

Academic Reading Paper 33

Clocks, Continents and Advice

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 hour that had to be invented

For most of recorded history an hour was not a fixed quantity. The day from sunrise to sunset was divided into twelve parts and the night into twelve more, which means that a summer hour was long and a winter hour was short, and in northern Europe the difference between them could exceed a quarter of an hour. This was not a defect. It was the sensible arrangement for a society whose work was daylight work, and it was what a sundial naturally produces, since a sundial cannot do anything else. An hour meant a twelfth of the working day, which is a perfectly good definition as long as nobody needs to compare one day with another.

The pressure to change it came from an unexpected direction, which was religious observance. Monastic communities were required to rise for offices during the night, and a sundial is useless in the dark. Water clocks with striking mechanisms were built to solve this, and they worked well enough in a warm climate and badly in a cold one, where water freezes and where the rate at which it flows through an opening changes with the temperature of the room. What was wanted was a device that would count something that did not depend on the weather, on the season, or on the sky being visible.

The answer appeared in Europe somewhere between about 1275 and 1300, and nobody knows who produced it. The escapement is a mechanism that lets a falling weight turn a toothed wheel in steps rather than continuously: a bar rocks back and forth, catching and releasing one tooth at a time, and the rocking is regulated by a horizontal beam carrying adjustable weights. The whole thing is crude. A clock of this kind could gain or lose anything from fifteen minutes to half an hour in a day, which was worse than a good sundial on a clear afternoon, and everybody involved knew it.

It nevertheless changed what an hour was, because a machine that counts its own oscillations has no way of knowing what season it is. It divides the day into twenty-four identical portions and cannot be persuaded to do otherwise. Within a few decades of the first public clocks, European towns had moved onto equal hours, and the older arrangement became unusable because there was now a bell in the square disagreeing with it. The unit people still live by is the unit a mechanism was capable of producing.

Those first clocks did not tell the time in the sense of showing it. Most had no dial and no hands at all; they were machines for striking a bell at intervals, and the word we use for them comes from the medieval word for a bell rather than from anything to do with measurement. The surviving examples at Salisbury and Wells, built in the last years of the fourteenth century, are iron frames the size of a wardrobe, driven by stone weights, whose entire output was noise, delivered at intervals, to a town that had no other way of agreeing when anything was.

Accuracy arrived nearly three centuries later and from mathematics rather than from craft. Christiaan Huygens applied the pendulum to clockwork in 1656, using the property Galileo had noticed, that a swinging weight takes very nearly the same time for each swing regardless of how far it travels. The error of a good clock fell from about fifteen minutes a day to about fifteen seconds, an improvement of a factor of sixty in one step.

A second advance followed within twenty years, when the anchor escapement allowed a long pendulum to be driven with a very small swing, since a wide swing is where the remaining inaccuracy lives. Errors came down to a few seconds a week. This is the point at which clocks acquired minute hands, and the order of events is worth noticing: the hand followed the accuracy. Before there was a mechanism that could hold a minute, marking minutes on a dial would have been a decoration rather than a measurement.

What the whole sequence illustrates is a pattern that recurs whenever a quantity becomes measurable. The instrument did not begin by measuring an existing thing more precisely. It replaced the thing. There was no equal hour before there was a machine that could only produce equal hours, and there was no practical minute before there was a mechanism that could keep one, and both are now treated as features of the world rather than as artefacts of the devices that made them countable. Nobody experiences an hour as a mechanical convenience, which is the surest sign that the replacement was complete.

Questions 1–5

Complete the notes below.

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

From the unequal hour to the equal one

Before the machine

- Daylight was divided into twelve parts, so an hour meant a twelfth of the working
1
- The arrangement suited a society whose work was 2 work.

What forced a change

- Monastic communities had to rise for night offices, and a sundial is useless in the dark.
- Water clocks failed in cold climates because water freezes and its flow rate changes with the
3 of the room.

The escapement, c. 1275–1300

- A bar rocks back and forth, releasing one 4 of the wheel at a time.
- Such a clock could gain or lose between fifteen minutes and half an 5 in a day.

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 earliest mechanical clocks were less accurate than a sundial in good conditions.
- 7 The unequal hour was an inadequate system for the societies that used it.
- 8 The person who invented the escapement was working for a monastery.
- 9 Minute hands appeared before clocks were accurate enough to keep a minute.

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 word for these machines comes from the medieval word for a
- 11 Huygens applied the pendulum to clockwork in
- 12 The pendulum reduced the error of a good clock to about fifteen a day.
- 13 The anchor escapement improved accuracy because a swing is where the remaining inaccuracy lives.

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

The idea that was right for the wrong reasons

- A** Alfred Wegener set out the case for moving continents in 1912 and expanded it into a book three years later. The evidence he assembled was substantial and is still taught. The coasts of South America and Africa fit together, and the fit is better below the waterline, at the edge of the continental shelf, than at the shore where the sea happens to stand today. Rock formations of the same age and type run to the edge of one continent and continue on the other. Fossils of animals that could not have swum an ocean are found on both sides, and the fossil evidence of ancient climates puts glaciers in places that are now tropical and coal swamps in places that are now cold. Taken one at a time each of these can be explained away; taken together they are a considerable weight.
- B** He was rejected, and the rejection was not stupidity. Wegener proposed that the continents ploughed through the crust of the ocean floor, driven by forces arising from the Earth's rotation and the pull of the sun and moon. Physicists calculated the strength of those forces and the strength of the rocks involved and reported that the mechanism was impossible by several orders of magnitude, which was correct. A body of circumstantial evidence attached to an impossible mechanism is a genuinely difficult thing to accept, and the objection was the right objection to make at the time. It was also, as it turned out, an objection to the wrong part of the argument.
- C** A workable engine was in fact proposed within fifteen years and made almost no difference. Arthur Holmes suggested in 1929 that heat from radioactive decay in the Earth's interior could drive slow convection currents in the mantle, and that continents might be carried on top of such currents rather than pushing through anything. The proposal was published in a respectable place, it was never refuted by anybody, and it was largely ignored, because it explained a phenomenon most geologists had already decided did not occur. A mechanism for something that does not happen is of no interest to anybody, whatever its merits.
- D** The evidence that reopened the question came from the sea floor, which nobody had mapped because there had been no way to. Marie Tharp spent the 1950s converting columns of echo-sounding measurements into contours, line by line, working at a desk in New York because women were not permitted on the research ships that supplied her with the numbers. What emerged was a mountain range running down the centre of the Atlantic, and down the middle of that range, a continuous valley. Her colleague Bruce Heezen dismissed the valley as an artefact of her drafting; when the same feature turned up, in the same place, in the pattern of earthquake locations he had been plotting separately, he stopped dismissing it. Two independent sets of measurements had produced one line.
- E** Harry Hess assembled these pieces in 1962 into a proposal he described, cautiously, as an essay in geopoetry. New ocean floor, he suggested, is created at the ridges where the mantle rises, spreads outwards on both sides like a pair of conveyor belts, and is eventually consumed where it dives

back down beneath a continent. The floor of an ocean is therefore young everywhere, and youngest at the middle. The continents do not plough through anything. They ride on plates that are themselves being manufactured at one edge and destroyed at another, which removes Wegener's difficulty entirely, since nothing has to force its way through anything.

F The test came the following year and it was as clean as this subject allows. The Earth's magnetic field reverses at irregular intervals, and molten rock cooling at a ridge locks in whichever direction is current at the time. If Hess was right, the ocean floor should carry a series of magnetic stripes running parallel to the ridge, matching the known sequence of reversals, and the pattern on one side should mirror the pattern on the other. Fred Vine and Drummond Matthews looked at the magnetic surveys, and it did. The stripes were there, they were symmetrical, and their widths matched the durations of the reversals.

G The episode is often used to show that a lone thinker was vindicated against a hidebound establishment, and it does not support that reading. Wegener was right about the movement and wrong about everything else, and the people who rejected him were applying a standard that had served them well. What settled it was not persistence but a new kind of measurement, taken with an instrument nobody had when the argument began, and addressed to a prediction precise enough to have failed.

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 Evidence that is weak singly and heavy together
- ii Evidence that is strong singly and weak together
- iii A rejection that was reasonable at the time
- iv A rejection that was never defensible
- v An engine proposed and set aside
- vi An engine proposed and adopted
- vii A map drawn from other people's soundings
- viii A proposal that removes the original difficulty
- ix A prediction precise enough to fail
- x What the episode does not show

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	Alfred Wegener
B	Arthur Holmes
C	Marie Tharp
D	Harry Hess

- 21** He suggested that heat from radioactive decay could drive currents in the mantle.
- 22** She turned columns of measurements into a picture in which a feature appeared.
- 23** He described his own proposal cautiously as an essay in geopoetry.
- 24** He assembled evidence from fossils, rock formations and ancient climates.

Questions 25–26

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

- 25** Why did Heezen stop dismissing the valley Tharp had drawn?
 - A** Other laboratories reproduced her contours.
 - B** The same feature appeared in his own plot of earthquake locations.
 - C** He was permitted to visit the site himself.
 - D** Hess's proposal predicted it.
- 26** According to the passage, what was Wegener right and wrong about?
 - A** Right about the mechanism, wrong about the movement.
 - B** Right about the movement, wrong about almost everything else.
 - C** Right about both, but too early to be believed.
 - D** Wrong about both, and vindicated by accident.

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

Why advice does not transfer

The most quoted advice in any field comes from the people it worked for, and that is the whole difficulty. Somebody who took an unusual course and prospered is asked how they did it, answers honestly, and the answer is recorded. The people who took the same course and did not prosper are not asked, because nobody knows who they are. What is collected is therefore not a sample of what happens when you follow the advice. It is a sample of the cases in which following it was followed by success, which is a different thing and is not a small difference.

The clearest illustration comes from the returning aircraft of the Second World War. Analysts examining bombers that came back mapped the bullet holes and proposed reinforcing the areas most often hit. A statistician pointed out that the holes showed where an aircraft could be hit and still return, and that the armour belonged in the places with no holes, because the aircraft hit there were not in the sample. The reasoning is not difficult once stated and is almost impossible to see beforehand, since the missing cases leave no trace anywhere in the data. There is no column for the aircraft that did not land.

That observation is usually where the argument stops, and stopping there produces the opposite error. If all advice is the residue of survivors, then nothing can be learned from anybody, success is entirely luck, and the sensible response is to ignore experience altogether. This is not true and it does not survive contact with anyone who has actually learned a craft. Some things transfer very reliably. The difficulty is that we do not usually distinguish between the kinds of advice that do and the kinds that do not.

The distinction I would draw is between advice about decisions and advice about process. Advice about a decision — take this job, enter this market, drop out and build the thing — is advice about a particular state of the world, and states of the world move. The market that was empty when the advice-giver entered it is now full, partly because they entered it and partly because everyone who read their advice did too. The conditions that made the risk sensible are precisely the conditions their success removed, and the advice arrives at the reader with its own foundation already dismantled.

Advice about process is different in kind, because it concerns what to do when you do not know what to do. How to test something cheaply before committing to it. How to tell whether you are stuck or merely uncomfortable. How to find out what has already been tried. When to write something down. These are answers to problems that recur in every state of the world, which is why a craftsman's advice about method survives a century and their advice about which trade to enter does not survive a decade.

There is a second reason process advice travels better, and it concerns what the giver can actually know. A person who succeeded knows in detail what they did. They do not know which parts of it mattered, because they ran the experiment once, without a control, and the memory has since been organised into

a story that makes the outcome look like a consequence. They can report their method accurately and their causation badly, and the request we usually make of them, which is to explain why it worked, is the one question they are least equipped to answer.

The concession is that some decision advice is worth having, and it is identifiable. It is worth having where the giver has seen many cases rather than one: an editor who has read three thousand manuscripts, an examiner who has marked ten thousand scripts, a surgeon who has done a thousand of an operation. These people are reporting a distribution rather than an anecdote. They have seen the failures as well, which is the part the successful individual structurally cannot, and their advice about what usually happens is evidence of a different order from one person's account of what happened to them.

So the useful question to ask of any advice is not whether the person succeeded. It is how many cases they have seen, and whether what they are telling you is a method or a choice. A method from somebody who has done a thing once may still be worth taking, because a method is a claim about handling uncertainty and not about the world staying still. A choice from somebody who has seen it once is a story, and stories are worth reading for other reasons entirely, none of which is guidance.

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 nothing useful can be learned from other people's experience.
- 28** The writer accepts that a successful person can describe their own method accurately.
- 29** Written advice is more reliable than advice given in conversation.
- 30** The writer believes the value of advice depends on whether the person giving it succeeded.
- 31** The writer holds that an editor who has read thousands of manuscripts is reporting something different from an anecdote.

Questions 32–36

Complete the summary below.

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

Two kinds of advice

What gets collected is not a sample of what happens when the advice is followed but of the cases in which following it was followed by **32** Advice about a decision concerns a particular state of the world, and the conditions that made the risk sensible are the ones the adviser's own success **33** Advice about process concerns what to do when you

do not know what to do, which is why a craftsman's advice about **34** outlasts their advice about which trade to enter. A successful person also ran the experiment once without a **35**, so their account of causation is unreliable even where their account of what they did is exact. The advice worth having comes from somebody who has seen many **36** rather than one.

Questions 37–40

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

- 37** What was the statistician's point about the returning bombers?
- A The holes showed where an aircraft could be hit and still return.
 - B The armour was already in the right places.
 - C The analysts had counted the holes incorrectly.
 - D Most aircraft were hit in the same place.
- 38** Which position does the writer reject?
- A That a method may be worth taking from somebody who has done a thing once.
 - B That success is entirely luck and experience should be ignored.
 - C That advice-givers know what they did but not which parts mattered.
 - D That markets can be filled by the people who advise entering them.
- 39** Why does the passage say the bomber reasoning is hard to see beforehand?
- A It requires advanced statistics.
 - B The missing cases leave no trace in the data.
 - C The analysts were under time pressure.
 - D The holes were difficult to map accurately.
- 40** Which of the following best expresses the writer's test?
- A Ask how many cases the adviser has seen, and whether they are offering a method or a choice.
 - B Ask whether the adviser is still successful today.
 - C Ignore all advice from individuals.
 - D Prefer advice from people in the same field.