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READING PASSAGE 1

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

ELECTRORECEPTION

A Open your eyes in sea water and it is difficult to see much more than a murky, bleary green colour. Sounds, too, are garbled and difficult to comprehend. Without specialised equipment humans would be lost in these deep sea habitats, so how do fish make it seem so easy? Much of this is due to a biological phenomenon known as electroreception – the ability to perceive and act upon electrical stimuli as part of the overall senses. This ability is only found in aquatic or amphibious species because water is an efficient conductor of electricity.

B Electroreception comes in two variants. While all animals (including humans) generate electric signals, because they are emitted by the nervous system, some animals have the ability – known as passive electroreception – to receive and decode electric signals generated by other animals in order to sense their location.

C Other creatures can go further still, however. Animals with active electroreception possess bodily organs that generate special electric signals on cue. These can be used for mating signals and territorial displays as well as locating objects in the water. Active electroreceptors can differentiate between the various resistances that their electrical currents encounter. This can help them identify whether another creature is prey, predator or something that is best left alone. Active electroreception has a range of about one body length – usually just enough to give its host time to get out of the way or go in for the kill.

D One fascinating use of active electroreception – known as the Jamming Avoidance Response mechanism – has been observed between members of some species known as the weakly electric fish. When two such electric fish meet in the ocean using the same frequency, each fish will then shift the frequency of its discharge so that they are transmitting on different frequencies. Doing so prevents their electroreception faculties from becoming jammed. Long before citizens' band radio users first had to yell "Get off my frequency!" at hapless novices cluttering the air waves, at least one species had found a way to peacefully and quickly resolve this type of dispute.

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E Electroreception can also play an important role in animal defences. Rays are one such example. Young ray embryos develop inside egg cases that are attached to the sea bed. The embryos keep their tails in constant motion so as to pump water and allow them to breathe through the egg's casing. If the embryo's electroreceptors detect the presence of a predatory fish in the vicinity, however, the embryo stops moving (and in so doing ceases transmitting electric currents) until the fish has moved on. Because marine life of various types is often travelling past, the embryo has evolved only to react to signals that are characteristic of the respiratory movements of potential predators such as sharks.

F Many people fear swimming in the ocean because of sharks. In some respects, this concern is well grounded – humans are poorly equipped when it comes to electroreceptive defence mechanisms. Sharks, meanwhile, hunt with extraordinary precision. They initially lock onto their prey through a keen sense of smell (two thirds of a shark's brain is devoted entirely to its olfactory organs). As the shark reaches proximity to its prey, it tunes into electric signals that ensure a precise strike on its target; this sense is so strong that the shark even attacks blind by letting its eyes recede for protection.

G Normally, when humans are attacked it is purely by accident. Since sharks cannot detect from electroreception whether or not something will satisfy their tastes, they tend to "try before they buy", taking one or two bites and then assessing the results (our sinewy muscle does not compare well with plumper, softer prey such as seals). Repeat attacks are highly likely once a human is bleeding, however; the force of the electric field is heightened by salt in the blood which creates the perfect setting for a feeding frenzy. In areas where shark attacks on humans are likely to occur, scientists are exploring ways to create artificial electroreceptors that would disorient the sharks and repel them from swimming beaches.

H There is much that we do not yet know concerning how electroreception functions. Although researchers have documented how electroreception alters hunting, defence and communication systems through observation, the exact neurological processes that encode and decode this information are unclear. Scientists are also exploring the role electroreception plays in navigation. Some have proposed that salt water and magnetic fields from the Earth's core may interact to form electrical currents that sharks use for migratory purposes.

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Questions 1–6

Reading Passage 1 has eight paragraphs, **A–H**.

Which paragraph contains the following information?

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

1 How electroreception can be used to help fish reproduce

2 A possible use for electroreception that will benefit humans

3 The term for the capacity which enables an animal to pick up but not send out electrical signals

4 Why only creatures that live in or near water have electroreceptive abilities

5 How electroreception might help creatures find their way over long distances

6 A description of how some fish can avoid disrupting each other's electric signals

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Questions 7–9

Label the diagram.

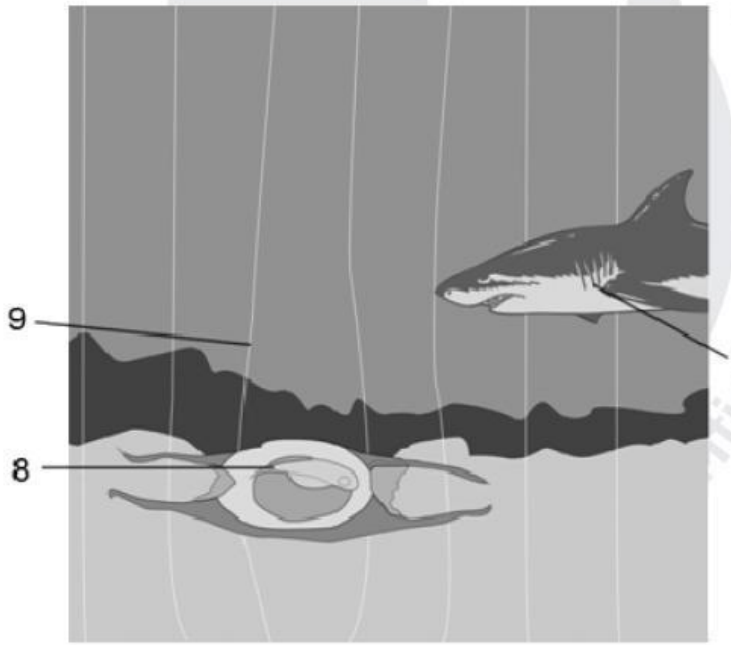
Choose ***NO MORE THAN TWO WORDS*** *from the passage for each answer.*

Write your answers in boxes 7–9 on your answer sheet.

Shark's **7** **……** alert the young ray to its presence

Embryo moves its **8** **……** in order to breathe

Embryo stops sending **9** **……** when predator close by



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Questions 10–13

Complete the summary below.

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

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

Shark Attack

A shark is a very effective hunter. Firstly, it uses its **10 ……..** to smell its target. When the shark gets close, it uses **11 ……..** to guide it toward an accurate attack. Within the final few feet the shark rolls its eyes back into its head. Humans are not popular food sources for most sharks due to their **12 ……..**. Nevertheless, once a shark has bitten a human, a repeat attack is highly possible as salt from the blood increases the intensity of the **13 ……..**.

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READING PASSAGE 2

*You should spend about 20 minutes on **Questions 14–27**, which are based on Reading Passage 2 below.*

FAIR GAMES?

For seventeen days every four years the world is briefly arrested by the captivating, dizzying spectacle of athleticism, ambition, pride and celebration on display at the Summer Olympic Games. After the last weary spectators and competitors have returned home, however, host cities are often left awash in high debts and costly infrastructure maintenance. The staggering expenses involved in a successful Olympic bid are often assumed to be easily mitigated by tourist revenues and an increase in local employment, but more often than not host cities are short changed and their taxpayers for generations to come are left settling the debt.

Olympic extravagances begin with the application process. Bidding alone will set most cities back about $20 million, and while officially bidding only takes two years (for cities that make the shortlist), most cities can expect to exhaust a decade working on their bid from the moment it is initiated to the announcement of voting results from International Olympic Committee members. Aside from the financial costs of the bid alone, the process ties up real estate in prized urban locations until the outcome is known. This can cost local economies millions of dollars of lost revenue from private developers who could have made use of the land, and can also mean that particular urban quarters lose their vitality due to the vacant lots. All of this can be for nothing if a bidding city does not appease the whims of IOC members – private connections and opinions on government conduct often hold sway (Chicago's 2012 bid is thought to have been undercut by tensions over U.S. foreign policy).

Bidding costs do not compare, however, to the exorbitant bills that come with hosting the Olympic Games themselves. As is typical with large-scale, one-off projects, budgeting for the Olympics is a notoriously formidable task. Los Angelinos have only recently finished paying off their budget-breaking 1984 Olympics; Montreal is still in debt for its 1976 Games (to add insult to injury, Canada is the only host country to have failed to win a single gold medal during its own Olympics). The tradition of runaway expenses has persisted in recent years. London Olympics managers have admitted that their 2012 costs may increase ten times over their initial projections, leaving tax payers 20 billion pounds in the red.

Hosting the Olympics is often understood to be an excellent way to update a city's sporting infrastructure. The extensive demands of Olympic sports include aquatic complexes, equestrian circuits, shooting ranges, beach volleyball courts, and, of course, an 80,000 seat athletic stadium. Yet these demands are typically only necessary to accommodate a brief influx of athletes from around the world. Despite the enthusiasm many populations initially have for the development of world-class

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sporting complexes in their home towns, these complexes typically fall into disuse after the Olympic fervour has waned. Even Australia, home to one of the world's most sportive populations, has left its taxpayers footing a $32 million-a-year bill for the maintenance of vacant facilities.

Another major concern is that when civic infrastructure developments are undertaken in preparation for hosting the Olympics, these benefits accrue to a single metropolitan centre (with the exception of some outlying areas that may get some revamped sports facilities). In countries with an expansive land mass, this means vast swathes of the population miss out entirely. Furthermore, since the International Olympic Committee favours prosperous "global" centres (the United Kingdom was told, after three failed bids from its provincial cities, that only London stood any real chance at winning), the improvement of public transport, roads and communication links tends to concentrate in places already well-equipped with world-class infrastructures. Perpetually by-passing minor cities creates a cycle of disenfranchisement: these cities never get an injection of capital, they fail to become first-rate candidates, and they are constantly passed over in favour of more secure choices.

Finally, there is no guarantee that an Olympics will be a popular success. The "feel good" factor that most proponents of Olympic bids extol (and that was no doubt driving the 90 to 100 per cent approval rates of Parisians and Londoners for their cities' respective 2012 bids) can be an elusive phenomenon, and one that is tied to that nation's standing on the medal tables. This ephemeral thrill cannot compare to the years of disruptive construction projects and security fears that go into preparing for an Olympic Games, nor the decades of debt repayment that follow (Greece's preparation for Athens 2004 famously deterred tourists from visiting the country due to widespread unease about congestion and disruption).

There are feasible alternatives to the bloat, extravagance and wasteful spending that comes with a modern Olympic Games. One option is to designate a permanent host city that would be re-designed or built from scratch especially for the task. Another is to extend the duration of the Olympics so that it becomes a festival of several months. Local businesses would enjoy the extra spending and congestion would ease substantially as competitors and spectators come and go according to their specific interests. Neither the "Olympic City" nor the extended length options really get to the heart of the issue, however. Stripping away ritual and decorum in favour of concentrating on athletic rivalry would be preferable.

Failing that, the Olympics could simply be scrapped altogether. International competition could still be maintained through world championships in each discipline. Most of these events are already held on non-Olympic years anyway – the International Association of Athletics Federations, for example, has run a biennial World Athletics Championship since 1983 after members decided that using the

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Olympics for their championship was no longer sufficient. Events of this nature keep world-class competition alive without requiring Olympic-sized expenses.

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Questions 14–18

Complete each sentence with the correct ending, ***A–K****, below.*

Write the correct letter, ***A–K,*** *in boxes 14–18 on your answer sheet.*

14 Bids to become a host city

15 Personal relationships and political tensions

16 Cost estimates for the Olympic Games

17 Purpose-built sporting venues

18 Urban developments associated with the Olympics

A	often help smaller cities to develop basic infrastructure.
B	tend to occur in areas where they are least needed.
C	require profitable companies to be put out of business.
D	are often never used again once the Games are over.
E	can take up to ten years to complete.
F	also satisfy needs of local citizens for first-rate sports facilities.
G	is usually only successful when it is from a capital city.
H	are closely related to how people feel emotionally about the Olympics.
I	are known for being very inaccurate.
J	often underlie the decisions of International Olympic Committee members.
K	are holding back efforts to reform the Olympics.

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Questions 19–25

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

In boxes 19–25 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*

19 Residents of host cities have little use for the full range of Olympic facilities.

20 Australians have still not paid for the construction of Olympic sports facilities.

21 People far beyond the host city can expect to benefit from improved infrastructure.

22 It is difficult for small cities to win an Olympic bid.

23 When a city makes an Olympic bid, a majority of its citizens usually want it to win.

24 Whether or not people enjoy hosting the Olympics in their city depends on how athletes from their country perform in Olympic events.

25 Fewer people than normal visited Greece during the run up to the Athens Olympics.

Questions 26 and 27

*Choose **TWO** letters, **A–E**.*

Write the correct letters in boxes 26 and 27 on your answer sheet.

Which **TWO** of the following does the author propose as alternatives to the current Olympics?

A The Olympics should be cancelled in favour of individual competitions for each sport.

B The Olympics should focus on ceremony rather than competition.

C The Olympics should be held in the same city every time.

D The Olympics should be held over a month rather than seventeen days.

E The Olympics should be made smaller by getting rid of unnecessary and unpopular sports.

26. **27.**

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READING PASSAGE 3

*You should spend about 20 minutes on **Questions 28–40**, which are based on Reading Passage 3 below.*

Time Travel

Time travel took a small step away from science fiction and toward science recently when physicists discovered that sub-atomic particles known as neutrinos – progeny of the sun's radioactive debris – can exceed the speed of light. The unassuming particle – it is electrically neutral, small but with a "non-zero mass" and able to penetrate the human form undetected – is on its way to becoming a rock star of the scientific world.

Researchers from the European Organisation for Nuclear Research (CERN) in Geneva sent the neutrinos hurtling through an underground corridor toward their colleagues at the Oscillation Project with Emulsion-Tracing Apparatus (OPERA) team 730 kilometres away in Gran Sasso, Italy. The neutrinos arrived promptly – so promptly, in fact, that they triggered what scientists are calling the unthinkable – that everything they have learnt, known or taught stemming from the last one hundred years of the physics discipline may need to be reconsidered.

The issue at stake is a tiny segment of time – precisely sixty nanoseconds (which is sixty billionths of a second). This is how much faster than the speed of light the neutrinos managed to go in their underground travels and at a consistent rate (15,000 neutrinos were sent over three years). Even allowing for a margin of error of ten billionths of a second, this stands as proof that it is possible to race against light and win. The duration of the experiment also accounted for and ruled out any possible lunar effects or tidal bulges in the earth's crust.

Nevertheless, there's plenty of reason to remain sceptical. According to Harvard University science historian Peter Galison, Einstein's relativity theory has been "pushed harder than any theory in the history of the physical sciences". Yet each prior challenge has come to no avail, and relativity has so far refused to buckle.

So is time travel just around the corner? The prospect has certainly been wrenched much closer to the realm of possibility now that a major physical hurdle – the speed of light – has been cleared. If particles can travel faster than light, in theory travelling back in time is possible. How anyone harnesses that to some kind of helpful end is far beyond the scope of any modern technologies, however, and will be left to future generations to explore.

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Certainly, any prospective time travellers may have to overcome more physical and logical hurdles than merely overtaking the speed of light. One such problem, posited by René Barjavel in his 1943 text *Le Voyageur Imprudent* is the so-called grandfather paradox. Barjavel theorised that, if it were possible to go back in time, a time traveller could potentially kill his own grandfather. If this were to happen, however, the time traveller himself would not be born, which is already known to be true. In other words, there is a paradox in circumventing an already known future; time travel is able to facilitate past actions that mean time travel itself cannot occur.

Other possible routes have been offered, though. For Igor Novikov, astrophysicist behind the 1980s' theorem known as the self-consistency principle, time travel is possible within certain boundaries. Novikov argued that any event causing a paradox would have zero probability. It would be possible, however, to "affect" rather than "change" historical outcomes if travellers avoided all inconsistencies. Averting the sinking of the Titanic, for example, would revoke any future imperative to stop it from sinking – it would be impossible. Saving selected passengers from the water and replacing them with realistic corpses would not be impossible, however, as the historical record would not be altered in any way.

A further possibility is that of parallel universes. Popularised by Bryce Seligman DeWitt in the 1960s (from the seminal formulation of Hugh Everett), the many-worlds interpretation holds that an alternative pathway for every conceivable occurrence actually exists. If we were to send someone back in time, we might therefore expect never to see him again – any alterations would divert that person down a new historical trajectory.

A final hypothesis, one of unidentified provenance, reroutes itself quite efficiently around the grandfather paradox. Non-existence theory suggests exactly that – a person would quite simply never exist if they altered their ancestry in ways that obstructed their own birth. They would still exist in person upon returning to the present, but any chain reactions associated with their actions would not be registered. Their "historical identity" would be gone.

So, will humans one day step across the same boundary that the neutrinos have? World-renowned astrophysicist Stephen Hawking believes that once spaceships can exceed the speed of light, humans could feasibly travel millions of years into the future in order to repopulate earth in the event of a forthcoming apocalypse. This is because, as the spaceships accelerate into the future, time would slow down around them (Hawking concedes that bygone eras are off limits – this would violate the fundamental rule that cause comes before effect).

Hawking is therefore reserved yet optimistic. "Time travel was once considered scientific heresy, and I used to avoid talking about it for fear of being labelled a crank. These days I'm not so cautious."

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Questions 28–33

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

In boxes 28–33 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*

28 It is unclear where neutrinos come from.

29 Neutrinos can pass through a person's body without causing harm.

30 It took scientists between 50-70 nanoseconds to send the neutrinos from Geneva to Italy.

31 Researchers accounted for effects the moon might have had on the experiment.

32 The theory of relativity has often been called into question unsuccessfully.

33 This experiment could soon lead to some practical uses for time travel.

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Questions 34–39

Complete the table below.

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

Write your answers in boxes 34–39 on your answer sheet.

Original Theorist	**Theory**	**Principle**
René Barjavel	Grandfather paradox	Time travel would allow for **34 ……** that would actually make time travel impossible.
Igor Novikov	Self-consistency principle	It is only possible to alter history in ways that result in no **35 ……** .
36 ……	Many-worlds interpretation	Each possible event has an **37 ……,** so a time traveller changing the past would simply end up in a different branch of history than the one he left.
Unknown	**38 ……**	If a time traveller changed the past to prevent his future life, he would not have a **39 ……** as the person never existed.

Question 40

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

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

Stephen Hawking has stated that

A Human time travel is theoretically possible, but is unlikely to ever actually occur.
B Human time travel might be possible, but only moving backward in time.
C Human time travel might be possible, but only moving forward in time.
D All time travel is impossible.

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