

Academic Reading Paper 01

Ice, Queues and Inventors

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 ice trade

- A** In February 1806 a young Boston merchant named Frederic Tudor loaded a brig¹ with 130 tonnes of ice, cut from a freshwater pond on his family's estate, and despatched it to the Caribbean island of Martinique. The venture was a commercial disaster. A large part of the cargo melted on the voyage; the islanders, who had never seen ice, had no idea what to do with it; and Tudor came home about \$4,000 poorer. Twice in the following decade he was imprisoned for debt. Yet by 1856 Boston alone was shipping 146,000 tonnes of ice a year to foreign ports, among them Calcutta, Rio de Janeiro and Hong Kong, and ice had become one of the most voluminous exports of the United States.
- B** Tudor's difficulty was never supply. Every winter, ice a foot thick or more formed on thousands of ponds across the north-eastern states, and it cost nothing but labour to remove. The difficulty was everything that came afterwards. The ice had to be cut into pieces that could be handled and stacked; it had to survive weeks at sea in a wooden hull; and, most awkward of all, it had to be sold to people in hot countries who had lived perfectly well without it. Tudor's early letters show him wrestling with all three problems at once, and it is characteristic of him that he treated the third as the most important. He gave ice away to bar-keepers on condition that they served chilled drinks at the same price as warm ones, calculating that a customer who had once drunk a cold drink in the tropics would not willingly go back.
- C** The insulation problem was solved almost by accident. Hay and straw, the obvious packing materials, absorbed water and rotted. Around 1815 Tudor began experimenting with sawdust, a waste product that the sawmills of Maine were glad to be rid of, and found that a thick layer of it around a stack of blocks cut the losses on a long voyage from about two thirds of a cargo to less than a third. What had been an unpredictable cargo became a calculable one, and it was this, rather than any saving in money, that opened the trade: a shipowner could now be told in advance what proportion of a load would arrive.
- D** Cutting was transformed in 1825 by Nathaniel Wyeth, a hotel manager whom Tudor later employed. Until then ice was chipped free with saws and chisels, which was slow and produced irregular lumps. Wyeth devised a horse-drawn cutter that scored the frozen surface into a grid, so that uniform rectangular blocks could be levered out and floated along channels to the ice house². The saving in labour brought the cost of harvesting a tonne down from about thirty cents to ten. The saving in melting was larger still, though nobody costed it: square blocks stack against one another without gaps, and a stack with no air in it melts far more slowly than a heap of irregular pieces.

- E** The most improbable of Tudor's markets was India. In 1833 the ship *Tuscany* sailed from Boston with 180 tonnes and reached Calcutta four months later with about 100 tonnes intact. The British residents, who had been paying heavily for locally made ice of poor quality, were delighted. An ice house with double walls and a deep pit was put up to receive later cargoes. For three decades the city was supplied with ice cut nineteen thousand kilometres away.
- F** By then ice had acquired something a natural product rarely has: a brand. Ice from Wenham Lake, north of Boston, was famous in London for its clarity, and a shop on the Strand kept a block in the window with a newspaper propped behind it, to show that the print could be read through the ice. Norwegian producers, noticing this, renamed one of their own lakes Wenham and shipped under that name.
- G** The American harvest peaked in 1886 at around twenty-five million tonnes, and the collapse that followed had two causes working at once. The ponds of an industrialising New England grew dirty, and consumers who had learned to put ice in their drinks became unwilling to put in ice of doubtful origin; a run of mild winters in the 1890s then produced what the newspapers called ice famines, and a commodity that cannot be guaranteed loses its customers to one that can. That alternative was already to hand. Mechanical refrigeration, developed for breweries in the 1870s, was by 1900 turning out artificial ice more cheaply than nature supplied it in Boston. The last commercial harvests in New England were made in the 1920s. The industry that had taught much of the world to want ice was destroyed by the world's success in learning to make it.

brig: a two-masted sailing ship

ice house: an insulated building in which ice is stored

Questions 1–5

Reading Passage 1 has seven paragraphs, A–G.

Which paragraph contains the following information?

Write the correct letter, A–G.

NB You may use any letter more than once.

- 1 a rival producer copying an established name
- 2 a figure for the fall in the cost of harvesting
- 3 a method of persuading people who had no use for the product
- 4 the reason a shipowner could be told in advance how much would survive
- 5 two causes of decline operating at the same time

Questions 6–9

Complete the table below.

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

The New England ice trade

Year	Development	Detail
1806	first cargo shipped to Martinique	Tudor loses about \$ 6
c.1815	sawdust replaces hay and straw	loss on a long voyage falls from two thirds of a cargo to under 7
1825	Wyeth's horse-drawn cutter	cost of harvesting a tonne falls to about 8 cents
1833	the Tuscany reaches Calcutta	an ice house is built with a deep pit and 9

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** In 1856 Boston shipped 146,000 tonnes of ice to Calcutta.
- 11** Sawdust reduced the losses on a long voyage by two thirds.
- 12** The ice house at Calcutta was paid for by Tudor's company.
- 13** By 1900 ice made by machine was cheaper in Boston than ice cut from ponds.

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

The psychology of waiting

- A** In the 1990s, executives at a large airport in Houston, Texas faced a problem they could not solve with money. Passengers were complaining about the time they spent waiting at the baggage carousel. The airport hired more handlers, and the average wait at the belt fell to eight minutes, comfortably inside the industry standard of ten. The complaints continued. Someone then noticed that arriving passengers walked for one minute from the gate and stood for seven at the belt. The airport moved the arrival gates further from the main terminal and routed the bags to the outermost carousel, so that passengers now walked for six minutes and stood for two. The total time from gate to bag was unchanged at eight minutes. Complaints fell by more than ninety per cent.
- B** The Houston story is repeated so often in management courses that it has acquired the polish of a fable, but the principle behind it is well established. What people object to in a queue is only loosely related to its length in minutes. In 1985 David Maister, then teaching at Harvard Business School, set out eight propositions about waiting that have organised the field ever since. The first, and the one the airport had stumbled on without reading him, is that unoccupied time feels longer than occupied time. Others followed: waits of uncertain length feel longer than waits of known length; unexplained waits feel longer than explained ones; anxiety makes waits feel longer; and — a proposition with awkward implications for anyone who runs a service — waiting alone feels longer than waiting in a group.
- C** Maister's propositions concern the individual. A second body of work concerns what happens when people wait together. Richard Larson, an engineer at the Massachusetts Institute of Technology who spent much of his career on the mathematics of queues, argued that the strongest determinant of dissatisfaction is not duration at all but the violation of the principle of first-come, first-served. A customer who waits ten minutes and sees nobody served out of turn is calmer than one who waits five and is overtaken. Larson coined the term 'queue rage' for the response, and it explains the spread of the single serpentine line in banks and post offices: such a line is no faster in total, and for any individual it is usually slower than joining the shortest of several parallel lines, but it removes the possibility of choosing badly.
- D** That the serpentine queue has not conquered everything is instructive. Supermarkets, which could adopt it tomorrow, mostly have not. The reason is that a single line for twelve tills is visibly long, and a shopper deciding at the door whether to shop here or elsewhere responds to what the queue looks like rather than to what it will cost in minutes. A design that is fairer once you have joined it may stop you from joining at all. Service organisations therefore trade one kind of complaint against another, and the balance depends on whether their customers have already committed themselves.

- E** Where a wait cannot be shortened or made fairer, it can at least be furnished. Mirrors beside lift doors, an old trick of building managers, work because people will watch themselves indefinitely. Menus placed before the ordering point of a drive-through turn dead time into preparation. The most systematic exploitation of the principle belongs to large theme parks, which post estimated waiting times at the entrance to each attraction and, as a matter of policy, overstate them. A visitor told the wait is forty minutes who reaches the front in thirty-two has been given something; the same visitor told thirty who waits thirty-two has had something taken away. Donald Norman, a cognitive scientist better known for his work on the design of everyday objects, has pointed out that what such a park is managing is not the queue but the memory of the queue, since it is the memory that determines whether the visitor comes back.
- F** Memory is indeed where much of the effect settles. Ziv Carmon, working with Daniel Kahneman, found that a person's retrospective judgement of a wait is dominated by how it felt at the end rather than by how long it lasted; a queue that moves briskly in its final stage is remembered as short even when it was not. The finding has a practical corollary. People abandon queues far less readily once they can see that they are near the front, which is why call centres that announce a caller's position — and, better, announce it again as it improves — lose fewer callers than those that play music into an undifferentiated silence.
- G** None of this makes the wait shorter, and it is worth being clear about what is being bought. Managing perception is cheap; adding capacity is expensive; and the temptation to do the first instead of the second is obvious. But the techniques depend on a kind of credit. A theme park that overstates its waiting times is believed because it errs in the same direction every time; an airline that explains a delay is believed until the explanations are found to be invented. Perception, once managed dishonestly, is the hardest thing in a service to repair.

Questions 14–19

Reading Passage 2 has seven sections, **A–G**.

Choose the correct heading for sections **A–D**, **F** and **G** from the list of headings below.

Write the correct number, I–X.

List of Headings

- i A change that made the walk longer
- ii A change that made the wait shorter
- iii A set of propositions about the individual
- iv A set of propositions about the group
- v When fairness matters more than speed
- vi When appearance matters more than fairness
- vii Occupying the time that is spent waiting
- viii Remembering the time that was spent waiting
- ix What managing perception cannot do
- x What managing perception costs to measure

— Example — Section E vii

- 14 Section A
- 15 Section B
- 16 Section C
- 17 Section D
- 18 Section F
- 19 Section G

Questions 20–23

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

Match each statement with the correct researcher, A–D.

NB You may use any letter more than once.

List of Researchers

- A David Maister
- B Richard Larson
- C Ziv Carmon
- D Donald Norman

- 20 He named the anger felt by someone who is overtaken in a queue.

- 21** He argued that what a business manages is a customer's recollection.
- 22** He found that the closing stage of a wait carries disproportionate weight.
- 23** He proposed that waiting by yourself feels longer than waiting with others.

Questions 24–26

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

- 24** After the arrival gates at Houston were moved,
- A** the average wait at the carousel fell to two minutes.
 - B** the total time from gate to bag fell to two minutes.
 - C** the average wait at the carousel fell to six minutes.
 - D** the total time from gate to bag fell by six minutes.
- 25** What does the passage say about the first of Maister's propositions?
- A** It was tested at Houston airport before he published it.
 - B** It describes the effect that the change at Houston exploited.
 - C** It concerns waits whose length is not known.
 - D** It concerns the effect of anxiety on a waiting person.
- 26** According to the passage, why do supermarkets avoid the single serpentine queue?
- A** It serves customers more slowly overall.
 - B** Their customers mind being overtaken less than other customers do.
 - C** It deters people who have not yet decided to shop there.
 - D** It requires more staff than several parallel lines.

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

The myth of the lone inventor

The story of invention, as it is usually told, has a single character in it. Newton sits under a tree. Bell shouts for Watson in the next room. Edison tries six thousand filaments and finds the one that burns. The shape of the story never varies: a problem that had defeated everybody, one person who saw what nobody else could see, and a moment at which the world changed. It is a satisfying shape, and for most of us it is very nearly the only shape in which we have ever met the history of technology.

The trouble is a body of evidence that has been sitting in plain view for a century. In 1922 two sociologists at Columbia University, William Ogburn and Dorothy Thomas, published a paper with the deflating title 'Are Inventions Inevitable?'. Attached to it was a list of a hundred and forty-eight inventions and discoveries that had been arrived at independently by two or more people who did not know of one another's work. Calculus was on the list, worked out by Newton and by Leibniz. So was oxygen, isolated by Scheele and by Priestley. So was natural selection, which Darwin had been sitting on for twenty years when Wallace sent him a manuscript containing it. The most exact case was the telephone: the applications of Alexander Graham Bell and Elisha Gray reached the United States patent office on the same February day in 1876, a few hours apart.

Historians call these events multiples, and the standard response to them is a shrug. Coincidences happen. But there is a serious argument behind the shrug, and it deserves to be met rather than waved away. It runs like this: that two people arrived at an idea at the same moment shows only that the moment had come. Somebody still had to do the work. The problem may have been ripe, but ripeness does not pick fruit.

The argument is serious, and it is also, on inspection, an answer to a question nobody asked. Consider what it means for a problem to be ripe. The biologist Stuart Kauffman gave the condition a name — the adjacent possible — for the set of things that can be reached in a single step from the things that already exist. A telephone requires a reliable current, an understanding of how a membrane can be made to move in step with a sound, a wire industry, and a public already used to the idea of sending messages down a line. Every one of these was in place in 1876 and none of them was in place in 1776, and no amount of individual brilliance would have closed that gap. What the adjacent possible fixes is the timing. What the individual determines is the name that gets attached. Those are not the same thing, and the defence of the lone inventor quietly substitutes the second for the first.

None of which means that people are interchangeable. They are plainly not. Of the many naturalists who had read Malthus and travelled in the tropics, two saw what was in front of them, and it is not an accident that they were the two who had thought hardest about it. The claim is narrower and more uncomfortable than the one usually attacked: individuals matter, but they are substitutable in a way that our institutions flatly deny. Wallace is the demonstration. He did the work, and almost nobody can name him.

The denial is not merely a habit of storytelling. It is written into the machinery. Patent law is built on the premise that there is a first inventor and that the office's task is to find them, which is a reasonable premise for a lock and a strange one for an idea that four laboratories are within months of reaching. The Nobel Foundation's statutes limit a prize to three recipients, a rule written when a physics paper carried one or two names. In 2016 the collaboration that detected gravitational waves published its result under the names of more than a thousand people; the prize that followed went to three of them. Nobody supposes that the rest were passengers. The instrument simply has no setting for what actually happened.

The costs of the mismatch are not confined to hurt feelings. Funding follows the story: a system that believes in stars will concentrate its money on a small number of them and starve the broad, unglamorous work — the better detector, the cleaner data set, the replication — on which the next adjacent possible actually depends. Careers follow the story too, which is why a young researcher is advised to find a problem nobody is working on rather than to improve something that already half works, although the second is where most progress comes from. And the version of history taught in schools, in which technology advances by a series of individual illuminations, leaves a citizen badly equipped to judge an argument about research funding, because it presents as a lottery something that is in fact an investment in conditions.

What follows is not that the individual should be written out of the account. It is that the credit we award should look more like the process we can observe: prizes without arbitrary limits on the number of recipients, hiring that is able to recognise a contribution to somebody else's result, and a history that names the network as well as the node. The lone inventor is a good story. It is a poor description, and we have built too much on it.

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** Ogburn and Thomas listed 148 discoveries that had each been made by two people.
- 28** The writer believes the telephone patent should have gone to Gray rather than to Bell.
- 29** The writer accepts that the case against the lone inventor has a serious objection to answer.
- 30** The writer thinks the telephone could have been invented much earlier by a sufficiently gifted person.
- 31** The writer wants the patent system to be abolished.
- 32** The writer regards the Nobel Foundation's limit of three recipients as no longer defensible.

Questions 33–36

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

List of Words

- A components
- B timing
- C work
- D name
- E cost
- F evidence
- G brilliance
- H order
- I method
- J credit

The writer's reply to the standard objection

The usual reply to cases of multiple discovery is that ripeness by itself achieves nothing, because somebody must still do the **33** The writer's answer is that a problem is ripe only when the necessary **34** are already present, and that this, not the individual, settles the **35** of an invention. What the individual settles is only the **36** under which it is afterwards remembered.

Questions 37–40

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

37 The Nobel Foundation's three-recipient rule

- A was introduced in 2016.
- B dates from a period when papers carried few names.
- C applies only to the physics prize.
- D was proposed by the gravitational-wave collaboration.

- 38** In the writer's view, the main weakness of the 'somebody still had to do the work' defence is that
- A** it rests on evidence that has since been discredited.
 - B** it accounts for whose name is attached rather than for when the invention happens.
 - C** it applies only to the inventions of the nineteenth century.
 - D** it assumes that discoveries are always made public.
- 39** What point does the writer make by noting that almost nobody can name Wallace?
- A** Wallace's contribution was smaller than Darwin's.
 - B** Recognition settles on one name whatever the work was actually like.
 - C** Darwin reached his conclusions before Wallace did.
 - D** Wallace's argument was not understood at the time.
- 40** Which of the following best describes the writer's overall position?
- A** Individuals contribute nothing that could not be supplied by somebody else.
 - B** The idea of individual genius should be kept because it motivates people.
 - C** Our institutions award credit in a way the evidence does not support.
 - D** Multiple discovery is too rare for any conclusion to be drawn from it.