READING PASSAGE 1

You should spend about 20 minutes on questions 1–13.

Domestic clocks

The domestic clock was not exactly invented; it was probably a spin-off from the scientific activities of churchmen, astrologers and mechanics of the Middle Ages interested in increasing their knowledge of the stars or improving discipline in religious communities. Perhaps some 13th-century king or bishop first had a clock in his house as a symbol of prestige or wealth, or perhaps from interest, or to call him to prayer. Certainly, the church assistant needed to know when to warn the watchman to ring the bell in the watchtower to warn the local people about some communal activity such as digging a ditch, preparing to defend themselves against raiders, or gathering to help put a fire out.

So possibly it was the watchman's clock on the wall that became the domestic iron clock of the medieval household. It was a valuable possession, and when the family moved it went with them, just as did any glass windows they had. Iron clocks and lantern clocks, hanging on the wall from a hook, were the first general domestic clocks. The weights that powered them hung below them and generally had to be pulled up twice a day. In some countries, it became fashionable to fit ornate wooden cases around them and mount these clocks on wooden brackets.

Although the weight-driven clock was not originally designed for domestic use, the spring-driven one undoubtedly was. The use of a coiled spring instead of a weight to provide power made possible first the portable clock and subsequently the smaller, personal clock, which was later called a watch. Spring clocks were first made in France in the 1400s, it seems, but little is known of their origin. The earliest spring-driven clock known is dated about 1450. It is like the weight-driven clock of the time but with the weights replaced by coiled springs.

The changeover from weight-driven to spring-driven clocks did not prove so simple, however, because, unlike the falling weight, the coiled spring did not provide a constant source of power. When wound up, the spring gave a force that was very strong, but only for a short time. The force then decreased unevenly for some hours before slowing rapidly. The middle of the range was most useful for driving the clock, but the reducing force was a problem. Early coiled springs also suffered from the fact that they could not be made very evenly or smoothly and did not coil accurately. When this happened, the power was released in uneven bursts. The means adopted to overcome these disadvantages, which directly affected timekeeping accuracy, were twofold.

The first step was to limit the use of the spring to the middle of its action to prevent it from driving the clock when it was too tightly wound up or not wound up tightly enough. The next step was to provide a form of gearing between the spring and the clock to make the power output more even. The method was so simple, ingenious and elegant that it has remained in use, at least in certain types of clock, from the time it was invented until today.

It is called the fusee, meaning a spindle wound with a thread. A fusee is a trumpet-shaped object with a toothed or gear wheel at the larger end, which is connected to the

driving wheel of the clock. The trumpet-shaped part has a spiral groove cut in it, and a strong thread attached to the groove at the larger end. The rest of the thread is wound round the barrel of the clock, containing the spring. When the fusee is turned with a key, the thread is pulled off the barrel, which winds up the spring inside it. The thread is wound on the fusee groove, which becomes smaller and smaller in diameter, so that in effect it means the spring drives the clock at a constant speed.

Fusees were used from the 1400s to the early 1900s. This relatively simple device to improve timekeeping by equalising the uneven pull of the mainspring achieved its purpose effectively. Granville Baillie, a leading clockmaker and watchmaker in the 1900s, said of the fusee, 'Perhaps no problem in mechanics has ever been solved so simply and so perfectly.'

Questions 1–5

Do the following statements agree with the information given in Reading Passage 1?

In boxes 1–5 on your answer sheet write

TRUE if the statement agrees with the information

FALSE if the statement contradicts the information

NOT GIVEN if there is no information on this

1 The earliest domestic clocks were developed to provide routine for householders.

2 Medieval clocks remained on the property when the owners sold their home.

3 Pulling the weights on wall-mounted clocks required precise skill.

4 It is the spring inside that allows a watch to be moved around.

5 The first spring-driven clocks had difficulty keeping the correct time.

Questions 6–10

Complete the notes below.

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

Write your answers in boxes 6–10 on your answer sheet.

Early domestic clocks

Weight-driven clocks

- Made of **6** .....
- Decorated clock cases fixed to the wall with **7** .....

Spring-driven clocks

- Location where first produced: **8** .....
- Problems keeping **9** ..... even

Questions 10–13

Answer the questions below.

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

Write your answers in boxes 10–13 on your answer sheet.

10 What does a fusee look like?

11 What is connected to the spiral groove on a fusee?

12 What object is required to wind the spring on the fusee?

13 What does the gradual reduction of the fusee groove ensure?

READING PASSAGE 2

You should spend about 20 minutes on questions 14–27.

Questions 14–21

Reading Passage 2 has eight paragraphs, **A–H**.

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

*Write the correct number, **i–xi**, in boxes 14–21 on your answer sheet.*

List of headings

i	A lack of information about what is in trash
ii	A change in public attitude
iii	The uncertainty of trash destination
iv	A typical householder's present action
v	Formulating the ultimate rubbish solution
vi	Selection of recycling centres
vii	A way to trace what happens to rubbish
viii	Details of how the research will be done
ix	Variations in the effect of waste on the surrounding area
x	Future sources of useful materials
xi	Network coverage for telecommunications

14 Paragraph A

15 Paragraph B

16 Paragraph C

17 Paragraph D

18 Paragraph E

19 Paragraph F

20 Paragraph G

21 Paragraph H

Trash trackers

A So you carefully separate your cardboard from your used glass containers, wash your empty tins and tear the staples off scrap paper. You fill your various bins and put them out to be taken away with the remains of the week's meals and domestic rubbish. And then, safe in the knowledge that you have done your bit for the environment, you forget all about it.

B In fact, the life story of your weekly garbage is just beginning. An aluminium can, for instance, could have a variety of fates. It might be crushed and sent back to the canning factory to be turned into new cans. Or it could end up in the nearest landfill site or get shipped off overseas to be either recycled or dumped. The truth is that nobody can be sure where an individual piece of rubbish will end up or how the junk in the landfill got there.

C New research is planning to find out. In a pilot project, a team from the Massachusetts Institute of Technology (MIT) together with members of the *New Scientist* journal tracked 60 pieces of trash in Seattle in the United States. The next phase of the experiment will begin – 1,000 more pieces of garbage will be electronically tagged and thrown away in New York, Seattle and London, and tracked for two months.

D The experiment is more than just an attempt to satisfy curiosity as to where trash ends up. The idea is to help plan for an ideal world of waste disposal, where nearly everything gets recycled or reused and materials are not sent to landfill faster than the planet is able to produce them.

E At present, that ideal world is a distant dream only. Part of the problem is that we do not know what we are dealing with. While a lot of effort has gone into creating green supply chains to bring products to customers, almost nothing is known about what happens to the waste. This waste is monitored, of course, but only to see how many tonnes of different kinds of garbage arrive at a sorting centre, landfill or incinerator, and how many leave. These are counted as electronic or household waste; the mass is measured, but not in terms of the content.

F In terms of environmental impact, it is the content, not the number of tonnes, that matters. Within the harmless-sounding category of 'household waste', for example, lies everything from carrot peelings to used babies' nappies and low-energy light bulbs containing mercury, or old electrical appliances, each of which gives a very different set of environmental challenges. In an ideal world each should be dealt with separately.

G Before that can happen, though, we need to get a clearer picture of the life cycle of different kinds of waste, which is how the tracking project can give useful information. The team have designed tags that can be fixed to all kinds of rubbish, and these tags beam out their location every 15 minutes for up to two months. Each is built around a mobile phone SIM card and battery, and a motion sensor. A low-power microprocessor keeps track of the motion sensor and, when the sensor registers movement it switches on the

SIM card, triggering a search for nearby mobile phone towers. The SIM then sends an SMS containing this information to the team and the team's software compares it with the standard map of signal strength fingerprints to determine the position of the tag. The tags are not precise to the metre. In cities where there is a dense network of mobile phone towers, the team can locate an object to within 100 to 500 metres. In rural zones, that may be a kilometre or more.

H While tagging waste can identify where recyclables are being tossed into landfill, or where hazardous waste is illegally shipped overseas, there is a more fundamental reason to tag trash: to find out where society stores the materials that it mines from the Earth and temporarily turns into products. Today's landfill sites contain large amounts of important metals, including gold, zinc, aluminium, nickel, copper, cadmium and mercury – in many cases at higher concentrations than natural ore deposits – plus huge quantities of recyclable glass and plastic. As commodities become scarce in the following centuries, we may have to mine landfills for their riches, and that means finding out exactly where to start digging.

Questions 22–23

*Choose TWO letters, **A–E**.*

Write the correct letter in boxes 22 and 23 on your answer sheet.

According to the writer, which TWO of the following things need to happen?

A Householders should be more aware of the waste-sorting process.

B We need to find out how much waste is in the system.

C We need to know more about the kinds of waste that have been thrown away.

D Business and industry must follow established guidelines.

E We should locate and reuse valuable resources.

Questions 24–27

Answer the questions below.

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

Write your answers in boxes 24–27 on your answer sheet.

24 Which item of rubbish does the writer use as an example to show the many ways rubbish can be dealt with?

25 Which city is involved in two stages of research?

26 What have people already tried hard to establish in order to get products to consumers?

27 What general term is used to cover a wide range of very different kinds of rubbish?

READING PASSAGE 3

You should spend about 20 minutes on questions 28–40.

Do animals think like humans?

A Some pet owners believe that their animals understand them when they speak, but how much do animals really understand of what we say? To what extent is their thinking a reflection of ours? Recent experiments have begun to throw light on the matter.

An Austrian dog – researchers call her Betsy – has a vocabulary of more than 300 words. 'Even our closest relatives, the great apes, can't do what Betsy can do – hear a word only once or twice and know that the acoustic pattern stands for something,' says cognitive psychologist Juliane Kaminski. 'Dogs' understanding of human forms of communication is something new that has evolved,' she says, 'something that's developed in them because of their long association with humans.' Scientists think that dogs were domesticated about 15,000 years ago, a relatively short time in which to develop language skills.

But how similar are these skills to those of humans? For abstract thinking, we employ symbols, letting one thing stand for another. Betsy, in an experiment, was shown a picture of a Frisbee, a picture she had never seen before, and told to find it. She brought the Frisbee from among other toys in another room.

B Other animals also have skills similar to those of humans. 'People were surprised to discover that chimpanzees make tools,' said Alex Kacelnik, a behavioural ecologist at Oxford University, referring to the straws and sticks chimpanzees use to pull termites out of their nests. 'But people also thought "Well, they share our ancestry – of course they're smart." Now we're finding these kinds of exceptional behavior in some species of birds. But we don't have a recently shared ancestry with birds. Their evolutionary history is very different; our last common ancestor with all birds was a reptile that lived over 300 million years ago. This means that evolution can invent similar forms of advanced intelligence more than once – that it's not something reserved only for primates or mammals.'

C Kacelnik and his colleagues are studying one of these smart species, the New Caledonian crow, which lives in the forests of the Pacific island of the same name. New Caledonian crows are among the most skilled of tool-making and tool-using birds, forming probes and hooks from sticks and leaf stems to poke into the palm trees where fat grubs hide. Since these birds, like chimpanzees, make and use tools, researchers can look for similarities in the evolutionary processes that shaped their brains. Something about the environment of both species favored the evolution of tool-making neural powers.

But is their use of tools rigid and limited, or can they be inventive? Do they have what researchers call mental flexibility? Chimpanzees certainly do. In the wild, a chimpanzee may use four sticks of different sizes to extract the honey from a bee's nest. And in captivity, they can figure out how to position several boxes so they can retrieve a banana hanging from a rope.

D Answering that question for New Caledonian crows – extremely shy birds – wasn't easy. Even after years of monitoring them in the wild, researchers couldn't determine if the birds' ability was innate, or if they learned to make and use their tools by watching one another. If it was a genetically inherited skill, could they, like the chimps, use their talent in different, creative ways?

To find out, Kacelnik and his students brought 23 crows of varying ages (all but one caught in the wild) to the aviary in his Oxford laboratory. Four hatchlings were raised in captivity, and all were carefully kept away from the adults, so they had no opportunity to be taught about tools. Yet soon after they fledged, all picked up sticks to probe busily into cracks and shaped different materials into tools.

E Birds can cheat too. Other studies by the same researcher show that western scrub jays can know another bird's intentions and act on that knowledge. A jay that has stolen food itself, for example, knows that if another jay watches it hide a nut, there's a chance the nut will be stolen. So the first jay will return to move the nut when the other jay is gone.

Such deceptive acts require a complicated form of thinking, since you must be able to attribute intentions to the other individual and predict that individual's behaviour.

F One school of thought argues that human intelligence evolved partly because of the pressure of living in a complex society of calculating beings. Chimpanzees, orang-utans, gorillas and bonobos share this capacity with us. In the wild, primatologists have seen apes hide food from the alpha male or steal his females. Kacelnik's study is the first to show the kind of ecological pressures, such as the need to hide food for winter use, that would lead to the evolution of such mental abilities. Most provocatively, his research demonstrates that some birds possess what is often another uniquely human skill: the ability to recall a specific past event.

Questions 28–32

Reading Passage 3 has six sections, **A–F**.

Which section contains the following information?

*Write the correct letter, **A–F**, in boxes 28–32 on your answer sheet.*

28 Animals cause difficulties for a dominant member of their group.

29 Young birds used skills without assistance from their parents.

30 Humans and two species of animal may descend from the same origin.

31 Animals' skills may come as a result of spending time with people.

32 Birds show dishonest conduct.

Questions 33–35

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

Write the correct letter in boxes 33–35 on your answer sheet.

33 The writer mentions the domestication of dogs in order to

- **A** say how different they are from another species of animal.
- **B** explain why they are easy to research.
- **C** show how quickly they have learned.
- **D** argue that they are suitable pets.

34 A western scrub jay has demonstrated

- **A** an ability to trick other birds.
- **B** a talent for copying other birds' calls.
- **C** a skill at hiding sticks for digging grubs from trees.
- **D** an aggressive way of behaving in the presence of other birds.

35 Kacelnik's research has shown that

- **A** captive birds do not know how to to steal from other birds.
- **B** birds can make use of their memories on later occasions.
- **C** monkeys can remember what happened in the past.
- **D** primates are affected by their social surroundings.

Questions 36–40

Do the following statements agree with the claims of the writer in Reading Passage 3?

In boxes 36–40 on your answer sheet write

YES if the statement agrees with the claims of the writer
NO if the statement contradicts the claims of the writer
NOT GIVEN if there is no information on this

36 Scientists anticipated primate ability to employ implements.

37 Chimpanzees and New Caledonian crows had surroundings that prompted them to develop a skill.

38 Chimpanzees show that they enjoy the challenge of problem-solving.

39 Observation in the wild was able to show that crows learnt by copying.

40 Complex thought processes may be displayed by western scrub jays.