

Academic Reading Paper 35

Canals, Tolerance and Intervals

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.

Built by people who had never built one

When work began on the Erie Canal in 1817 there was no such profession as a civil engineer in the United States, and none of the men put in charge of it had built a canal. Benjamin Wright was a county judge who had done some surveying. James Geddes was a salt manufacturer who had also done some surveying, and had learned it from a borrowed book. Canvass White was twenty-seven and had no relevant experience at all. Between them they were to cut a waterway three hundred and sixty-three miles long across the state of New York, through forest, swamp and a limestone escarpment, with a total rise and fall of five hundred and sixty-eight feet handled by eighty-three locks.

The scheme was widely regarded as absurd, and the objection was reasonable. The longest canal then existing in the country was about twenty-seven miles, and this one would be more than thirteen times that. The federal government declined to fund the work, so the state borrowed the money on its own credit, some seven million dollars, which was an enormous sum for a state of that size to stake on the judgement of a judge and a salt manufacturer. There was no precedent to appeal to and no expert who could be brought in to check the plan, because the expertise did not exist in the country.

What they did have was a specific and unglamorous set of problems, and they solved them one at a time by inventing things. The first was trees. A canal cut through standing forest requires the trees to be removed and, far worse, the stumps, which do not pull out. Somebody in the contracting parties designed a machine consisting of a large wheel on an axle with a cable and a lever, which allowed seven men and a team of horses to draw out something like forty stumps in a day, and it was afterwards used across the whole route. A machine of that kind is not a scientific advance, and without it the schedule was impossible.

The second was cement. Locks stand in water, and mortar made in the ordinary way dissolves in it, so what is needed is a cement that sets under water. In Europe this was known and made, and in America it was not available in any quantity. Canvass White was sent to England, where he walked some two thousand miles along the canal system taking notes on locks, aqueducts and construction methods, and came home with the principle rather than the material, since the English cement could not be shipped in the quantities the locks would need.

The material he then found at home. A quarry in Madison County, close to the line of the canal, yielded a limestone containing enough clay that when burned and ground it produced a cement which hardened under water. White patented the process. The commissioners used it in every lock on the canal and afterwards contested his royalties, and he spent years trying to be paid for the material without which the works could not have been built at all. He died before the matter was resolved.

Progress was deliberately arranged to produce early results. The middle section, across level ground between Utica and Rome, was cut first, because it was easy and could be opened to traffic and tolls while the difficult parts were still being argued about. Money began coming in before the canal existed as a whole, which kept the legislature attached to the project through the years when it looked least likely to succeed. Nothing about that sequencing was accidental.

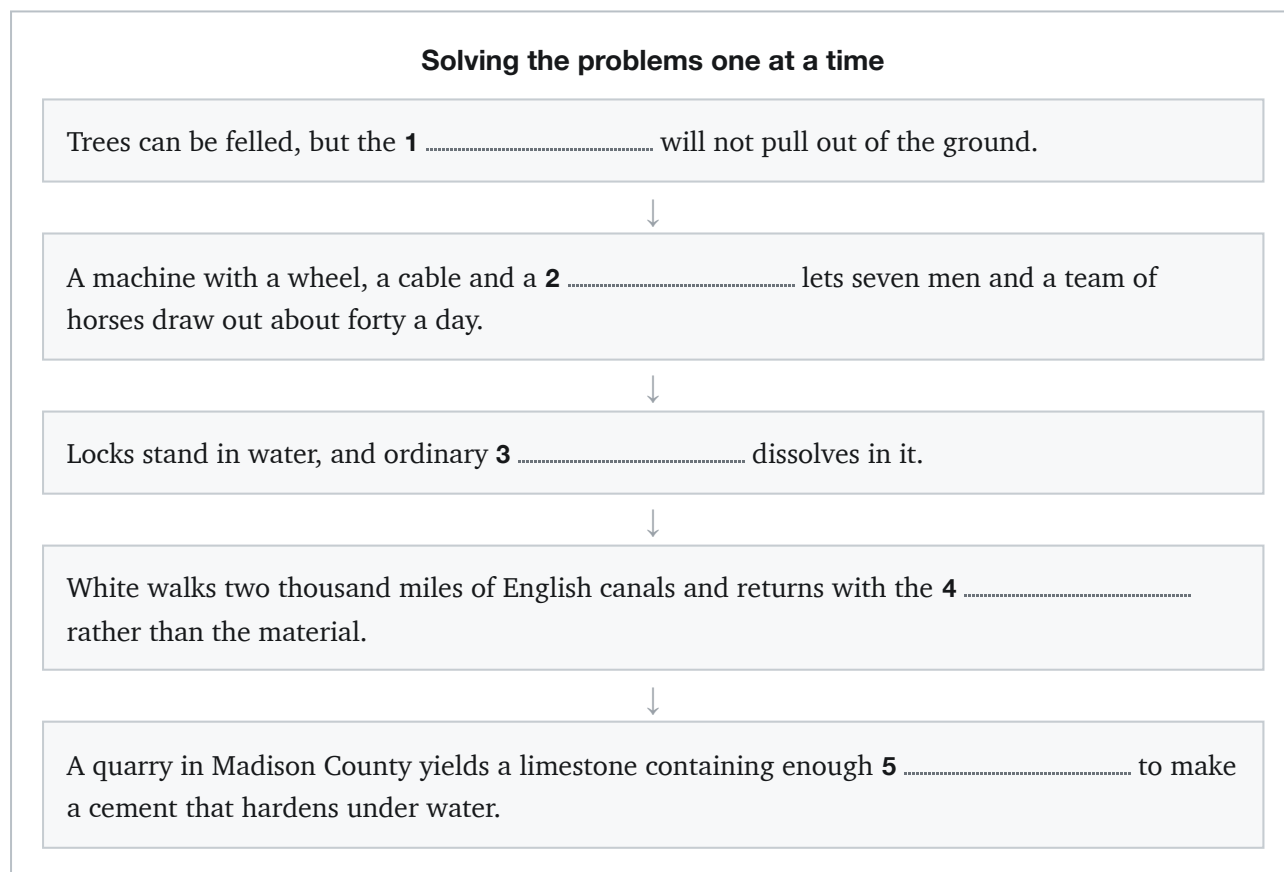
The canal opened in October 1825. Before it, moving a ton of freight from Buffalo to New York City cost something like a hundred dollars and took about three weeks. Afterwards it cost around ten dollars and took eight or nine days. That is not an improvement in transport; it is a change in what can be grown, mined or manufactured in the interior of a continent and still be worth carrying to a port.

The consequences arrived quickly and were mostly not the ones predicted. New York overtook Philadelphia and Boston to become the dominant American port, and remained so. Wheat from the Great Lakes reached the Atlantic cheaply enough to undercut farms in New England, many of which were abandoned and are now woodland. The tolls repaid the construction debt within about a decade. And the men who had learned engineering on the job were hired away to build canals and then railways elsewhere, so that the canal's most durable output was arguably a profession rather than a waterway, and the men who built it trained the men who would put it out of business.

Questions 1–5

Complete the flow-chart below.

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



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 doubts about the project were reasonable ones.
- 7 White was rewarded by the commissioners for the cement he developed.
- 8 The stump-pulling machine was patented by the man who designed it.
- 9 The canal made farming in New England more profitable.

Questions 10–13

Complete the sentences below.

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

- 10 The canal is three hundred and sixty-three miles long and its total rise and fall is handled by locks.
- 11 The state borrowed about million dollars on its own credit.
- 12 Before the canal, moving a ton of freight from Buffalo to New York took about three •
- 13 The tolls repaid the construction debt within about a •

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

Telling yourself from everything else

- A** An immune system that attacks anything foreign has a problem it cannot solve by being better at attacking. It has to distinguish the body it defends from everything else, and it has to do this without having been given a list, since the body it is defending is different in every individual and the threats it will meet have not been invented yet, some of them because the organisms that will produce them do not exist yet either. How that distinction is made was the central question of the subject for most of the twentieth century. The answer turned out to require dismantling the question, which is a common shape for an answer and an uncomfortable one for a field that has organised itself around asking it.
- B** Frank Macfarlane Burnet proposed in the late 1940s that tolerance of one's own tissues is not built in but learned, during development, before birth. The prediction is testable and slightly outrageous: if an embryo is exposed to foreign cells early enough, it should treat them as its own thereafter. Peter Medawar tested it by injecting mouse embryos with cells from a different strain, and found that those mice, grown up, would accept skin grafts from that strain and reject grafts from any other. The system had been taught what counted as itself, and had been taught something false. Tolerance was therefore not a property of the tissue but a state the animal had been put into.
- C** Burnet then supplied the mechanism, and it explained two things at once. Each lymphocyte, he proposed, carries receptors of one kind only, and the enormous variety of the population is generated before any encounter with a pathogen. When something arrives that fits a particular cell, that cell divides and its descendants do the work. Cells whose receptors fit the body's own tissues are removed during development, which is why tolerance can be learned and why exposing an embryo to a foreign cell teaches it the wrong lesson. One proposal accounted for the variety of the response and for the tolerance at the same time, which is the usual mark of a good one.
- D** That account left an arithmetical difficulty that took another twenty years to resolve. A human being can make antibodies against essentially any molecule, including ones synthesised in a laboratory that have never existed before, which implies a variety running to billions. The genome does not contain billions of genes; it contains something in the region of twenty thousand. Susumu Tonegawa showed in 1976 how the trick is done. The genes for antibodies are not inherited whole. They exist as sets of segments, and in each developing cell the DNA is physically cut and rejoined to select one segment from each set, so that variety is generated by shuffling rather than by storage. It is the only known case in which the DNA of a body cell is deliberately rearranged as a matter of normal development.
- E** By the 1980s the theory looked complete and it had a hole in it that everybody worked around. An antigen injected on its own provokes very little response; to get an immune reaction reliably, experimenters had for decades added an adjuvant, a mixture whose active ingredients were bacterial

fragments and whose necessity nobody could explain. Charles Janeway named this in 1989 as the immunologist's dirty little secret, and proposed the explanation: the adaptive system does not act on foreignness alone. It waits for a signal from an older system, which recognises molecular patterns common to whole classes of microbe, and which is in effect telling it that something dangerous is present rather than merely something new. The adjuvant had been supplying that signal all along, which is why nobody could get a response without one.

F That proposal was correct, and the receptors involved were identified over the following decade. It also changed the shape of the question. If a response requires both a foreign molecule and a danger signal, then foreignness alone is not what the system is detecting, and the neat opposition between self and non-self is doing less work than it appeared to.

G The awkward cases had been visible all along. The bacteria in a human gut outnumber human cells and are unmistakably foreign, and a healthy immune system tolerates them. A foetus carries paternal genes and is not rejected. Transplanted organs are attacked while a chronic parasite may be ignored for years. Polly Matzinger argued from these that the system responds to damage rather than to difference, which remains contested. The honest position is that the original distinction was a good approximation, that it has been replaced by a set of overlapping mechanisms, and that nobody has yet reduced those to a single sentence worth teaching.

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 question that had to be taken apart
- ii A question that was answered as posed
- iii Tolerance turns out to be taught
- iv Tolerance turns out to be inherited
- v One proposal that explains two things
- vi Two proposals that explain one thing
- vii Where the variety actually comes from
- viii A missing signal, supplied all along by an additive
- ix The shape of the question changes
- x The cases the distinction never fitted

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 contributions and the list of people below.
Match each contribution with the correct person, A–D.

List of People	
A	Frank Macfarlane Burnet
B	Peter Medawar
C	Susumu Tonegawa
D	Charles Janeway

- 21** He tested a prediction on embryos and produced animals that accepted foreign grafts.
- 22** He explained where the enormous variety of receptors comes from.
- 23** He named a gap in the theory that everybody had been working around.
- 24** He proposed that each lymphocyte carries receptors of one kind only.

Questions 25–26

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

- 25** According to the passage, what does the adaptive system wait for?
 - A** A foreign molecule alone.
 - B** A signal from an older system that something dangerous is present.
 - C** Confirmation from a second lymphocyte.
 - D** The removal of self-reactive cells.
- 26** What is the passage's assessment of the self and non-self distinction?
 - A** It has been shown to be entirely wrong.
 - B** It was a good approximation now replaced by overlapping mechanisms.
 - C** It is confirmed by the case of the foetus.
 - D** It applies only to transplanted organs.

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

What boredom was for

Two claims about boredom circulate widely and they cannot both be right. The first is that it is waste, a gap to be filled, and that the technology which has abolished waiting is straightforwardly good. The second is that boredom is the seedbed of creativity, that children should be allowed to have it, and that we have lost something important by removing it. The first is held by almost everyone in practice and the second by almost everyone in conversation, which is usually a sign that neither has been examined very hard.

The evidence for the romantic version is thinner than its confidence suggests. There is a well-known experiment in which participants given a tedious task beforehand produced more uses for an everyday object afterwards than a control group, and the effect was real and small. There is a body of work showing that the brain in an undemanding state is not idle but active in a particular network associated with recollection and imagined scenarios. That is interesting and it is a long way from establishing that being bored makes people creative, and anybody who has been bored in a waiting room can supply the counter-example themselves.

The dismissive version is worse, because it mistakes what was removed. The telephone did not abolish boredom; boredom is a feeling and it is available at any moment. What the device abolished is the gap: the ten minutes in a queue, the walk without a podcast, the period between putting the light out and going to sleep. Those intervals were not valuable because they were unpleasant. They were valuable because they were unstructured and had no input arriving, and boredom was simply the most common thing that happened to be occupying them.

Once the distinction is drawn the disagreement mostly dissolves. What appears to matter is undirected attention, a state in which nothing external is setting the agenda and the mind is left to go where it goes. Boredom is one route into that state and a poor one, since it is aversive and most people escape it as soon as they can. Walking is a better route. So is repetitive physical work, and a long journey through unremarkable country, and the specific quality of a shower. None of these involve being bored, and all of them produce the effect that boredom is credited with, at less cost to the person doing them.

This explains why the advice usually given is so ineffective. Telling somebody to be bored is telling them to endure an unpleasant state on the promise of a benefit that arrives unreliably and cannot be pointed at, which is not a plan anybody follows. Telling a parent to let a child be bored has the same defect, and is very often said by an adult who has a phone in their pocket and no intention of putting it down. The instruction is aimed at the feeling rather than at the conditions, and the conditions are the part that can actually be arranged.

There is a real cost to their absence, and it is worth being precise about what it is rather than gesturing at attention spans. Certain kinds of thinking require a period in which nothing is arriving: noticing that a problem you have been carrying has changed shape, remembering something you did not know you were looking for, or arriving at a decision that you have in fact already made and have not yet admitted. These are not activities. They cannot be scheduled, they produce nothing that looks like output, and they occur in the intervals rather than in the sessions set aside for thinking.

The concession is that most of what is said in defence of boredom is nostalgia dressed as psychology, and that the intervals in question were never as productive as they are now remembered. A great many of them were spent in mild irritation and produced nothing at all. The claim is not that the queue was a spiritual resource. It is narrower: that a life with no unstructured intervals in it has removed the conditions for a kind of thinking, and that nobody made a decision to do this.

So the useful version of the advice is about arrangement rather than endurance. Protect intervals in which no input is arriving, by whatever means suits the person, and do not require them to be uncomfortable. The walk counts. The washing-up counts. What does not count is the interval that is noticed, reclaimed and then immediately filled with something else, which is what happens by default, because a filled interval feels like a recovered one and there is nothing in the experience itself to indicate what has been given up.

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 being bored is what produces the benefit.
- 28** The writer accepts that much of the defence of boredom is nostalgia.
- 29** Children are more affected by the loss of these intervals than adults are.
- 30** The writer believes the telephone removed the feeling of boredom.
- 31** The writer holds that some kinds of thinking happen in intervals rather than in sessions.

Questions 32–36

Complete the summary below.

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

What the argument is really about

The experiment usually cited found a real effect on the number of uses participants could invent, and the writer describes that effect as **32** What the device removed was not the feeling but the **33**, and those intervals mattered because they were unstructured

and no **34** was arriving. What actually matters, on this account, is **35**, which boredom is only one route into. The advice usually given fails because it is aimed at the feeling rather than at the **36**

Questions 37–40

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

- 37** Why does the writer mention the waiting room?
- A To show that boredom is unpleasant in public places.
 - B As a counter-example anybody can supply to the claim that boredom makes people creative.
 - C To illustrate the default mode network.
 - D To argue that queues should be shortened.
- 38** Which position does the writer reject?
- A That walking can produce the effect boredom is credited with.
 - B That telling somebody to be bored is ineffective advice.
 - C That the intervals were valuable because they were unpleasant.
 - D That certain kinds of thinking cannot be scheduled.
- 39** What does the writer say about the instruction to let a child be bored?
- A It is the most effective advice available.
 - B It is often given by an adult with a phone they do not intend to put down.
 - C It has been tested and found to work.
 - D It applies only to older children.
- 40** Which of the following best expresses the writer's recommendation?
- A Protect intervals with no input arriving, and do not require them to be uncomfortable.
 - B Endure boredom regularly for its benefits.
 - C Remove all technology from daily life.
 - D Schedule fixed sessions for thinking.