READING PASSAGE 1

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

Deep sea discovery

Recent research has provided new insights into how fish communicate.

Nico Michiels is an ecologist from the University of Tübingen in Germany who spends part of each year in Egypt, where he dives in the Red Sea, observing fish life and gathering data on its coral reefs. In September 2007 he decided to find out how far red light could penetrate the ocean depths. Seawater absorbs different colours at different depths, and as an experienced diver, Michiels was aware that red light is extinguished not far below the surface whereas blue-green light penetrates deeper. To find out the depth at which red disappeared in this particular ocean, however, he attached a special plastic filter to his dive mask, which was designed to block out all colours except red. Then he began to descend. In theory, once he reached about 15 metres, he should have been plunged into darkness. Instead, something totally unexpected happened. Sure enough, 20 metres down it was as dark as night. 'All the fish disappeared. With no light from the surface, they were effectively black and had become invisible,' he says. 'But it didn't stay black for long. Then I saw a group of goby fish with bright red eyes lit up against the background. After that, red spots began to show up all over the reef.'

Even with the red filter removed, Michiels could pick them out without much trouble once his eyes grew accustomed to the gloom. It seems strange that no diver or researcher had spotted all this red before, but as Michiels points out, no one saw it because no one expected to see it. On that one dive, Michiels discovered three fish species with prominent red markings, and has found many others since.

But how can fish appear red where there's no red light? Ordinary red *pigments** look red because they reflect red light while absorbing all other wavelengths. At 20 metres down, there had to be some other explanation for the red Michiels was seeing. He suspected fluorescence. Fluorescent pigments behave differently from ordinary ones: they receive incoming light of one wavelength, for example blue, and emit light of a longer wavelength, in this case red. On the reef in the Red Sea during daytime, the most likely explanation was that the predominantly blue and green wavelengths at depth triggered the emission of fluorescent red in the fish.

**pigments: a pigment is a substance that gives something a particular colour.*

With only a week left in Egypt, and lacking the equipment to confirm that the fish were fluorescent, Michiels photographed as many of them as he could. Then, once back in Germany, he bought an assortment of tropical fish and installed them in his lab. Here he confirmed that the fish did indeed fluoresce. In most of the fish he looked at, the fluorescence could be traced to specialised pigment cells that lie in the skin beneath the scales. These cells contain ‘guanine crystals’, which scatter light to give fish their silvery sheen. However, Michiels says they are still not sure exactly what is fluorescing. ‘It’s not the crystals themselves. It’s probably a fluorescent protein built into the crystals, and we have a suspicion that it might be made by bacteria.’

Intrigued, Michiels began a systematic search for red fluorescence in reef fish. He and his colleagues, Nils Anthes and Dennis Sprenger, have identified some 50 species with red fluorescence. The most common markings tend to be on the body towards the head and to a lesser extent around the eyes, and then the fins. To Michiels, the distribution of these markings is one of the strongest indications that red fluorescence has a very particular function: communication with other members of the species. According to several recent studies, a whole range of animals employ fluorescence as a natural highlighter to boost the visibility of body parts they use to signal, for example to ward off enemies. In reef fish, the red tends to be confined to parts of the body used to signal, suggesting these markings serve a similar function. But instead of highlighting an existing colour, the fluorescence gives the fish a colour that otherwise wouldn’t exist. For example, fish commonly use eye rings to signal that they are present and their direction of gaze, and Michiels suspects that red-eyed gobies use signals to indicate their location and keep their group together.

Red light, whatever its source, doesn’t travel far through water, which suggests signals are intended to be private, seen only by nearby fish of the right species. There are several lines of evidence to support this, says Michiels. And closely related species do not have completely identical markings, which suggests they might be important in species recognition.

Michiels suspects red fluorescence has another important role for some reef fish: helping them blend in. During his first dive with the red filter, he noticed corals glow a dark but faint red too. Against this irregular red background, a fish that glows red all over would be hard to distinguish. More compelling for Michiels is the case of the scorpionfish, which lies perfectly still until food swims past, which it then sucks in.

Yet if red plays any part in a fish’s life, then it must be able to see it. Fish that live in a world dominated by blue-green light are assumed to have eyes tuned to those wavelengths, and most marine fish that have been studied are thought incapable of seeing red. One exception is the seahorse, whose eyes are sensitive to red. As for the other fish, it remains to be seen.

Questions 1–6

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

In boxes 1–6 on your answer sheet, write

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

1 During his 2007 dive, Michiels expected to encounter total darkness at about 15 metres.

2 Michiels could see the red markings on fish without the aid of the red filter.

3 Other divers had assumed they would see fish with red markings.

4 All the fish with red markings that Michiels found during his diving expeditions came from the Red Sea.

5 Michiels first thought of the possibility that fish could fluoresce while he was in Germany.

6 Michiels remains uncertain as to what creates fluorescence in fish.

Questions 7–13

Complete the notes below.

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

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

Michiels's findings

Michiels has observed:

- 50 types of fish with red fluorescence in total
- markings mainly near the **7** _______

Some of Michiels's beliefs are that:

- red fluorescence is used specifically for **8** _______ purposes
- fish, like some animals, use fluorescence to keep **9** _______ away
- gobies depend on red fluorescence to show their **10** _______
- there are variations in the markings of fish among those **11** _______ which are very similar

Other benefits of red fluorescence:

- fish cannot easily be seen near backgrounds of **12** _______ which give off a red light
- helps some fish catch their prey

The ability to see red amongst fish:

- the only fish proven to have this ability is the **13** _______

判断题（1–6）

题号	答案	题干翻译	定位句（段落）	定位句翻译	解释
1	TRUE	在 2007 年那次潜水中，Michiels 预计在大约 15 米处会遇到一片漆黑。	“In theory, once he reached about **15 metres**, he **should have been plunged into darkness**.”（第 A 段）	理论上，他到达约 15 米时应该会陷入黑暗。	题干说“预计（expected）”，与原文 “should have been” 一致。
2	TRUE	不用红滤镜，Michiels 也能看到鱼身上的红色标记。	“**Even with the red filter removed**, Michiels could pick them out…”（第 B 段）	即使把红色滤镜取下，Michiels 也能把它们辨认出来。	清楚说明在去掉滤镜后仍能看到。
3	FALSE	其他潜水员原本就以为能看到带红色标记的鱼。	“…no one saw it **because no one expected to see it.**”（第 B 段）	没有人看到，是因为没人**期待**会看到。	与题干相反，因此为 FALSE。
4	NOT GIVEN	Michiels 在潜水考察中发现的所有带红色标记的鱼都来自红海。	“On that one dive… **three fish species… and has found many others since.**”（第 B 段）	在那一次潜水中发现了三种…此后又发现了许多其他的。	文中只明确红海那一潜发现了 3 种；其后“许多其他”并未说明是否也来自红海、是否都在“潜水考察”中发现，信息不足。
5	FALSE	他是在德国时**第一次想到**鱼可能会发荧光。	“**He suspected fluorescence.**”（第 C 段，描述 20 米深处的观察）	他怀疑这是**荧光**。	这是在红海潜水时产生的判断，不是在德国实验室。
6	TRUE	对于是什么产生了鱼的荧光，Michiels 仍不确定。	“they are **still not sure exactly what is fluorescing**… ‘It's probably a fluorescent protein… might be made by bacteria.’ ”（第 D 段）	他们仍不确定究竟**什么在发荧光**……可能是蛋白，也可能由细菌产生。	明确表达仍不确定，因此为 TRUE。

笔记填空（7–13，每空 ONE WORD ONLY）

题号	答案	题干翻译	定位句（段落）	定位句翻译	解释
7	head	标记主要位于**头部**附近。	“The most common markings tend to be on the body **towards the head** …”（第 E 段）	最常见的标记倾向于位于身体靠近**头部**的地方……	“towards the head” 概括为单词 **head**。
8	communication	红色荧光被专门用于**交流**目的。	“…one of the strongest indications that red fluorescence has a very particular function: **communication** with other members of the species.”（第 E 段）	红色荧光有一个非常特殊的功能：与同种个体进行**交流**。	按题干语法填 **communication**（用于 communication purposes）。
9	enemies	鱼类（像一些动物一样）利用荧光把**敌人**驱离。	“…animals employ fluorescence … to signal, for example to **ward off enemies**.”（第 E 段）	许多动物利用荧光……例如**驱赶敌人**。	“keep ___ away” 与 “ward off enemies” 同义。
10	location	沙锥鱼（gobies）依靠红色荧光来显示它们的**位置**。	“…gobies use signals to indicate their **location** and keep their group together.”（第 E 段）	沙锥鱼用信号表明它们的**位置**，以便群体保持在一起。	直接对应 “indicate their location”。
11	species	**在彼此非常相似的**那些鱼当中，其标记存在差异。	“**closely related species** do not have completely identical markings…”（第 F 段）	**近缘物种**的标记并非完全相同……	“those ___ which are very similar” 指代 “closely related **species**”。
12	corals	在会发出红光的**珊瑚**背景附近，鱼不易被看见。	“he noticed **corals** glow a dark but faint red… Against this… background, a fish that glows red… would be hard to distinguish.”（第 G 段）	他注意到**珊瑚**也发出暗而微弱的红光……在这种背景下，通体发红的鱼很难被分辨。	“backgrounds of corals which give off a red light” → **corals**。
13	seahorse	目前唯一被证实能看见红色的鱼是**海马**。	“One exception is the **seahorse**, whose eyes are sensitive to red.”（第 H 段）	有一个例外是**海马**，它的眼睛对红色敏感。	直接对应题干。