

Reading Passage 1

You should spend about 20 minutes on **Questions 1 - 13**, which are based on Reading Passage 1 below.

Sleep

Historically, it was difficult to study sleep. Not much can be gleaned from observing recumbent persons and questionnaires are no use, because people remember little of their experience during sleep. The breakthrough came in the 1950's with electroencephalogram (EEG) recordings of brain electrical activity, when it was confirmed that sleep is anything but dormant.

We need sleep for biological restoration. It promotes cell growth, regeneration and memory consolidation. By shutting down most of the body's machinery, resources can be focused on repairing damage and development. When people are deprived of sleep for any reason, there is deterioration in performance, particularly on tasks requiring concentration, and eventually, behaviour becomes shambolic. The individual becomes progressively incoherent and irritable and, after a few days, may experience delusions and hallucinations. The disruptive effects of sleep deprivation have even been successfully used as a basis of persuasion in interrogation.

A vital part of sleep is dreaming, which happens most intensively during rapid eye movement (REM) sleep. We typically spend more than two hours each night dreaming, though this is often spread over four or five separate periods. Infants spend up to 50 per cent of their sleep time in REM sleep, which is understandable when one realises that REM sleep is the time used for brain development, as well as learning, thinking, and organising information. If people are woken when REM sleep commences, depriving them specifically of dream-sleep, the proportion of REM sleep increases once they fall asleep again to make up what was lost. This suggests that REM sleep is an essential aspect of sleep.

Sleep and sleep-related problems play a role in a large number of human disorders and affect almost every field of medicine. For example, problems like a stroke tend to occur more frequently during the night and early morning, due to changes in hormones, heart rate, and other characteristics associated with sleep. Sleep also affects some kinds of epilepsy in complex ways. REM sleep seems to help prevent seizures that begin in one part of the brain from spreading to other brain regions, while deep sleep may promote the spread of these seizures. Sleep deprivation can also trigger seizures in people with some types of epilepsy.

The neurons that control sleep interact strongly with the immune system. As anyone who has had the flu knows, infectious diseases tend to make people feel sleepy. This probably happens because cytokines, chemicals produced while fighting an infection, are powerful sleep-inducing substances. Sleep helps the body conserve energy that the body's immune system needs to mount an attack.

Sleeping problems occur in almost all people with mental disorders, including those with depression and schizophrenia. People with depression, for example, often awaken in the early hours of the morning and find themselves unable to get back to sleep. The amount of sleep a person gets also strongly influences the symptoms of mental disorders. Sleep deprivation is an effective therapy for people with certain types of depression, while it can

actually cause depression in other people. Extreme sleep deprivation can lead to a seemingly psychotic state of paranoia and hallucinations in otherwise healthy people, and disrupted sleep can trigger episodes of mania in people with manic depression.

Sleeping problems are common in many other disorders as well, including Alzheimer's disease, stroke, cancer, and head injury. These sleeping problems may arise from changes in the brain regions and neurotransmitters that control sleep, or from the drugs used to control symptoms of other disorders. In patients who are hospitalised or who receive round-the-clock care, treatment schedules or hospital routines also may disrupt sleep. The old joke about a patient being awakened by a nurse so he could take a sleeping pill contains a grain of truth. Once sleeping problems develop, they can add to a person's impairment and cause confusion, frustration, or depression. Patients who are unable to sleep also notice pain more and may increase their requests for pain medication. Better management of sleeping problems in people who have a variety of disorders could improve the health of these patients and their quality of life.

Insomnia is a widespread affliction. It is linked with conditions such as depression and chronic pain, but occurs also in otherwise healthy people. It is often due to temporary life circumstances, like trouble at work or anticipation of an exciting event, however, some people just have difficulty sleeping regardless of circumstances. What is interesting is that complaints of sleeplessness are often exaggerated, because people remember more easily the times they are awake during the night than the times they are asleep. When insomniacs are observed in a sleep lab, their EEG records often suggest that their sleep pattern is fairly normal, even though in the morning they maintain they hardly slept a wink. Various devices for monitoring one's own sleep patterns are now marketed, for example mobile phone apps connected with forehead electrodes.

The fact that a third of our life is spent in sleep would, in itself, be sufficient justification for studying it scientifically. The discovery that it is not just a passive state, but a highly active process of profound biological and psychological importance, has led to great efforts in recent decades to further our understanding of it. Despite that, we are far from unravelling all of sleep's mysteries.

Questions 1 - 7

Complete the notes below.

Write **NO MORE THAN TWO WORDS** for each answer.

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

Sleep

- * Sleep study only advanced after the electroencephalogram started to be used.
- * Sleep is used to restore the body and cells, and strengthen the (1) _____.
- * With little sleep, people operate worse, especially when (2) _____ is needed.
- * The effects of sleep deprivation can be severe and have been used in interrogations.
- * REM sleep is when dreaming occurs; important especially for (3) _____, who need a lot of REM sleep for their brains.
- * If REM sleep is lost, the body increases the (4) _____ of REM sleep in the next sleep to make it up.
- * Strokes are more common during or after sleep, and (5) _____ and other seizures can both be caused and prevented by sleep.
- * Sleep is closely associated with the (6) _____, as cytokines produced while the body fights infectious disease induce sleepiness; sleeping when sick helps people save the (7) _____ to fight infections.

Questions 8 - 13

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

In boxes **8 – 13** on your answer sheet write:

TRUE *if the statement agrees with the information*

FALSE *if the statement contradicts the information*

NOT GIVEN *if there is no information on this*

- 8 A lack of sleep can both help and hinder people suffering from depression.
- 9 Better sleep routines can help people who suffer from Parkinson's disease.
- 10 People who are sleep-deprived actually have a better tolerance to pain.
- 11 In spite of media reports, insomnia is not a common problem.
- 12 Insomniacs often sleep more than they realise.
- 13 Overuse of mobile phone apps can cause insomnia in some people.

Reading Passage 2

You should spend about 20 minutes on **Questions 14 - 26**, which are based on Reading Passage 2 below.

Comets

Comets arrive to grace our skies every year; some are new to the inner Solar System, and some are old friends on a repeat visit, but only comparatively rarely do they reach sufficient brightness to become apparent to the unaided eye.

Comets do not behave like any other object that we can observe in the night sky with the unaided eye. Stars remain fixed in the pattern of their constellations, and are regular in their motion through the sky from one night to the next, and from one month to the next. A planet follows a fairly slow but expected path. By comparison, a comet is a totally different kind of event: it will appear unexpectedly and at any place in the sky, it will change position from one night to the next relative to the background of stars, and its path will be along a separate direction and path across the sky from the planets and stars. During the few weeks or months that it is observable, it will first steadily increase in brightness from one night to the next, may change its shape – growing bigger, longer or extra tails – and then wane to invisibility, never to be seen again. Throughout history, comets have always signified evil, war and death, and they were supposed to leave chaos and calamity in their wake. Indeed, plenty of past comets have been blamed by the astrologers of their day for bringing or marking misfortune.

There have been many spectacular comets throughout history; on average we are visited by what is termed a 'great comet' about three times a century. This appellation is saved for those comets that reach exceptional brightness. The most famous of all comets is Halley's comet; not that it is the most spectacular, but study of its orbit by the English astronomer, Edmond Halley, was fundamental to pinning down the real nature of comets. During the 17th century, Halley was using Newton's new mathematics of calculus to try to characterise the orbits of twenty-four comets from sightings recorded over the previous four centuries. He realised that the orbital path of the bright comet recently seen in 1682 was very similar to that followed by two other comets – one observed in 1531 and one in 1607. All moved in a retrograde direction (i.e. opposite to the revolution of the planets round the Sun), following an elliptical orbit that had a similar orientation to the plane of the planets' motion. The great comet of 1456 was also known to have travelled in a retrograde direction. Halley's inspiration was to realise that these were four apparitions of the same comet, following a set path around the Sun, but which only became apparent to observers on Earth when its orbit returned the comet to the inner Solar System, after an interval of about 76 years. Although he did not live to see the success of his prediction of the comet's return in 1758, when the comet was spotted on schedule, it was given his name. Subsequently, at least 23 previous appearances of Halley's comet have been identified from historical records, the first known being from a Chinese text dating from 240BC.

The nucleus is the sole solid component of a comet, and the only part that is always present. It resembles a dark-coloured iceberg; it is a frozen chunk of ice ranging between 5 to 20 km in size, and with a somewhat irregular shape. The ice is not just water ice, but also contains the ices of frozen ammonia, carbon dioxide, methane and carbon monoxide. The ices are blackened, as they contain small fragments of dust embedded within them, and the whole nucleus is of a low density, suggesting it to be a partially porous body. When travelling along

the outer reaches of its orbit, far from the Sun, the nucleus remains frozen and dormant. As soon as its path brings the icy block into the inner Solar system, it begins to warm up and its surface becomes active. The solid ice turns directly into gas, in a process known as 'sublimation,' and is liberated from the surface. The process is particularly apparent on the sunward flank of the nucleus, where the gases escape as jets, particularly through any fissures that open up in the structure. These jets also push out the particles of solid dust that are embedded in the ice.

The closer an orbit brings a nucleus to the Sun, the warmer it becomes, and the more spectacular tails are generated with them, sometimes being visible during the day. There are two types of comet tails: dust and gas ion. A dust tail contains small, solid particles that are about the same size as those found in cigarette smoke. This tail forms because sunlight pushes on these small particles, gently shoving them away from the comet's nucleus. Because the pressure from sunlight is relatively weak, the dust particles end up forming a diffuse curved tail in the direction of the comet's orbit. A gas ion tail forms when ultraviolet sunlight rips one or more electrons from gas atoms in the coma, making them into ions. The solar wind then carries these ions straight outward away from the Sun. As a comet heads away from the Sun, its tails dissipate, and the matter contained in its nucleus freezes into a rock-like material.

Glossary

Constellation – a recognised pattern of bodies in the sky.

Elliptical – oval-shaped.

Sublimation - the change of a substance from solid to gas without an intermediate liquid stage.

Questions 14 - 18

Complete the summary using the words in the box below.

Write your answers in boxes **14 - 18** on your answer sheet.

COMETS

Comets are quite common in our solar system, but they are seldom (14) _____. Comets behave differently to other sky objects; they are seemingly quite (15) _____ in their movements and (16) _____. Comets have often been seen as predicting (17) _____.

Halley's comet is probably the best known 'great comet.' Using previous (18) _____, Edmond Halley was successfully able to predict the comet's next appearance, although it occurred after his death.

observations	dangerous	visible	beautiful	naming
disaster	success	unpredictable	properties	stars

Questions 19 - 23

Complete the sentences below.

Write **NO MORE THAN TWO WORDS** from the text for each answer.

Write your answers in boxes **19 - 23** on your answer sheet.

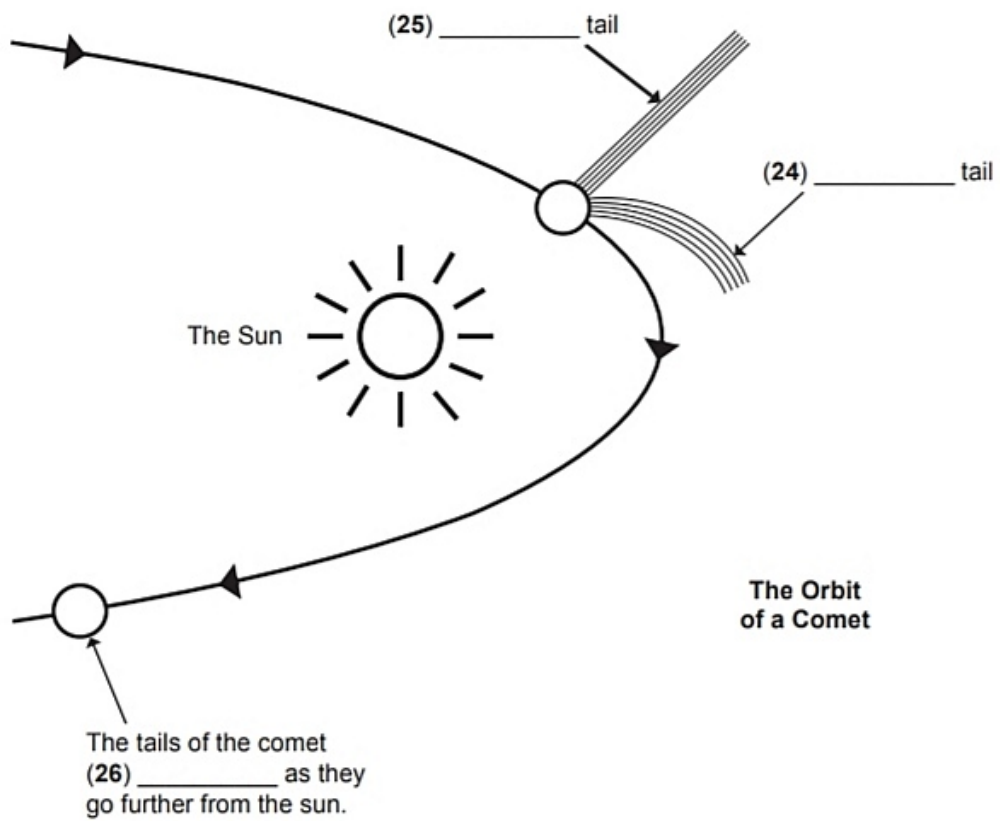
- 19 The nucleus of a comet is the only part that is known to be _____ and to remain present through its orbit.
- 20 The frozen components of a comet's nucleus are _____ due to the presence of dust particles.
- 21 The nucleus of a comet has been theorised to be porous because of its _____.
- 22 When far from the sun, a comet's nucleus is icy and _____.
- 23 Gas jets eject more frequently from the _____ side of a comet.

Questions 24 - 26

Label the diagram below.

Write **NO MORE THAN TWO WORDS** from the text for each answer.

Write your answers in boxes **24 - 26** on your answer sheet.



Reading Passage 3

You should spend about 20 minutes on **Questions 27 - 40**, which are based on Reading Passage 3 below.

US Shale Gas Fracking

Paragraph A

We have had widespread drilling for oil and gas deposits for more than 100 years in the United States. Until the 1990's, most of this recovery has occurred from conventional wells that were drilled down to rock formations, from which hydrocarbons could be pumped to the surface. The discovery of hydraulic fracturing in the late 1940's has long allowed companies to extract gas and oil from shale, but the perfection of these two techniques over the past few decades has allowed the process to become cost effective. There are numerous shale plays in the United States from which shale gas can be extracted, and firms are busy drilling wells in many areas of the country.

Paragraph B

Shale gas is natural methane in rock formations deep underground that, before fracking, was not feasible to extract. Its removal today depends on hydraulic fracturing and horizontal drilling. Hydraulic fracturing is the use of pressure to force liquids containing proppants (often sand) into rock strata, so that hydrocarbons are available for extraction. Current technology uses water, sand, and miscellaneous fluids, all of which must be imported to the well site. A wellbore is drilled, and then the fracturing fluid is forced through holes in the casing into the plays. High pressures are used to create fissures where the proppants are deposited to hold fissures open, so that hydrocarbons can be released. Hydraulic fracturing occurs in a number of stages and the fracturing fluid is forced into a small portion of the wellbore at each stage. After the hydraulic fracturing is completed, some of the fracturing fluid comes back up the well. Because the flowback and wastewater from a well can be toxic, it must be disposed of in a manner that does not create any health, safety, or environmental problems. The underground areas from which the gas is extracted may be left with cavities, which in turn can sometimes cause ground subsidence.

Paragraph C

The development of American shale gas deposits has been accompanied by notable benefits and a significant impact on the American economy. Next year, it is estimated that the development of America's shale gas resources will employ 869,000 people. The shale gas industry will have capital expenditures of \$48 billion and pay more than \$28 billion in federal and state taxes this year. Due to shale gas, the US is using less coal and the country's electricity costs have been lowered by about ten per cent. Shale gas has also contributed to a decrease in imports of foreign natural gas.

Paragraph D

Yet not everything is positive. The development of shale gas resources is associated with its toxic pollutants and environmental problems. It needs to be mentioned that the American federal and state governments were not prepared for the problems that accompany shale gas development. A lack of sufficient regulatory oversight in the US when the industry began allowed some unfortunate situations and instances of damage that could have been prevented.

Paragraph E

Sites where wells are drilled for extracting shale gas often cover about two hectares and involve increased traffic, noise, light, dangerous equipment, and toxic chemicals. The activities and conditions at a site therefore create a potential for contamination and environmental degradation. The major risk involves damage from the toxic chemicals used in hydraulic fracturing. The fracking fluid is approximately 99.5 per cent water and sand and 0.5 per cent additives used to enhance hydrocarbon recovery. An average of 5000 gallons of chemical additives may be used to frack a well and some of them are toxic. Since different chemicals and different amounts are used at each well, the toxicities may vary.

Paragraph F

Under US federal law, the chemicals used at a well are exempted from full reporting requirements. Under most state laws, the supplier or the service company of a fracturing operation must disclose information, unless the chemicals are claimed as a trade secret. Recently, it was estimated that in approximately two-thirds of the cases the complete chemical compositions were not reported. Chemical secrecy is a problem, because persons working at wells and persons who come into contact with chemicals used at a well do not have sufficient information to know whether they need medical attention. Without timely information of the chemicals involved in a spill or release, first responders to emergencies, health professionals, and property owners may lack key information for deciding what actions they should take.

Paragraph G

Issues are also being raised about the need for better management practices to reduce the risks that accompany shale gas development. Hundreds of best management practices have been identified to employ during energy development and extraction, but most of these are currently voluntary. In the absence of mandatory management practices covering all of the stages of shale gas development, there are not sufficient assurances that people and the environment are adequately protected against health and safety problems. By adopting more mandatory management practices, the industry may be able to reduce the risks and shale gas development would be beneficial overall.

Paragraph H

The American experiences can be helpful in discerning whether other countries might proceed with shale gas development. The activities connected with developing shale gas can be assessed to learn about the risks, dangers, and problems that need to be addressed. Then, existing laws and regulations can be evaluated to determine their probable success in addressing the risks. Additional regulations can be developed if they are needed and firms can be required to adopt best management practices. Governments can require disclosure of dangerous materials and establish funding mechanisms to pay for regulatory oversight and for collecting monies to be used to remedy future damages caused by fracking.

Glossary

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Shale play – An underground formation of a type of rock containing natural gas.

Proppant – A solid material used in fracking to keep holes open during the fracking process.

Questions 27 – 34

The text above has 8 paragraphs **A - H**.

Which paragraph contains the following information?

Write your answers in boxes **27 – 34** on your answer sheet.

- 27 Not all chemicals used for fracking are poisonous.
- 28 Shale gas is found deep under the ground.
- 29 At present, recommended management practices for fracking companies are not compulsory.
- 30 The US government did not initially enforce enough control on the fracking industry.
- 31 Fracking techniques have been available since the 1940's.
- 32 Finance should be set aside to pay for future problems that fracking might create.
- 33 Some companies do not publicise the chemicals that they use for fracking.
- 34 Using shale gas has reduced US expenditure on electricity generation.

Questions 35 - 39

Choose **FIVE** letters, **A - I**.

Which of the following sentences below accurately describe disadvantages to the US shale gas fracking industry?

Write the correct letter, **A - I**, in any order in boxes **35 - 39** on your answer sheet.

- A** Toxic liquid can flow up a drilling installation and potentially create pollution.
- B** Underground gas explosions can be a risk to local communities.
- C** The ground over the fracking areas can sometimes become unsafe.
- D** Oil deposits can sometimes be lost during gas fracking.
- E** Fracking installations generate additional traffic pollution.
- F** Excess light can be present at fracking installations.
- G** Sand used in fracking can pollute the water table.
- H** Workers contaminated during fracking operations can have correct treatment delayed.
- I** Tax dollars are taken out of the country by overseas extraction companies.

Question 40

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

Write the correct letter in box **40** on your answer sheet.

- 40 What is the writer's purpose in Reading Passage 3?
- A** To analyse the government's role in US fracking.
 - B** To criticise US fracking techniques.
 - C** To compare US and European fracking methods.
 - D** To provide an overview of the benefits and risks of US fracking.