

Academic Reading Paper 48

Firemarks, Neutrinos and Second Opinions

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.

Who pays for the fire

The fire that began in a bakery in Pudding Lane in September 1666 burned for four days and destroyed something in the region of thirteen thousand houses and eighty-seven parish churches, which was most of the City of London inside the walls. The recorded death toll is very low and the record is very poor, so nobody knows. What is certain is that at the moment the fire started there was no such thing as fire insurance anywhere in the world, and that within twenty years there was an industry.

The first office opened in 1680. It was set up by Nicholas Barbon, a physician who had given up medicine for speculative building and who had made money rebuilding the burnt city. The product was simple enough to explain in a sentence: pay a sum each year, and if the house burns down the office pays to put it up again. Competitors appeared within a few years, and by the early eighteenth century a London householder could choose between several. The business rested on a calculation nobody had made before, which was how often a house of a given construction, in a given street, could be expected to catch fire.

The offices then discovered something that follows directly from the arrangement. Paying for a house to be rebuilt is far more expensive than stopping it from burning, so each office began to employ men with hand-pumped engines to put out fires in the buildings it had insured. This is the origin of the firemark, a metal plate fixed high on the front wall of a building showing which office held the policy, sometimes with the policy number stamped into it. Hundreds of these plates survive on London walls, well above head height, where they were placed so that they could be seen from a distance and not easily removed.

The story everybody knows about those marks is that a brigade would arrive at a burning house, look up, and go away again if the mark belonged to a rival or was missing. It is largely a Victorian invention, and the reason it is wrong is worth stating because it is a point about incentives rather than about charity. Fire spreads. An office with a dozen insured houses in a street had every reason to fight a blaze in an uninsured one standing between them. The marks served mainly to identify a building and to advertise the company. What was genuinely absent was not willingness but obligation: no brigade owed a duty to any building, and there was nobody a householder could complain to.

In 1833 ten of the London offices merged their separate brigades into a single organisation and put James Braidwood in charge of it. Braidwood had built the brigade in Edinburgh and he changed the practice as much as the structure. He trained his men in a systematic way, selected them young and fit, and taught a doctrine that had not been standard: that firefighters should go inside a burning building and attack the fire where it was, rather than direct water at it from the street.

He was killed at a warehouse fire in Tooley Street in 1861, crushed by a falling wall. That fire burned for two weeks and consumed goods on a scale the insurance offices could not absorb, and it forced the question that had been left open since 1680. A service paid for by policyholders was in practice protecting an

entire city, including every building whose owner had paid nothing towards it, and the people paying had begun to notice.

They said so, and the change followed quickly. The offices announced that they would not go on carrying the cost, and in 1865 Parliament passed an Act transferring the London brigade to public control, to be funded from local rates, from a levy on the insurance companies themselves and from a government contribution. The service became a public one not because anybody had concluded that protection from fire was a duty of the state, but because the private parties who had been providing it declined to continue.

The shape of that argument is worth naming, because it has not gone away. An insurer who will have to pay for a loss has a direct interest in preventing it, and will spend on prevention up to the point where the cost of prevention exceeds its own exposure, which is not the point where it exceeds the loss to everybody else. The gap between those two figures is the space into which public provision has always eventually moved. The same argument is being conducted at present about flooding, and about insurance against attacks on computer systems, in almost the same words.

Questions 1–5

Complete the table below.

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

From private offices to a public brigade	
Year	What happened
1666	fire destroys about thirteen thousand houses and eighty-seven parish 1
1680	Nicholas Barbon, formerly a 2, opens the first fire office
1833	ten offices merge their brigades; Braidwood teaches his men to attack a fire from 3 the building
1861	Braidwood is killed at Tooley Street by a falling 4
1865	the brigade passes to public control, paid for partly out of local 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 Brigades regularly left uninsured buildings to burn.

- 7 An office had reason to fight a fire in a building it had not insured.
- 8 Barbon's office employed more men than the offices that competed with it.
- 9 Braidwood picked firefighters who were young and physically fit.

Questions 10–13

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

- 10 According to the passage, what were the firemarks mainly for?
- A deciding which fires a brigade would attend
 - B identifying a building and advertising the office
 - C recording the value of the policy
 - D marking buildings that had already burned
- 11 Why does the writer say the familiar story about the marks is wrong?
- A The marks were fixed too high to be read from the street.
 - B Fire spreads, so an office had an interest in uninsured buildings nearby.
 - C Brigades were legally required to attend every fire.
 - D The offices had already merged by that date.
- 12 Why did the London brigade become a public service?
- A Parliament concluded that protection from fire was a duty of the state.
 - B The insurance offices refused to go on paying for it.
 - C Braidwood's death produced a public outcry.
 - D The offices could no longer recruit enough men.
- 13 What comparison does the writer draw in the final paragraph?
- A between fire and the spread of disease
 - B between this case and present arguments about flooding and attacks on computer systems
 - C between the London and Edinburgh brigades
 - D between what public and private firefighters were paid

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

A particle proposed with an apology

When a radioactive nucleus emits an electron, the energy carried off by that electron should be a fixed quantity, because it is set by the difference between the state the nucleus started in and the state it ended in. Measured in the nineteen-twenties, it was not fixed. The electrons came out with energies spread all the way from almost nothing up to the expected value, and only the very top of the range matched the calculation. Energy was apparently disappearing, and the situation was serious enough that Niels Bohr was willing to consider giving up the conservation of energy in the very small.

Wolfgang Pauli proposed the alternative in December 1930, in a letter to a conference he had decided not to attend, addressed to its participants as dear radioactive ladies and gentlemen. Suppose, he said, that a second particle leaves the nucleus at the same time as the electron and takes a share of the energy with it. To have escaped notice it would have to be electrically neutral, extremely light, and so reluctant to interact with matter that it would pass through anything. Pauli described his own suggestion as a desperate remedy and said he had done what no theorist should do, which was to postulate a particle that could not be detected.

Enrico Fermi gave the idea a mathematical form in 1934 and supplied the name by which the particle is now known. The theory had a consequence that discouraged everybody, which was that the strength of the interaction could now be estimated. On those numbers the average distance such a particle would travel through solid matter before doing anything at all came out in light-years. Detection was not merely difficult; it looked like a category of thing that could not be attempted. Fermi's paper was rejected by one journal on the grounds that it was too remote from physical reality to interest the reader.

Clyde Cowan and Frederick Reines attempted it anyway in 1956, by accepting the tiny probability and compensating with an enormous supply. A nuclear reactor produces these particles in vast numbers, so they placed large tanks of water, with cadmium dissolved in it, beside a reactor at Savannah River. What they looked for was not one signal but two in a fixed order: a flash as a positron annihilated, and then, a few millionths of a second later, a second flash as a neutron was captured by a cadmium nucleus. Nothing in the background produces that pair with that spacing. When it worked they sent Pauli a telegram. Twenty-six years had passed since the letter to the ladies and gentlemen, and Pauli is said to have replied that everything comes to those who know how to wait.

The next problem arrived from the Sun. From 1968 Raymond Davis ran a detector at the bottom of a gold mine in South Dakota, consisting of a tank holding six hundred tonnes of dry-cleaning fluid, in which a passing solar particle would very occasionally turn one chlorine atom into an atom of argon. Davis then extracted and counted those argon atoms, a few dozen at a time, from a tank the size of a house. Over three decades he consistently found about a third of the number that the accepted models of the Sun predicted, and the shortfall was far too large to be a counting error.

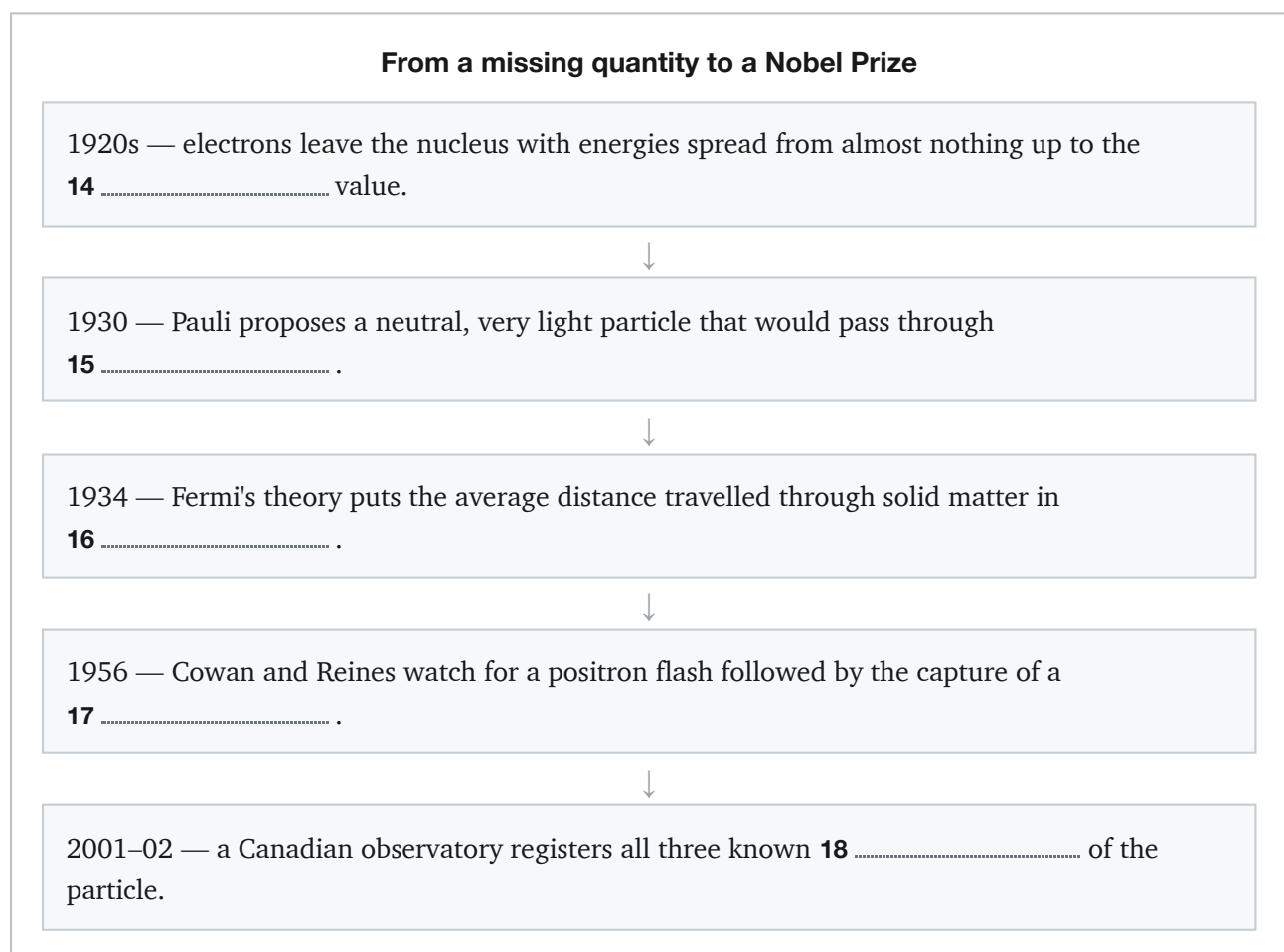
For most of those thirty years the shortfall was blamed either on Davis's technique or on the models of the Sun, and both were examined repeatedly and both survived. The answer came in 2001 and 2002 from an observatory two kilometres down in a Canadian nickel mine, which was built to detect all three known varieties of the particle rather than only the one that Davis's chemistry could register. Counted that way, the total agreed with the models exactly. The particles had been arriving all along; two thirds of them had changed into a different variety on the way from the Sun.

Changing variety is only possible for a particle that has mass, and the standard theory of particle physics had assumed this one had none. A shortfall that had looked for three decades like an error in somebody's arithmetic therefore turned out to be the first solid evidence that the standard theory is incomplete. One caution belongs with the story, and it concerns Pauli's own words, which are usually quoted to show that theorists should be bolder. He was right that the particle was almost undetectable and wrong that it could not be detected, and the difference between those two statements is not a matter of nerve. It is that cannot be detected was a claim about the instruments that existed in 1930.

Questions 14–18

Complete the flow-chart below.

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



Questions 19–22

Look at the following descriptions and the list of scientists below.
Match each description with the correct scientist or pair, A–D.

List of Scientists	
A	Wolfgang Pauli
B	Enrico Fermi
C	Cowan and Reines
D	Raymond Davis

- 19** described his own suggestion as a desperate remedy
- 20** supplied the name by which the particle is now known
- 21** made up for a very small probability by using an enormous supply
- 22** counted a few dozen atoms taken out of a very large tank

Questions 23–26

Complete each sentence with the correct ending, A–G, below.

List of Endings	
A	nothing in the background produces them in that order at that spacing.
B	has mass, which the standard theory had assumed it did not.
C	either Davis's technique or the models of the Sun.
D	giving up the conservation of energy in the very small.
E	travels a little more slowly than light.
F	was being produced in smaller numbers than expected.
G	the tank had been too small to give a reliable count.

- 23** The spread of energies was serious enough that Bohr was willing to consider
- 24** The pair of flashes could be separated from background because
- 25** For three decades the shortfall was blamed on
- 26** Being able to change variety shows that the particle

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

What the second opinion was shown

- A** Two judgements are better than one. The second checks the first, and where they agree the conclusion is stronger than either would have been alone. All of this is true, and all of it depends on a condition that is stated in the textbooks and almost never met in practice, which is that the two judgements have to be independent. The entire value of the exercise sits inside that word, and it is the first thing that any real arrangement gives away, usually for reasons that look like efficiency at the time.
- B** Consider how a second opinion is normally obtained. The second doctor is sent the first doctor's notes, including the diagnosis. The second reviewer of a paper can see the first review. The second analyst is handed the same file, assembled by the same person, and was very likely trained in the same institution by the same people. Each of these arrangements is sensible when considered on its own, and saves time, and prevents the second person from working in the dark. Each of them also removes some part of the independence that the second judgement was supposed to supply, and the removal is invisible because nothing appears to have gone wrong.
- C** The mechanism is anchoring, and it is not a matter of weak character or insufficient professionalism. Once a plausible answer has been seen, later judgement moves towards it, and the movement happens in people who know about the effect, have been warned about it that morning, and are actively trying to resist. In radiology this has been measured directly: rates of agreement between a first and a second reader change substantially depending on whether the second reader was shown the first report.
- D** The sharpest demonstration comes from forensic science, where the material is supposed to be objective and the examiner is supposed to be reading it rather than interpreting it. Itiel Dror and colleagues gave fingerprint examiners pairs of prints that those same examiners had personally matched some years earlier, and supplied context suggesting that the earlier conclusion had been wrong. A proportion of the examiners reversed their own previous judgement on a pair of prints they themselves had already decided about. Nothing about the prints had changed in the interval; the only new thing in the room was the context.
- E** There is a serious counter-argument and it should not be brushed aside. Independence is expensive, and in some settings it is dangerous. A second doctor deliberately kept away from the history will order tests that have already been done, may miss something the first one found and recorded, and can arrive at a confident conclusion from half the available picture. The shared file is not always a design fault. In a great many settings it is the only way the work can be done at all, and an insistence on purity would simply stop the second opinion being sought.

- F** That is why the useful question is not whether to obtain a second opinion but what the second person ought to be shielded from, and the distinction turns out to be reasonably clean. There is information that helps somebody see: the images, the measurements, the patient's history, the raw evidence. And there is information that tells them what to conclude: the first report, the suspicion expressed in the referring letter, the name of the person the police already have in mind. The first kind should be shared and the second kind withheld until a judgement has been recorded.
- G** Where this has actually been designed rather than assumed, it works and it is not complicated. Some review panels require every member to write a judgement before anybody speaks. Blind second reading, in which the second reader does not see the first report until they have committed to their own, is standard practice in breast screening programmes in several countries. Forensic laboratories have introduced sequential unmasking, in which the examiner receives the physical evidence first and the case context only afterwards, so that the context cannot shape what they saw, only what they make of it afterwards.
- H** None of this makes a dependent second opinion worthless. It still catches outright mistakes, transpositions and omissions, and an organisation with two pairs of eyes is better off than one with a single pair. What it should not do is describe or count that as two opinions. A diagnosis confirmed by a second reader who had already seen the first report is one opinion with a supporter attached, and a patient told that two specialists agree, or a court told that two experts concur, is entitled to ask a question that is almost never asked: what was the second one shown, and when.

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** The writer thinks the practice of seeking second opinions should be given up.
- 28** The writer accepts that keeping the second person away from the history can do harm.
- 29** The writer thinks blind second reading ought to be made compulsory everywhere.
- 30** The writer believes anchoring works on people who are aware of it and trying to resist it.
- 31** The writer regards the arrangements that remove independence as plainly careless.
- 32** The writer thinks forensic examiners are less reliable than doctors.

Questions 33–36

Complete the summary below.

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

What has to be withheld

Two judgements are worth more than one only where they are **33**, and most arrangements give that up. The mechanism is **34**: once a plausible answer has been seen, later judgement moves towards it. The remedy is not to withhold everything but to divide what helps somebody see from what tells them what to **35** Several screening programmes therefore use blind second **36**, in which the second person commits before seeing the first report.

Questions 37–40

Reading Passage 3 has eight paragraphs, A–H.

Which paragraph contains the following information?

Write the correct letter, A–H.

NB You may use any letter more than once.

List of Paragraphs

- A** Paragraph A
- B** Paragraph B
- C** Paragraph C
- D** Paragraph D
- E** Paragraph E
- F** Paragraph F
- G** Paragraph G
- H** Paragraph H

- 37** an experiment in which people reversed a decision they had made themselves
- 38** a statement of which kinds of information should be passed on and which held back
- 39** a warning against describing one supported judgement as two
- 40** three named arrangements in which independence has been built in deliberately