis: the production of new material from sunlight, water and carbon dioxide.

E It has also been proposed that trees may produce vivid red colours to convince herbivorous insects that they are healthy and robust and would be easily able to mount chemical defences against infestation. If insects paid attention to such advertisements, they might be prompted to lay their eggs on a duller, and presumably less resistant host. The flaw in this theory lies in the lack of proof to support it. No one has as yet ascertained whether more robust trees sport the brightest leaves, or whether insects make choices according to colour intensity.

F Perhaps the most plausible suggestion as to why leaves would go to the trouble of making anthocyanins when they're busy packing up for the winter is the theory known as the 'light screen' hypothesis. It sounds paradoxical, because the idea behind this hypothesis is that the red pigment is made in autumn leaves to protect chlorophyll, the light-absorbing chemical, from too much light. Why does chlorophyll need protection when it is the natural world's supreme light absorber? Why protect chlorophyll at a time when the tree is breaking it down to salvage as much of it as possible?

G Chlorophyll, although exquisitely evolved to capture the energy of sunlight, can sometimes be overwhelmed by it, especially in situations of drought, low temperatures, or nutrient deficiency. Moreover, the problem of oversensitivity to light is even more acute in the fall, when the leaf is busy preparing for winter by dismantling its internal machinery. The energy absorbed by the chlorophyll molecules of the unstable autumn leaf is not

immediately channelled into useful products and processes, as it would be in an intact summer leaf. The weakened fall leaf then becomes vulnerable to the highly destructive effects of the oxygen created by the excited chlorophyll molecules.

H Even if you had never suspected that this is what was going on when leaves turn red, there are clues out there. One is straightforward: on many trees, the leaves that are the reddest are those on the side of the tree which gets most sun. Not only that, but the red is brighter on the upper side of the leaf. It has also been recognised for decades that the best conditions for intense red colours are dry, sunny days and cool nights, conditions that nicely match those that make leaves susceptible to excess light. And finally, trees such as maples usually get much redder the more north you travel in the northern hemisphere. It's colder there, they're more stressed, their chlorophyll is more sensitive and it needs more sunblock.

I What is still not fully understood, however, is why some trees resort to producing red pigments while others don't bother, and simply reveal their orange or yellow hues. Do these trees have other means at their disposal to prevent overexposure to light in autumn? Their story, though not as spectacular to the eye, will surely turn out to be as subtle and as complex.

Questions 19-22

Complete the notes below.

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

Why believe the 'light screen' hypothesis?

- The most vividly coloured red leaves are found on the side of the tree facing the **88**.....
- The **81**.....surfaces of leaves contain the most red pigment.
- Red leaves are most abundant when daytime weather conditions are **82**.....and sunny.
- The intensity of the red colour of leaves increases as you go further **83**.....

Beyond the blue horizon

Ancient voyagers who settled the far-flung islands of the Pacific Ocean

(1) An important archaeological discovery on the island of Efate in the Pacific archipelago of Vanuatu has revealed traces of an ancient seafaring people, the distant ancestors of today's Polynesians. The site came to light only by chance. An agricultural worker, digging in the grounds of a derelict plantation, scraped open a grave – the first of dozens in a burial ground some 3,000 years old. It is the oldest cemetery ever found in the Pacific islands, and it harbors the remains of an ancient people archaeologists call the Lapita.

(2) They were daring blue-water adventurers who used basic canoes to rove across the ocean. But they were not just explorers. They were also pioneers who carried with them everything they would need to build new lives – their livestock, taro seedlings and stone tools. Within the span of several centuries, the Lapita stretched the boundaries of their world from the jungle-clad volcanoes of Papua New Guinea to the loneliest coral outliers of Tonga.

(3) The Lapita left precious few clues about themselves, but Efate expands the volume of data available to researchers dramatically. The remains of 62 individuals have been uncovered so far, and archaeologists were also thrilled to find six complete Lapita pots. Other items included a Lapita burial urn with modeled birds arranged on the rim as though peering down at the human remains sealed inside. 'It's an important discovery,' says Matthew Spriggs, professor of archaeology at the Australian National University and head of the international team digging up the site, 'for it conclusively identifies the remains as Lapita.'

(4) DNA teased from these human remains may help answer one of the most puzzling questions in Pacific anthropology: did all Pacific islanders spring from one source or many? Was there only one outward migration from a single point in Asia, or several from different points? 'This represents the best opportunity we've had yet,' says Spriggs, 'to find out who the Lapita actually were, where they came from, and who their closest descendants are today.'

(5) There is one stubborn question for which archaeology has yet to provide any answers: how did the Lapita accomplish the ancient equivalent of a moon landing, many times over? No-one has found one of their canoes or any rigging, which could reveal how the canoes were sailed. Nor do the oral histories and traditions of later Polynesians offer any insights, for they turn into myths long before they reach as far back in time as the Lapita.

(6) 'All we can say for certain is that the Lapita had canoes that were capable of ocean voyages, and they had the ability to sail them,' says Geoff Irwin, a professor of archaeology at the University of Auckland. Those sailing skills, he says, were developed and passed down over thousands of years by earlier mariners who worked their way through the archipelagoes of the western Pacific, making short crossings to nearby islands. The real adventure didn't begin, however, until their Lapita descendants sailed out of sight of land, with empty horizons on every side. This must have been as difficult for them as landing on the moon is for us today. Certainly it distinguished them from their ancestors, but what gave them the courage to launch out on such risky voyages?

(7) The Lapita thrust into the Pacific was eastward, against the prevailing trade winds, Irwin notes. Those nagging headwinds, he argues, may have been the key to their success. 'They could sail out for days into the unknown and assess the area, secure in the knowledge that if they didn't find anything, they could turn about and catch a swift ride back on the trade winds. This is what would have made the whole thing work.' Once out there, skilled seafarers would have detected abundant leads to follow to land: seabirds, coconuts and twigs carried out to sea by the tides, and the afternoon pile-up of clouds on the horizon which often indicates an island in the distance.

(8) For returning explorers, successful or not, the geography of their own archipelagoes would have provided a safety net. Without this to go by, overshooting their home ports, getting lost and sailing off into eternity would have been all too easy. Vanuatu, for example, stretches more than 500 miles in a northwest-southeast trend, its scores of innumerable islands forming a backstop for mariners riding the trade winds home.

(9) All this presupposes one essential detail, says Atholl Anderson, professor of prehistory at the Australian National University: the Lapita had mastered the advanced art of sailing against the wind. 'And there's no proof they could do any such thing,' Anderson says. 'There has been this assumption they did, and people have built canoes to re-create those early voyages based on that assumption. But nobody has any idea what their canoes looked like or how they were rigged.'

(10) Rather than give all the credit to human skill, Anderson invokes the winds of chance. El Nino, the same climate disruption that affects the Pacific today, may have helped scatter the Lapita, Anderson suggests. He points out that climate data obtained from slow-growing corals around the Pacific indicate a series of unusually frequent El Ninos around the time of the Lapita expansion. By reversing the regular east-to-west flow of the trade winds for weeks at a time, these super El Ninos might have taken the Lapita on long unplanned voyages.

(11) However they did it, the Lapita spread themselves a third of the way across the Pacific, then called it quits for reasons known only to them. Ahead lay the vast emptiness of the central Pacific and perhaps they were too thinly stretched to venture farther. They probably never numbered more than a few thousand in total, and in their rapid migration eastward they encountered hundreds of islands – more than 300 in Fiji alone.

Questions 91-95

Completing Summary (*Complete the summary using the list of words and phrases, A-J, below.*)

The Efate burial site

A 3,000-year-old burial ground of a seafaring people called the Lapita has been found on an abandoned **91**..... on the Pacific island of Efate.

The cemetery, which is a significant **92**, was uncovered accidentally by an agricultural worker.

The Lapita explored and colonised many Pacific islands over several centuries. They took many things with them on their voyages including **93**..... and tools.

The burial ground increases the amount of information about the Lapita available to scientists. A team of researchers, led by Matthew Spriggs from the Australian National University, are helping with the excavation of the site. Spriggs believes the **94**..... which was found at the site is very important since it confirms that the **95**..... found inside are Lapita.

A proof

D bones

F archaeological

H source

B plantation

E data

discovery

I animals

C harbour

G burial urn

J maps

READING PASSAGE 19

The megafires of California

Drought, housing expansion, and oversupply of tinder make for bigger, hotter fires in the western United States

Wildfires are becoming an increasing menace in the western United States, with Southern California being the hardest hit area. There's a reason fire squads battling more frequent blazes in Southern California are having such difficulty containing the flames, despite better preparedness than ever and decades of experience fighting fires fanned by the 'Santa Ana Winds'. The wildfires themselves, experts say, are generally hotter, faster, and spread more erratically than in the past.

Megafires, also called 'siege fires', are the increasingly frequent blazes that burn 500,000 acres or more - 10 times the size of the average forest fire of 20 years ago. Some recent wildfires are among the biggest ever in California in terms of acreage burned, according to state figures and news reports.

One explanation for the trend to more superhot fires is that the region, which usually has dry summers, has had significantly below normal precipitation in many recent years. Another reason, experts say, is related to the century-long policy of the US Forest Service to stop wildfires as quickly as possible.

The unintentional consequence has been to halt the natural eradication of underbrush, now the primary fuel for megafires.

Three other factors contribute to the trend, they add. First is climate change, marked by a 1-degree Fahrenheit rise in average yearly temperature across the western states. Second is fire seasons that on average are 78 days longer than they were 20 years ago. Third is increased construction of homes in wooded areas.

'We are increasingly building our homes in fire-prone ecosystems,' says Dominik Kulakowski, adjunct professor of biology at Clark University Graduate School of Geography in Worcester, Massachusetts. 'Doing that in many of the forests of the western US is like building homes on the side of an active volcano.'

In California, where population growth has averaged more than 600,000 a year for at least a decade, more residential housing is being built. 'What once was open space is now residential homes providing fuel to make fires burn with greater intensity,' says Terry McHale of the California Department of Forestry firefighters' union. 'With so much dryness, so many communities to catch fire, so many fronts to fight, it becomes an almost incredible job.'

That said, many experts give California high marks for making progress on preparedness in recent years, after some of the largest fires in state history scorched thousands of acres, burned thousands of homes, and killed numerous people. Stung in the past by criticism of bungling that allowed fires to spread when they might have been contained, personnel are meeting the peculiar challenges of neighborhood - and canyon- hopping fires better than previously, observers say.

State promises to provide more up-to-date engines, planes, and helicopters to fight fires have been fulfilled. Firefighters' unions that in the past complained of dilapidated equipment, old fire engines, and insufficient blueprints for fire safety are now praising the state's commitment, noting that funding for firefighting has increased, despite huge cuts in many other programs. 'We are pleased that the current state administration has been very proactive in its support of us, and [has] come through with budgetary support of the infrastructure needs we have long sought,' says Mr. McHale of the firefighters' union.

Besides providing money to upgrade the fire engines that must traverse the mammoth state and wind along serpentine canyon roads, the state has invested in better command-and-control facilities as well as in the strategies to run them. 'In the fire sieges of earlier years, we found that other jurisdictions and states were willing to offer mutual-aid help, but we were not able to communicate adequately with them,' says Kim Zagaris, chief of the state's Office of Emergency Services Fire and Rescue Branch.

After a commission examined and revamped communications procedures, the statewide response 'has become far more professional and responsive,' he says. There is a sense among both government officials and residents that the speed, dedication, and coordination of firefighters from several states and jurisdictions are resulting in greater efficiency than in past 'siege fire' situations.

In recent years, the Southern California region has improved building codes, evacuation procedures, and procurement of new technology. 'I am extraordinarily impressed by the improvements we have witnessed,' says Randy Jacobs, a Southern California-based lawyer who has had to evacuate both his home and business to escape wildfires. 'Notwithstanding all the damage that will continue to be caused by wildfires, we will no longer suffer the loss of life endured in the past because of the fire prevention and firefighting measures that have been put in place,' he says.

Questions 1-6

Choose **ONE WORD AND/OR A NUMBER** from the passage for each answer.

Wildfires

• Characteristics of wildfires and wildfire conditions today compared to the past:

- occurrence: more frequent
- temperature: hotter
- speed: faster
- movement: **96**..... more unpredictably
- size of fires: **97**..... greater on average than two decades ago

• Reasons wildfires cause more damage today compared to the past:

- rainfall: **98**..... average
- more brush to act as **99**.....
- increase in yearly temperature
- extended fire **100**.....
- more building of **101**..... in vulnerable places

READING PASSAGE 20

Second nature

Your personality isn't necessarily set in stone. With a little experimentation, people can reshape their temperaments and inject passion, optimism, joy and courage into their lives

A

Psychologists have long held that a person's character cannot undergo a transformation in any meaningful way and that the key traits of personality are determined at a very young age. However, researchers have begun looking more closely at ways we *can* change. Positive psychologists have identified 24 qualities we admire, such as loyalty and kindness, and are studying them to find out why they come so naturally to some people. What they're discovering is that many of these qualities amount to habitual behaviour that determines the way we respond to the world. The good news is that all this can be learned.

Some qualities are less challenging to develop than others, optimism being one of them. However, developing qualities requires mastering a range of skills which are diverse and sometimes surprising. For example, to bring more joy and passion into your life, you must be open to experiencing negative emotions. Cultivating such qualities will help you realise your full potential.

B

'The evidence is good that most personality traits can be altered,' says Christopher Peterson, professor of psychology at the University of Michigan, who cites himself as an example. Inherently introverted, he realised early on that as an academic, his reticence would prove disastrous in the lecture hall. So he learned to be more outgoing and to entertain his classes. 'Now my extroverted behaviour is spontaneous,' he says.

C

David Fajgenbaum had to make a similar transition. He was preparing for university, when he had an accident that put an end to his sports career. On campus, he quickly found that beyond ordinary counselling, the university had no services for students who were undergoing physical rehabilitation and suffering from depression like him. He therefore launched a support group to help others in similar situations. He took action despite his own pain - a typical response of an optimist.

D

Suzanne Segerstrom, professor of psychology at the University of Kentucky, believes that the key to increasing optimism is through cultivating optimistic behaviour, rather than positive thinking. She recommends you train yourself to pay attention to good fortune by writing down three positive things that come about each day. This will help you convince yourself that favourable outcomes actually happen all the time, making it easier to begin taking action.

E

You can recognise a person who is passionate about a pursuit by the way they are so strongly involved in it. Tanya Streeter's passion is freediving - the sport of plunging deep into the water without tanks or other breathing equipment. Beginning in 1998, she set nine world records and can hold her breath for six minutes. The physical stamina required for this sport is intense but the psychological demands are even more overwhelming. Streeter learned to untangle her fears from her judgment of what her body and mind could do. 'In my career as a competitive freediver, there was a limit to what I could do - but it wasn't anywhere near what I thought it was/ she says.

F

Finding a pursuit that excites you can improve anyone's life. The secret about consuming passions, though, according to psychologist Paul Silvia of the University of North Carolina, is that 'they require discipline, hard work and ability, which is why they are so rewarding.' Psychologist Todd Kashdan has this advice for those people taking up a new passion: 'As a newcomer, you also have to tolerate and laugh at your own ignorance. You must be willing to accept the negative feelings that come your way,' he says.

G

In 2004, physician-scientist Mauro Zappaterra began his PhD research at Harvard Medical School. Unfortunately, he was miserable as his research wasn't compatible with his curiosity about healing. He finally took a break and during eight months in Santa Fe, Zappaterra learned about alternative healing techniques not taught at Harvard. When he got back, he switched labs to study how

cerebrospinal fluid nourishes the developing nervous system. He also vowed to look for the joy in everything, including failure, as this could help him learn about his research and himself.

One thing that can hold joy back is a person's concentration on avoiding failure rather than their looking forward to doing something well. 'Focusing on being safe might get in the way of your reaching your goals,' explains Kashdan. For example, are you hoping to get through a business lunch without embarrassing yourself, or are you thinking about how fascinating the conversation might be?

H

Usually, we think of courage in physical terms but ordinary life demands something else. For marketing executive Kenneth Pedeleose, it meant speaking out against something he thought was ethically wrong. The new manager was intimidating staff so Pedeleose carefully recorded each instance of bullying and eventually took the evidence to a senior director, knowing his own job security would be threatened. Eventually the manager was the one to go. According to Cynthia Pury, a psychologist at Clemson University, Pedeleose's story proves the point that courage is not motivated by fearlessness, but by moral obligation. Pury also believes that people can acquire courage. Many of her students said that faced with a risky situation, they first tried to calm themselves down, then looked for a way to mitigate the danger, just as Pedeleose did by documenting his allegations.

Over the long term, picking up a new character trait may help you move toward being the person you want to be. And in the short term, the effort itself could be surprisingly rewarding, a kind of internal adventure.

Questions 102-106

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

Psychologists have traditionally believed that a personality **102**..... was impossible and that by a **103**..... a person's character tends to be fixed. This is not true according to positive psychologists, who say that our personal qualities can be seen as habitual behaviour. One of the easiest qualities to acquire is **104**..... However, regardless of the quality, it is necessary to learn a wide variety of different **105**..... in order for a new quality to develop; for example, a person must understand and feel some **106**..... in order to increase their happiness.

HOW DOES THE BIOLOGICAL CLOCK TICK?

A

Our life span is restricted. Everyone accepts this as 'biologically' obvious. 'Nothing lives for ever!' However, in this statement we think of artificially produced, technical objects, products which are subjected to natural wear and tear during use. This leads to the result that at some time or other the object stops working and is unusable ('death' in the biological sense). But are the wear and tear and loss of function of technical objects and the death of living organisms really similar or comparable?

B

Our 'dead' products are 'static', closed systems. It is always the basic material which constitutes the object and which, in the natural course of things, is worn down and becomes 'older'. Ageing in this case must occur according to the laws of physical chemistry and of thermodynamics. Although the same law holds for a living organism, the result of this law is not inexorable in the same way. At least as long as a biological system has the ability to renew itself it could actually become older without ageing; an organism is an open, dynamic system through which new material continuously flows. Destruction of old material and formation of new material are thus in permanent dynamic equilibrium. The material of which the organism is formed changes continuously. Thus our bodies continuously exchange old substance for new, just like a spring which more or less maintains its form and movement, but in which the water molecules are always different.

C

Thus ageing and death should not be seen as inevitable, particularly as the organism possesses many mechanisms for repair. It is not, in principle, necessary for a biological system to age and die. Nevertheless, a restricted life span, ageing, and then death are basic characteristics of life. The reason for this is easy to recognise: in nature, the existent organisms either adapt or are regularly replaced by new types. Because of changes in the genetic material (mutations) these have new characteristics and in the course of their individual lives they are tested for optimal or better adaptation to the environmental conditions. Immortality would disturb this system - it needs room for new and better life. This is the basic problem of evolution.

D

Every organism has a life span which is highly characteristic. There are striking differences in life span between different species, but within one species the parameter is relatively constant. For example, the average duration of human life has hardly changed in thousands of years. Although more and more people attain an advanced age as a result of developments in medical care and better nutrition, the characteristic upper limit for most remains 80 years. A further argument against the simple wear and tear theory is the observation that the time within which organisms age lies between a few days (even a few hours for unicellular organisms) and several thousand years, as with mammoth trees.

E

If a life span is a genetically determined biological characteristic, it is logically necessary to propose the existence of an internal clock, which in some way measures and controls the ageing process and which finally determines death as the last step in a fixed programme. Like the life span, the metabolic rate has for different organisms a fixed mathematical relationship to the body mass. In comparison to the life span this relationship is 'inverted': the larger the organism the lower its metabolic rate. Again this relationship is valid not only for birds, but also, similarly on average within the systematic unit, for all other organisms (plants, animals, unicellular organisms).

F

Animals which behave 'frugally' with energy become particularly old, for example, crocodiles and tortoises. Parrots and birds of prey are often held chained up. Thus they are not able to 'experience life' and so they attain a high life span in captivity. Animals which save energy by hibernation or lethargy (e.g. bats or hedgehogs) live much longer than those which are always active. The metabolic rate of mice can be reduced by a very low consumption of food (hunger diet). They then may live twice as long as their well fed

comrades. Women become distinctly (about 10 per cent) older than men. If you examine the metabolic rates of the two sexes you establish that the higher male metabolic rate roughly accounts for the lower male life span. That means that they live life 'energetically' - more intensively, but not for as long.

G

It follows from the above that sparing use of energy reserves should tend to extend life. Extreme high performance sports may lead to optimal cardiovascular performance, but they quite certainly do not prolong life. Relaxation lowers metabolic rate, as does adequate sleep and in general an equable and balanced personality. Each of us can develop his or her own 'energy saving programme' with a little self-observation, critical self-control and, above all, logical consistency. Experience will show that to live in this way not only increases the life span but is also very healthy. This final aspect should not be forgotten.

Questions 107-110

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

- Objects age in accordance with principles of **107**.....and of **108**.....
- Through mutations, organisms can **109**..... better to the environment
- **110**..... would pose a serious problem for the theory of evolution

MULTIPLE CHAISES

Multiple choices

Tip: use the key words in the question to help you find the right part of the text. Read the whole of the part and consider all four options.

Example

Here is a part of a text about poetry and one of the questions.

Poetry is notoriously difficult to define. It is often regarded as the most personal of literary forms. In which the poet pours out his or her soul in an effusion of feeling. Yet there numerous examples impassioned pose. Bothe fiction and polemic. Until a century ago most poetry – in English. at least used rhythm and rhyme , and the listener – for poetry is easily intended to be hard – could industry recognize it as poetry rather than pose. Twentieth century developments have put paid to the utility of this distinction when characterizing poetry as a hole, and incidentally, given several generation the mistaken belief that poetry is necessarily hard to understand. The defining characteristic of poetry, surely, is that it evokes and heightens joy, sorrow, fear or myriad other emotions and provides catharsis, the release of emotional tension.

Q. In the writer's opinion the main difference between poetry and other literature lies in:

- A. the amount of effort it requires from the reader
- B. its use of rhythm and rhyme
- C. its effects on the reader
- D. the extent to which it reflects the writer's feelings.

Answer: C

Explanation: the underlined and highlighted parts of the text show that **C** is correct because this is writer's opinion. Remember the question as you read each option. **D** refers to the sentence beginning it is often regarded as, but this is not the writer's opinion. **A** is incorrect because it says it is a mistaken belief and **B** is also incorrect because it says that poetry no longer necessarily uses rhythm and rhyme.

Pay attention to phrases like "in the writer's opinion" in the questions as the text may include several different points of view.

READING PASSAGE 5

A neuroscientist reveals how to think differently

In the last decade a revolution has occurred in the way that scientists think about the brain.

We now know that the decisions humans make can be traced to the firing patterns of neurons in specific parts of the brain. These discoveries have led to the field known as neuroeconomics, which studies the brain's secrets to success in an economic environment that demands innovation and being able to do things differently from competitors. A brain that can do this is an iconoclastic one. Briefly, an iconoclast is a person who does something that others say can't be done.

This definition implies that iconoclasts are different from other people, but more precisely, it is their brains that are different in three distinct ways: perception, fear response, and social intelligence. Each of these three functions utilizes a different circuit in the brain. Naysayers might suggest that the brain is irrelevant, that thinking in an original, even revolutionary, way is more a matter of personality than brain function. But the field of neuroeconomics was born out of the realization that the physical workings of the brain place limitations on the way we make decisions. By understanding these constraints, we begin to understand why some people march to a different drumbeat.

The first thing to realize is that the brain suffers from limited resources. It has a fixed energy budget, about the same as a 40 watt light bulb, so it has evolved to work as efficiently as possible. This is where most people are impeded from being an iconoclast. For example, when confronted with information streaming from the eyes, the brain will interpret this information in the quickest way possible. Thus it will draw on both past experience and any other source of information, such as what other people say, to make sense of what it is seeing. This happens all the time. The brain takes shortcuts that work so well we are hardly ever aware of them.

We think our perceptions of the world are real, but they are only biological and electrical rumblings. Perception is not simply a product of what your eyes or ears transmit to your brain. More than the physical reality of photons or sound waves, perception is a product of the brain.

Perception is central to iconoclasm. Iconoclasts see things differently to other people. Their brains do not fall into efficiency pitfalls as much as the average person's brain. Iconoclasts, either because they were born that way or through learning, have found ways to work around the perceptual shortcuts that plague most people. Perception is not something that is hardwired into the brain. It is a learned process, which is both a curse and an opportunity for change. The brain faces the fundamental problem of interpreting physical stimuli from the senses. Everything the brain sees, hears, or touches has multiple interpretations. The one that is ultimately chosen is simply the brain's best theory. In technical terms, these conjectures have their basis in the statistical likelihood of one interpretation over another and are heavily influenced by past experience and, importantly for potential iconoclasts, what other people say.

The best way to see things differently to other people is to bombard the brain with things it has never encountered before. Novelty releases the perceptual process from the chains of past experience and forces the brain to make new judgments. Successful iconoclasts have an extraordinary willingness to be exposed to what is fresh and different. Observation of iconoclasts shows that they embrace novelty while most people avoid things that are different.

The problem with novelty, however, is that it tends to trigger the brain's fear system. Fear is a major impediment to thinking like an iconoclast and stops the average person in his tracks. There are many types of fear, but the two that inhibit iconoclastic thinking and people generally find difficult to deal with are fear of uncertainty and fear of public ridicule. These may seem like trivial phobias. But fear of public speaking, which everyone must do from time to time, afflicts one-third of the population. This makes it too common to be

considered a mental disorder. It is simply a common variant of human nature, one which iconoclasts do not let inhibit their reactions.

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.

Questions 27-31 (*Choose the correct letter, A, B, C or D*).

1. Neuroeconomics is a field of study which seeks to

- | | | | |
|---|---|---|--|
| A cause a change in how scientists understand brain chemistry. | B understand how good decisions are made in the brain. | C understand how the brain is linked to achievement in competitive fields. | D trace the specific firing patterns of neurons in different areas of the brain |
|---|---|---|--|

2. According to the writer, iconoclasts are distinctive because

- | | | | |
|--|---|---|--------------------------------------|
| A they create unusual brain circuits. | B their brains function differently. | C their personalities are distinctive. | D they make decisions easily. |
|--|---|---|--------------------------------------|

3 According to the writer, the brain works efficiently because

- | | | | |
|------------------------------------|--|---------------------------------------|--------------------------------------|
| A it uses the eyes quickly. | B it interprets data logically. | C it generates its own energy. | D it relies on previous event |
|------------------------------------|--|---------------------------------------|--------------------------------------|

4. The writer says that perception is

- | | | | |
|--|---|---------------------------------------|---|
| A a combination of photons and sound waves. | B a reliable product of what your senses transmit. | C a result of brain processes. | D a process we are usually conscious of. |
|--|---|---------------------------------------|---|

5. According to the writer, an iconoclastic thinker

- | | |
|--|--|
| A centralises perceptual thinking in one part of the brain. | C has a brain that is hardwired for learning. |
| B. avoids cognitive traps. | D has more opportunities than the average person. |

READING PASSAGE 6

The Development of Museums

A

The conviction that historical relics provide infallible testimony about the past is rooted in the nineteenth and early twentieth centuries, when science was regarded as objective and value free. As one writer observes: 'Although it is now evident that artefacts are as easily altered as chronicles, public faith in their veracity endures: a tangible relic seems ipso facto real.' Such conviction was, until recently, reflected in museum displays. Museums used to look - and some still do - much like storage rooms of objects packed together in showcases: good for scholars who wanted to study the subtle differences in design, but not for the ordinary visitor, to whom it all looked alike. Similarly, the information accompanying the objects often made little sense to the lay visitor. The content and format of explanations dated back to a time when the museum was the exclusive domain of the scientific researcher.

B

Recently, however, attitudes towards history and the way it should be presented have altered. The key word in heritage display is now 'experience', the more exciting the better and, if possible, involving all the senses. Good examples of this approach in the UK are the Jorvik Centre in York; the National Museum of Photography, Film and Television in Bradford; and the Imperial War Museum in London. In the US the trend emerged much earlier: Williamsburg has been a prototype for many heritage developments in other parts of the world. No one can predict where the process will end. On so-called heritage sites the re-enactment of historical events is increasingly popular, and computers will soon provide virtual reality experiences, which will present visitors with a vivid image of the period of their choice, in which they themselves can act as if part of the historical environment. Such developments have been criticised as an intolerable vulgarisation, but the success of many historical theme parks and similar locations suggests that the majority of the public does not share this opinion.

C

In a related development, the sharp distinction between museum and heritage sites on the one hand, and theme parks on the other, is gradually evaporating. They already borrow ideas and concepts from one another. For example, museums have adopted story lines for exhibitions, sites have accepted 'theming' as a relevant tool, and theme parks are moving towards more authenticity and research-based presentations. In zoos, animals are no longer kept in cages, but in great spaces, either in the open air or in enormous greenhouses, such as the jungle and desert environments in Burgers' Zoo in Holland. This particular trend is regarded as one of the major developments in the presentation of natural history in the twentieth century.

D

Theme parks are undergoing other changes, too, as they try to present more serious social and cultural issues, and move away from fantasy. This development is a response to market forces and, although museums and heritage sites have a special, rather distinct, role to fulfil, they are also operating in a very competitive environment, where visitors make choices on how and where to spend their free time. Heritage and museum experts do not have to invent stories and recreate historical environments to attract their visitors: their assets are already in place. However, exhibits must be both based on artefacts and facts as we know them, and attractively presented. Those who are professionally engaged in the art of interpreting history are thus in a difficult position, as they must steer a narrow course between the demands of 'evidence' and 'attractiveness', especially given the increasing need in the heritage industry for income-generating activities.

E

It could be claimed that in order to make everything in heritage more 'real', historical accuracy must be increasingly altered. For example, *Pithecanthropus erectus* is depicted in an Indonesian museum with Malay facial features, because this corresponds to public perceptions. Similarly, in the Museum of Natural History in Washington, Neanderthal man is shown making a dominant gesture to his wife. Such presentations tell us more about contemporary perceptions of the world than about our ancestors. There is one compensation, however, for the professionals who make these interpretations: if they did not provide

the interpretation, visitors would do it for themselves, based on their own ideas, misconceptions and prejudices. And no matter how exciting the result, it would contain a lot more bias than the presentations provided by experts.

F

Human bias is inevitable, but another source of bias in the representation of history has to do with the transitory nature of the materials themselves. The simple fact is that not everything from history survives the historical process. Castles, palaces and cathedrals have a longer lifespan than the dwellings of ordinary people. The same applies to the furnishings and other contents of the premises. In a town like Leyden in Holland, which in the seventeenth century was occupied by approximately the same number of inhabitants as today, people lived within the walled town, an area more than five times smaller than modern Leyden. In most of the houses several families lived together in circumstances beyond our imagination. Yet in museums, fine period rooms give only an image of the lifestyle of the upper class of that era. No wonder that people who stroll around exhibitions are filled with nostalgia; the evidence in museums indicates that life was so much better in the past. This notion is induced by the bias in its representation in museums and heritage centres.

Questions 6-11 (*Choose the correct letter, A, B, C or D.*)

6. Compared with today's museums, those of the past

- | | |
|--|---|
| A did not present history in a detailed way. | C were more clearly organised. |
| B were not primarily intended for the public. | D preserved items with greater care. |

7. According to the writer, current trends in the heritage industry

- | | |
|---|-----------------------------------|
| A emphasise personal involvement. | C rely on computer images. |
| B have their origins in York and London. | D reflect minority tastes. |

8 The writer says that museums, heritage sites and theme parks

- | | |
|---|---|
| A often work in close partnership. | C have similar exhibits. |
| B try to preserve separate identities. | D are less easy to distinguish than before |

9. The writer says that in preparing exhibits for museums, experts

- | | |
|---|--|
| A should pursue a single objective. | C should be free from commercial constraints. |
| B have to do a certain amount of language translation. | D have to balance conflicting priorities. |

10. In paragraph E, the writer suggests that some museum exhibits

- | | |
|---|---|
| A fail to match visitor expectations. | C reveal more about present beliefs than about the past. |
| B are based on the false assumptions of professionals. | D allow visitors to make more use of their imagination. |

11. The passage ends by noting that our view of history is biased because

- | | |
|--|--|
| A we fail to use our imagination. | C we tend to ignore things that displease us. |
| B only very durable objects remain from the past. | D museum exhibits focus too much on the local area. |

READING PASSAGE 7

.The meaning and power of smell

The sense of smell, or olfaction, is powerful. Odours affect us on a physical, psychological and social level. For the most part, however, we breathe in the aromas which surround us without being consciously aware of their importance to us. It is only when the faculty of smell is impaired for some reason that we begin to realise the essential role the sense of smell plays in our sense of well-being

A

A survey conducted by Anthony Synott at Montreal's Concordia University asked participants to comment on how important smell was to them in their lives. It became apparent that smell can evoke strong emotional responses. A scent associated with a good experience can bring a rush of joy, while a foul odour or one associated with a bad memory may make us grimace with disgust. Respondents to the survey noted that many of their olfactory likes and dislikes were based on emotional associations. Such associations can be powerful enough so that odours that we would generally label unpleasant become agreeable, and those that we would generally consider fragrant become disagreeable for particular individuals. The perception of smell, therefore, consists not only of the sensation of the odours themselves, but of the experiences and emotions associated with them.

B

Odours are also essential cues in social bonding. One respondent to the survey believed that there is no true emotional bonding without touching and smelling a loved one. In fact, infants recognise the odours of their mothers soon after birth and adults can often identify their children or spouses by scent. In one well-known test, women and men were able to distinguish by smell alone clothing worn by their marriage partners from similar clothing worn by other people. Most of the subjects would probably never have given much thought to odour as a cue for identifying family members before being involved in the test, but as the experiment revealed, even when not consciously considered, smells register.

C

In spite of its importance to our emotional and sensory lives, smell is probably the most undervalued sense in many cultures. The reason often given for the low regard in which smell is held is that, in comparison with its importance among animals, the human sense of smell is feeble and undeveloped. While it is true that the olfactory powers of humans are nothing like as fine as those possessed by certain animals, they are still remarkably acute. Our noses are able to recognise thousands of smells, and to perceive odours which are present only in extremely small quantities.

D

Smell, however, is a highly elusive phenomenon. Odours, unlike colours, for instance, cannot be named in many languages because the specific vocabulary simply doesn't exist. 'It smells like . . .', we have to say when describing an odour, struggling to express our olfactory experience. Nor can odours be recorded: there is no effective way to either capture or store them over time. In the realm of olfaction, we must make do with descriptions and recollections. This has implications for olfactory research.

E

Most of the research on smell undertaken to date has been of a physical scientific nature. Significant advances have been made in the understanding of the biological and chemical nature of olfaction, but many fundamental questions have yet to be answered. Researchers have still to decide whether smell is one sense or two - one responding to odours proper and the other registering odourless chemicals in the air. Other unanswered questions are whether the nose is the only part of the body affected by odours, and how smells can be measured objectively given the nonphysical components. Questions like these mean that interest in the psychology of smell is inevitably set to play an increasingly important role for researchers.

F

However, smell is not simply a biological and psychological phenomenon. Smell is cultural, hence it is a social and historical phenomenon. Odours are invested with cultural values: smells that are considered to be offensive in some cultures may be perfectly acceptable in others. Therefore, our sense of smell is a means of, and model for, interacting with the world. Different smells can provide us with intimate and emotionally charged experiences and the value that we attach to these experiences is interiorised by the members of society in a

deeply personal way. Importantly, our commonly held feelings about smells can help distinguish us from other cultures. The study of the cultural history of smell is, therefore, in a very real sense, an investigation into the essence of human culture.

Questions 33-36 (*Choose the correct letter, A, B, C or D*).

12 According to the introduction, we become aware of the importance of smell when

- | | |
|--|---|
| A we discover a new smell. | C our ability to smell is damaged. |
| B we experience a powerful smell. | D we are surrounded by odours. |

12 The experiment described in paragraph B

- | | |
|---|---|
| A shows how we make use of smell without realising it. | C proves that a sense of smell is learnt. |
| B demonstrates that family members have a similar smell. | D compares the sense of smell in males and females |

14 What is the writer doing in paragraph C?

- | | |
|------------------------------------|------------------------------------|
| A supporting other research | C rejecting a common belief |
| B making a proposal | D describing limitations |

15 What does the writer suggest about the study of smell in the atmosphere in paragraph E?

- | | |
|--|---|
| A The measurement of smell is becoming more accurate. | B Researchers believe smell is a purely physical reaction. |
| | C Most smells are inoffensive. |
| | D Smell is yet to be defined. |

READING PASSAGE 8

Striking Back at Lightning With Lasers

Seldom is the weather more dramatic than when thunderstorms strike. Their electrical fury inflicts death or serious injury on around 500 people each year in the United States alone. As the clouds roll in, a leisurely round of golf can become a terrifying dice with death - out in the open, a lone golfer may be a lightning bolt's most inviting target. And there is damage to property too. Lightning damage costs American power companies more than \$100 million a year.

But researchers in the United States and Japan are planning to hit back. Already in laboratory trials they have tested strategies for neutralising the power of thunderstorms, and this winter they will brave real storms, equipped with an armoury of lasers that they will be pointing towards the heavens to discharge thunderclouds before lightning can strike.

The idea of forcing storm clouds to discharge their lightning on command is not new. In the early 1960s, researchers tried firing rockets trailing wires into thunderclouds to set up an easy discharge path for the huge electric charges that these clouds generate. The technique survives to this day at a test site in Florida run by the University of Florida, with support from the Electrical Power Research Institute (EPRI), based in California. EPRI, which is funded by power companies, is looking at ways to protect the United States' power grid from lightning strikes. 'We can cause the lightning to strike where we want it to using rockets,' says Ralph Bernstein, manager of lightning projects at EPRI. The rocket site is providing precise measurements of lightning voltages and allowing engineers to check how electrical equipment bears up.

Bad behavior

But while rockets are fine for research, they cannot provide the protection from lightning strikes that everyone is looking for. The rockets cost around \$1,200 each, can only be fired at a limited frequency and their failure rate is about 40 per cent. And even when they do trigger lightning, things still do not always go according to plan. 'Lightning is not perfectly well behaved,' says Bernstein. 'Occasionally, it will take a branch and go someplace it wasn't supposed to go.'

And anyway, who would want to fire streams of rockets in a populated area? 'What goes up must come down,' points out Jean-Claude Diels of the University of New Mexico. Diels is leading a project, which is backed by EPRI, to try to use lasers to discharge lightning safely- and safety is a basic requirement since no one wants to put themselves or their expensive equipment at risk. With around \$500,000 invested so far, a promising system is just emerging from the laboratory.

The idea began some 20 years ago, when high-powered lasers were revealing their ability to extract electrons out of atoms and create ions. If a laser could generate a line of ionisation in the air all the way up to a storm cloud, this conducting path could be used to guide lightning to Earth, before the electric field becomes strong enough to break down the air in an uncontrollable surge. To stop the laser itself being struck, it would not be pointed straight at the clouds. Instead it would be directed at a mirror, and from there into the sky. The mirror would be protected by placing lightning conductors close by. Ideally, the cloud-zapper (gun) would be cheap enough to be installed around all key power installations, and portable enough to be taken to international sporting events to beam up at brewing storm clouds.

A stumbling block

However, there is still a big stumbling block. The laser is no nifty portable: it's a monster that takes up a whole room. Diels is trying to cut down the size and says that a laser around the size of a small table is in the offing. He plans to test this more manageable system on live thunderclouds next summer. Bernstein says that Diels's system is attracting lots of interest from the power companies.

But they have not yet come up with the \$5 million that EPRI says will be needed to develop a commercial system, by making the lasers yet smaller and cheaper. 'I cannot say I have money yet, but I'm working on it,'

says Bernstein. He reckons that the forthcoming field tests will be the turning point - and he's hoping for good news. Bernstein predicts 'an avalanche of interest and support' if all goes well. He expects to see cloud-zappers eventually costing \$50,000 to \$100,000 each.

Other scientists could also benefit. With a lightning 'switch' at their fingertips, materials scientists could find out what happens when mighty currents meet matter. Diels also hopes to see the birth of 'interactive meteorology' - not just forecasting the weather but controlling it. 'If we could discharge clouds, we might affect the weather,' he says.

And perhaps, says Diels, we'll be able to confront some other meteorological menaces. 'We think we could prevent hail by inducing lightning,' he says. Thunder, the shock wave that comes from a lightning flash, is thought to be the trigger for the torrential rain that is typical of storms. A laser thunder factory could shake the moisture out of clouds, perhaps preventing the formation of the giant hailstones that threaten crops. With luck, as the storm clouds gather this winter, laser-toting researchers could, for the first time, strike back.

Questions 17-20 (*Choose the correct letter, A, B, C or D*).

17 The main topic discussed in the text is

A. The damage caused to US golf courses and golf players by lightning strikes.

B. The effect of lightning on power supplies in the US and in Japan.

C. A variety of methods used in trying to control lightning strikes.

D. A laser technique used in trying to control lightning strikes.

18 According to the text, every year lightning

A Does considerable damage to buildings during thunderstorms.

B Kills or injures mainly golfers in the United States.

C Kills or injures around 500 people throughout the world.

D Damages more than 100 American power companies.

19. Researchers at the University of Florida and at the University of New Mexico

A. Receive funds from the same source.

B. Rre using the same techniques.

C. Rre employed by commercial companies.

D. Rre in opposition to each other.

LAND OF THE RISING SUN

A

Japan has a significantly better record in terms of average mathematical attainment than England and Wales. Large sample international comparisons of pupils' attainments since the 1960s have established that not only did Japanese pupils at age 13 have better scores of average attainment, but there was also a larger proportion of 'low' attainers in England, where, incidentally, the variation in attainment scores was much greater. The percentage of Gross National Product spent on education is reasonably similar in the two countries, so how is this higher and more consistent attainment in maths achieved?

B

Lower secondary schools in Japan cover three school years, from the seventh grade (age 13) to the ninth grade (age 15). Virtually all pupils at this stage attend state schools: only 3 per cent are in the private sector. Schools are usually modern in design, set well back from the road and spacious inside. Classrooms are large and pupils sit at single desks in rows. Lessons last for a standardised 50 minutes and are always followed by a 10-minute break, which gives the pupils a chance to let off steam. Teachers begin with a formal address and mutual bowing, and then concentrate on whole-class teaching. Classes are large - usually about 40 - and are unstreamed. Pupils stay in the same class for all lessons throughout the school and develop considerable class identity and loyalty. Pupils attend the school in their own neighbourhood, which in theory removes ranking by school. In practice in Tokyo, because of the relative concentration of schools, there is some competition to get into the 'better' school in a particular area.

C

Traditional ways of teaching form the basis of the lesson and the remarkably quiet classes take their own notes of the points made and the examples demonstrated. Everyone has their own copy of the textbook supplied by the central education authority, Monbusho, as part of the concept of free compulsory education up to the age of 15. These textbooks are, on the whole, small, presumably inexpensive to produce, but well set out and logically developed. (One teacher was particularly keen to introduce colour and pictures into maths textbooks: he felt this would make them more accessible to pupils brought up in a cartoon culture.) Besides approving textbooks, Monbusho also decides the highly centralised national curriculum and how it is to be delivered.

D

Lessons all follow the same pattern. At the beginning, the pupils put solutions to the homework on the board, then the teachers comment, correct or elaborate as necessary. Pupils mark their own homework: this is an important principle in Japanese schooling as it enables pupils to see where and why they made a mistake, so that these can be avoided in future. No one minds mistakes or ignorance as long as you are prepared to learn from them.

After the homework has been discussed, the teacher explains the topic of the lesson, slowly and with a lot of repetition and elaboration. Examples are demonstrated on the board; questions from the textbook are worked through first with the class, and then the class is set questions from the textbook to do individually. Only rarely are supplementary worksheets distributed in a maths class. The impression is that the logical nature of the textbooks and their comprehensive coverage of different types of examples, combined with the relative homogeneity of the class, renders work sheets unnecessary. At this point, the teacher would circulate and make sure that all the pupils were coping well.

E

It is remarkable that large, mixed-ability classes could be kept together for maths throughout all their compulsory schooling from 6 to 15. Teachers say that they give individual help at the end of a lesson or after school, setting extra work if necessary. In observed lessons, any strugglers would be assisted by the teacher or quietly seek help from their neighbour. Carefully fostered class identity makes pupils keen to help each other - anyway, it is in their interests since the class progresses together.

This scarcely seems adequate help to enable slow learners to keep up. However, the Japanese attitude towards education runs along the lines of 'if you work hard enough, you can do almost anything'. Parents are kept closely informed of their children's progress and will play a part in helping their

children to keep up with class, sending them to 'Juku' (private evening tuition) if extra help is needed and encouraging them to work harder. It seems to work, at least for 95 per cent of the school population.

F

So what are the major contributing factors in the success of maths teaching? Clearly, attitudes are important. Education is valued greatly in Japanese culture; maths is recognised as an important compulsory subject throughout schooling; and the emphasis is on hard work coupled with a focus on accuracy.

Other relevant points relate to the supportive attitude of a class towards slower pupils, the lack of competition within a class, and the positive emphasis on learning for oneself and improving one's own standard. And the view of repetitively boring lessons and learning the facts by heart, which is sometimes quoted in relation to Japanese classes, may be unfair and unjustified. No poor maths lessons were observed. They were mainly good and one or two were inspirational.

Questions 10-13 (*Choose the correct letter, A, B, C or D*).

20 Maths textbooks in Japanese schools are

- | | |
|--|---|
| A. cheap for pupils to buy. | C. written to be used in conjunction with TV programmes. |
| B. well organised and adapted to the needs of the pupils. | D. not very popular with many Japanese teachers. |

21 When a new maths topic is introduced,

- | | |
|--|---|
| A. students answer questions on the board. | D. it is usual for students to use extra worksheets. |
| B. students rely entirely on the textbook. | |
| C. it is carefully and patiently explained to the students. | |

17 How do schools deal with students who experience difficulties?

- | | |
|---|---|
| A. They are given appropriate supplementary tuition. | C. They are forced to explain their slow progress. |
| B. They are encouraged to copy from other pupils. | D. They are placed in a mixed-ability class |

18. Why do Japanese students tend to achieve relatively high rates of success in maths?

- | | |
|--|---|
| A. It is a compulsory subject in Japan. | C. Much effort is made and correct answers are emphasised. |
| B. They are used to working without help from others. | D. There is a strong emphasis on repetitive learning. |

READING PASSAGE 10

.Biological control of pests

The continuous and reckless use of synthetic chemicals for the control of pests which pose a threat to agricultural crops and human health is proving to be counter-productive. Apart from engendering widespread ecological disorders, pesticides have contributed to the emergence of a new breed of chemical-resistant, highly lethal superbugs.

According to a recent study by the Food and Agriculture Organisation (FAO), more than 300 species of agricultural pests have developed resistance to a wide range of potent chemicals. Not to be left behind are the disease-spreading pests, about 100 species of which have become immune to a variety of insecticides now in use.

One glaring disadvantage of pesticides' application is that, while destroying harmful pests, they also wipe out many useful non-targeted organisms, which keep the growth of the pest population in check. This results in what agroecologists call the 'treadmill syndrome'. Because of their tremendous breeding potential and genetic diversity, many pests are known to withstand synthetic chemicals and bear offspring with a built-in resistance to pesticides.

The havoc that the 'treadmill syndrome' can bring about is well illustrated by what happened to cotton farmers in Central America. In the early 1940s, basking in the glory of chemical-based intensive agriculture, the farmers avidly took to pesticides as a sure measure to boost crop yield. The insecticide was applied eight times a year in the mid-1940s, rising to 28 in a season in the mid-1950s, following the sudden proliferation of three new varieties of chemical-resistant pests.

By the mid-1960s, the situation took an alarming turn with the outbreak of four more new pests, necessitating pesticide spraying to such an extent that 50% of the financial outlay on cotton production was accounted for by pesticides. In the early 1970s, the spraying frequently reached 70 times a season as the farmers were pushed to the wall by the invasion of genetically stronger insect species.

Most of the pesticides in the market today remain inadequately tested for properties that cause cancer and mutations as well as for other adverse effects on health, says a study by United States environmental agencies. The United States National Resource Defense Council has found that DDT was the most popular of a long list of dangerous chemicals in use.

In the face of the escalating perils from indiscriminate applications of pesticides, a more effective and ecologically sound strategy of biological control, involving the selective use of natural enemies of the pest population, is fast gaining popularity - though, as yet, it is a new field with limited potential. The advantage of biological control in contrast to other methods is that it provides a relatively low-cost, perpetual control system with a minimum of detrimental side-effects. When handled by experts, bio-control is safe, non-polluting and self-dispersing.

The Commonwealth Institute of Biological Control (CIBC) in Bangalore, with its global network of research laboratories and field stations, is one of the most active, non-commercial research agencies engaged in pest control by setting natural predators against parasites. CIBC also serves as a clearing-house for the export and import of biological agents for pest control world-wide.

CIBC successfully used a seed-feeding weevil, native to Mexico, to control the obnoxious parthenium weed, known to exert devious influence on agriculture and human health in both India and Australia. Similarly the Hyderabad-based Regional Research Laboratory (RRL), supported by CIBC, is now trying out an Argentinian weevil for the eradication of water hyacinth, another dangerous weed, which has become a nuisance in many parts of the world. According to Mrs Kaiser Jamil of RRL, 'The Argentinian weevil does not attack any other

plant and a pair of adult bugs could destroy the weed in 4-5 days.' CIBC is also perfecting the technique for breeding parasites that prey on 'disapene scale' insects - notorious defoliant of fruit trees in the US and India.

How effectively biological control can be pressed into service is proved by the following examples. In the late 1960s, when Sri Lanka's flourishing coconut groves were plagued by leaf-mining hispid, a larval parasite imported from Singapore brought the pest under control. A natural predator indigenous to India, *Neodumetia sangawani*, was found useful in controlling the Rhodes grass-scale insect that was devouring forage grass in many parts of the US. By using *Neochetina bruci*, a beetle native to Brazil, scientists at Kerala Agricultural University freed a 12-kilometre-long canal from the clutches of the weed *Salvinia molesta*, popularly called 'African Payal' in Kerala. About 30,000 hectares of rice fields in Kerala are infested by this weed.

Questions 14-17 (*Choose the correct letter, A, B, C, or D*).

17 The use of pesticides has contributed to

- A a change in the way ecologies are classified by agroecologists.
- B an imbalance in many ecologies around the world.
- C the prevention of ecological disasters in some parts of the world.
- D an increase in the range of ecologies which can be usefully farmed.

18 The Food and Agriculture Organisation has counted more than 300 agricultural pests which

- A are no longer responding to most pesticides in use.
- B can be easily controlled through the use of pesticides.
- C continue to spread disease in a wide range of crops.
- D may be used as part of bio-control's replacement of pesticides.

19 Cotton farmers in Central America began to use pesticides

- A because of an intensive government advertising campaign.
- B in response to the appearance of new varieties of pest.
- C as a result of changes in the seasons and the climate.
- D to ensure more cotton was harvested from each crop.

20 By the mid-1960s, cotton farmers in Central America found that pesticides

- A were wiping out 50% of the pests plaguing the crops.
- B were destroying 50% of the crops they were meant to protect.
- C were causing a 50% increase in the number of new pests reported.
- D were costing 50% of the total amount they spent on their crops.

The psychology of innovation

Why are so few companies truly innovative?

Innovation is key to business survival, and companies put substantial resources into inspiring employees to develop new ideas. There are, nevertheless, people working in luxurious, state-of-the-art centres designed to stimulate innovation who find that their environment doesn't make them feel at all creative. And there are those who don't have a budget, or much space, but who innovate successfully.

For Robert B. Cialdini, Professor of Psychology at Arizona State University, one reason that companies don't succeed as often as they should is that innovation starts with recruitment. Research shows that the fit between an employee's values and a company's values makes a difference to what contribution they make and whether, two years after they join, they're still at the company. Studies at Harvard Business School show that, although some individuals may be more creative than others, almost every individual can be creative in the right circumstances.

One of the most famous photographs in the story of rock'n'roll emphasises Cialdini's views. The 1956 picture of singers Elvis Presley, Carl Perkins, Johnny Cash and Jerry Lee Lewis jamming at a piano in Sun Studios in Memphis tells a hidden story. Sun's 'million-dollar quartet' could have been a quintet. Missing from the picture is Roy Orbison, a greater natural singer than Lewis, Perkins or Cash. Sam Phillips, who owned Sun, wanted to revolutionise popular music with songs that fused black and white music, and country and blues. Presley, Cash, Perkins and Lewis instinctively understood Phillips's ambition and believed in it. Orbison wasn't inspired by the goal, and only ever achieved one hit with the Sun label.

The value fit matters, says Cialdini, because innovation is, in part, a process of change, and under that pressure we, as a species, behave differently, 'When things change, we are hard-wired to play it safe.' Managers should therefore adopt an approach that appears counterintuitive -they should explain what stands to be lost if the company fails to seize a particular opportunity. Studies show that we invariably take more gambles when threatened with a loss than when offered a reward.

Managing innovation is a delicate art. It's easy for a company to be pulled in conflicting directions as the marketing, product development, and finance departments each get different feedback from different sets of people. And without a system which ensures collaborative exchanges within the company, it's also easy for small 'pockets of innovation' to disappear. Innovation is a contact sport. You can't brief people just by saying, 'We're going in this direction and I'm going to take you with me.'

Cialdini believes that this 'follow-the-leader syndrome, is dangerous, not least because it encourages bosses to go it alone. 'It's been scientifically proven that three people will be better than one at solving problems, even if that one person is the smartest person in the field.' To prove his point, Cialdini cites an interview with molecular biologist James Watson. Watson, together with Francis Crick, discovered the structure of DNA, the genetic information carrier of all living organisms. 'When asked how they had cracked the code ahead of an array of highly accomplished rival investigators, he said something that stunned me. He said "he and Crick had succeeded because they were aware that they weren't the most intelligent of the scientists pursuing the answer. The smartest scientist was called Rosalind Franklin who, Watson said, "was so intelligent she rarely sought advice".'

Teamwork taps into one of the basic drivers of human behaviour. 'The principle of social proof is so pervasive that we don't even recognise it,' says Cialdini. 'If your project is being resisted, for example, by a group of veteran employees, ask another old-timer to speak up for it.' Cialdini is not alone in advocating this strategy. Research shows that peer power, used horizontally not vertically, is much more powerful than any boss's speech.

Writing, visualising and prototyping can stimulate the flow of new ideas. Cialdini cites scores of research papers and historical events that prove that even something as simple as writing deepens every individual's engagement in the project. It is, he says, the reason why all those competitions on breakfast cereal packets encouraged us to write in saying, in no more than 10 words: 'I like Kellogg's Corn Flakes because...' The very act of writing makes us more likely to believe it.

Authority doesn't have to inhibit innovation but it often does. The wrong kind of leadership will lead to what Cialdini calls "captainitis, the regrettable tendency of team members to opt out of team responsibilities that are properly their'. He calls it captainitis because, he says, "crew members of multipilot aircraft exhibit a sometimes deadly passivity when the flight captain makes a clearly wrong-headed decision". This behaviour is not, he says, unique to air travel, but can happen in any workplace where the leader is overbearing.

At the other end of the scale is the 1980s Memphis design collective, a group of young designers for whom "the only rule was that there were no rule". This environment encouraged a free interchange of ideas, which led to more creativity with form, function, colour and materials that revolutionised attitudes to furniture design.

Many theorists believe the ideal boss should lead from behind, taking pride in collective accomplishment and giving credit where it is due. Cialdini says: "Leaders should encourage everyone to contribute and simultaneously assure all concerned that every recommendation is important to making the right decision and will be given full attention" The frustrating thing about innovation is that there are many approaches, but no magic formula. However, a manager who wants to create a truly innovative culture can make their job a lot easier by recognising these psychological realities.

Questions 27-30

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

28. The example of the 'million-dollar quartet' underlines the writer's point about

- | | |
|------------------------------|-------------------------------------|
| A recognising talent. | C having a shared objective. |
| B working as a team. | D being an effective leader. |

29. James Watson suggests that he and Francis Crick won the race to discover the DNA code because they

- | | |
|---|---|
| A were conscious of their own limitations. | C were determined to outperform their brighter |
| B brought complementary skills to their | rivals. |
| partnership. | D encouraged each other to realise their joint |
| | ambition. |

30. The writer mentions competitions on breakfast cereal packets as an example of how to

- | | |
|-------------------------------------|--|
| A inspire creative thinking. | C promote loyalty to a group. |
| B generate concise writing. | D strengthen commitment to an idea. |

31. In the last paragraph, the writer suggests that it is important for employees to

- | | |
|--|---|
| A be aware of their company's goals. | C have respect for their co-workers' |
| B feel that their contributions are valued. | achievements. |
| D understand why certain management decisions are made. | |

Museums of fine art and their public

The fact that people go to the Louvre museum in Paris to see the original painting Mona Lisa when they can see a reproduction anywhere leads us to question some assumptions about the role of museums of fine art in today's world

One of the most famous works of art in the world is Leonardo da Vinci's Mona Lisa. Nearly everyone who goes to see the original will already be familiar with it from reproductions, but they accept that fine art is more rewardingly viewed in its original form.

However, if Mona Lisa was a famous novel, few people would bother to go to a museum to read the writer's actual manuscript rather than a printed reproduction. This might be explained by the fact that the novel has evolved precisely because of technological developments that made it possible to print out huge numbers of texts, whereas oil paintings have always been produced as unique objects. In addition, it could be argued that the practice of interpreting or 'reading' each medium follows different conventions. With novels, the reader attends mainly to the meaning of words rather than the way they are printed on the page, whereas the 'reader' of a painting must attend just as closely to the material form of marks and shapes in the picture as to any ideas they may signify.

Yet it has always been possible to make very accurate facsimiles of pretty well any fine art work. The seven surviving versions of Mona Lisa bear witness to the fact that in the 16th century, artists seemed perfectly content to assign the reproduction of their creations to their workshop apprentices as regular 'bread and butter' work. And today the task of reproducing pictures is incomparably more simple and reliable, with reprographic techniques that allow the production of high-quality prints made exactly to the original scale, with faithful colour values, and even with duplication of the surface relief of the painting.

But despite an implicit recognition that the spread of good reproductions can be culturally valuable, museums continue to promote the special status of original work.

Unfortunately, this seems to place severe limitations on the kind of experience offered to visitors.

One limitation is related to the way the museum presents its exhibits. As repositories of unique historical objects, art museums are often called 'treasure houses'. We are reminded of this even before we view a collection by the presence of security guards, attendants, ropes and display cases to keep us away from the exhibits. In many cases, the architectural style of the building further reinforces that notion. In addition, a major collection like that of London's National Gallery is housed in numerous rooms, each with dozens of works, any one of which is likely to be worth more than all the average visitor possesses. In a society that judges the personal status of the individual so much by their material worth, it is therefore difficult not to be impressed by one's own relative 'worthlessness' in such an environment.

Furthermore, consideration of the 'value' of the original work in its treasure house setting impresses upon the viewer that, since these works were originally produced, they have been assigned a huge monetary value by some person or institution more powerful than themselves. Evidently, nothing the viewer thinks about the work is going to alter that value, and so today's viewer is deterred from trying to extend that spontaneous, immediate, self-reliant kind of reading which would originally have met the work.

The visitor may then be struck by the strangeness of seeing such diverse paintings, drawings and sculptures brought together in an environment for which they were not originally created. This 'displacement effect' is further heightened by the sheer volume of exhibits. In the case of a major collection, there are probably more works on display than we could realistically view in weeks or even months.

This is particularly distressing because time seems to be a vital factor in the appreciation of all art forms. A fundamental difference between paintings and other art forms is that there is no prescribed time over which a painting is viewed. By contrast, the audience encourage an opera or a play over a specific time, which is the duration of the performance. Similarly novels and poems are read in a prescribed temporal sequence, whereas a picture has no clear place at which to start viewing, or at which to finish. Thus art works themselves encourage us to view them superficially, without appreciating the richness of detail and labour that is involved.

Consequently, the dominant critical approach becomes that of the art historian, a specialised academic approach devoted to ‘discovering the meaning’ of art within the cultural context of its time. This is in perfect harmony with the museum’s function, since the approach is dedicated to seeking out and conserving ‘authentic’, original, readings of the exhibits. Again, this seems to put paid to that spontaneous, participatory criticism which can be found in abundance in criticism of classic works of literature, but is absent from most art history.

The displays of art museums serve as a warning of what critical practices can emerge when spontaneous criticism is suppressed. The museum public, like any other audience, experience art more rewardingly when given the confidence to express their views. If appropriate works of fine art could be rendered permanently accessible to the public by means of high-fidelity reproductions, as literature and music already are, the public may feel somewhat less in awe of them. Unfortunately, that may be too much to ask from those who seek to maintain and control the art establishment.

Questions 32-35 (*Choose the correct letter, A, B, C or D*).

32. The writer mentions London’s National Gallery to illustrate

- A** the undesirable cost to a nation of maintaining a huge collection of art.
- B** the conflict that may arise in society between financial and artistic values.
- C** the negative effect a museum can have on visitors’ opinions of themselves.
- D** the need to put individual well-being above large-scale artistic schemes.

33. The writer says that today, viewers may be unwilling to criticise a because

- A** they lack the knowledge needed to support an opinion.
- B** they fear it may have financial implications.
- C** they have no real concept of the work’s value.
- D** they feel their personal reaction is of no significance.

34. According to the writer, the ‘displacement effect’ on the visitor is caused by

- A** the variety of works on display and the way they are arranged.
- B** the impossibility of viewing particular works of art over a long period.
- C** the similar nature of the paintings and the lack of great works.
- D** the inappropriate nature of the individual works selected for exhibition.

35. The writer says that unlike other forms of art, a painting does not

- A** involve direct contact with an audience.
- B** require a specific location for a performance.
- C** need the involvement of other professionals.
- D** have a specific beginning or end.

READING PASSAGE 13

Beyond the blue horizon

Ancient voyagers who settled the far-flung islands of the Pacific Ocean

(1)

An important archaeological discovery on the island of Efate in the Pacific archipelago of Vanuatu has revealed traces of an ancient seafaring people, the distant ancestors of today's Polynesians. The site came to light only by chance. An agricultural worker, digging in the grounds of a derelict plantation, scraped open a grave – the first of dozens in a burial ground some 3,000 years old. It is the oldest cemetery ever found in the Pacific islands, and it harbors the remains of an ancient people archaeologists call the Lapita.

(2)

They were daring blue-water adventurers who used basic canoes to rove across the ocean. But they were not just explorers. They were also pioneers who carried with them everything they would need to build new lives – their livestock, taro seedlings and stone tools. Within the span of several centuries, the Lapita stretched the boundaries of their world from the jungle-clad volcanoes of Papua New Guinea to the loneliest coral outliers of Tonga.

(3)

The Lapita left precious few clues about themselves, but Efate expands the volume of data available to researchers dramatically. The remains of 62 individuals have been uncovered so far, and archaeologists were also thrilled to find six complete Lapita pots. Other items included a Lapita burial urn with modeled birds arranged on the rim as though peering down at the human remains sealed inside. 'It's an important discovery,' says Matthew Spriggs, professor of archaeology at the Australian National University and head of the international team digging up the site, 'for it conclusively identifies the remains as Lapita.'

(4)

DNA teased from these human remains may help answer one of the most puzzling questions in Pacific anthropology: did all Pacific islanders spring from one source or many? Was there only one outward migration from a single point in Asia, or several from different points? 'This represents the best opportunity we've had yet,' says Spriggs, 'to find out who the Lapita actually were, where they came from, and who their closest descendants are today.'

(5)

There is one stubborn question for which archaeology has yet to provide any answers: how did the Lapita accomplish the ancient equivalent of a moon landing, many times over? No-one has found one of their canoes or any rigging, which could reveal how the canoes were sailed. Nor do the oral histories and traditions of later Polynesians offer any insights, for they turn into myths long before they reach as far back in time as the Lapita.

(6)

'All we can say for certain is that the Lapita had canoes that were capable of ocean voyages, and they had the ability to sail them,' says Geoff Irwin, a professor of archaeology at the University of Auckland. Those sailing skills, he says, were developed and passed down over thousands of years by earlier mariners who worked their way through the archipelagoes of the western Pacific, making short crossings to nearby islands. The real adventure didn't begin, however, until their Lapita descendants sailed out of sight of land, with empty horizons on every side. This must have been as difficult for them as landing on the moon is for us today. Certainly it distinguished them from their ancestors, but what gave them the courage to launch out on such risky voyages?

(7)

The Lapita was thrust into the Pacific was eastward, against the prevailing trade winds, Irwin notes. Those nagging headwinds, he argues, may have been the key to their success. 'They could sail out for days into the unknown and assess the area, secure in the knowledge that if they didn't find anything, they could turn about and catch a swift ride back on the trade winds. This is what would have made the whole thing work.' Once out there, skilled seafarers would have detected abundant leads to follow to land: seabirds, coconuts and twigs carried out to sea by the tides, and the afternoon pile-up of clouds on the horizon which often indicates an island in the distance.

(8)

For returning explorers, successful or not, the geography of their own archipelagoes would have provided a safety net. Without this to go by, overshooting their home ports, getting lost and sailing off into eternity would have been all too easy. Vanuatu, for example, stretches more than 500 miles in a northwest-southeast trend, its scores of innervisible islands forming a backstop for mariners riding the trade winds home.

(9)

All this presupposes one essential detail, says Atholl Anderson, professor of prehistory at the Australian National University: the Lapita had mastered the advanced art of sailing against the wind. 'And there's no proof they could do any such thing,' Anderson says. 'There has been this assumption they did, and people have built canoes to re-create those early voyages based on that assumption. But nobody has any idea what their canoes looked like or how they were rigged.'

(10)

Rather than give all the credit to human skill, Anderson invokes the winds of chance. El Nino, the same climate disruption that affects the Pacific today, may have helped scatter the Lapita, Anderson suggests. He points out that climate data obtained from slow-growing corals around the Pacific indicate a series of unusually frequent El Ninos around the time of the Lapita expansion. By reversing the regular east-to-west flow of the trade winds for weeks at a time, these super El Ninos might have taken the Lapita on long unplanned voyages.

(11)

However they did it, the Lapita spread themselves a third of the way across the Pacific, then called it quits for reasons known only to them. Ahead lay the vast emptiness of the central Pacific and perhaps they were too thinly stretched to venture farther. They probably never numbered more than a few thousand in total, and in their rapid migration eastward they encountered hundreds of islands – more than 300 in Fiji alone.

Questions 36-39

36 According to the writer, there are difficulties explaining how the Lapita accomplished their journeys because

- A the canoes that have been discovered offer relatively few clues.
- B archaeologists have shown limited interest in this area of research.
- C little information relating to this period can be relied upon for accuracy.
- D technological advances have altered the way such achievements are viewed.

37 According to the sixth paragraph, what was extraordinary about the Lapita?

- A They sailed beyond the point where land was visible.
- B Their cultural heritage discouraged the expression of fear.
- C They were able to build canoes that withstood ocean voyages.
- D Their navigational skills were passed on from one generation to the next.

38 What does 'This' refer to in the seventh paragraph?

- | | |
|--|---|
| A the Lapita's seafaring talent | D the Lapita's belief they would be able to return home |
| B the Lapita's ability to detect signs of land | |
| C the Lapita's extensive knowledge of the region | |

39 According to the eighth paragraph, how was the geography of the region significant?

- | | |
|---|--|
| A It played an important role in Lapita culture. | C It provided a navigational aid for the Lapita. |
| B It meant there were relatively few storms at sea. | D It made a large number of islands habitable. |

When evolution runs backwards

Evolution isn't supposed to run backwards - yet an increasing number of examples show that it does and that it can sometimes represent the future of a species.

The description of any animal as an 'evolutionary throwback' is controversial. For the better part of a century, most biologists have been reluctant to use those words, mindful of a principle of evolution that says 'evolution cannot run backwards. But as more and more examples come to light and modern genetics enters the scene, that principle is having to be rewritten. Not only are evolutionary throwbacks possible, they sometimes play an important role in the forward march of evolution.

The technical term for an evolutionary throwback is an 'atavism', from the Latin *atavus*, meaning forefather. The word has ugly connotations thanks largely to Cesare Lombroso, a 19th-century Italian medic who argued that criminals were born not made and could be identified by certain physical features that were throwbacks to a primitive, sub-human state.

While Lombroso was measuring criminals, a Belgian palaeontologist called Louis Dollo was studying fossil records and coming to the opposite conclusion. In 1890 he proposed that evolution was irreversible: that 'an organism is unable to return, even partially, to a previous stage already realised in the ranks of its ancestors. Early 20th-century biologists came to a similar conclusion, though they qualified it in terms of probability, stating that there is no reason why evolution cannot run backwards - it is just very unlikely. And so the idea of irreversibility in evolution stuck and came to be known as 'Dollo's law.

If Dollo's law is right, atavisms should occur only very rarely, if at all. Yet almost since the idea took root, exceptions have been cropping up. In 1919, for example, a humpback whale with a pair of leglike appendages over a metre long, complete with a full set of limb bones, was caught off Vancouver Island in Canada. Explorer Roy Chapman Andrews argued at the time that the whale must be a throwback to a land-living ancestor. 'I can see no other explanation, he wrote in 1921.

Since then, so many other examples have been discovered that it no longer makes sense to say that evolution is as good as irreversible. And this poses a puzzle: how can characteristics that disappeared millions of years ago suddenly reappear?

In 1994, Rudolf Raff and colleagues at Indiana University in the USA decided to use genetics to put a number on the probability of evolution going into reverse. They reasoned that while some evolutionary changes involve the loss of genes and are therefore irreversible, others may be the result of genes being switched off. If these silent genes are somehow switched back on, they argued, longlost traits could reappear.

Raff's team went on to calculate the likelihood of it happening. Silent genes accumulate random mutations, they reasoned, eventually rendering them useless. So how long can a gene survive in a species if it is no longer used? The team calculated that there is a good chance of silent genes surviving for up to 6 million years in at least a few individuals in a population, and that some might survive as long as 10 million years. In other words, throwbacks are possible, but only to the relatively recent evolutionary past.

As a possible example, the team pointed to the mole salamanders of Mexico and California. Like most amphibians these begin life in a juvenile 'tadpole' state, then metamorphose into the adult form - except for one species, the axolotl, which famously lives its entire life as a juvenile. The simplest explanation for this is that the axolotl lineage alone lost the ability to metamorphose, while others retained it. From a detailed analysis of the salamanders' family tree, however, it is clear that the other lineages evolved from an ancestor that itself had lost the ability to metamorphose. In other words, metamorphosis in mole salamanders is an atavism. The salamander example fits with Raff's 10million-year time frame.

More recently, however, examples have been reported that break the time limit, suggesting that silent genes may not be the whole story. In a paper published last year, biologist Gunter Wagner of Yale University reported some work on the evolutionary history of a group of South American lizards called *Bachia*. Many of these have minuscule limbs; some look more like snakes than lizards and a few have completely lost the toes on their hind limbs. Other species, however, sport up to four toes on their hind legs. The simplest explanation is that the toed lineages never lost their toes, but Wagner begs to differ. According to his analysis of the *Bachia* family tree, the toed species re-evolved toes from toeless ancestors and, what is more, digit loss and gain has occurred on more than one occasion over tens of millions of years.

So what's going on? One possibility is that these traits are lost and then simply reappear, in much the same way that similar structures can independently arise in unrelated species, such as the dorsal fins of sharks and killer whales. Another more intriguing possibility is that the genetic information needed to make toes somehow survived for tens or perhaps hundreds of millions of years in the lizards and was reactivated. These atavistic traits provided an advantage and spread through the population, effectively reversing evolution.

But if silent genes degrade within 6 to million years, how can long-lost traits be reactivated over longer timescales? The answer may lie in the womb. Early embryos of many species develop ancestral features. Snake embryos, for example, sprout hind limb buds. Later in development these features disappear thanks to developmental programs that say 'lose the leg'. If for any reason this does not happen, the ancestral feature may not disappear, leading to an atavism.

Questions 40

40. When discussing the theory developed by Louis Dollo, the writer says that

- | | |
|---|--|
| A it was immediately referred to as Dollo's law. | C it was modified by biologists in the early twentieth century. |
| B it supported the possibility of evolutionary throwbacks. | D it was based on many years of research. |

41. The humpback whale caught off Vancouver Island is mentioned because of

- | | |
|--|---|
| A the exceptional size of its body. | C the amount of local controversy it caused. |
| B the way it exemplifies Dollo's law. | D the reason given for its unusual features. |

42. What is said about 'silent genes'?

- | | |
|---|--|
| A Their numbers vary according to species. | characteristics. |
| B Raff disagreed with the use of the term. | D They can have an unlimited life span. |
| C They could lead to the re-emergence of certain | |

43. The writer mentions the mole salamander because

- | | |
|---|---|
| A it exemplifies what happens in the development of most amphibians. | C it has lost and regained more than one ability. |
| B it suggests that Raffe's theory is correct. | D its ancestors have become the subject of extensive research. |

44. Which of the following does Wagner claim?

- A** Members of the *Bachia* lizard family have lost and regained certain features several times.
- B** Evidence shows that the evolution of the *Bachia* lizard is due to the environment.
- C** His research into South American lizards supports Raffe's assertions.
- D** His findings will apply to other species of South American lizards.

QUESTION AND ANSWER

Short answer question

Tips:

Make sure you copy the words correctly and you spell them as they are spelled in the text.

Example:

Here is part of a text about a vessel that is used to explore the depth of the ocean. Each answer should be no more than two words and /or a number.

A great deal of research into the depth of the ocean has been carried out using the submersible Alvin, a craft that can carry three people down to the depth 4,500 metres, constructed in 1964, it is operated by the woods hole oceanographic institution (WHOI) in the (USA).

Alvin is manufactured from syntactic from a material which is strong enough to withstand the enormous water pressure that the submersible encounters. It is equipped with lights, two robotic arms to manipulate instruments, and a basket for tools and for samples picked up from the ocean floor.

Question:

1. In which year was Alvin built?(in) 1964.....(right)
2. What material is Alvin made of?.....*syntactic from*.....(wrong)
3. What equipment on Alvin can operate instruments?.....robotic arm.....(wrong)
4. What equipment on Alvin is used as a container?Basket.....(right)

Explanation:

In 2 one word, 'foam', has been copied wrongly, so the answer won't get a mark. In 3 one of the two words, 'arms', has been copied wrongly, so this answer will be marked wrong.

READING PASSAGE 1

William Henry Perkin

The man who invented synthetic dyes

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.

Historically, textile dyes were made from such natural sources as plants and animal excretions. Some of these, such as the glandular mucus of snails, were difficult to obtain and outrageously expensive. Indeed, the purple colour extracted from a snail was once so costly that in society at the time only the rich could afford it. Further, natural dyes tended to be muddy in hue and fade quickly. It was against this backdrop that Perkin's discovery was made.

Perkin quickly grasped that his purple solution could be used to colour fabric, thus making it the world's first synthetic dye. Realising the importance of this breakthrough, he lost no time in patenting it. But perhaps

the most fascinating of all Perkin's reactions to his find was his nearly instant recognition that the new dye had commercial possibilities.

Perkin originally named his dye Tyrian Purple, but it later became commonly known as mauve (from the French for the plant used to make the colour violet). He asked advice of Scottish dye works owner Robert Pullar, who assured him that manufacturing the dye would be well worth it if the colour remained fast (i.e. would not fade) and the cost was relatively low. So, over the fierce objections of his mentor Hofmann, he left college to give birth to the modern chemical industry.

With the help of his father and brother, Perkin set up a factory not far from London. Utilising the cheap and plentiful coal tar that was an almost unlimited by product of London's gas street lighting, the dye works began producing the world's first synthetically dyed material in 1857. The company received a commercial boost from the Empress Eugenie of France, when she decided the new colour flattered her. Very soon, mauve was the necessary shade for all the fashionable ladies in that country.

Not to be outdone, England's Queen Victoria also appeared in public wearing a mauve gown, thus making it all the rage in England as well. The dye was bold and fast, and the public clamoured for more. Perkin went back to the drawing board.

Although Perkin's fame was achieved and fortune assured by his first discovery, the chemist continued his research. Among other dyes he developed and introduced were aniline red (1859) and aniline black (1863) and, in the late 1860s, Perkin's green. It is important to note that Perkin's synthetic dye discoveries had outcomes far beyond the merely decorative. The dyes also became vital to medical research in many ways. For instance, they were used to stain previously invisible microbes and bacteria, allowing researchers to identify such bacilli as tuberculosis, cholera, and anthrax. Artificial dyes continue to play a crucial role today. And, in what would have been particularly pleasing to Perkin, their current use is in the search for a vaccine against malaria.

Questions 8-13

Answer the questions below.

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

- 1 Before Perkin's discovery, with what group in society was the colour purple associated?
- 2 What potential did Perkin immediately understand that his new dye had?
- 3 What was the name finally used to refer to the first colour Perkin invented?
- 4 What was the name of the person Perkin consulted before setting up his own dye works?
- 5 In what country did Perkin's newly invented colour first become fashionable?

6 According to the passage, which disease is now being targeted by researchers using synthetic dyes?

READING PASSAGE 2

The history of the tortoise

If you go back far enough, everything lived in the sea. At various points in evolutionary history, enterprising individuals within many different animal groups moved out onto the land, sometimes even to the most parched deserts, taking their own private seawater with them in blood and cellular fluids. In addition to the reptiles, birds, mammals and insects which we see all around us, other groups that have succeeded out of water include scorpions, snails, crustaceans such as woodlice and land crabs, millipedes and centipedes, spiders and various worms. And we mustn't forget the plants, without whose prior invasion of the land none of the other migrations could have happened.

Moving from water to land involved a major redesign of every aspect of life, including breathing and reproduction. Nevertheless, a good number of thoroughgoing land animals later turned around, abandoned their hard-earned terrestrial re-tooling, and returned to the water again. Seals have only gone part way back. They show us what the intermediates might have been like, on the way to extreme cases such as whales and dugongs. Whales (including the small whales we call dolphins) and dugongs, with their close cousins the manatees, ceased to be land creatures altogether and reverted to the full marine habits of their remote ancestors. They don't even come ashore to breed. They do, however, still breathe air, having never developed anything equivalent to the gills of their earlier marine incarnation. Turtles went back to the sea a very long time ago and, like all vertebrate returnees to the water, they breathe air. However, they are, in one respect, less fully given back to the water than whales or dugongs, for turtles still lay their eggs on beaches.

There is evidence that all modern turtles are descended from a terrestrial ancestor which lived before most of the dinosaurs. There are two key fossils called *Proganochelys quenstedti* and *Palaeochersis talampayensis* dating from early dinosaur times, which appear to be close to the ancestry of all modern turtles and tortoises. You might wonder how we can tell whether fossil animals lived on land or in water, especially if only fragments are found. Sometimes it's obvious. Ichthyosaurs were reptilian contemporaries of the dinosaurs, with fins and streamlined bodies. The fossils look like dolphins and they surely lived like dolphins, in the water. With turtles it is a little less obvious. One way to tell is by measuring the bones of their forelimbs.

Walter Joyce and Jacques Gauthier, at Yale University, obtained three measurements in these particular bones

of 71 species of living turtles and tortoises. They used a kind of triangular graph paper to plot the three measurements against one another. All the land tortoise species formed a tight cluster of points in the upper part of the triangle; all the water turtles cluster in the lower part of the triangular graph. There was no overlap, except when they added some species that spend time both in water and on land. Sure enough, these amphibious species show up on the triangular graph approximately half way between the 'wet cluster' of sea turtles and the 'dry cluster' of land tortoises. The next step was to determine where the fossils fell. The bones of *P. quenstedti* and *JR. talampayensis* leave us in no doubt. Their points on the graph are right in the thick of

the dry cluster. Both these fossils were dry-land tortoises. They come from the era before our turtles returned to the water.

You might think, therefore, that modern land tortoises have probably stayed on land ever since those early terrestrial times, as most mammals did after a few of them went back to the sea. But apparently not. If you draw out the family tree of all modern turtles and tortoises, nearly all the branches are aquatic. Today's land tortoises constitute a single branch, deeply nested among branches consisting of aquatic turtles. This suggests that modern land tortoises have not stayed on land continuously since the time of *P. quenstedti* and *P. talampayensis*. Rather, their ancestors were among those who went back to the water, and they then re-emerged back onto the land in (relatively) more recent times.

Tortoises therefore represent a remarkable double return. In common with all mammals, reptiles and birds, their remote ancestors were marine fish and before that various more or less worm-like creatures stretching back, still in the sea, to the primeval bacteria. Later ancestors lived on land and stayed there for a very large number of generations. Later ancestors still evolved back into the water and became sea turtles. And finally they returned yet again to the land as tortoises, some of which now live in the driest of deserts.

Questions 7-10

Answer the questions below.

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

- 7 What had to transfer from sea to land before any animals could migrate?
- 8 Which TWO processes are mentioned as those in which animals had to make big changes as they moved onto land?
- 9 Which physical feature, possessed by their ancestors, do whales lack?
- 10 Which animals might ichthyosaurs have resembled?

READING PASSAGE 3

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.

B

A preliminary study in New Zealand has shown that classroom noise presents a major concern for teachers and pupils. Modern teaching practices, the organisation of desks in the classroom, poor classroom acoustics, and mechanical means of ventilation such as air-conditioning units all contribute to the number of children unable to comprehend the teacher's voice. Education researchers Nelson and Soli have also suggested that recent trends in learning often involve collaborative interaction of multiple minds and tools as much as individual possession of information. This all amounts to heightened activity and noise levels, which have the potential to be particularly serious for children experiencing auditory function deficit. Noise in classrooms can only exacerbate their difficulty in comprehending and processing verbal communication with other children and instructions from the teacher.

C

Children with auditory function deficit are potentially failing to learn to their maximum potential because of noise levels generated in classrooms. The effects of noise on the ability of children to learn effectively in typical classroom environments are now the subject of increasing concern. The International Institute of Noise Control Engineering (I-INCE), on the advice of the World Health Organization, has established an international working party, which includes New Zealand, to evaluate noise and reverberation control for school rooms.

D

While the detrimental effects of noise in classroom situations are not limited to children experiencing disability, those with a disability that affects their processing of speech and verbal communication could be extremely vulnerable. The auditory function deficits in question include hearing impairment, autistic spectrum disorders (ASD) and attention deficit disorders (ADD/ADHD).

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.

I

A number of countries are already in the process of formulating their own standards for the control and reduction of classroom noise. New Zealand will probably follow their example. The literature to date on noise in school rooms appears to focus on the effects on schoolchildren in general, their teachers and the hearing impaired. Only limited attention appears to have been given to those students experiencing the other disabilities involving auditory function deficit. It is imperative that the needs of these children are taken into account in the setting of appropriate international standards to be promulgated in future.

Questions 7-10

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

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

READING PASSAGE 4

Stepwells

A millennium ago, stepwells were fundamental to life in the driest parts of India. Although many have been neglected, recent restoration has returned them to their former glory. Richard Cox travelled to north-western India to document these spectacular monuments from a bygone era.

During the sixth and seventh centuries, the inhabitants of the modern-day states of Gujarat and Rajasthan in North-western India developed a method of gaining access to clean, fresh groundwater during the dry season for drinking, bathing, watering animals and irrigation. However, the significance of this invention – the stepwell – goes beyond its utilitarian application.

Unique to the region, stepwells are often architecturally complex and vary widely in size and shape. During their heyday, they were places of gathering, of leisure, of relaxation and of worship for villagers of all but the lowest castes. Most stepwells are found dotted around the desert areas of Gujarat (where they are called vav) and Rajasthan (where they are known as baori), while a few also survive in Delhi. Some were located in or near villages as public spaces for the community; others were positioned beside roads as resting places for travellers.

As their name suggests, stepwells comprise a series of stone steps descending from ground level to the water source (normally an underground aquifer) as it recedes following the rains. When the water level was high, the user needed only to descend a few steps to reach it; when it was low, several levels would have to be negotiated.

Some wells are vast, open craters with hundreds of steps paving each sloping side, often in tiers. Others are more elaborate, with long stepped passages leading to the water via several storeys built from stone and supported by pillars, they also included pavilions that sheltered visitors from the relentless heat. But perhaps the most impressive features are the intricate decorative sculptures that embellish many stepwells, showing activities from fighting and dancing to everyday acts such as women combing their hair and churning butter.

Down the centuries, thousands of wells were constructed throughout northwestern India, but the majority have now fallen into disuse; many are derelict and dry, as groundwater has been diverted for industrial use and the wells no longer reach the water table. Their condition hasn't been helped by recent dry spells: southern Rajasthan suffered an eight-year drought between 1996 and 2004.

However, some important sites in Gujarat have recently undergone major restoration, and the state government announced in June last year that it plans to restore the stepwells throughout the state.

In Patan, the state's ancient capital, the stepwell of Rani Ki Vav (Queen's Stepwell) is perhaps the finest current example. It was built by Queen Udayamati during the late 11th century, but became silted up following a flood during the 13th century. But the Archaeological Survey of India began restoring it in the 1960s, and today it's in pristine condition. At 65 metres long, 20 metres wide and 27 metres deep, Rani Ki Vav features 500 distinct sculptures carved into niches throughout the monument, depicting gods such as Vishnu and Parvati in various incarnations. Incredibly, in January 2001, this ancient structure survived a devastating earthquake that measured 7.6 on the Richter scale.

Another example is the Surya Kund in Modhera, northern Gujarat, next to the Sun Temple, built by King Bhima I in 1026 to honour the sun god Surya. It's actually a tank (kund means reservoir or pond) rather than a well, but displays the hallmarks of stepwell architecture, including four sides of steps that descend to the bottom in a stunning geometrical formation. The terraces house 108 small, intricately carved shrines between the sets of steps.

Rajasthan also has a wealth of wells. The ancient city of Bundi, 200 kilometres south of Jaipur, is renowned for its architecture, including its stepwells. One of the larger examples is Raniji Ki Baori, which was built by the queen of the region, Nathavatji, in 1699. At 46 metres deep, 20 metres wide and 40 metres long, the intricately carved monument is one of 21 baoris commissioned in the Bundi area by Nathavatji.

In the old ruined town of Abhaneri, about 95 kilometres east of Jaipur, is Chand Baori, one of India's oldest and deepest wells; aesthetically, it's perhaps one of the most dramatic. Built in around 850 AD next to the temple of Harshat Mata, the baori comprises hundreds of zigzagging steps that run along three of its sides, steeply descending 11 storeys, resulting in a striking geometric pattern when seen from afar. On the fourth side, covered verandas supported by ornate pillars overlook the steps.

Still in public use is Neemrana Ki Baori, located just off the Jaipur–Dehli highway. Constructed in around 1700, it's nine storeys deep, with the last two levels underwater. At ground level, there are 86 colonnaded openings from where the visitor descends 170 steps to the deepest water source.

Today, following years of neglect, many of these monuments to medieval engineering have been saved by the Archaeological Survey of India, which has recognised the importance of preserving them as part of the country's rich history. Tourists flock to wells in far-flung corners of northwestern India to gaze in wonder at these architectural marvels from 1,000 years ago, which serve as a reminder of both the ingenuity and artistry of ancient civilisations and of the value of water to human existence

Questions 15-17

Answer the questions below.

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

- 15 Which part of some stepwells provided shade for people?
- 16 What type of serious climatic event, which took place in southern Rajasthan, is mentioned in the article?
- 17 Who are frequent visitors to stepwells nowadays?

FINDINGS

Matching feature (findings)

Tips: in the text , underline the names , dates, numbers, etc. from the questions or options , so that you can then locate quickly.

Example : Here is part of a text about the development of fertilizers in the nineteenth century. In this example the questions follow the order of the text.

Food production was greatly improved in the nineteenth century. One reason behind the development of effective fertilizers. The German chemist Justus von liebig (1803-1873) added considerably to knowledge of plant nutrition indentifying the crucial importance of nitrogen . and the France scientist Jean Baptiste boussingault (1802- 1887) discovered that different kinds of fertilizers required different amounts of nitrogen. However a business venture by Von Lieble failed: although the fertilizer he sold was much less expensive than the guano it was intended to replace, crops were unable to absorb it adequately . Von Liebia later develop a manufacturing process for making beef extract cubes, which are still used in kitchens around the world.

In Britain , Jhan bennet laws (1814-1900) owned a farm where he experimented with crops and manures: at first he tested the effects of various manures on potted plants and later worked on crops in the field . in 1849 the patented a successful superphosphate which was the first artificial manure. Laws made provision for the experimental farm to continue after his death and it exists to this day.

Question :

1. He showed that nitrogen is essential for the plant nutrition. C
2. He demonstrated the need to vary the quantity of nitrogen in fertilizers. A
3. He introduced a fertilizer that saved money but was ineffective. C
4. He invented a method of processing a food for human consumption .C
5. He invented the first synthetic manure. B
6. He set up a research establishment that is still in operation. B

List of scientist

- A. Boussingault
- B. Laws
- C. Von Liebig

Explanation: the highlighted parts of the text show you where you can find the answer of each question.

✚ Names and dates may appear more than once. So make sure you read all the relevant parts of the text .

READING PASSAGE 1

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.

B

A preliminary study in New Zealand has shown that classroom noise presents a major concern for teachers and pupils. Modern teaching practices, the organisation of desks in the classroom, poor classroom acoustics, and mechanical means of ventilation such as air-conditioning units all contribute to the number of children unable to comprehend the teacher's voice. Education researchers Nelson and Soli have also suggested that recent trends in learning often involve collaborative interaction of multiple minds and tools as much as individual possession of information. This all amounts to heightened activity and noise levels, which have the potential to be particularly serious for children experiencing auditory function deficit. Noise in classrooms can only exacerbate their difficulty in comprehending and processing verbal communication with other children and instructions from the teacher.

C

Children with auditory function deficit are potentially failing to learn to their maximum potential because of noise levels generated in classrooms. The effects of noise on the ability of children to learn effectively in typical classroom environments are now the subject of increasing concern. The International Institute of Noise Control Engineering (I-INCE), on the advice of the World Health Organization, has established an international working party, which includes New Zealand, to evaluate noise and reverberation control for school rooms.

D

While the detrimental effects of noise in classroom situations are not limited to children experiencing disability, those with a disability that affects their processing of speech and verbal communication could be extremely vulnerable. The auditory function deficits in question include hearing impairment, autistic spectrum disorders (ASD) and attention deficit disorders (ADD/ADHD).

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.

I

A number of countries are already in the process of formulating their own standards for the control and reduction of classroom noise. New Zealand will probably follow their example. The literature to date on noise in school rooms appears to focus on the effects on schoolchildren in general, their teachers and the hearing impaired. Only limited attention appears to have been given to those students experiencing the other disabilities involving auditory function deficit. It is imperative that the needs of these children are taken into account in the setting of appropriate international standards to be promulgated in future.

Questions 1-6

Reading Passage 1 has nine sections, A-I.

Which section contains the following information?

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

- 1** An account of a national policy initiative
- 2** A description of a global team effort
- 3** A hypothesis as to one reason behind the growth in classroom noise
- 4** A demand for suitable worldwide regulations
- 5** A list of medical conditions which place some children more at risk from noise than others
- 6** The estimated proportion of children in New Zealand with auditory problems

Questions 7 and 8

Choose TWO letters, A-F.

The list below includes factors contributing to classroom noise.

Which TWO are mentioned by the writer of the passage?

- | | | |
|-----------------------------------|----------------------------|-------------------------------|
| A Current teaching methods | C Cooling systems | E Loud-voiced teachers |
| B Echoing corridors | D Large class sizes | F Playground games |

Question 9

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

What is the writer's overall purpose in writing this article?

- A** to compare different methods of dealing with auditory problems
- B** to provide solutions for overly noisy learning environments
- C** to increase awareness of the situation of children with auditory problems
- D** to promote New Zealand as a model for other countries to follow

Venus in transit

June 2004 saw the first passage, known as a 'transit', of the planet Venus across the face of the Sun in 122 years. Transits have helped shape our view of the whole Universe, as Heather Cooper and Nigel Henbest explain

A

On 8 June 2004, more than half the population of the world were treated to a rare astronomical event. For over six hours, the planet Venus steadily inched its way over the surface of the Sun. This 'transit' of Venus was the first since 6 December 1882. On that occasion, the American astronomer Professor Simon Newcomb led a party to South Africa to observe the event. They were based at a girls' school, where - it is alleged - the combined forces of three schoolmistresses outperformed the professionals with the accuracy of their observations.

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.

C

Halley was aware that the AU was one of the most fundamental of all astronomical measurements. Johannes Kepler, in the early 17th century, had shown that the distances of the planets from the Sun governed their orbital speeds, which were easily measurable. But no-one had found a way to calculate accurate distances to the planets from the Earth. The goal was to measure the AU; then, knowing the orbital speeds of all the other planets round the Sun, the scale of the Solar System would fall into place. However, Halley realised that Mercury was so far away that its parallax angle would be very difficult to determine. As Venus was closer to the Earth, its parallax angle would be larger, and Halley worked out that by using Venus it would be possible to measure the Sun's distance to 1 part in 500. But there was a problem: transits of Venus, unlike those of Mercury, are rare, occurring in pairs roughly eight years apart every hundred or so years. Nevertheless, he accurately predicted that Venus would cross the face of the Sun in both 1761 and 1769 - though he didn't survive to see either.

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.

G

June 2004's transit of Venus was thus more of an astronomical spectacle than a scientifically important event. But such transits have paved the way for what might prove to be one of the most vital breakthroughs in the cosmos - detecting Earth-sized planets orbiting other stars.

Questions 14-17

Reading Passage 2 has seven paragraphs, A-G.

Which paragraph contains the following information?

Write the correct letter, A-G, in boxes 14-17 on your answer sheet.

- 10** examples of different ways in which the parallax principle has been applied
- 11** a description of an event which prevented a transit observation
- 12** a statement about potential future discoveries leading on from transit observations
- 13** a description of physical states connected with Venus which early astronomical instruments failed to overcome

Questions 18-21

Look at the following statements (Questions 18-21) and the list of people below.

Match each statement with the correct person, A, B, C or D.

Write the correct letter, A, B, C or D, in boxes 18-21 on your answer sheet.

- 14** He calculated the distance of the Sun from the Earth based on observations of Venus with a fair degree of accuracy.
- 15** He understood that the distance of the Sun from the Earth could be worked out by comparing observations of a transit.
- 16** He realised that the time taken by a planet to go round the Sun depends on its distance from the Sun.
- 17** He witnessed a Venus transit but was unable to make any calculations

	List of People
A	Edmond Halley
B	Johannes Kepler
C	Guillaume Le Gentil
D	Johann Franz Encke

Tidal Power

Undersea turbines which produce electricity from the tides are set to become an important source of renewable energy for Britain. It is still too early to predict the extent of the impact they may have, but all the signs are that they will play a significant role in the future

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.

B

Tidal sites have already been identified that will produce one sixth or more of the UK's power - and at prices competitive with modern gas turbines and undercutting those of the already ailing nuclear industry. One site alone, the Pentland Firth, between Orkney and mainland Scotland, could produce 10% of the country's electricity with banks of turbines under the sea, and another at Alderney in the Channel Islands three times the 1,200 megawatts of Britain's largest and newest nuclear plant, Sizewell B, in Suffolk. Other sites identified include the Bristol Channel and the west coast of Scotland, particularly the channel between Campbeltown and Northern Ireland.

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.

F

One technical difficulty is cavitation, where low pressure behind a turning blade causes air bubbles. These can cause vibration and damage the blades of the turbines. Dr Bahaj said: 'We have to test a number of blade types to avoid this happening or at least make sure it does not damage the turbines or reduce performance. Another

slight concern is submerged debris floating into the blades. So far we do not know how much of a problem it might be. We will have to make the turbines robust because the sea is a hostile environment, but all the signs that we can do it are good.'

Questions 14-17

Reading Passage 2 has six paragraphs, A-F.

Which paragraph contains the following information?

Write the correct letter, A-F, in boxes 14-17 on your answer sheet.

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

- 19 The location of the first test site
- 20 A way of bringing the power produced on one site back into Britain
- 21 A reference to a previous attempt by Britain to find an alternative source of energy
- 22 Mention of the possibility of applying technology from another industry

Questions 23-27

Choose FIVE letters, A-J.

Write the correct letters in boxes 18-22 on your answer sheet.

Which FIVE of the following claims about tidal power are made by the writer?

- A It is a more reliable source of energy than wind power.
- B It would replace all other forms of energy in Britain.
- C Its introduction has come as a result of public pressure.
- D It would cut down on air pollution.
- E It could contribute to the closure of many existing power stations in Britain.
- F It could be a means of increasing national income.
- G It could face a lot of resistance from other fuel industries.
- H It could be sold more cheaply than any other type of fuel.
- I It could compensate for the shortage of inland sites for energy production.
- J It is best produced in the vicinity of coastlines with particular features.

READING PASSAGE 4

Information theory - the big idea

Information theory lies at the heart of everything - from DVD players and the genetic code of DNA to the physics of the universe at its most fundamental. It has been central to the development of the science of communication, which enables data to be sent electronically and has therefore had a major impact on our lives

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 27-32

Reading Passage 3 has six paragraphs, A-F.

Which paragraph contains the following information?

Write the correct letter, A-F, in boxes 27-32 on your answer sheet.

- 28** An explanation of the factors affecting the transmission of information
- 29** An example of how unnecessary information can be omitted
- 30** A reference to Shannon's attitude to fame
- 31** Details of a machine capable of interpreting incomplete information
- 32** A detailed account of an incident involving information theory
- 33** A reference to what Shannon initially intended to achieve in his research

READING PASSAGE 5

Young children's sense of identity

A

A sense of self develops in young children by degrees. The process can usefully be thought of in terms of the gradual emergence of two somewhat separate features: the self as a subject, and the self as an object. William James introduced the distinction in 1892, and contemporaries of his, such as Charles Cooley, added to the developing debate. Ever since then psychologists have continued building on the theory.

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.

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 34- 39

Which paragraph contains the following information?

*Write the correct letter, **A-H**, in boxes 14-19 on your answer sheet.*

NB You may use any letter more than once.

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

Questions 20-23

Look at the following findings (Questions 20-23) and the list of researchers below.

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

List of Researchers

- | | | |
|-----------------|--------------------------------|------------------|
| A James | C Lewis and Brooks-Gunn | E Bronson |
| B Cooley | D Mead | |

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

READING PASSAGE 6

A Chronicle of Timekeeping

Our conception of time depends on the way we measure it

A

According to archaeological evidence, at least 5,000 years ago, and long before the advent of the Roman Empire, the Babylonians began to measure time, introducing calendars to co-ordinate communal activities, to plan the shipment of goods and, in particular, to regulate planting and harvesting. They based their calendars on three natural cycles: the solar day, marked by the successive periods of light and darkness as the earth rotates on its axis; the lunar month, following the phases of the moon as it orbits the earth; and the solar year, defined by the changing seasons that accompany our planet's revolution around the sun.

B

Before the invention of artificial light, the moon had greater social impact. And, for those living near the equator in particular, its waxing and waning was more conspicuous than the passing of the seasons. Hence, the calendars that were developed at the lower latitudes were influenced more by the lunar cycle than by the solar year. In more northern climes, however, where seasonal agriculture was practised, the solar year became more crucial. As the Roman Empire expanded northward, it organised its activity chart for the most part around the solar year.

C

Centuries before the Roman Empire, the Egyptians had formulated a municipal calendar having 12 months of 30 days, with five days added to approximate the solar year. Each period of ten days was marked by the appearance of special groups of stars called decans. At the rise of the star Sirius just before sunrise, which occurred around the all-important annual flooding of the Nile, 12 decans could be seen spanning the heavens. The cosmic significance the Egyptians placed in the 12 decans led them to develop a system in which each interval of darkness (and later, each interval of daylight) was divided into a dozen equal parts. These periods became known as temporal hours because their duration varied according to the changing length of days and nights with the passing of the seasons. Summer hours were long, winter ones short; only at the spring and autumn equinoxes were the hours of daylight and darkness equal. Temporal hours, which were first adopted by the Greeks and then the Romans, who disseminated them through Europe, remained in use for more than 2,500 years.

D

In order to track temporal hours during the day, inventors created sundials, which indicate time by the length or direction of the sun's shadow. The sundial's counterpart, the water clock, was designed to measure temporal hours at night. One of the first water clocks was a basin with a small hole near the bottom through which the water dripped out. The falling water level denoted the passing hour as it dipped below hour lines inscribed on the inner surface. Although these devices performed satisfactorily around the Mediterranean, they could not always be depended on in the cloudy and often freezing weather of northern Europe.

E

The advent of the mechanical clock meant that although it could be adjusted to maintain temporal hours, it was naturally suited to keeping equal ones. With these, however, arose the question of when to begin counting, and so, in the early 14th century, a number of systems evolved. The schemes that divided the day into 24 equal parts varied according to the start of the count: Italian hours began at sunset, Babylonian hours at sunrise, astronomical hours at midday and 'great clock' hours, used for some large public clocks in Germany, at midnight. Eventually these were superseded by 'small clock', or French, hours, which split the day into two 12-hour periods commencing at midnight.

F

The earliest recorded weight-driven mechanical clock was built in 1283 in Bedfordshire in England. The revolutionary aspect of this new timekeeper was neither the descending weight that provided its motive force nor the gear wheels (which had been around for at least 1,300 years) that transferred the power; it was the part called the escapement. In the early 1400s came the invention of the coiled spring or fusee which maintained constant force to the gear wheels of the timekeeper despite the changing tension of its

mainspring. By the 16th century, a pendulum clock had been devised, but the pendulum swung in a large arc and thus was not very efficient.

G

To address this, a variation on the original escapement was invented in 1670, in England. It was called the anchor escapement, which was a lever-based device shaped like a ship's anchor. The motion of a pendulum rocks this device so that it catches and then releases each tooth of the escape wheel, in turn allowing it to turn a precise amount. Unlike the original form used in early pendulum clocks, the anchor escapement permitted the pendulum to travel in a very small arc. Moreover, this invention allowed the use of a long pendulum which could beat once a second and thus led to the development of a new floorstanding case design, which became known as the grandfather clock.

H

Today, highly accurate timekeeping instruments set the beat for most electronic devices. Nearly all computers contain a quartz-crystal clock to regulate their operation. Moreover, not only do time signals beamed down from Global Positioning System satellites calibrate the functions of precision navigation equipment, they do so as well for mobile phones, instant stock-trading systems and nationwide power-distribution grids. So integral have these time-based technologies become to day-to-day existence that our dependency on them is recognised only when they fail to work.

Questions 1-4

Which paragraph contains the following information?

*Write the correct letter, **A-H**, in boxes 1-4 on your answer sheet*

- 44 A description of an early timekeeping invention affected by cold temperatures.....
- 45 An explanation of the importance of geography in the development of the Calendar in farming communities.....
- 46 A description of the origins of the pendulum clock.....
- 47 Details of the simultaneous efforts of different societies to calculate time using uniform hours.....

Questions 5-8

Look at the following events (Questions 5-8) and the list of nationalities below.

*Match each event with the correct nationality, **A-F**.*

List of Nationalities

- | | | |
|----------------------|------------------|------------------|
| A Babylonians | C Greeks | E Germans |
| B Egyptians | D English | F French |

- 48 They devised a civil calendar in which the months were equal in length.
- 49 They divided the day into two equal halves.
- 50 They developed a new cabinet shape for a type of timekeeper.
- 51 They created a calendar to organise public events and work schedules.

READING PASSAGE 7

THE LITTLE ICE AGE

A

This book will provide a detailed examination of the Little Ice Age and other climatic shifts, but, before I embark on that, let me provide a historical context. We tend to think of climate - as opposed to weather - as something unchanging, yet humanity has been at the mercy of climate change for its entire existence, with at least eight glacial episodes in the past 730,000 years. Our ancestors adapted to the universal but irregular global warming since the end of the last great Ice Age, around 10,000 years ago, with dazzling opportunism. They developed strategies for surviving harsh drought cycles, decades of heavy rainfall or unaccustomed cold; adopted agriculture and stock-raising, which revolutionised human life; and founded the world's first pre-industrial civilisations in Egypt, Mesopotamia and the Americas. But the price of sudden climate change, in famine, disease and suffering, was often high.

B

The Little Ice Age lasted from roughly 1300 until the middle of the nineteenth century. Only two centuries ago, Europe experienced a cycle of bitterly cold winters; mountain glaciers in the Swiss Alps were the lowest in recorded memory, and pack ice surrounded Iceland for much of the year. The climatic events of the Little Ice Age did more than help shape the modern world. They are the deeply important context for the current unprecedented global warming. The Little Ice Age was far from a deep freeze, however; rather an irregular seesaw of rapid climatic shifts, few lasting more than a quarter-century, driven by complex and still little understood interactions between the atmosphere and the ocean. The seesaw brought cycles of intensely cold winters and easterly winds, then switched abruptly to years of heavy spring and early summer rains, mild winters, and frequent Atlantic storms, or to periods of droughts, light northeasterly winds, and summer heat waves.

C

Reconstructing the climate changes of the past is extremely difficult, because systematic weather observations began only a few centuries ago, in Europe and North America. Records from India and tropical Africa are even more recent. For the time before records began, we have only 'proxy records' reconstructed largely from tree rings and ice cores, supplemented by a few incomplete written accounts. We now have hundreds of tree-ring records from throughout the northern hemisphere, and many from south of the equator, too, amplified with a growing body of temperature data from ice cores drilled in Antarctica, Greenland, the Peruvian Andes, and other locations. We are close to a knowledge of annual summer and winter temperature variations over much of the northern hemisphere going back 600 years.

D

This book is a narrative history of climatic shifts during the past ten centuries, and some of the ways in which people in Europe adapted to them. Part One describes the Medieval Warm Period, roughly 900 to 1200. During these three centuries, Norse voyagers from Northern Europe explored northern seas, settled Greenland, and visited North America. It was not a time of uniform warmth, for then, as always since the Great Ice Age, there were constant shifts in rainfall and temperature. Mean European temperatures were about the same as today, perhaps slightly cooler.

E

It is known that the Little Ice Age cooling began in Greenland and the Arctic in about 1200. As the Arctic ice pack spread southward, Norse voyages to the west were rerouted into the open Atlantic, then ended altogether. Storminess increased in the North Atlantic and North Sea. Colder, much wetter weather descended on Europe between 1315 and 1319, when thousands perished in a continent-wide famine. By 1400, the weather had become decidedly more unpredictable and stormier, with sudden shifts and lower temperatures that culminated in the cold decades of the late sixteenth century. Fish were a vital commodity in growing towns and cities, where food supplies were a constant concern. Dried cod and herring were already the staples of the European fish trade, but changes in water temperatures forced fishing fleets to work further offshore. The Basques, Dutch, and English developed the first offshore fishing boats adapted to a colder and stormier Atlantic. A gradual agricultural revolution in northern Europe stemmed from concerns over food supplies at a time of rising populations. The revolution involved intensive commercial farming and the growing of animal fodder on

land not previously used for crops. The increased productivity from farmland made some countries self-sufficient in grain and livestock and offered effective protection against famine.

F

Global temperatures began to rise slowly after 1850, with the beginning of the Modern Warm Period. There was a vast migration from Europe by land-hungry farmers and others, to which the famine caused by the Irish potato blight contributed, to North America, Australia, New Zealand, and southern Africa. Millions of hectares of forest and woodland fell before the newcomers' axes between 1850 and 1890, as intensive European farming methods expanded across the world. The unprecedented land clearance released vast quantities of carbon dioxide into the atmosphere, triggering for the first time humanly caused global warming. Temperatures climbed more rapidly in the twentieth century as the use of fossil fuels proliferated and greenhouse gas levels continued to soar. The rise has been even steeper since the early 1980s. The Little Ice Age has given way to a new climatic regime, marked by prolonged and steady warming. At the same time, extreme weather events like Category 5 hurricanes are becoming more frequent.

Questions 23-26

Classify the following events as occurring during the

- A** *Medieval Warm Period*
- B** *Little Ice Age*
- C** *Modern Warm Period*

Write the correct letter, A, B or C, in boxes 23-26 on your answer sheet.

- 52** Many Europeans started farming abroad.
- 53** The cutting down of trees began to affect the climate.
- 54** Europeans discovered other lands.
- 55** Changes took place in fishing patterns.

READING PASSAGE 8

The Nature of Genius

There has always been an interest in geniuses and prodigies. The word 'genius', from the Latin gens (= family) and the term 'genius', meaning 'begetter', comes from the early Roman cult of a divinity as the head of the family. In its earliest form, genius was concerned with the ability of the head of the family, the paterfamilias, to perpetuate himself. Gradually, genius came to represent a person's characteristics and thence an individual's highest attributes derived from his 'genius' or guiding spirit. Today, people still look to stars or genes, astrology or genetics, in the hope of finding the source of exceptional abilities or personal characteristics.

The concept of genius and of gifts has become part of our folk culture, and attitudes are ambivalent towards them. We envy the gifted and mistrust them. In the mythology of giftedness, it is popularly believed that if people are talented in one area, they must be defective in another, that intellectuals are impractical, that prodigies burn too brightly too soon and burn out, that gifted people are eccentric, that they are physical weaklings, that there's a thin line between genius and madness, that genius runs in families, that the gifted are so clever they don't need special help, that giftedness is the same as having a high IQ, that some races are more intelligent or musical or mathematical than others, that genius goes unrecognised and unrewarded, that adversity makes men wise or that people with gifts have a responsibility to use them. Language has been enriched with such terms as 'highbrow', 'egghead', 'blue-stocking', 'wiseacre', 'know-all', 'boffin' and, for many, 'intellectual' is a term of denigration.

The nineteenth century saw considerable interest in the nature of genius, and produced not a few studies of famous prodigies. Perhaps for us today, two of the most significant aspects of most of these studies of genius are the frequency with which early encouragement and teaching by parents and tutors had beneficial effects on the intellectual, artistic or musical development of the children but caused great difficulties of adjustment later in their lives, and the frequency with which abilities went unrecognised by teachers and schools. However, the difficulty with the evidence produced by these studies, fascinating as they are in collecting together anecdotes and apparent similarities and exceptions, is that they are not what we would today call norm-referenced. In other words, when, for instance, information is collated about early illnesses, methods of upbringing, schooling, etc., we must also take into account information from other historical sources about how common or exceptional these were at the time. For instance, infant mortality was high and life expectancy much shorter than today, home tutoring was common in the families of the nobility and wealthy, bullying and corporal punishment were common at the best independent schools and, for the most part, the cases studied were members of the privileged classes. It was only with the growth of paediatrics and psychology in the twentieth century that studies could be carried out on a more objective, if still not always very scientific, basis.

Geniuses, however they are defined, are but the peaks which stand out through the mist of history and are visible to the particular observer from his or her particular vantage point. Change the observers and the vantage points, clear away some of the mist, and a different lot of peaks appear. Genius is a term we apply to those whom we recognise for their outstanding achievements and who stand near the end of the continuum of human abilities which reaches back through the mundane and mediocre to the incapable. There is still much truth in Dr Samuel Johnson's observation, 'The true genius is a mind of large general powers, accidentally determined to some particular direction'. We may disagree with the 'general', for we doubt if all musicians of genius could have become scientists of genius or vice versa, but there is no doubting the accidental determination which nurtured or triggered their gifts into those channels into which they have poured their powers so successfully. Along the continuum of abilities are hundreds of thousands of gifted men and women, boys and girls.

What we appreciate, enjoy or marvel at in the works of genius or the achievements of prodigies are the manifestations of skills or abilities which are similar to, but so much superior to, our own. But that their minds

are not different from our own is demonstrated by the fact that the hard-won discoveries of scientists like Kepler or Einstein become the commonplace knowledge of schoolchildren and the once outrageous shapes and colours of an artist like Paul Klee so soon appear on the fabrics we wear. This does not minimise the supremacy of their achievements, which outstrip our own as the sub-four-minute milers outstrip our jogging.

To think of geniuses and the gifted as having uniquely different brains is only reasonable. If we accept that each human brain is uniquely different. The purpose of instruction is to make us even more different from one another, and in the process of being educated we can learn from the achievements of those more gifted than ourselves. But before we try to emulate geniuses or encourage our children to do so we should note that some of the things we learn from them may prove unpalatable. We may envy their achievements and fame, but we should also recognise the price they may have paid in terms of perseverance, single-mindedness, dedication, restrictions on their personal lives, the demands upon their energies and time, and how often they had to display great courage to preserve their integrity or to make their way to the top.

Genius and giftedness are relative descriptive terms of no real substance. We may, at best, give them some precision by defining them and placing them in a context but, whatever we do, we should never delude ourselves into believing that gifted children or geniuses are different from the rest of humanity, save in the degree to which they have developed the performance of their abilities.

Questions 56-60

Choose **FIVE** letters, **A-K**.

Write the correct letters in boxes 56-60 on your answer sheet

NB Your answers may be given in any order.

Below are listed some popular beliefs about genius and giftedness.

*Which **FIVE** of these beliefs are reported by the writer of the text?*

- A** Truly gifted people are talented in all areas.
- B** The talents of geniuses are soon exhausted.
- C** Gifted people should use their gifts.
- D** A genius appears once in every generation.
- E** Genius can be easily destroyed by discouragement.
- F** Genius is inherited.
- G** Gifted people are very hard to live with.
- H** People never appreciate true genius.
- I** Geniuses are natural leaders.
- J** Gifted people develop their greatness through difficulties.
- K** Genius will always reveal itself.

READING PASSAGE 9

Collecting Ant Specimens

Collecting ants can be as simple as picking up stray ones and placing them in a glass jar, or as complicated as completing an exhaustive survey of all species present in an area and estimating their relative abundances. The exact method used will depend on the final purpose of the collections. For taxonomy, or classification, long series, from a single nest, which contain all castes (workers, including majors and minors, and, if present, queens and males) are desirable, to allow the determination of variation within species. For ecological studies, the most important factor is collecting identifiable samples of as many of the different species present as possible. Unfortunately, these methods are not always compatible. The taxonomist sometimes overlooks whole species in favour of those groups currently under study, while the ecologist often collects only a limited number of specimens of each species, thus reducing their value for taxonomic investigations.

To collect as wide a range of species as possible, several methods must be used. These include hand collecting, using baits to attract the ants, ground litter sampling, and the use of pitfall traps. Hand collecting consists of searching for ants everywhere they are likely to occur. This includes on the ground, under rocks, logs or other objects on the ground, in rotten wood on the ground or on trees, in vegetation, on tree trunks and under bark. When possible, collections should be made from nests or foraging columns and at least 20 to 25 individuals collected. This will ensure that all individuals are of the same species, and so increase their value for detailed studies. Since some species are largely nocturnal, collecting should not be confined to daytime. Specimens are collected using an aspirator (often called a pooter), forceps, a fine, moistened paint brush, or fingers, if the ants are known not to sting. Individual insects are placed in plastic or glass tubes (1.5-3-0 ml capacity for small ants, 5-8 ml for larger ants) containing 75% to 95% ethanol. Plastic tubes with secure tops are better than glass because they are lighter, and do not break as easily if mishandled.

Baits can be used to attract and concentrate foragers. This often increases the number of individuals collected and attracts species that are otherwise elusive. Sugars and meats or oils will attract different species and a range should be utilised. These baits can be placed either on the ground or on the trunks of trees or large shrubs. When placed on the ground, baits should be situated on small paper cards or other flat, light-coloured surfaces, or in test-tubes or vials. This makes it easier to spot ants and to capture them before they can escape into the surrounding leaf litter.

Many ants are small and forage primarily in the layer of leaves and other debris on the ground. Collecting these species by hand can be difficult. One of the most successful ways to collect them is to gather the leaf litter in which they are foraging and extract the ants from it. This is most commonly done by placing leaf litter on a screen over a large funnel, often under some heat. As the leaf litter dries from above, ants (and other animals) move downward and eventually fall out the bottom and are collected in alcohol placed below the funnel. This method works especially well in rain forests and marshy areas. A method of improving the catch when using a funnel is to sift the leaf litter through a coarse screen before placing it above the funnel. This will concentrate the litter and remove larger leaves and twigs. It will also allow more litter to be sampled when using a limited number of funnels.

The pitfall trap is another commonly used tool for collecting ants. A pitfall trap can be any small container placed in the ground with the top level with the surrounding surface and filled with a preservative. Ants are collected when they fall into the trap while foraging.

The diameter of the traps can vary from about 18 mm to 10 cm and the number used can vary from a few to several hundred. The size of the traps used is influenced largely by personal preference (although larger sizes are generally better), while the number will be determined by the study being undertaken. The preservative used is usually ethylene glycol or propylene glycol, as alcohol will evaporate quickly and the traps will dry out.

One advantage of pitfall traps is that they can be used to collect over a period of time with minimal maintenance and intervention. One disadvantage is that some species are not collected as they either avoid the traps or do not commonly encounter them while foraging.

Questions 31-36

Classify the following statements as referring to

- A** *hand collecting*
- B** *using bait*
- C** *sampling ground litter*
- D** *using a pitfall trap*

Write the correct letter, A, B, C or D, in boxes 31-36 on your answer sheet.

- 61** It is preferable to take specimens from groups of ants.
- 62** It is particularly effective for wet habitats.
- 63** It is a good method for species which are hard to find.
- 64** Little time and effort is required.
- 65** Separate containers are used for individual specimens.
- 66** Non-alcoholic preservative should be used.

READING PASSAGE 10

Gifted children and learning

A Internationally, 'giftedness' is most frequently determined by a score on a general intelligence test, known as an IQ test, which is above a chosen cutoff point, usually at around the top 2-5%. Children's educational environment contributes to the IQ score and the way intelligence is used. For example, a very close positive relationship was found when children's IQ scores were compared with their home educational provision (Freeman, 2010). The higher the children's IQ scores, especially over IQ 130, the better the quality of their educational backup, measured in terms of reported verbal interactions with parents, number of books and activities in their home etc. Because IQ tests are decidedly influenced by what the child has learned, they are to some extent measures of current achievement based on age-norms; that is, how well the children have learned to manipulate their knowledge and know-how within the terms of the test. The vocabulary aspect, for example, is dependent on having heard those words. But IQ tests can neither identify the processes of learning and thinking nor predict creativity.

B Excellence does not emerge without appropriate help. To reach an exceptionally high standard in any area very able children need the means to learn, which includes material to work with and focused challenging tuition -and the encouragement to follow their dream. There appears to be a qualitative difference in the way the intellectually highly able think, compared with more average-ability or older pupils, for whom external regulation by the teacher often compensates for lack of internal regulation. To be at their most effective in their self-regulation, all children can be helped to identify their own ways of learning – metacognition – which will include strategies of planning, monitoring, evaluation, and choice of what to learn. Emotional awareness is also part of metacognition, so children should be helped to be aware of their feelings around the area to be learned, feelings of curiosity or confidence, for example.

C High achievers have been found to use self-regulatory learning strategies more often and more effectively than lower achievers, and are better able to transfer these strategies to deal with unfamiliar tasks. This happens to such a high degree in some children that they appear to be demonstrating talent in particular areas. Overlooking research on the thinking process of highly able children, (Shore and Kanevsky, 1993) put the instructor's problem succinctly: 'If they [the gifted] merely think more quickly, then we need only teach more quickly. If they merely make fewer errors, then we can shorten the practice'. But of course, this is not entirely the case; adjustments have to be made in methods of learning and teaching, to take account of the many ways individuals think.

D Yet in order to learn by themselves, the gifted do need some support from their teachers. Conversely, teachers who have a tendency to 'overdirect' can diminish their gifted pupils' learning autonomy. Although 'spoon-feeding' can produce extremely high examination results, these are not always followed by equally impressive life successes. Too much dependence on the teachers risks loss of autonomy and motivation to discover. However, when teachers o pupils to reflect on their own learning and thinking activities, they increase their pupils' self-regulation. For a young child, it may be just the simple question 'What have you learned today?' which helps them to recognise what they are doing. Given that a fundamental goal of education is to transfer the control of learning from teachers to pupils, improving pupils' learning to learn techniques should be a major outcome of the school experience, especially for the highly competent. There are quite a number of new methods which can help, such as child- initiated learning, ability-peer tutoring, etc. Such practices have been found to be particularly useful for bright children from deprived areas.

E But scientific progress is not all theoretical, knowledge is a so vital to outstanding performance: individuals who know a great deal about a specific domain will achieve at a higher level than those who do not (Elshout, 1995). Research with creative scientists by Simonton (1988) brought him to the conclusion that above a certain high level, characteristics such as independence seemed to contribute more to reaching the highest levels of expertise than intellectual skills, due to the great demands of effort and time needed for learning and

practice. Creativity in all forms can be seen as expertise se mixed with a high level of motivation (Weisberg, 1993).

F To sum up, learning is affected by emotions of both the individual and significant others. Positive emotions facilitate the creative aspects of earning and negative emotions inhibit it. Fear, for example, can limit the development of curiosity, which is a strong force in scientific advance, because it motivates problem-solving behaviour. In Boekaerts' (1991) review of emotion the learning of very high IQ and highly achieving children, she found emotional forces in harness. They were not only curious, but often had a strong desire to control their environment, improve their learning efficiency and increase their own learning resources.

Questions 67-70

Reading Passage 2 has six paragraphs, A-F.

Which paragraph contains the following information?

Write the correct letter, A-E, in boxes 14-17 on your answer sheet

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

- 67** a reference to the influence of the domestic background on the gifted child.
- 68** reference to what can be lost if learners are given too much guidance.
- 69** reference to the damaging effects of anxiety.
- 70** examples of classroom techniques which favour socially-disadvantaged children.

Questions 18-22

Look at the following statements (Questions 18-22) and the list of people below.

Match each statement with the correct person or people, A-E.

Write the correct letter, A-E, in boxes 18-22 on your answer sheet.

- 71** Less time can be spent on exercises with gifted pupils who produce accurate work.
- 72** Self-reliance is a valuable tool that helps gifted students reach their goals.
- 73** Gifted children know how to channel their feelings to assist their learning.
- 74** The very gifted child benefits from appropriate support from close relatives.
- 75** Really successful students have learnt a considerable amount about their subject.

List of People

A Freeman
B Shore and Kanevsky

C Elshout
D Simonton

E Boekaerts

READING PASSAGE 11

Autumn leaves

Canadian writer Jay Ingram investigates the mystery of why leaves turn red in the fall

A One of the most captivating natural events of the year in many areas throughout North America is the turning of the leaves in the fall. The colours are magnificent, but the question of exactly why some trees turn yellow or orange, and others red or purple, is something which has long puzzled scientists.

B Summer leaves are green because they are full of chlorophyll, the molecule that captures sunlight converts that energy into new building materials for the tree. As fall approaches in the northern hemisphere, the amount of solar energy available declines considerably. For many trees – evergreen conifers being an exception – the best strategy is to abandon photosynthesis* until the spring. So rather than maintaining the now redundant leaves throughout the winter, the tree saves its precious resources and discards them. But before letting its leaves go, the tree dismantles their chlorophyll molecules and ships their valuable nitrogen back into the twigs. As chlorophyll is depleted, other colours that have been dominated by it throughout the summer begin to be revealed. This unmasking explains the autumn colours of yellow and orange, but not the brilliant reds and purples of trees such as the maple or sumac.

C The source of the red is widely known: it is created by anthocyanins, water-soluble plant pigments reflecting the red to blue range of the visible spectrum. They belong to a class of sugar-based chemical compounds also known as flavonoids. What's puzzling is that anthocyanins are actually newly minted, made in the leaves at the same time as the tree is preparing to drop them. But it is hard to make sense of the manufacture of anthocyanins – why should a tree bother making new chemicals in its leaves when it's already scrambling to withdraw and preserve the ones already there?

D Some theories about anthocyanins have argued that they might act as a chemical defence against attacks by insects or fungi, or that they might attract fruit-eating birds or increase a leaf's tolerance to freezing. However there are problems with each of these theories, including the fact that leaves are red for such a relatively short period that the expense of energy needed to manufacture the anthocyanins would outweigh any anti-fungal or anti-herbivore activity achieved.* photosynthesis: the production of new material from sunlight, water and carbon dioxide.

E It has also been proposed that trees may produce vivid red colours to convince herbivorous insects that they are healthy and robust and would be easily able to mount chemical defences against infestation. If insects paid attention to such advertisements, they might be prompted to lay their eggs on a duller, and presumably less resistant host. The flaw in this theory lies in the lack of proof to support it. No one has as yet ascertained whether more robust trees sport the brightest leaves, or whether insects make choices according to colour intensity.

F Perhaps the most plausible suggestion as to why leaves would go to the trouble of making anthocyanins when they're busy packing up for the winter is the theory known as the 'light screen' hypothesis. It sounds paradoxical, because the idea behind this hypothesis is that the red pigment is made in autumn leaves to protect chlorophyll, the light-absorbing chemical, from too much light. Why does chlorophyll need protection when it is the natural world's supreme light absorber? Why protect chlorophyll at a time when the tree is breaking it down to salvage as much of it as possible?

G Chlorophyll, although exquisitely evolved to capture the energy of sunlight, can sometimes be overwhelmed by it, especially in situations of drought, low temperatures, or nutrient deficiency. Moreover, the problem of oversensitivity to light is even more acute in the fall, when the leaf is busy preparing for winter by dismantling its internal machinery. The energy absorbed by the chlorophyll molecules of the unstable autumn leaf is not immediately channelled into useful products and processes, as it would be in an intact summer leaf. The

weakened fall leaf then becomes vulnerable to the highly destructive effects of the oxygen created by the excited chlorophyll molecules.

H Even if you had never suspected that this is what was going on when leaves turn red, there are clues out there. One is straightforward: on many trees, the leaves that are the reddest are those on the side of the tree which gets most sun. Not only that, but the red is brighter on the upper side of the leaf. It has also been recognised for decades that the best conditions for intense red colours are dry, sunny days and cool nights, conditions that nicely match those that make leaves susceptible to excess light. And finally, trees such as maples usually get much redder the more north you travel in the northern hemisphere. It's colder there, they're more stressed, their chlorophyll is more sensitive and it needs more sunblock.

I What is still not fully understood, however, is why some trees resort to producing red pigments while others don't bother, and simply reveal their orange or yellow hues. Do these trees have other means at their disposal to prevent overexposure to light in autumn? Their story, though not as spectacular to the eye, will surely turn out to be as subtle and as complex.

Questions 76-80

Reading Passage 2 has nine paragraphs, A-I.

Which paragraph contains the following information?

Write the correct letter, A-I, in boxes 76-80 on your answer sheet.

NB You may use any letter more than once.

- 76 a description of the substance responsible for the red colouration of leaves
- 77 the reason why trees drop their leaves in autumn
- 78 some evidence to confirm a theory about the purpose of the red leaves
- 79 an explanation of the function of chlorophyll
- 80 a suggestion that the red colouration in leaves could serve as a warning signal

Second nature

Your personality isn't necessarily set in stone. With a little experimentation, people can reshape their temperaments and inject passion, optimism, joy and courage into their lives

A Psychologists have long held that a person's character cannot undergo a transformation in any meaningful way and that the key traits of personality are determined at a very young age. However, researchers have begun looking more closely at ways we *can* change. Positive psychologists have identified 24 qualities we admire, such as loyalty and kindness, and are studying them to find out why they come so naturally to some people. What they're discovering is that many of these qualities amount to habitual behaviour that determines the way we respond to the world. The good news is that all this can be learned.

Some qualities are less challenging to develop than others, optimism being one of them. However, developing qualities requires mastering a range of skills which are diverse and sometimes surprising. For example, to bring more joy and passion into your life, you must be open to experiencing negative emotions. Cultivating such qualities will help you realise your full potential.

B 'The evidence is good that most personality traits can be altered,' says Christopher Peterson, professor of psychology at the University of Michigan, who cites himself as an example. Inherently introverted, he realised early on that as an academic, his reticence would prove disastrous in the lecture hall. So he learned to be more outgoing and to entertain his classes. 'Now my extroverted behaviour is spontaneous,' he says.

C David Fajgenbaum had to make a similar transition. He was preparing for university, when he had an accident that put an end to his sports career. On campus, he quickly found that beyond ordinary counselling, the university had no services for students who were undergoing physical rehabilitation and suffering from depression like him. He therefore launched a support group to help others in similar situations. He took action despite his own pain - a typical response of an optimist.

D Suzanne Segerstrom, professor of psychology at the University of Kentucky, believes that the key to increasing optimism is through cultivating optimistic behaviour, rather than positive thinking. She recommends you train yourself to pay attention to good fortune by writing down three positive things that come about each day. This will help you convince yourself that favourable outcomes actually happen all the time, making it easier to begin taking action.

E You can recognise a person who is passionate about a pursuit by the way they are so strongly involved in it. Tanya Streeter's passion is freediving - the sport of plunging deep into the water without tanks or other breathing equipment. Beginning in 1998, she set nine world records and can hold her breath for six minutes. The physical stamina required for this sport is intense but the psychological demands are even more overwhelming. Streeter learned to untangle her fears from her judgment of what her body and mind could do. 'In my career as a competitive freediver, there was a limit to what I could do - but it wasn't anywhere near what I thought it was/ she says.

F Finding a pursuit that excites you can improve anyone's life. The secret about consuming passions, though, according to psychologist Paul Silvia of the University of North Carolina, is that 'they require discipline, hard work and ability, which is why they are so rewarding.' Psychologist Todd Kashdan has this advice for those people taking up a new passion: 'As a newcomer, you also have to tolerate and laugh at your own ignorance. You must be willing to accept the negative feelings that come your way,' he says.

G In 2004, physician-scientist Mauro Zappaterra began his PhD research at Harvard Medical School. Unfortunately, he was miserable as his research wasn't compatible with his curiosity about healing. He finally took a break and during eight months in Santa Fe, Zappaterra learned

about alternative healing techniques not taught at Harvard. When he got back, he switched labs to study how cerebrospinal fluid nourishes the developing nervous system. He also vowed to look for the joy in everything, including failure, as this could help him learn about his research and himself.

One thing that can hold joy back is a person's concentration on avoiding failure rather than their looking forward to doing something well. 'Focusing on being safe might get in the way of your reaching your goals,' explains Kashdan. For example, are you hoping to get through a business lunch without embarrassing yourself, or are you thinking about how fascinating the conversation might be?

Usually, we think of courage in physical terms but ordinary life demands something else. For marketing executive Kenneth Pedeleose, it meant speaking out against something he thought was ethically wrong. The new manager was intimidating staff so Pedeleose carefully recorded each instance of bullying and eventually took the evidence to a senior director, knowing his own job security would be threatened. Eventually the manager was the one to go. According to Cynthia Pury, a psychologist at Clemson University, Pedeleose's story proves the point that courage is not motivated by fearlessness, but by moral obligation. Pury also believes that people can acquire courage. Many of her students said that faced with a risky situation, they first tried to calm themselves down, then looked for a way to mitigate the danger, just as Pedeleose did by documenting his allegations.

Over the long term, picking up a new character trait may help you move toward being the person you want to be. And in the short term, the effort itself could be surprisingly rewarding, a kind of internal adventure.

Questions 81-84

Match each statement with the correct person, **A-G**.

Write the correct letter, **A-G**, in boxes **81-84** on your answer sheet.

- 81** People must accept that they do not know much when first trying something new.
- 82** It is important for people to actively notice when good things happen.
- 83** Courage can be learned once its origins in a sense of responsibility are understood.
- 84** It is possible to overcome shyness when faced with the need to speak in public.

List of People

A Christopher Peterson

D Tanya Streeter

G Cynthia Pury

B David Fajgenbaum

E Todd Kashdan

C Suzanne Segerstrom

F Kenneth Pedeleose

Questions 85-88

Reading Passage 2 has eight sections, **A-H**.

Which section contains the following information? Write the correct letter.

- 85** a mention of how rational thinking enabled someone to achieve physical goals
- 86** an account of how someone overcame a sad experience
- 87** a description of how someone decided to rethink their academic career path
- 88** an example of how someone risked his career out of a sense of duty

COMPLETING SENTENCE

READING PASSAGE 1

A neuroscientist reveals how to think differently

In the last decade a revolution has occurred In the way that scientists think about the brain.

We now know that the decisions humans make can be traced to the firing patterns of neurons in specific parts of the brain. These discoveries have led to the field known as neuroeconomics, which studies the brain's secrets to success in an economic environment that demands innovation and being able to do things differently from competitors. A brain that can do this is an iconoclastic one. Briefly, an iconoclast is a person who does something that others say can't be done.

This definition implies that iconoclasts are different from other people, but more precisely, it is their brains that are different in three distinct ways: perception, fear response, and social intelligence. Each of these three functions utilizes a different circuit in the brain. Naysayers might suggest that the brain is irrelevant, that thinking in an original, even revolutionary, way is more a matter of personality than brain function. But the field of neuroeconomics was born out of the realization that the physical workings of the brain place limitations on the way we make decisions. By understanding these constraints, we begin to understand why some people march to a different drumbeat.

The first thing to realize is that the brain suffers from limited resources. It has a fixed energy budget, about the same as a 40 watt light bulb, so it has evolved to work as efficiently as possible. This is where most people are impeded from being an iconoclast. For example, when confronted with information streaming from the eyes, the brain will interpret this information in the quickest way possible. Thus it will draw on both past experience and any other source of information, such as what other people say, to make sense of what it is seeing. This happens all the time. The brain takes shortcuts that work so well we are hardly ever aware of them.

We think our perceptions of the world are real, but they are only biological and electrical rumblings. Perception is not simply a product of what your eyes or ears transmit to your brain. More than the physical reality of photons or sound waves, perception is a product of the brain.

Perception is central to iconoclasm. Iconoclasts see things differently to other people. Their brains do not fall into efficiency pitfalls as much as the average person's brain. Iconoclasts, either because they were born that way or through learning, have found ways to work around the perceptual shortcuts that plague most people. Perception is not something that is hardwired into the brain. It is a learned process, which is both a curse and an opportunity for change. The brain faces the fundamental problem of interpreting physical stimuli from the senses. Everything the brain sees, hears, or touches has multiple interpretations. The one that is ultimately chosen is simply the brain's best theory. In technical terms, these conjectures have their basis in the statistical likelihood of one interpretation over another and are heavily influenced by past experience and, importantly for potential iconoclasts, what other people say.

The best way to see things differently to other people is to bombard the brain with things it has never encountered before. Novelty releases the perceptual process from the chains of past experience and forces the brain to make new judgments. Successful iconoclasts have an extraordinary willingness to be exposed to what is fresh and different. Observation of iconoclasts shows that they embrace novelty while most people avoid things that are different.

The problem with novelty, however, is that it tends to trigger the brain's fear system. Fear is a major impediment to thinking like an iconoclast and stops the average person in his tracks. There are many types of fear, but the two that inhibit iconoclastic thinking and people generally find difficult to deal with are fear of uncertainty and fear of public ridicule. These may seem like trivial phobias. But fear of public speaking, which

everyone must do from time to time, afflicts one-third of the population. This makes it too common to be considered a mental disorder. It is simply a common variant of human nature, one which iconoclasts do not let inhibit their reactions.

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.

Questions 1-3

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

- 1 Thinking like a successful iconoclast is demanding because it
- 2 The concept of the social brain is useful to iconoclasts because it
- 3 Iconoclasts are generally an asset because their way of thinking

Write the correct letter, A-E, in boxes 38-40 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.

READING PASSAGE 2

Telepathy

Can human beings communicate by thought alone? For more than a century the issue of telepathy has divided the scientific community, and even today it still sparks bitter controversy among top academics

Since the 1970s, parapsychologists at leading universities and research institutes around the world have risked the derision of sceptical colleagues by putting the various claims for telepathy to the test in dozens of rigorous scientific studies. The results and their implications are dividing even the researchers who uncovered them.

Some researchers say the results constitute compelling evidence that telepathy is genuine. Other parapsychologists believe the field is on the brink of collapse, having tried to produce definitive scientific proof and failed. Sceptics and advocates alike do concur on one issue, however: that the most impressive evidence so far has come from the so-called 'ganzfeld' experiments, a German term that means 'whole field'. Reports of telepathic experiences had by people during meditation led parapsychologists to suspect that telepathy might involve 'signals' passing between people that were so faint that they were usually swamped by normal brain activity. In this case, such signals might be more easily detected by those experiencing meditation-like tranquillity in a relaxing 'whole field' of light, sound and warmth.

The ganzfeld experiment tries to recreate these conditions with participants sitting in soft reclining chairs in a sealed room, listening to relaxing sounds while their eyes are covered with special filters letting in only soft pink light. In early ganzfeld experiments, the telepathy test involved identification of a picture chosen from a random selection of four taken from a large image bank. The idea was that a person acting as a 'sender' would attempt to beam the image over to the 'receiver' relaxing in the sealed room.

Once the session was over, this person was asked to identify which of the four images had been used. Random guessing would give a hit-rate of 25 per cent; if telepathy is real, however, the hit-rate would be higher. In 1982, the results from the first ganzfeld studies were analysed by one of its pioneers, the American parapsychologist Charles Honorton. They pointed to typical hit-rates of better than 30 per cent - a small effect, but one which statistical tests suggested could not be put down to chance.

The implication was that the ganzfeld method had revealed real evidence for telepathy. But there was a crucial flaw in this argument - one routinely overlooked in more conventional areas of science. Just because chance had been ruled out as an explanation did not prove telepathy must exist; there were many other ways of getting positive results. These ranged from 'sensory leakage' - where clues about the pictures accidentally reach the receiver - to outright fraud. In response, the researchers issued a review of all the ganzfeld studies done up to 1985 to show that 80 per cent had found statistically significant evidence. However, they also agreed that there were still too many problems in the experiments which could lead to positive results, and they drew up a list demanding new standards for future research.

After this, many researchers switched to autoganzfeld tests - an automated variant of the technique which used computers to perform many of the key tasks such as the random selection of images. By minimising human involvement, the idea was to minimise the risk of flawed results. In 1987, results from hundreds of autoganzfeld tests were studied by Honorton in a 'meta-analysis', a statistical technique for finding the overall results from a set of studies. Though less compelling than before, the outcome was still impressive.

Yet some parapsychologists remain disturbed by the lack of consistency between individual ganzfeld studies. Defenders of telepathy point out that demanding impressive evidence from every study ignores one basic statistical fact: it takes large samples to detect small effects. If, as current results suggest, telepathy produces hit-rates only marginally above the 25 per cent expected by chance, it's unlikely to be detected by a typical ganzfeld study involving around 40 people: the group is just not big enough. Only when many studies are combined in a meta-analysis will the faint signal of telepathy really become apparent. And that is what researchers do seem to be finding.

What they are certainly not finding, however, is any change in attitude of mainstream scientists: most still totally reject the very idea of telepathy. The problem stems at least in part from the lack of any plausible mechanism for telepathy.

Various theories have been put forward, many focusing on esoteric ideas from theoretical physics. They include 'quantum entanglement', in which events affecting one group of atoms instantly affect another group, no matter how far apart they may be. While physicists have demonstrated entanglement with specially prepared atoms, no-one knows if it also exists between atoms making up human minds. Answering such questions would transform parapsychology. This has prompted some researchers to argue that the future lies not in collecting more evidence for telepathy, but in probing possible mechanisms. Some work has begun already, with researchers trying to identify people who are particularly successful in autoganzfeld trials. Early results show that creative and artistic people do much better than average: in one study at the University of Edinburgh, musicians achieved a hit-rate of 56 per cent. Perhaps more tests like these will eventually give the researchers the evidence they are seeking and strengthen the case for the existence of telepathy.

Questions 27-30

*Complete each sentence with the correct ending, A-G, below.
Write the correct letter, A-G, in boxes 27-30 on your answer sheet.*

- A** the discovery of a mechanism for telepathy.
 - B** the need to create a suitable environment for telepathy.
 - C** their claims of a high success rate.
 - D** a solution to the problem posed by random guessing.
 - E** the significance of the ganzfeld experiments.
 - F** a more careful selection of subjects.
 - G** a need to keep altering conditions.
-
- 4 Researchers with differing attitudes towards telepathy agree on.....
 - 5 Reports of experiences during meditation indicated.....
 - 6 Attitudes to parapsychology would alter drastically with
 - 7 Recent autoganzfeld trials suggest that success rates will

READING PASSAGE 3

Biological control of pests

The continuous and reckless use of synthetic chemicals for the control of pests which pose a threat to agricultural crops and human health is proving to be counter-productive. Apart from engendering widespread ecological disorders, pesticides have contributed to the emergence of a new breed of chemical-resistant, highly lethal superbugs.

According to a recent study by the Food and Agriculture Organisation (FAO), more than 300 species of agricultural pests have developed resistance to a wide range of potent chemicals. Not to be left behind are the disease-spreading pests, about 100 species of which have become immune to a variety of insecticides now in use.

One glaring disadvantage of pesticides' application is that, while destroying harmful pests, they also wipe out many useful non-targeted organisms, which keep the growth of the pest population in check. This results in what agroecologists call the 'treadmill syndrome'. Because of their tremendous breeding potential and genetic diversity, many pests are known to withstand synthetic chemicals and bear offspring with a built-in resistance to pesticides.

The havoc that the 'treadmill syndrome' can bring about is well illustrated by what happened to cotton farmers in Central America. In the early 1940s, basking in the glory of chemical-based intensive agriculture, the farmers avidly took to pesticides as a sure measure to boost crop yield. The insecticide was applied eight times a year in the mid-1940s, rising to 28 in a season in the mid-1950s, following the sudden proliferation of three new varieties of chemical-resistant pests.

By the mid-1960s, the situation took an alarming turn with the outbreak of four more new pests, necessitating pesticide spraying to such an extent that 50% of the financial outlay on cotton production was accounted for by pesticides. In the early 1970s, the spraying frequently reached 70 times a season as the farmers were pushed to the wall by the invasion of genetically stronger insect species.

Most of the pesticides in the market today remain inadequately tested for properties that cause cancer and mutations as well as for other adverse effects on health, says a study by United States environmental agencies. The United States National Resource Defense Council has found that DDT was the most popular of a long list of dangerous chemicals in use.

In the face of the escalating perils from indiscriminate applications of pesticides, a more effective and ecologically sound strategy of biological control, involving the selective use of natural enemies of the pest population, is fast gaining popularity - though, as yet, it is a new field with limited potential. The advantage of biological control in contrast to other methods is that it provides a relatively low-cost, perpetual control system with a minimum of detrimental side-effects. When handled by experts, bio-control is safe, non-polluting and self-dispersing.

The Commonwealth Institute of Biological Control (CIBC) in Bangalore, with its global network of research laboratories and field stations, is one of the most active, non-commercial research agencies engaged in pest control by setting natural predators against parasites. CIBC also serves as a clearing-house for the export and import of biological agents for pest control world-wide.

CIBC successfully used a seed-feeding weevil, native to Mexico, to control the obnoxious parthenium weed, known to exert devious influence on agriculture and human health in both India and Australia. Similarly the Hyderabad-based Regional Research Laboratory (RRL), supported by CIBC, is now trying out an Argentinian weevil for the eradication of water hyacinth, another dangerous weed, which has become a nuisance in many

parts of the world. According to Mrs Kaiser Jamil of RRL, 'The Argentinian weevil does not attack any other plant and a pair of adult bugs could destroy the weed in 4-5 days.' CIBC is also perfecting the technique for breeding parasites that prey on 'disapene scale' insects - notorious defoliants of fruit trees in the US and India.

How effectively biological control can be pressed into service is proved by the following examples. In the late 1960s, when Sri Lanka's flourishing coconut groves were plagued by leaf-mining hispides, a larval parasite imported from Singapore brought the pest under control. A natural predator indigenous to India, *Neodumetia sangawani*, was found useful in controlling the Rhodes grass-scale insect that was devouring forage grass in many parts of the US. By using *Neochetina bruci*, a beetle native to Brazil, scientists at Kerala Agricultural University freed a 12-kilometre-long canal from the clutches of the weed *Salvinia molesta*, popularly called 'African Payal' in Kerala. About 30,000 hectares of rice fields in Kerala are infested by this weed.

Questions 22-26

Complete each sentence with the correct ending, **A-I**, below.
Write the correct letter, **A-I**, in boxes 22-26 on your answer sheet.

- | | |
|--------------------------|-------------------------------|
| A forage grass. | F parthenium weed. |
| B rice fields. | G Brazilian beetles. |
| C coconut trees. | H grass-scale insects. |
| D fruit trees. | I larval parasites. |
| E water hyacinth. | |

- 13 Disapene scale insects feed on....
- 14 *Neodumetia sangawani* ate.....
- 15 Leaf-mining hispides blighted.....
- 16 An Argentinian weevil may be successful in wiping out.....
- 17 *Salvinia molesta* plagues.....

The psychology of innovation

Why are so few companies truly innovative?

Innovation is key to business survival, and companies put substantial resources into inspiring employees to develop new ideas. There are, nevertheless, people working in luxurious, state-of-the-art centres designed to stimulate innovation who find that their environment doesn't make them feel at all creative. And there are those who don't have a budget, or much space, but who innovate successfully.

For Robert B. Cialdini, Professor of Psychology at Arizona State University, one reason that companies don't succeed as often as they should is that innovation starts with recruitment. Research shows that the fit between an employee's values and a company's values makes a difference to what contribution they make and whether, two years after they join, they're still at the company. Studies at Harvard Business School show that, although some individuals may be more creative than others, almost every individual can be creative in the right circumstances.

One of the most famous photographs in the story of rock'n'roll emphasises Cialdini's views. The 1956 picture of singers Elvis Presley, Carl Perkins, Johnny Cash and Jerry Lee Lewis jamming at a piano in Sun Studios in Memphis tells a hidden story. Sun's 'million-dollar quartet' could have been a quintet. Missing from the picture is Roy Orbison, a greater natural singer than Lewis, Perkins or Cash. Sam Phillips, who owned Sun, wanted to revolutionise popular music with songs that fused black and white music, and country and blues. Presley, Cash, Perkins and Lewis instinctively understood Phillips's ambition and believed in it. Orbison wasn't inspired by the goal, and only ever achieved one hit with the Sun label.

The value fit matters, says Cialdini, because innovation is, in part, a process of change, and under that pressure we, as a species, behave differently, 'When things change, we are hard-wired to play it safe.' Managers should therefore adopt an approach that appears counterintuitive -they should explain what stands to be lost if the company fails to seize a particular opportunity. Studies show that we invariably take more gambles when threatened with a loss than when offered a reward.

Managing innovation is a delicate art. It's easy for a company to be pulled in conflicting directions as the marketing, product development, and finance departments each get different feedback from different sets of people. And without a system which ensures collaborative exchanges within the company, it's also easy for small 'pockets of innovation' to disappear. Innovation is a contact sport. You can't brief people just by saying, 'We're going in this direction and I'm going to take you with me.'

Cialdini believes that this 'follow-the-leader syndrome, is dangerous, not least because it encourages bosses to go it alone. 'It's been scientifically proven that three people will be better than one at solving problems, even if that one person is the smartest person in the field.' To prove his point, Cialdini cites an interview with molecular biologist James Watson. Watson, together with Francis Crick, discovered the structure of DNA, the genetic information carrier of all living organisms. 'When asked how they had cracked the code ahead of an array of highly accomplished rival investigators, he said something that stunned me. He said "he and Crick had succeeded because they were aware that they weren't the most intelligent of the scientists pursuing the answer. The smartest scientist was called Rosalind Franklin who, Watson said, "was so intelligent she rarely sought advice".'

Teamwork taps into one of the basic drivers of human behaviour. 'The principle of social proof is so pervasive that we don't even recognise it,' says Cialdini. 'If your project is being resisted, for example, by a group of veteran employees, ask another old-timer to speak up for it.' Cialdini is not alone in advocating

this strategy. Research shows that peer power, used horizontally not vertically, is much more powerful than any boss's speech.

Writing, visualising and prototyping can stimulate the flow of new ideas. Cialdini cites scores of research papers and historical events that prove that even something as simple as writing deepens every individual's engagement in the project. It is, he says, the reason why all those competitions on breakfast cereal packets encouraged us to write in saying, in no more than 10 words: 'I like Kellogg's Corn Flakes because...' The very act of writing makes us more likely to believe it.

Authority doesn't have to inhibit innovation but it often does. The wrong kind of leadership will lead to what Cialdini calls "captainitis, the regrettable tendency of team members to opt out of team responsibilities that are properly their'. He calls it captainitis because, he says, "crew members of multipilot aircraft exhibit a sometimes deadly passivity when the flight captain makes a clearly wrong-headed decision". This behaviour is not, he says, unique to air travel, but can happen in any workplace where the leader is overbearing.

At the other end of the scale is the 1980s Memphis design collective, a group of young designers for whom "the only rule was that there were no rule". This environment encouraged a free interchange of ideas, which led to more creativity with form, function, colour and materials that revolutionised attitudes to furniture design.

Many theorists believe the ideal boss should lead from behind, taking pride in collective accomplishment and giving credit where it is due. Cialdini says: "Leaders should encourage everyone to contribute and simultaneously assure all concerned that every recommendation is important to making the right decision and will be given full attention" The frustrating thing about innovation is that there are many approaches, but no magic formula. However, a manager who wants to create a truly innovative culture can make their job a lot easier by recognising these psychological realities.

Questions 31-35

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

Write the correct letter, A-G, in boxes 31-35 on your answer sheet

18. Employees whose values match those of their employers are more likely to
19. At times of change, people tend to
20. If people are aware of what they might lose, they will often
21. People working under a dominant boss are liable to
22. Employees working in organisations with few rules are more likely to

A take chances.

D get promotion.

F ignore their duties.

B share their ideas.

E avoid risk.

G remain in their jobs.

C become competitive.

READING PASSAGE 5

The Context, Meaning and Scope of Tourism

A Travel has existed since the beginning of time, when primitive man set out, often traversing great distances in search of game, which provided the food and clothing necessary for his survival. Throughout the course of history, people have travelled for purposes of trade, religious conviction, economic gain, war, migration and other equally compelling motivations. In the Roman era, wealthy aristocrats and high government officials also travelled for pleasure. Seaside resorts located at Pompeii and Herculaneum afforded citizens the opportunity to escape to their vacation villas in order to avoid the summer heat of Rome. Travel, except during the Dark Ages, has continued to grow and, throughout recorded history, has played a vital role in the development of civilisations and their economies.

B Tourism in the mass form as we know it today is a distinctly twentieth-century phenomenon. Historians suggest that the advent of mass tourism began in England during the industrial revolution with the rise of the middle class and the availability of relatively inexpensive transportation. The creation of the commercial airline industry following the Second World War and the subsequent development of the jet aircraft in the 1950s signalled the rapid growth and expansion of international travel. This growth led to the development of a major new industry: tourism. In turn, international tourism became the concern of a number of world governments since it not only provided new employment opportunities but also produced a means of earning foreign exchange.

C Tourism today has grown significantly in both economic and social importance. In most industrialised countries over the past few years the fastest growth has been seen in the area of services. One of the largest segments of the service industry, although largely unrecognised as an entity in some of these countries, is travel and tourism. According to the World Travel and Tourism Council (1992), Travel and tourism is the largest industry in the world on virtually any economic measure including value-added capital investment, employment and tax contributions. In 1992 the industry's gross output was estimated to be \$3.5 trillion, over 12 per cent of all consumer spending. The travel and tourism industry is the world's largest employer the almost 130 million jobs, or almost 7 per cent of all employees. This industry is the world's leading industrial contributor, producing over 6 per cent of the world's national product and accounting for capital investment in excess of \$422 billion in direct indirect and personal taxes each year. Thus, tourism has a profound impact both on the world economy and, because of the educative effect of travel and the effects on employment, on society itself.

D However, the major problems of the travel and tourism industry that have hidden, or obscured, its economic impact are the diversity and fragmentation of the industry itself. The travel industry includes: hotels, motels and other types of accommodation; restaurants and other food services; transportation services and facilities; amusements, attractions and other leisure facilities; gift shops and a large number of other enterprises. Since many of these businesses also serve local residents, the impact of spending by visitors can easily be overlooked or underestimated. In addition, Meis (1992) points out that the tourism industry involves concepts that have remained amorphous to both analysts and decision makers. Moreover, in all nations this problem has made it difficult for the industry to develop any type of reliable or credible tourism information base in order to estimate the contribution it makes to regional, national and global economies. However, the nature of this very diversity makes travel and tourism ideal vehicles for economic development in a wide variety of countries, regions or communities.

E Once the exclusive province of the wealthy, travel and tourism have become an institutionalised way of life for most of the population. In fact, McIntosh and Goeldner (1990) suggest that tourism has become the largest commodity in international trade for many nations and, for a significant number of other countries, it ranks second or third. For example, tourism is the major source of income in Bermuda, Greece, Italy, Spain, Switzerland and most Caribbean countries. In addition, Hawkins and Ritchie, quoting from data published by the American Express Company, suggest that the travel and tourism industry is the number one ranked

employer in the Bahamas, Brazil, Canada, France, (the former) West Germany, Hong Kong, Italy, Jamaica, Japan, Singapore, the United Kingdom and the United States. However, because of problems of definition, which directly affect statistical measurement, it is not possible with any degree of certainty to provide precise, valid or reliable data about the extent of world-wide tourism participation or its economic impact. In many cases, similar difficulties arise when attempts are made to measure domestic tourism.

Questions 23-25

Complete the sentences below.

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

*Write your answers in boxes **11-13** on your answer sheet.*

23. In Greece, tourism the most important.....

24. The travel and tourism industry in Jamaica is the major.....

25. The problems associated with measuring international tourism are often reflected in the measurement of.....

READING PASSAGE 6

When evolution runs backwards

Evolution isn't supposed to run backwards - yet an increasing number of examples show that it does and that it can sometimes represent the future of a species.

The description of any animal as an 'evolutionary throwback' is controversial. For the better part of a century, most biologists have been reluctant to use those words, mindful of a principle of evolution that says 'evolution cannot run backwards. But as more and more examples come to light and modern genetics enters the scene, that principle is having to be rewritten. Not only are evolutionary throwbacks possible, they sometimes play an important role in the forward march of evolution.

The technical term for an evolutionary throwback is an 'atavism', from the Latin atavus, meaning forefather. The word has ugly connotations thanks largely to Cesare Lombroso, a 19th-century Italian medic who argued that criminals were born not made and could be identified by certain physical features that were throwbacks to a primitive, sub-human state.

While Lombroso was measuring criminals, a Belgian palaeontologist called Louis Dollo was studying fossil records and coming to the opposite conclusion. In 1890 he proposed that evolution was irreversible: that 'an organism is unable to return, even partially, to a previous stage already realised in the ranks of its ancestors. Early 20th-century biologists came to a similar conclusion, though they qualified it in terms of probability, stating that there is no reason why evolution cannot run backwards - it is just very unlikely. And so the idea of irreversibility in evolution stuck and came to be known as 'Dollo's law.

If Dollo's law is right, atavisms should occur only very rarely, if at all. Yet almost since the idea took root, exceptions have been cropping up. In 1919, for example, a humpback whale with a pair of leglike appendages over a metre long, complete with a full set of limb bones, was caught off Vancouver Island in Canada. Explorer Roy Chapman Andrews argued at the time that the whale must be a throwback to a land-living ancestor. 'I can see no other explanation, he wrote in 1921.

Since then, so many other examples have been discovered that it no longer makes sense to say that evolution is as good as irreversible. And this poses a puzzle: how can characteristics that disappeared millions of years ago suddenly reappear?

In 1994, Rudolf Raff and colleagues at Indiana University in the USA decided to use genetics to put a number on the probability of evolution going into reverse. They reasoned that while some evolutionary changes involve the loss of genes and are therefore irreversible, others may be the result of genes being switched off. If these silent genes are somehow switched back on, they argued, longlost traits could reappear.

Raff's team went on to calculate the likelihood of it happening. Silent genes accumulate random mutations, they reasoned, eventually rendering them useless. So how long can a gene survive in a species if it is no longer used? The team calculated that there is a good chance of silent genes surviving for up to 6 million years in at least a few individuals in a population, and that some might survive as long as 10 million years. In other words, throwbacks are possible, but only to the relatively recent evolutionary past.

As a possible example, the team pointed to the mole salamanders of Mexico and California. Like most amphibians these begin life in a juvenile 'tadpole' state, then metamorphose into the adult form - except for one species, the axolotl, which famously lives its entire life as a juvenile. The simplest explanation for this is that the axolotl lineage alone lost the ability to metamorphose, while others retained it. From a detailed analysis of the salamanders' family tree, however, it is clear that the other lineages evolved from an ancestor that itself had lost the ability to metamorphose. In other words, metamorphosis in mole salamanders is an atavism. The salamander example fits with Raff's 10million-year time frame.

More recently, however, examples have been reported that break the time limit, suggesting that silent genes may not be the whole story. In a paper published last year, biologist Gunter Wagner of Yale University reported some work on the evolutionary history of a group of South American lizards called *Bachia*. Many of these have minuscule

limbs; some look more like snakes than lizards and a few have completely lost the toes on their hind limbs. Other species, however, sport up to four toes on their hind legs. The simplest explanation is that the toed lineages never lost their toes, but Wagner begs to differ. According to his analysis of the *Bachia* family tree, the toed species re-evolved toes from toeless ancestors and, what is more, digit loss and gain has occurred on more than one occasion over tens of millions of years.

So what's going on? One possibility is that these traits are lost and then simply reappear, in much the same way that similar structures can independently arise in unrelated species, such as the dorsal fins of sharks and killer whales. Another more intriguing possibility is that the genetic information needed to make toes somehow survived for tens or perhaps hundreds of millions of years in the lizards and was reactivated. These atavistic traits provided an advantage and spread through the population, effectively reversing evolution.

But if silent genes degrade within 6 to million years, how can long-lost traits be reactivated over longer timescales? The answer may lie in the womb. Early embryos of many species develop ancestral features. Snake embryos, for example, sprout hind limb buds. Later in development these features disappear thanks to developmental programs that say 'lose the leg'. If for any reason this does not happen, the ancestral feature may not disappear, leading to an atavism.

Questions 26-30

*Complete each sentence with the correct ending, A-G, below.
Write the correct letter, A-G, in boxes 32-36 on your answer sheet.*

- 26** For a long time biologists rejected
- 27** Opposing views on evolutionary throwbacks are represented by
- 28** Examples of evolutionary throwbacks have led to
- 29** The shark and killer whale are mentioned to exemplify
- 30** One explanation for the findings of Wagner's research is

- A** the question of how certain long-lost traits could reappear.
- B** the occurrence of a particular feature in different species.
- C** parallels drawn between behaviour and appearance.
- D** the continued existence of certain genetic information.
- E** the doubts felt about evolutionary throwbacks.
- F** the possibility of evolution being reversible.
- G** Dollo's findings and the convictions held by Lombroso.

Solution

❖ List of heading

Question no.	Answer
1	iv
2	vii
3	i
4	ii
5.	
6	ii
7	vi
8	i
9	iii
9.a	ii
10	iii
11	v
12	iv
13	viii
14	vii
16	ii
17	vii

18	ix
19	iv
20	viii
21	ii
22	vi
23	i
24	iii
25	ix
26	ii
27	vii
28	i
29	viii
30	iv
31	vii
32	i
33	v
34	ii
35	viii
37	viii

38	iii
39	xi
40	i
41	v
42	x
43	ii
44	iv
45	iv
46	viii
47	vii
48	i
49	vi
50	ix
51	ii
52	ii
53	i
54	v
55	vii

❖ True, false, not given

Question no.	answer
1	False
2	Not given
3	False
4	True
5	Not given
6	True
7	Not given
8	Not given
9	False
10	True
11	False
12	False
13	True
14	Not given

16	True
17	True
18	True
19	False
20	False
21	Not given
22	True
23	False
24	True
25	Not given
26	False
27	Not given
28	False
29	True
30	False

31	False
32	Not given
33	True
34	True
35	False
36	True
37	True
38	Not given
39	False
40	True
41	True
42	True
43	True
44	False
45	True
46	True

47	Not given
48	True
49	Not given
50	True
51	Not given
52	True
53	False
54	False
55	True
56	Not given
57	Not given
58	True
59	True

60	False
61	Not given
62	Not given
63	False
64	Not given
65	True
66	False
67	False
68	Not given
69	True
70	True
71	Not given
72	Not given

73	True
74	False
75	Not given
76	False
77	True
78	Not given
79	True
80	False
81	True
82	True
83	Not given
84	False
85	False

❖ Yes, no, not given

Question no.	answer
1	yes
2	yes
3	Not given
4	No
5	Not given
6	No
7	Yes
8	Yes
9	Not given
10	No
11	Not given
12	No
13	Yes
14	No
15	Yes
16	Not given
17	Yes

18	Yes
19	No
20	Yes
21	No
22	Yes
23	Not given
24	No
25	Yes
26	Not given
27	Yes
28	Yes
29	No
30	Not given
31	No
32	Not given
33	Yes
34	No
35	Yes
36	No

37	Yes
38	Not given
39	Not given
40	No
41	Not given
42	No
43	Yes
44	Not given
45	No
46	No
47	Yes
48	Not given
49	Yes
50	Not given
51	Not given
52	Yes
53	No
54	Yes

❖ Fill in the gaps

Questio	Answer
---------	--------

n no.	
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1	3 measurement
---	---------------

2	(Triangular) graph
3	cluster
4	Amphibious
5	Half way
6	Dry-land tortoises
7	H
8	F
9	A
10	C
11	Maintenance
12	slow
13	Low pressure
14	Cavitation
16	(In either order; both required for on mark) Jupitor saturn
17	Solar system
18	(In either order; both required for on mark) sensors Circuits
19	Spares
20	Radio dish
21	thorium
22	pitchblende
23	radium
24	soldiers
25	illness
26	neutron
27	Leukaemia/leukemia
28	mirror
29	communication
30	ownership
31	(SHIP'S) anchor/(an/the) anchor
32	(Escape) wheel
33	tooth
34	(Long) pendulum
35	Second

36	Sender
37	Picture/image
38	receiver
39	Sensory leakage (In any order)
40	(outright) fraud (In any order)
41	Computers
42	Human involvement
43	Meta- analysis
44	Lack of consistency
45	Big/large enough
46	Spinning
47	(perfectly) unblemished
48	Labour/labor-intensive
49	Thickness
50	Marked
51	(Molten) glass
52	(Molten) tin/metal
53	Rollers
54	C (In any order)
55	D (In any order)
56	A
57	H
58	G
59	Clothing
60	Vocabulary
61	Chemicals
62	Cultures
63	Power companies
64	Safely
65	Size
66	B
67	C
68	G
69	D
70	Heat
71	Leaf litter
72	Screen
73	Alcohol
74	earthquake
75	4/four side
76	Tank
77	Verandas/verandahs
78	underwater

79	(In any order) books (and) activities
80	Internal regulation /self-regulation
81	Emotional awareness
82	Spoon feeding
83	B
84	H
85	L
86	G
87	D
88	Sun (light)
87	upper
89	dry
90	North
91	B
92	F
93	I
94	G
95	D
96	spread
97	10/ten time
98	Below
99	fuel
100	Seasons
101	Homes/housing
102	Transformation/change
103	Young age
104	optimism
105	Skills/techniques
106	Negative emotion/feelings
107	Physical chemistry (In any order)
108	Thermodynamics (In any order)
109	adapt
110	immortality

❖ Multiple choice

Question no.	Answer
1	C
2	B
3	D
4	C
5	B
6	B
7	A
8	D
9	D
10	C
11	B
12	C
13	A
14	C

16	D
17	D
18	A
19	A
20	B
21	C
22	A
23	C
24	B
25	A
26	D
27	D
28	C
29	A

30	D
31	B
32	C
33	D
34	A
35	D
36	C
37	A
38	D
39	C
40	C
41	D
42	C
43	B
44	A

❖ Question and answer

Question no.	Answer
1	(the/only) rich
2	Commercial (possibilities)
3	Mauve (was/is)
4	(Robert) puller
5	(In) france
6	Malaria (is)
7	Plants
8	(In either order, both required)

	breathing , reproduction.
9	gills
10	Dolphins
11	Two decades
12	Crowd
13	Invisible (disabilities/disability)
14	Objective 3
15	pavilions
16	Drought
17	Tourists

❖ Findings

Question no.	Answer
1	H
2	C

3	B
4	I
5	D
6	A

7	A (IN ANY ORDER)
8	C (IN ANY ORDER)

9	C
10	F
11	D
12	G
13	E
14	D
16	A
17	B
18	C
19	C
20	E
21	A
22	C
23	A (in any order)
24	D (in any order)
25	E (in any order)
26	F (in any order)
27	J (in any order)
28	D
29	F
30	B
31	E
32	A
33	C
34	G
35	C
36	G
37	D

38	H
39	E
40	D
41	B
42	E
43	C
44	D
45	B
46	F
47	E
48	B
49	F
50	D
51	A
52	C
53	C
54	A
55	B
56	B (IN ANY ORDER)
57	C (IN ANY ORDER)
58	F (IN ANY ORDER)
59	H (IN ANY ORDER)
60	J (IN ANY ORDER)
61	A

62	C
63	B
64	D
65	A
66	D
67	A
68	D
69	F
70	D
71	B
72	D
73	E
74	A
75	C
76	C
77	B
78	H
79	B
80	E
81	E
82	C
83	G
84	A
85	E
86	C
87	G
88	H

❖ Completing sentence

Question no.	Answer
1	A
2	B
3	C
4	E
5	B
6	A
7	F
8	D
9	H

10	C
11	E
12	B
13	D
14	H
15	C
16	E
17	B
18	G
19	E
20	A

21	F
22	B
23	Source of income/industry
24	Employer
25	Domestic tourism
26	F
27	G
28	A
29	B
30	D

Notes:

Notes:

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