

Academic Reading Paper 25

Cod, Compasses and Anecdotes

Time allowed: 1 hour

INSTRUCTIONS TO CANDIDATES

- Do not open this booklet until you are told to do so.
- Write your name and the date at the top of the answer sheet.
- Answer **all** the questions.
- Write your answers **on the answer sheet**, not in this booklet.
- You must transfer your answers within the hour. **No extra time is given for transferring answers in the Reading test.**
- Do not remove this booklet from the examination room.

INFORMATION FOR CANDIDATES

- There are 40 questions in this paper.
- Each question carries one mark.
- There are three passages, with 13, 13 and 14 questions.

These passages were written for this library. They are **not** reproduced from any published past paper. The format, timing and task types follow the published specification for the Academic Reading test so that sitting this on paper feels like the real thing.

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

The number that stayed high while the fish disappeared

The Grand Banks lie off the coast of Newfoundland, where a cold current from the north meets warm water from the south over a shelf shallow enough for sunlight to reach the bottom. The combination produced one of the largest concentrations of fish that has ever existed, and boats were crossing the Atlantic to work it within a few years of Europeans learning it was there. For something close to four centuries the fishery was carried on from small vessels, close to shore, in season, with hooks and lines, and it took in the region of two hundred and fifty thousand tonnes of cod a year, for generation after generation, without any evident decline.

What changed was not the number of boats but what a boat could do. The factory freezer trawler, the first of which sailed in 1954, could stay at sea for weeks, work in weather that would have kept an older vessel in harbour, drag a net across the seabed, and process and freeze the catch on board rather than racing back with it. A fleet of these is not a larger version of the old fishery. It is a different activity that happens to remove the same animal. The seasons that had limited the old fishery stopped limiting anything, and the depth at which cod could shelter stopped being a refuge.

The catch rose accordingly and reached about eight hundred and ten thousand tonnes in 1968, roughly three times the long-run figure. It then fell, which was noticed, and in 1977 Canada declared an exclusive zone extending two hundred miles from its coast and required the foreign fleets to leave. This was understood at the time as the rescue of the fishery, and in a sense it was the opposite. The zone transferred the resource to Canada, Canada invested in trawlers of its own with public money, and the total pressure on the stock did not fall.

The part that ought to trouble anybody who manages anything is what the science was doing meanwhile. Assessments of how many fish remained relied heavily on a quantity called catch per unit of effort: how much a boat brings in for each day it fishes. Under ordinary conditions this is a reasonable index, and it has the great practical advantage of costing nothing to collect, because the fleet generates it while going about its business. If the fish become scarce, a day's fishing yields less, and the number falls in step with the population.

Cod do not oblige. They gather to spawn in dense concentrations, and as the total population fell the remaining fish went on gathering in the same way, in a smaller number of places. Meanwhile the boats acquired sonar, satellite positioning and the accumulated knowledge of where the concentrations form. The result was that a day's fishing continued to produce a full hold while there was less and less left to find. The index did not merely become inaccurate. It stayed high precisely because the stock was collapsing into the aggregations the fleet was best at locating.

Assessments built on that index put the stock repeatedly above what it was, and the quotas set from those assessments were repeatedly at the upper end of what the figures could be made to support. Inshore fishermen, who were catching almost nothing, said for years that the stock was going. They were describing the population and the trawlers were describing the aggregations, and the second description was the one with numbers attached to it. In a disagreement between a fisherman's impression and a series of figures, the figures win, and on this occasion they should not have.

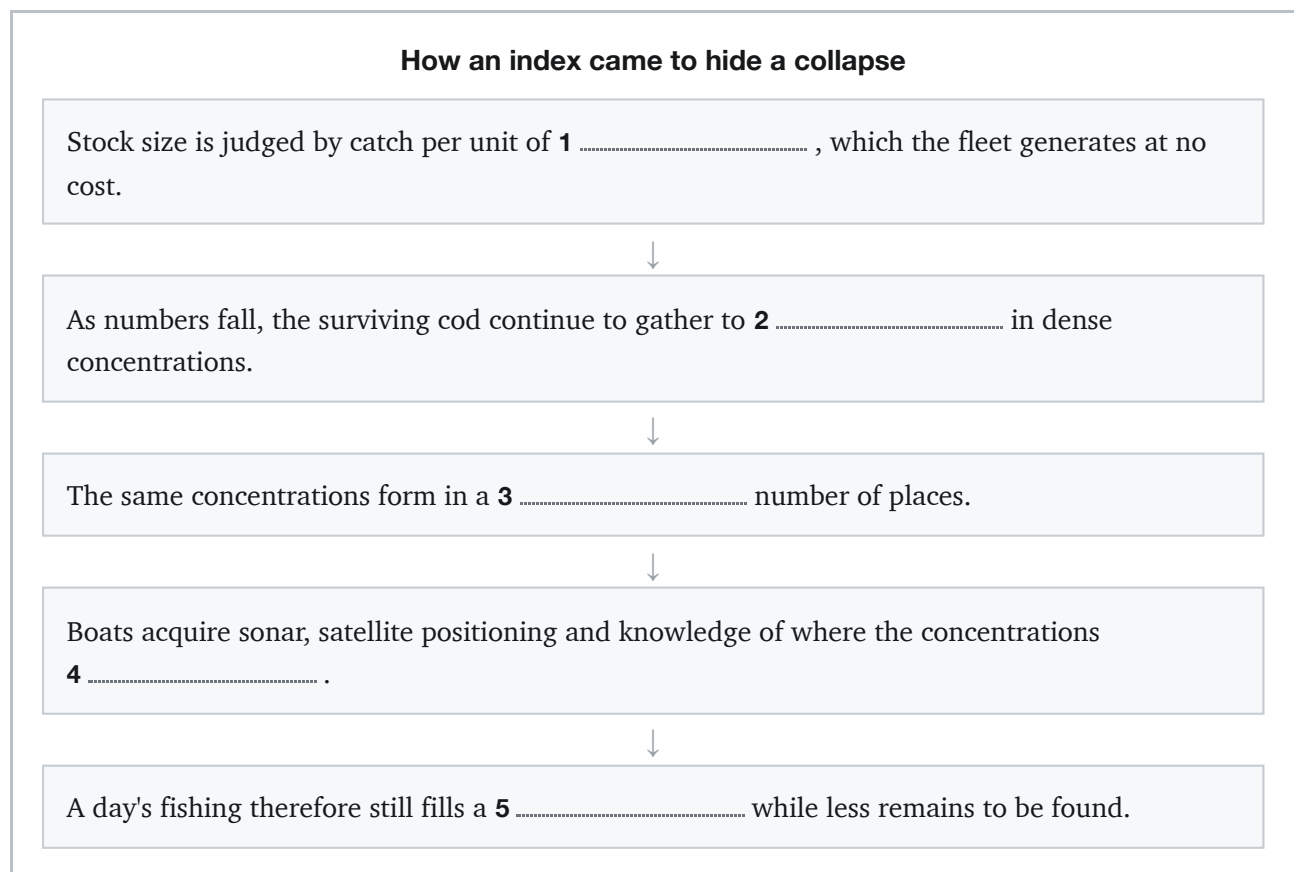
On 2 July 1992 the Canadian government closed the fishery. About thirty thousand people lost their work on the same day, the largest single layoff in the country's history, and the stock was later estimated to have fallen to somewhere near one per cent of what it had been. The moratorium was announced as a two-year measure, which is what everybody involved expected the recovery to take.

More than thirty years later the cod have not come back in any comparable quantity. The expectation had been that removing the fishing would return the system to its earlier state, and it has not, because the system did not stay still while the cod were removed. The capelin that cod feed on collapsed as well. Crab and shrimp, which had been of no interest, expanded into the space and became the basis of a profitable fishery with its own dependents. There is now a working economy built on the arrangement that replaced the one everybody wanted back, and a constituency that would lose by its return.

Questions 1–6

Complete the flow-chart below.

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





Assessments built on the index place the stock **6** what it is, and quotas follow.

Questions 7–9

Complete the sentences below.

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

- 7** The catch peaked at about eight hundred and ten thousand tonnes in
- 8** Canada's exclusive zone, declared in 1977, extended miles from the coast.
- 9** By the time of the closure the stock was estimated at about one of its former size.

Questions 10–13

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

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

- 10** Inshore fishermen reported the decline before the fishery was closed.
- 11** The exclusive zone reduced the total pressure on the stock.
- 12** Crab and shrimp fishing is more profitable than the cod fishery had been.
- 13** The moratorium was intended to last indefinitely.

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

How a bird finds north

- A** A European robin migrating at night, under cloud, over ground it has never seen, holds a consistent heading. It is not using stars, because it manages without them, and it is not using landmarks. That it uses the Earth's magnetic field has been accepted since the 1960s. What that sentence means physically has taken another fifty years to work out and is not finished, because a magnetic field of the strength available here is an extraordinarily faint thing for a living body to detect: it carries far less energy than the random jostling of molecules at body temperature, which ought to drown it entirely. Any proposed mechanism has to explain not only how the field is read but how the reading survives the noise.
- B** The first real constraint on any explanation came from Wolfgang and Roswitha Wiltschko in 1972. Working with robins in cages that record which way a restless bird tries to go, they changed the artificial field around the birds one component at a time. Reversing the horizontal direction of the field did nothing to the birds' choice. Reversing the vertical component turned them round completely, and reversing both together left them heading as before. What the bird reads is therefore not the direction a compass needle points but the angle at which the field lines meet the ground, which tells it which way lies towards the pole and which towards the equator, and cannot distinguish north from south in the way a magnetised needle does. A bird carried across the equator with such a compass would fly the wrong way, and this has been demonstrated.
- C** An explanation for how a cell might read that came from theoretical chemistry rather than from biology. Klaus Schulten proposed in 1978 that light striking a suitable molecule produces a pair of fragments whose unpaired electrons remain linked, and that a weak magnetic field alters the rate at which that pair switches between two states, and so alters how much of each product is formed. It is not a mechanism that moves anything. It is a chemical reaction whose outcome depends slightly on the direction of the field, and it can work at the Earth's field strength provided the linkage survives long enough. Schulten was proposing this some years before anybody had a candidate molecule to put in the role.
- D** The prediction that follows is unusual and testable: a compass of this kind must be driven by light. A bird using one should be unable to orient in the dark, and should be affected by the colour of the light it is given. Both are the case. The compass works under blue and green light and fails under red, which is difficult to explain if the receptor is a lump of magnetic material and straightforward if it is a molecule in the eye absorbing photons. The molecule now generally proposed is cryptochrome, which is present in the retina and is known to form exactly the kind of linked pair the theory requires.

- E** Henrik Mouritsen supplied the result that convinced most of the remaining sceptics, and it came out of a nuisance. Robins tested in wooden huts on a university campus would not orient at all. Screening the huts electrically restored the behaviour, and the birds could then be disoriented again by introducing extremely weak radio-frequency fields, far below any intensity considered biologically active. A field that faint cannot move a magnetic particle. It can, however, interfere with the linked electron pair that Schulten had described, which is very nearly the only known way it could have any effect at all.
- F** Meanwhile the rival account was collapsing. Iron-rich cells had been reported in the upper beak of pigeons, described as magnetic sensors, mapped in diagrams and cited for years. In 2012 a group led by Christoph Treiber examined thousands of them and found they were not nerve cells. They were macrophages, the immune cells that clear debris and accumulate iron in the process, and their number and position varied from one bird to the next in a way no sense organ does.
- G** None of that settles the question, and the honest summary is narrower than the story usually told. The light-dependent compass in the eye is well supported and the molecule most likely to be doing it is identified but not proven in a living bird. Magnetic material is still a plausible basis for a separate ability, the sense of position rather than direction, which appears to work differently and to be carried by a different nerve. A bird may well have two magnetic senses that answer two different questions — which way am I heading, and where am I — and only one of them is close to being understood.

Questions 14–20

Reading Passage 2 has seven sections, A–G.

Choose the correct heading for each section from the list of headings below.

Write the correct number, I–X.

List of Headings

- i** A signal too faint for the noise around it
- ii** A signal strong enough to overcome the noise
- iii** Which part of the field the bird is reading
- iv** Which part of the sky the bird is reading
- v** A mechanism proposed before its molecule was known
- vi** A molecule found before anyone could explain it
- vii** A prediction about light, and its confirmation
- viii** An accident in a hut that settled the argument
- ix** A rival account taken apart
- x** What can and cannot yet be claimed

14 Section A

- 15** Section B
16 Section C
17 Section D
18 Section E
19 Section F
20 Section G

Questions 21–24

Look at the following findings and the list of researchers below.
Match each finding with the correct researchers, A–D.

List of Researchers	
A	Wolfgang and Roswitha Wiltschko
B	Klaus Schulten
C	Henrik Mouritsen
D	Christoph Treiber and colleagues

- 21** They proposed that a magnetic field could alter the outcome of a chemical reaction.
22 They established which component of the field the bird responds to.
23 They showed that cells described as sensors were of a different type altogether.
24 They disoriented birds using fields far too weak to move anything.

Questions 25–26

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

- 25** What does the passage say about the bird's compass and red light?
- A It works under red light but not under blue.
 - B It fails under red light, which suits a molecular explanation.
 - C Colour makes no difference to it.
 - D Red light improves accuracy at night.

- 26** According to the final section, magnetic material may still account for
- A** the bird's sense of direction.
 - B** the bird's sense of position.
 - C** the bird's ability to see in the dark.
 - D** the failure of the compass under red light.

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

Against the origin story

Every field keeps a small collection of founding anecdotes, and they have three things in common: they are short, they are memorable, and the interesting part of them did not happen. An apple falls and gravity is discovered. A dish of mould is left by an open window and antibiotics follow. A young naturalist looks at some finches and evolution arrives. These are not lies exactly. They are compressions, and what has been compressed out is the whole of the work. Each of them is also, in its own field, the single thing that everybody knows.

Newton did see an apple fall, and told the story himself in old age to a visitor who wrote it down, so the anecdote has a better provenance than most. He was not struck on the head. What the fall prompted was a question about whether the force holding an apple to the ground might extend as far as the moon, and answering it took him something like twenty years, a mathematics that did not yet exist, and a long argument with the astronomical data of the time. The apple is the first minute of a project measured in decades.

Fleming's mould is worse, because in the popular version the story stops at the moment of least consequence. He did notice, in 1928, that a contaminating mould had cleared the bacteria around it, and he did publish. He then failed to obtain the active substance in any usable quantity and largely moved on. It became a drug because Howard Florey, Ernst Chain and Norman Heatley took the problem up more than a decade later and solved a series of grim industrial difficulties, one of which was that the mould produced so little of the compound that the first patients were treated with penicillin recovered from their own urine.

The finches are almost entirely a later invention. Darwin did not label his specimens by island, which is the detail on which the whole textbook version depends, and he had to reconstruct the provenance afterwards from other people's collections. The identification of the birds as related species was done by John Gould in London after the voyage. They appear only glancingly in the book that made the argument, and the argument itself rests on domestic pigeons and barnacles and a great deal of correspondence with breeders.

The usual response to all this is debunking, and debunking is its own vanity. It offers the pleasure of knowing better while leaving the reader with nothing except a slightly smaller store of stories, and it frequently overshoots: the apple probably did happen, Fleming did observe something real, and treating every famous anecdote as a fabrication is no more accurate than believing all of them. The point is not that the stories are false. It is that they are the wrong shape, and that the shape is doing more work on the listener than the content is.

What they encode is a model of discovery in which a prepared individual has a moment, and everything after the moment is administration. Almost nothing works like that. The characteristic pattern is a long, unglamorous middle in which somebody who is not the person in the anecdote does work that is difficult, repetitive and organisationally hard, and the reason that part is missing from the story is not conspiracy but form. The middle does not compress. It has no scene in it, no single day on which anything happened, and nobody to put at the centre of the picture.

This does real damage, and the damage falls on exactly the people the stories are told to. A student who has absorbed the model expects insight to feel like insight, and reads the absence of that feeling as evidence of unsuitability. The part of the work they are actually being asked to do — the decade, the purification, the correspondence — has been edited out of every account they have been given, so when they encounter it they have no way to recognise it as the job rather than as a failure to be doing the job.

The remedy is not to stop telling stories, which will not happen and should not, since a subject with no stories attached to it is not taught to anybody twice. It is to tell the second half, which is more interesting than the first and has the additional merit of being imitable. Nobody can copy an apple, and nobody can be taught to have a moment. Anybody can copy Heatley building an extraction plant out of milk churns and a doorbell, and a student who knows that this is what the work looks like has been given something the anecdote withheld from them.

Questions 27–32

Do the following statements agree with the claims of the writer in Reading Passage 3?

Write **YES** if the statement agrees with the claims of the writer, **NO** if the statement contradicts the claims of the writer, or **NOT GIVEN** if it is impossible to say what the writer thinks about this.

- 27** The writer thinks the founding anecdotes are fabrications.
- 28** The writer accepts that Newton's apple story has good documentary support.
- 29** Fleming later regretted abandoning the problem.
- 30** The writer believes debunking these stories is a sufficient response.
- 31** The writer holds that the missing middle is left out for reasons of form rather than concealment.
- 32** Students who know the fuller account go on to produce better work.

Questions 33–36

Complete the summary using the list of words, A–H, below.

List of Words

- A moment
- B middle
- C scene
- D provenance
- E unsuitability
- F imitable
- G conspiracy
- H administration

What the shape teaches

The anecdotes encode a model in which a prepared individual has a **33** and everything afterwards is administration. The long **34** is dropped because it will not compress: there is no **35** in it. A student who expects insight to feel like insight reads its absence as **36**

Questions 37–40

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

- 37** What does the passage say the falling apple prompted?
- A An immediate understanding of gravity.
 - B A question about whether the force reached as far as the moon.
 - C A blow to the head that Newton described in old age.
 - D The invention of a mathematics he already possessed.
- 38** Which position does the writer reject?
- A That the famous anecdotes are useful for teaching.
 - B That discovery consists of a moment followed by administration.
 - C That the missing part of the story is imitable.
 - D That Fleming published his observation.

- 39** Why does the writer say the finch story is 'almost entirely a later invention'?
- A** Darwin never visited the islands.
 - B** The birds were not finches.
 - C** Darwin did not label his specimens by island, and the taxonomy was done by someone else afterwards.
 - D** Gould's identification was later shown to be wrong.
- 40** Which of the following best expresses the writer's recommendation?
- A** Tell the second half of the story, because it can be copied.
 - B** Stop teaching with stories altogether.
 - C** Correct each anecdote whenever it is repeated.
 - D** Give students only primary sources.