

Academic Reading Paper 47

Bar Codes, Trees and Certainty

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 lines that had to wait

The idea began with a conversation that one of the parties was not meant to hear. In 1948 a graduate student at a technical college in Philadelphia overheard the president of a food chain asking a dean whether anybody could devise a way of capturing product information automatically as customers left a shop. The dean declined. The student, Bernard Silver, mentioned it to a friend, Norman Joseph Woodland, and the two of them began work on a problem that neither the chain nor the college had commissioned.

The form of the answer came to Woodland on a beach in Florida, where he had gone to think. He knew Morse code from his time in the Boy Scouts, and sitting in the sand he drew a row of dots and dashes with his fingers and then pulled the fingers straight down. The dots became narrow lines and the dashes wide ones. To allow the mark to be read from any direction he bent the pattern into a set of concentric circles, and it was in this form, as a bullseye, that the two of them filed a patent in 1949 and received it in 1952.

Nothing existed that could read it. The apparatus they built used a five-hundred-watt bulb, because that was what it took to get enough light through the pattern to a photomultiplier tube taken from a cinema sound system, and it ran hot enough to scorch the paper it was pointed at. The device filled a desk and had to be operated in a darkened room. In 1962 the patent was sold for fifteen thousand dollars, and it expired in 1969 without a single commercial use, which is the sort of detail that gets left out of accounts of successful inventions. Neither man made anything from it.

What changed was not the mark but the machinery around it. The laser was demonstrated in 1960 and gave a narrow beam of steady light that needed no furnace to produce. The integrated circuit made it possible to decode a signal at the counter rather than in a back room. By the end of the sixties the reading of a printed pattern at speed had become an ordinary engineering problem rather than an exotic one. The invention had spent twenty years waiting for components that had nothing to do with shops.

The obstacle that remained was not technical, and it is the more interesting one. No shopkeeper would buy scanners while the goods on the shelves carried no marks, and no manufacturer would print marks on packaging while there were no scanners to read them. Each side was waiting for the other, and no individual firm could gain by moving first. A problem of that shape cannot be solved by anybody acting alone, however clever, and it had nothing to do with the quality of the invention.

It was settled by committee, which is not how these stories usually end. Between 1970 and 1973 a body drawn from the American grocery trade considered the competing designs and chose a single one, so that every manufacturer and every retailer would be printing and reading the same thing. The winner

was a rectangle of parallel lines designed by George Laurer at IBM. Woodland's bullseye lost partly for a practical reason: printing presses smear ink slightly in the direction the paper travels, which turns a circle into an unreadable blur but merely thickens a straight line that runs the same way.

The first sale across a scanner took place on the twenty-sixth of June 1974, in a supermarket in Troy, Ohio. The item was a packet of chewing gum, and it was chosen deliberately: the committee wanted to know whether the pattern could be printed legibly on something that small. Adoption after that was slow rather than sudden. By 1978 well under one store in a hundred in the United States had a scanner, and it was the middle of the following decade before enough of both sides had moved for the thing to become unavoidable.

Two consequences are worth stating because they are not the ones usually described. The equipment was expensive, so the savings went first and most fully to the chains large enough to buy it, and the mark is regularly named among the mechanisms by which very large retailers grew at the expense of small ones. And the code itself carries no price. It identifies the product and nothing else; the price sits in the shop's own computer. That moved the setting of prices off the shelf edge and into the back office, where it could be changed for every branch at once, by somebody the customer would never meet and could not argue with.

Questions 1–5

Complete the flow-chart below.

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

From a beach to a checkout

On a Florida beach Woodland drew **1** code in the sand and drew his fingers downwards.

↓

So that it could be read from any direction the pattern was bent into concentric **2**

↓

The first reader used a 500-watt bulb and a **3** tube from a cinema sound system.

↓

1962 — the patent was sold for **4** dollars.

↓

1974 — the first item passed across a scanner was a packet of **5**

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 The patent ran out without ever having been used commercially.
- 7 The bullseye design was rejected because it could not be read from every angle.
- 8 The committee looked at designs submitted from outside the United States.
- 9 By 1978 fewer than one American shop in a hundred had a scanner.

Questions 10–13

Complete the table below.

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

Why it took twenty-five years	
What stood in the way	What removed it
No light source both narrow and steady	the 10 , demonstrated in 1960
Decoding had to be done away from the counter	the 11 circuit allowed it to be done at the counter
Shops and manufacturers each waited for the other	an industry 12 chose a single design for everybody
The mark carries no price	the price is held in the shop's own 13

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

How water reaches the top of a tree

- A** A tall tree presents a problem that looks impossible before it is explained and remains slightly alarming afterwards. A coastal redwood may stand a hundred metres high, and every day it moves several hundred litres of water from its roots to leaves at the top, through vessels no wider than a human hair, with no pump anywhere in the system and no moving part of any kind. Whatever is happening is passive, and it is working against gravity for the height of a thirty-storey building. Nothing built by people moves water that far without a pump.
- B** The first serious measurements ruled out the obvious answer. Stephen Hales, an English clergyman who spent the seventeen-twenties attaching glass tubes to the cut stems of plants, showed that roots do push water upwards with a measurable force. He also showed that the force was nowhere near enough. Root pressure can raise water a few metres in some species and is absent altogether in others, including tall ones in full leaf, and it cannot be the mechanism in a tree of any height. Hales had answered his own question in the negative, which is a useful thing for a first investigation to do.
- C** Suction from above is ruled out by physics rather than by measurement, and the limit is exact. Atmospheric pressure at sea level will support a column of water about 10.3 metres high, and not one centimetre more, and no pump drawing on the top of a column can do better, because what is doing the lifting is the atmosphere pressing on the surface below. A perfect vacuum applied to the top of a pipe a hundred metres tall would leave the water ninety metres short. Anything that reaches the top of a redwood is not being sucked in the ordinary sense of the word. The figure is not an engineering limit that better equipment might beat; it follows from the weight of the atmosphere.
- D** The explanation offered in 1894 by Henry Dixon and John Joly, working in Dublin, requires the water to be pulled rather than pushed, and to be strong enough to be pulled. Evaporation from the leaves removes molecules from the top of the column. Water molecules attract one another, and in a tube narrow enough the column holds together as a single thread rather than separating, so that removing a molecule at the top exerts a pull on the whole length beneath. The column is therefore not compressed but stretched: the water in a tall tree is under negative pressure, commonly between one and two megapascals below zero, which is a state most liquids are never asked to be in.
- E** The obvious objection is that a liquid under that much tension should not survive. A stretched column ought to break, and it breaks by forming a bubble, which then expands to fill the vessel and stops the flow through it. This does happen, and it happens constantly. Michael Milburn and colleagues showed in the nineteen-sixties that the breakages can be detected as sharp clicks in the ultrasonic range, so that a stressed tree is audibly snapping its own water columns all day. Trees survive because the plumbing is divided into a very large number of separate narrow vessels rather than a few wide ones, so a break disables one thread and leaves the rest of the trunk working.

- F** Measuring the tension in a living plant was for a long time impossible, and the instrument that solved it is disarmingly simple. Per Scholander introduced the pressure chamber in the nineteen-sixties. A leaf is cut and sealed into a container with the cut end protruding, gas pressure inside the chamber is raised until sap appears at the cut surface, and the pressure required is read off a gauge. That reading is the tension the water had been under before the leaf was cut. The device is portable, costs little, and made it possible to take the measurement on a hillside rather than in a laboratory.
- G** Two cautions belong with this. The first is about language: the description most people are taught, in which a tree draws or sucks water up, points at the wrong physics and makes the ten-metre limit invisible. The water is being pulled from above by a column in tension, which is a different arrangement from anything a pump does. The second is that the account is not finished. Vessels that have filled with gas are sometimes found full of water again later, apparently refilled while the surrounding tissue is still under tension, and how that is done is disputed. A theory can be correct in its main claim and still leave a mechanism of that importance unexplained after a century.

Questions 14–20

Reading Passage 2 has seven paragraphs, A–G.

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

Write the correct number, I–X.

List of Headings

- i** A force that turned out to be too weak
- ii** A force that turned out to be sufficient
- iii** A limit that no equipment can beat
- iv** A limit that better equipment has since beaten
- v** A column that is stretched rather than pushed
- vi** Breakages, and why they are survived
- vii** A simple instrument for a hard measurement
- viii** What the usual description gets wrong, and what is still unknown
- ix** The size of the task
- x** How the vessels themselves are built

- 14** Paragraph A
- 15** Paragraph B
- 16** Paragraph C
- 17** Paragraph D
- 18** Paragraph E

19 Paragraph F

20 Paragraph G

Questions 21–26

Complete the summary below.

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

Pulled, not pushed

Roots do push water upwards, but the push is far too weak, and in some tall species it is
21 altogether. Suction cannot be the answer either, since atmospheric pressure
will support a column only about **22** metres high. Dixon and Joly proposed
instead that evaporation at the leaves pulls the column, which holds together because water
molecules **23** one another. The water in the column is therefore under
24 pressure. Columns do break, and the breaks can be detected as clicks in the
25 range. Scholander's chamber measures the tension by raising the gas pressure
until **26** appears at the cut surface.

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

Why we trust the confident

How sure somebody sounds and how right they turn out to be are only loosely related, and the relationship is weaker in exactly the settings where it is relied upon most heavily. This has been examined in courtrooms, in hiring, in medicine and in forecasting, and the finding is stable enough to be uninteresting to the people who study it and apparently impossible to act on for everybody else. Confidence continues to be read as a signal of competence, because there is nothing else immediately available, because it feels like one, and because the alternative requires work that nobody has time for at the moment of deciding.

The clearest case is the identification of a stranger by a witness. Here the research contains a distinction that almost every popular account leaves out, and dropping it produces the wrong conclusion. Confidence expressed at the moment of the first identification, before any feedback of any kind, does carry real information: a witness who says immediately that they are certain is substantially more likely to be right than one who hesitates. Confidence expressed in a courtroom months later carries very little, because in the interval the witness has been told they picked the same person as somebody else, has been prepared by lawyers, and has repeated the account until it is smooth. The confidence has grown and the accuracy has not.

That case is worth holding onto because it shows what the signal actually measures. Confidence is a report on an internal state. It tells you how strongly the evidence available to that person seems to them to point in one direction, which is genuine information about them and only indirectly about the world. Whether it is also information about the world depends entirely on whether that person has ever been in a position to find out how often their strong feelings were correct.

That last condition is the whole of it, and it is rarely met. A weather forecaster who says seventy per cent finds out, every day, and can be scored over a season; forecasters are consequently among the best-calibrated people ever measured. A consultant who says a strategy will work finds out slowly, ambiguously, and usually after moving on. A senior clinician making a diagnosis may never learn what happened to the patient. The difference between these people is not intelligence or honesty. It is whether the world has been in the habit of answering back.

There is a second mechanism, and it is social rather than individual. In groups, the member who speaks with the most assurance disproportionately determines what the group decides, and this holds when the group has been told that the confident member is not the most accurate. Confidence is contagious in a way that hedging is not, and a meeting will converge on the person who sounds least troubled by the question, and will do so faster when the question is hard. Anybody who has watched a committee will recognise the mechanism operating on themselves as well as on other people.

The tempting conclusion is that confidence should be discounted altogether, and it is wrong. Within one well-calibrated person, confidence is one of the most useful signals available: a surgeon who says this one worries me is reporting something worth more than any checklist, and an experienced engineer's unease about a design has a good record. Treating all expressions of certainty as noise throws away the very thing that expertise partly consists of, and it is also unusable, since no organisation can operate by ignoring what its most experienced people say about how sure they are.

So neither of the available positions survives, and the reason is that both treat confidence as a fixed quantity with a fixed value. It is not. The same expression means different things depending on a fact about the speaker's history that is not visible in the expression itself, and is often not visible to the speaker either. Somebody can be entirely honest, entirely experienced, and systematically overconfident, because nothing in their working life has ever told them otherwise.

What can be done is smaller than a solution and more useful than a complaint. Ask two questions. What would change your mind, and how often have you been wrong about this kind of thing before. A person whose judgement has been tested can answer both, usually with specifics and without discomfort, because the answers are simply things they know about themselves. A person who has never been scored will find the first question strange and the second one offensive, and that reaction, rather than anything they said about the decision itself, is the most informative thing you will get out of the conversation.

Questions 27–30

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

- 27** What does the passage say about a witness's confidence?
- A It is worth nothing at any stage.
 - B It carries information at the first identification but very little in court.
 - C It becomes more accurate as time passes.
 - D It matters only when the witness already knew the person.
- 28** Why are weather forecasters unusually well calibrated?
- A They are more intelligent than other professionals.
 - B They get an answer every day and can be scored over a season.
 - C The law requires them to state probabilities.
 - D They work in teams rather than alone.
- 29** What does the passage say happens in groups?
- A The most accurate member is generally followed.
 - B The most assured member has disproportionate influence even when the group has been warned.
 - C Groups reach better decisions than individuals do.
 - D Hedging spreads through a group faster than confidence.

- 30** Why does the writer refuse to discount confidence altogether?
- A** Because doing so would offend experienced staff.
 - B** Because within a well-calibrated person it is one of the most useful signals there is.
 - C** Because calibration cannot be measured.
 - D** Because confidence and accuracy match each other exactly.

Questions 31–36

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.

- 31** The writer thinks confidence tells you more about the speaker than about the world.
- 32** The writer believes somebody honest and experienced cannot also be overconfident.
- 33** The writer thinks juries should be told about the research on witnesses.
- 34** The writer accepts that no organisation could work by ignoring what its experienced people say about their own certainty.
- 35** The writer regards confidence as a quantity whose value is fixed.
- 36** The writer thinks some professions display confidence more openly than others.

Questions 37–40

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

List of Words

- A** state
- B** correct
- C** wrong
- D** discomfort
- E** signal
- F** hesitant
- G** certain
- H** delay

What to ask instead

Confidence is a report on an internal **37**, and it becomes information about the world only where the speaker has had the chance to learn how often such feelings turned out to be **38**, Two questions are worth putting: what would change your mind, and how often you have been **39** about this before. Somebody whose judgement has been tested answers both without **40**, while somebody who has never been scored finds the second question offensive.