

# Academic Reading Paper 31

Longitude, Vents and Meetings

---

**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.

## Two answers to the same question

Finding your latitude at sea is straightforward and was solved in antiquity: measure the height of the sun at noon, or of the pole star at night, and the angle gives you how far north or south you are. Longitude is a different kind of problem, because the Earth turns and there is no fixed mark in the sky to measure against. What a navigator needs is the difference between the local time, which can be read from the sun, and the time at a place of known longitude. Every hour of difference is fifteen degrees. The question is how to carry the second time across an ocean, on a wooden ship, through changes of temperature and humidity, for weeks.

The cost of not being able to do it was paid regularly and occasionally in public. In October 1707 a British fleet returning from Gibraltar struck the rocks of the Isles of Scilly in fog, and four ships and something between fourteen hundred and two thousand men were lost. The navigators had believed themselves well to the west of where they were, and the error was in longitude, which nobody aboard had any reliable way of checking. Seven years later Parliament passed an Act offering twenty thousand pounds for a method of determining longitude to within half a degree at the end of a voyage to the West Indies, which is a demand for a clock that gains or loses no more than about two minutes in six weeks.

Two methods were pursued and the story is usually told as though only one of them was serious. The first was astronomical. The moon moves against the background of stars at a rate that can be tabulated in advance, so if a navigator measures the angle between the moon and a chosen star, and consults a table giving that angle as seen from a reference place at a given moment, he has the reference time. The method requires no clock at all, which is its great strength, and it requires a great deal of arithmetic, which was its weakness.

The second was mechanical. John Harrison, a Lincolnshire carpenter turned clockmaker, spent forty years building timekeepers that would run accurately at sea, where a pendulum is useless. His solutions were ingenious in a way that is still admired: bearings that needed no oil, because oil thickens with cold; a pair of linked balances that cancelled the ship's motion; and a bimetallic strip that compensated for the expansion of the balance spring as the temperature changed. His fourth machine, completed in 1759, was the size of a large pocket watch.

On a voyage to Jamaica in 1761 and 1762 that watch lost about five seconds in eighty-one days. It was a demonstration nobody could argue with, and the Board of Longitude argued with it anyway, on the grounds that a single good result might be luck and that a machine nobody else could build was not a method available to the navy. A second trial to Barbados followed. Harrison received the award in stages and only after prolonged dispute, including an intervention by Parliament in 1773.

That dispute is the part of the story everybody knows, and it has crowded out the fact that the astronomical method was working. Nevil Maskelyne, who is usually cast as the villain of the piece, published the first Nautical Almanac in 1767, containing the lunar tables pre-computed for every three hours of the year. The calculation that had taken a competent navigator four hours came down to about thirty minutes. The tables were cheap, they could be printed in quantity, and any ship could carry them.

The chronometer was better and it was not yet practical. Harrison's watch had taken years to make by hand, and the copies made to prove it could be reproduced were also slow and enormously expensive; a marine timekeeper around 1800 still cost as much as a small house. Ships accordingly carried the almanac, and the lucky or wealthy ones carried a chronometer as well, and the two were used against each other, which is the arrangement that actually made navigation reliable. A clock can stop. A table cannot.

The moral usually drawn is that a lone craftsman was cheated by a jealous establishment. What the record shows is a board with a statutory duty to certify a method rather than a machine, confronted by one solution that was superb and unrepeatable and another that was adequate, cheap and immediately available, and choosing for a considerable time to support both. Chronometers became ordinary only when manufacture caught up, some decades after the argument had ended, and the almanac went on being printed long after that.

### Questions 1–5

Complete the table below.

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

| The two methods compared |                                                                                        |                                                                     |
|--------------------------|----------------------------------------------------------------------------------------|---------------------------------------------------------------------|
|                          | The lunar method                                                                       | The chronometer                                                     |
| What it needs            | the angle between the moon and a chosen <b>1</b> ....., and a set of tables            | a timekeeper that runs accurately where a <b>2</b> ..... is useless |
| Its weakness             | a great deal of <b>3</b> .....                                                         | it can stop                                                         |
| What changed it          | the first Nautical Almanac of 1767 cut the calculation to about <b>4</b> ..... minutes | around 1800 one still cost as much as a small <b>5</b> .....        |

### Questions 6–9

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.

- 6 Latitude had been possible to determine long before longitude was.
- 7 The passage presents Maskelyne as an obstacle to a working solution.
- 8 The loss of the fleet at Scilly led directly to the Longitude Act.
- 9 The Board accepted the result of the Jamaica voyage without objection.

### Questions 10–13

Complete the sentences below.

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

- 10 Every hour of difference between local time and the reference time is ..... degrees of longitude.
- 11 Harrison used bearings needing no oil, because oil ..... with cold.
- 12 On the Jamaica voyage the watch lost about five seconds in ..... days.
- 13 Parliament's Act of 1714 offered twenty thousand pounds for accuracy to within half a .....

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

## Life without sunlight

- A** In February 1977 a small submersible called Alvin descended to a spreading ridge on the sea floor north-east of the Galápagos Islands. The expedition was geological. Measurements of heat coming out of the ocean crust did not match what the theory of sea-floor spreading predicted: too little was escaping by simple conduction to account for the totals. The most likely explanation was that sea-water was circulating down through cracks in the rock, being heated by the magma beneath, and returning to the sea floor as hot springs. The team went to look for hot water, and expected to photograph mineral deposits and take temperature readings. There was no biologist on board, which was a reasonable decision given what anybody expected to find.
- B** What they found around the vents was an animal community denser than anything known from the deep sea. Clams the size of dinner plates, mussels in banks, crabs, and worms standing in white tubes more than a metre long with scarlet plumes at the top, all of it clustered within a few metres of the openings and absent from the bare rock around them. The photographs were sent up and the reaction on the surface ship was disbelief, since the deep sea floor was understood to be a desert, sustained by the slow fall of scraps from the sunlit water far above and supporting a scattered and impoverished fauna. Two and a half kilometres down, in permanent darkness, at close to freezing, there was more animal flesh per square metre than in most shallow seas.
- C** The animals themselves posed a sharper problem than their abundance. The largest of the tube worms, when examined, had no mouth, no gut and no anus. It was not a filter feeder, it was not a predator, and there was no obvious route by which anything could get into it. Most of the inside of it was occupied by a single large organ nobody could assign a function to. An animal a metre long with no digestive system is not a curiosity to be filed; it is a demand for an explanation, and for three years nobody had one. Chemical analysis showed the tissue was rich in sulfur compounds, which was another fact without a home.
- D** The explanation was supplied by Colleen Cavanaugh, then a graduate student, during a seminar in which the worms were being described. She had been working on bacteria that oxidise sulfur, and she proposed that the worm was not feeding at all in the ordinary sense but housing such bacteria inside its own tissue, in the large organ that occupies most of its body, and that they were obtaining energy by oxidising the hydrogen sulfide coming out of the vent. The worm's blood, which is red because it carries a haemoglobin, would be transporting sulfide and oxygen to them, and the plume at the top of the tube would be the surface across which both are absorbed.
- E** The proposal was testable and it was tested. The organ turned out to be packed with bacteria, at densities of billions per gram, and to contain the enzymes required for fixing carbon by that route. Holger Jannasch and others established that the bacteria of the vents could indeed build organic matter using chemical energy, and the community was shown to rest on that production rather

than on anything sinking from above. Similar partnerships were then found in the clams and mussels, which house bacteria in their gills. The phrase that entered the textbooks was that here was an ecosystem independent of the sun.

**F** That phrase is not quite right and the correction matters. The bacteria oxidise sulfide with oxygen, and the oxygen dissolved in deep seawater was put there by photosynthesis at the surface. Remove the sun and the vents would not run in their present form. What is true, and remarkable enough, is that the energy driving the community comes from chemistry rather than from light, and that the carbon entering it is fixed in total darkness by organisms that have no use for the sun except as a distant supplier of an oxidant.

**G** Two consequences followed that were larger than the discovery itself. The first is that life turned out to be possible wherever there is an energy gradient and liquid water, which reshaped the search for it elsewhere in the solar system and made the ice-covered oceans of certain moons interesting. The second is a caution about expeditions: the most consequential biological find of the century was made by a team of geologists who had gone to look at rocks, and who had to preserve the first specimens in vodka from the ship's stores, because nothing aboard had been packed for keeping animals.

## 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** Looking for one thing and finding another
- ii** Looking for something and finding it
- iii** More life than anyone expected to see
- iv** Less life than anyone expected to see
- v** An animal that could not be fed
- vi** An animal that fed on an unexpected diet
- vii** A suggestion made in a seminar
- viii** The suggestion tested and confirmed
- ix** A famous phrase that needs correcting
- x** What the discovery changed elsewhere

**14** Section A

**15** Section B

**16** Section C

- 17** Section D
- 18** Section E
- 19** Section F
- 20** Section G

### Questions 21–23

Look at the following statements and the list of people below.

Match each statement with the correct person, A, B or C.

| List of People |                                       |
|----------------|---------------------------------------|
| A              | the geologists on the 1977 expedition |
| B              | Colleen Cavanaugh                     |
| C              | Holger Jannasch                       |

- 21** They preserved their first specimens in a drink taken from the ship's stores.
- 22** She proposed that an animal was housing the organisms that fed it.
- 23** He established that vent bacteria could build organic matter from chemical energy.

### Questions 24–26

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

- 24** Why had the heat measurements not matched the theory?
- A Too much heat was escaping from the crust.
  - B Too little was escaping by conduction alone to account for the totals.
  - C The theory of sea-floor spreading had been abandoned.
  - D The instruments had been calibrated incorrectly.
- 25** What does the passage say about the phrase 'an ecosystem independent of the sun'?
- A It is accurate and useful.
  - B It was never actually used in textbooks.
  - C It is not quite right, because the oxygen used comes from photosynthesis.
  - D It applies only to the clams and mussels.

- 26** According to the passage, what made the ice-covered oceans of certain moons interesting?
- A** Life turned out to be possible wherever there is an energy gradient and liquid water.
  - B** Hydrogen sulfide had been detected on them.
  - C** They were found to contain tube worms.
  - D** They receive more sunlight than had been thought.

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

## Against the meeting

There are two standard positions on meetings and they are both held loudly. The first is that they are a waste of time, that most of them could have been an email, and that the modern working day has been eaten by them. The second is that they are how an organisation coheres: that trust, culture and shared understanding are built in a room and cannot be built in a document. Both positions describe something real, and neither of them explains why the number of meetings keeps rising in organisations whose members complain about them constantly. A practice that everybody dislikes and nobody stops is being held in place by something, and it is worth finding out what.

Start with a number that is almost never calculated. An hour-long meeting of eight people is a working day, and a weekly one is about forty-five working days a year. Nobody would authorise a project costing forty-five days without asking what it produced, and the meeting is not asked because its cost is distributed across other people's calendars and appears in no budget. Anything whose cost is invisible will be over-used, and this is the ordinary reason there are too many of them. It is also the least interesting reason, because it would be true of anything free.

But that observation does not get at what meetings are for, and the email argument fails precisely here. A great many meetings genuinely could be a document, and those are the ones that distribute information: the update, the report, the briefing. If the purpose is that everyone should know something, writing it down is better in every respect. It can be read at the reader's speed, skipped by those who know it already, searched afterwards, corrected in place, and consulted by somebody who joins the organisation next year. Reading a slide aloud to eleven people is a way of transmitting information at the speed of speech to an audience who can all read faster than that.

The meetings that survive that test are the ones where something has to be decided, and the reason a decision benefits from a room is not that discussion improves it. It is that a decision made in front of witnesses becomes hard to un-make quietly afterwards. Everyone present has heard the same thing, at the same time, and knows that everyone else heard it. That property is genuinely difficult to produce in writing, and it is the function that keeps meetings in existence.

Which suggests a diagnosis for the organisations that hold the most of them. If the only reliable way to get a decision recognised is to assemble people in a room, then meetings will multiply until the calendar is full, and the multiplication is a symptom of something else: that written decisions are not treated as binding, that authority is unclear, or that nobody is willing to decide alone. The complaint about too many meetings is very often a complaint about decision-making, addressed to the wrong object.

There is a further use, less often admitted, which is the distribution of responsibility. A decision taken by one person is attributable. The same decision taken after a meeting of nine is attributable to nobody, and this is sometimes what the meeting is for. It is not always cynical: in an organisation that punishes indi-

vidual error harshly, seeking company before acting is rational behaviour, and the meetings are the visible symptom of an incentive nobody designed on purpose. Telling people in that position to hold fewer meetings is asking them to absorb a risk on behalf of an institution that has not agreed to carry it.

The concessions are real and worth stating. Disagreement is easier to surface in a room, because people who will not write an objection will voice one when they hear it contradicted. Anything where tone carries information — a difficult conversation, a negotiation, an apology — is worse in writing, and attempting it in writing tends to produce a second problem on top of the first. And a group that has never met has a thinner set of assumptions about each other, which shows up later in how charitably they read each other's messages.

So the useful reform is not fewer meetings, which fails because it treats the symptom. It is to require of each one a named decision and a named person who will make it, and to convert everything else into a document that people read. Where the decision cannot be named, the meeting is either a broadcast, which should be written, or an exercise in shared cover, which is worth recognising honestly, since an organisation that needs a great deal of it has a problem that no change to the calendar will fix.

### Questions 27–31

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 answer is simply to hold fewer meetings.
- 28** The writer accepts that objections surface more easily in a room than in writing.
- 29** Written decisions are treated as binding in most organisations.
- 30** The writer regards seeking company before a decision as always cynical.
- 31** The writer holds that a decision made in front of witnesses is harder to reverse quietly.

### Questions 32–36

Complete the summary below.

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

#### What a meeting is actually doing

An hour-long meeting of eight people costs a working day, and a weekly one about forty-five working days a year, but the cost is spread across other people's calendars and appears in no

**32** ..... Meetings whose purpose is to pass on information should be written instead, since a document can be read at the reader's own **33** ..... What survives is the meeting that decides something, because everyone present knows that everyone else heard the

same thing, which is difficult to produce in **34** ..... Where meetings multiply, the writer treats this as a symptom of unclear **35** ....., and the reform he proposes is to require of each meeting a named decision and a named **36** ..... who will make it.

### Questions 37–40

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

- 37** Why does the writer call the invisible cost the least interesting reason?
- A Because the figure is hard to calculate.
  - B Because it would be true of anything free.
  - C Because meetings are not in fact expensive.
  - D Because nobody complains about it.
- 38** Which position does the writer reject?
- A That a meeting to pass on information should be a document.
  - B That discussion in a room improves the quality of a decision.
  - C That tone carries information that writing loses.
  - D That an unnamed decision means the meeting is a broadcast or shared cover.
- 39** What does the passage say about reading a slide aloud to eleven people?
- A It ensures everyone has understood.
  - B It transmits information more slowly than the audience can read.
  - C It is the best use of a meeting.
  - D It is impossible to do in a document.
- 40** Which of the following best expresses the writer's conclusion?
- A Require a named decision and a named decider, and write down everything else.
  - B Abolish meetings in favour of documents.
  - C Hold meetings only when tone matters.
  - D Reduce the number of people invited to each meeting.