READING

READING PASSAGE 1

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

LET'S GO BATS

A Bats have a problem: how to find their way around in the dark. They hunt at night, and cannot use light to help them find prey ( ) and avoid obstacles ( ) . You might say that this is a problem of their own making ( ) , one that they could avoid simply by changing their habits and hunting by day. But the daytime economy ( ) is already heavily exploited ( ) by other creatures ( ) such as birds. Given that there is a living to be made ( ) at night, and given that ( ) alternative ( ) daytime trades are thoroughly ( ) occupied ( ) , natural selection has favoured ( ) bats that make a go ( ) of the night-hunting ( ) trade. It is probable that the nocturnal ( ) trades go way back in ( ) the ancestry ( ) of all mammal ( ) s. In the time when the dinosaurs ( ) dominated ( ) the daytime economy, our mammalian ancestors probably only managed to survive at all because they found ways of scraping a living ( ) at night. Only after the mysterious ( ) mass extinction ( ) of the dinosaurs about 65 million years ago were our ancestors able to emerge ( ) into the daylight in any substantial ( ) numbers.

B Bats have an engineering ( ) problem: how to find their way and find their prey in the absence of ( ) light. Bats are not the only creatures to face this difficulty today. Obviously the night-flying ( ) insects ( ) that they prey on must find their way about somehow ( ) . Deep-sea ( ) fish and whales ( ) have little or no light by day or by night. Fish and dolphins ( ) that live in extremely muddy ( ) water cannot see because, although there is light, it is obstructed ( ) and scattered ( ) by the dirt ( ) in the water. Plenty of other modern animals make their living in conditions where seeing is difficult or impossible.

C Given the questions of how to manoeuvre ( ) in the dark, what solutions ( ) might an engineer consider? The first one that might occur to him is to manufacture ( ) light, to use a lantern ( ) or a searchlight ( ) . Fireflies ( ) and some fish **(**usually with the help of bacteria ( ) **)** have the power to manufacture their own light, but the process seems to consume ( ) a large amount of energy. Fireflies use their light for attracting mate ( ) s. This doesn't require a prohibitive ( ) amount of energy: a male's tiny pinprick ( ) of light can be seen by a female from some distance on a dark night, since her eyes are exposed ( ) directly to the light source itself. However, using light to find one's own way around requires vastly more energy, since the eyes have to

detect ( ) the tiny fraction ( ) of the light that bounces ( ) off each part of the scene ( ) . The light source ( ) must therefore be immensely ( ) brighter if it is to be used as a headlight ( ) to illuminate ( ) the path, than if it is to be used as a signal ( ) to others. In any event, whether or not the reason is the energy expense ( ) , it seems to be the case that, with the possible exception ( ) of some weird ( ) deep-sea fish, no animal apart from ( ) man uses manufactured light to find its way about.

D What else might the engineer think of?. Well, blind humans sometimes seem to have an uncanny ( ) sense of obstacles in their path. It has been given the name 'facial vision', because blind people have reported that it feels a bit like the sense of touch, on the face. One report tells of ( ) a totally blind boy who could ride ( ) his tricycle ( ) at good speed round the block ( ) near his home, using facial vision. Experiments showed that, in fact, facial vision is nothing to do with touch or the front of the face, although the sensation ( ) may be referred to the front of the face, like the referred pain in a phantom ( ) limb ( ) . The sensation of facial vision, it turns out, really goes in through the ears. Blind people, without even being aware of the fact, are actually using echoes ( ) of their own footsteps and of other sounds, to sense the presence ( ) of obstacles. Before this was discovered ( ) , engineers had already built instruments ( ) to exploit the principle, for example to measure the depth of the sea under a ship. After this technique had been invented, it was only a matter of time before weapons designers ( ) adapted it for ( ) the detection of submarines ( ) . Both sides in the Second World War relied heavily on these devices ( ) , under such codenames ( ) as Asdic (British) and Sonar ( ) (American), as well as Radar ( ) (American) or RDF ( ) (British), which uses radio echoes rather than sound echoes.

E The Sonar and Radar pioneers ( ) didn't know it then, but all the world now knows that bats, or rather natural selection working on bats, had perfected the system tens of millions of years earlier, and their 'radar' achieves feats ( ) of detection and navigation ( ) that would strike an engineer dumb ( ) with admiration ( ) . It is technically ( ) incorrect to talk about bat 'radar', since they do not use radio waves. It is sonar. But the underlying ( ) mathematical ( ) theories of radar and sonar are very similar, and much of our scientific understanding of the details of what bats are doing has come from applying radar theory to them. The American zoologist ( ) Donald Griffin, who was largely responsible for the discovery of sonar in bats, coined ( ) the term 'echolocation' ( ) to cover ( ) both sonar and radar, whether used by animals or by human instruments.