UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE NAME

CENTRE NUMBER | | | | | |

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**21ST CENTURY SCIENCE** **0608/04**

Paper 4 **October/November 2009**

**1 hour 30 minutes**

Candidates answer on the Question Paper.

No Additional Materials are required.

**READ THESE INSTRUCTIONS FIRST**

Write your Centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
You may use a pencil for any diagrams or graphs.
Do not use staples, paper clips, highlighters, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.
At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

| For Examiner's Use | |
|---|---|
| 1 | |
| 2 | |
| 3 | |
| 4 | |
| 5 | |
| 6 | |
| 7 | |
| 8 | |
| 9 | |
| Total | |

This document consists of **16** printed pages.

**1** This question is about gases in the air.

**(a)** The table shows three gases.

Finish the table by adding the percentage of each gas in unpolluted air.

| gas | percentage in unpolluted air |
|---|---|
| argon | |
| nitrogen | |
| oxygen | |

[2]

**(b)** Nitrogen dioxide is a pollutant gas.

Scientists measure the concentration of nitrogen dioxide in the air next to a busy highway and a quiet country road.

Their results are shown in the table.

| | nitrogen dioxide concentration / micrograms per cubic metre | | | | | |
|---|---|---|---|---|---|---|
| location | sample 1 | sample 2 | sample 3 | sample 4 | sample 5 | mean |
| highway | 45 | 43 | 43 | 46 | 48 | 45 |
| country road | 8 | 12 | 9 | 10 | 6 | 9 |

**(i)** The scientists use the mean (average) values from their results as best estimates of the concentration of nitrogen dioxide in each location.

They decide that the best estimate of the nitrogen dioxide concentration from the highway is more reliable than that from the country road.

Suggest why this best estimate is more reliable.

.....

..... [1]

**(ii)** The scientists decide that there is a **real difference** between the nitrogen dioxide concentration in the air next to the highway and next to the country road.

Show how their results support this decision.

.....

.....

[2]

**(c)** Car exhaust fumes contain nitrogen monoxide. This reacts with oxygen in the air to form nitrogen dioxide.

Complete the diagram below to show the molecules of nitrogen dioxide produced in this reaction.

nitrogen monoxide oxygen nitrogen dioxide

[2]

**[Total: 7]**

**2** Sewage pipes used to be made from ceramic material. This is made by heating clay in an oven. Ceramic material is hard, inflexible and brittle.

Modern sewage pipes are made from poly(ethene) which is tough and flexible.

**(a)** Sewage pipes are laid underground and sometimes crack when the ground moves.

Explain why poly(ethene) is better than ceramic material for sewage pipes.

.....

..... [1]

**(b)** Some parts of the Life Cycle Assessment (LCA) for sewage pipes made from poly(ethene) are different from those for sewage pipes made from ceramic material.

Describe two parts of the LCA that are different for sewage pipes made from these two materials.

1 .....

.....

2 .....

..... [2]

**(c)** Poly(ethene) is also used to make supermarket carrier bags.

The LCA for poly(ethene) in sewage pipes is different from that for poly(ethene) in carrier bags.

Describe one part of the LCA that is different and explain why.

.....

.....

.....

..... [2]

**(d)** Poly(ethene) can be made more flexible by adding a plasticizer. The addition of this chemical also lowers the melting point of the polymer.

Use ideas about the forces between particles to explain how the plasticizer changes the properties of poly(ethene).

.....

.....

.....

..... [2]

**3** This question is about some of the compounds found in plants.

**(a)** Look at these three chemical formulae: $C_2H_6$, $C_6H_{12}O_6$, $C_2H_5O_2N$.

Choose the name of each type of compound from this list.

**amino acid** **carbohydrate** **hydrocarbon**

Write the type of compound in the box below each formula.

| $C_2H_6$ | $C_6H_{12}O_6$ | $C_2H_5O_2N$ |
|---|---|---|
| | | |

[2]

**(b)** To make compounds containing nitrogen, plants absorb soluble nitrogen compounds from the soil.

**(i)** Some farmers add soluble nitrogen compounds to the soil in synthetic fertilisers. Others do no use synthetic fertilisers.

Use ideas about social and economic contexts to explain this difference.

.....

.....

.....

..... [2]

**(ii)** Soluble nitrogen compounds are added to the soil naturally in the nitrogen cycle.

Describe two ways that nitrogen compounds are added to the soil as part of the nitrogen cycle.

1 .....

.....

2 .....

..... [2]

**[Total: 6]**

**4** This question is about the theory of **continental drift**.

**(a)** In 1915, Alfred Wegener suggested his theory of continental drift.

He based his theory on a number of observations he and other scientists made.

Write down two observations which Wegener used to support his theory.

Observation 1 .....

.....

Observation 2 .....

..... [2]

**(b)** In 1915, other scientists did not agree with Wegener's theory of continental drift.

Suggest **one** reason why they did not agree with Wegener's theory.

.....

..... [1]

**(c)** Wegener's theory is now accepted as being true.

It was supported by the discovery that some sea-floors are getting larger. This is called sea-floor spreading.

State a typical distance that a sea-floor would spread in a year.

typical sea-floor spread = ..... [1]

**(d)** The evidence for sea-floor spreading was provided by magnetic 'stripes' of rocks sea-floor near mid-ocean ridges.

In the diagram below, the black stripes are magnetised in one direction, and the white stripes are magnetised in the opposite direction.


**(i)** Explain what has happened to the rocks to give the differences in magnetism shown by the black and white stripes.

In your answer, you should explain what is happening at the mid-ocean ridge.

.....

.....

..... [2]

**(ii)** Explain how the diagram provides evidence for sea-floor spreading.

.....

.....

..... [2]

**[Total: 8]**

**5** Mobile phones are getting more and more popular throughout the world, but some people are concerned that their microwave radiation may be harmful.

Read these different people's views on mobile phones.

**Aruna**

No-one can be certain that mobile phones are safe. I'm not going to have one myself.

**Bilal**

Microwaves cannot split molecules into bits. The only way they can harm you is by heating. They are too weak to heat you much.

**Chen**

Everyone I know has a mobile phone, and none of them has any health problems.

**David**

I need my mobile phone for important calls. I don't use it very much.

**(a)** Which two of these people mention a way to reduce the possible risk from mobile phone radiation?

Put ticks (✓) in the boxes next to the **two** correct names.

Aruna ☐

Bilal ☐

Chen ☐

David ☐

[2]

**(b)** Which **one** of these people says that the benefits of having a mobile phone are greater than the risks they might cause?

Put a tick (✓) in the box next to the correct name.

Aruna ☐

Bilal ☐

Chen ☐

David ☐

[1]

**(c)** Which **one** of these people is applying the **precautionary principle**?

Put a tick (✓) in the box next to the correct name.

Aruna ☐

Bilal ☐

Chen ☐

David ☐

[1]

**(d)** Which **one** of these people is telling us that microwaves are **not** ionizing?

Put a tick (✓) in the box next to the correct name.

Aruna ☐

Bilal ☐

Chen ☐

David ☐

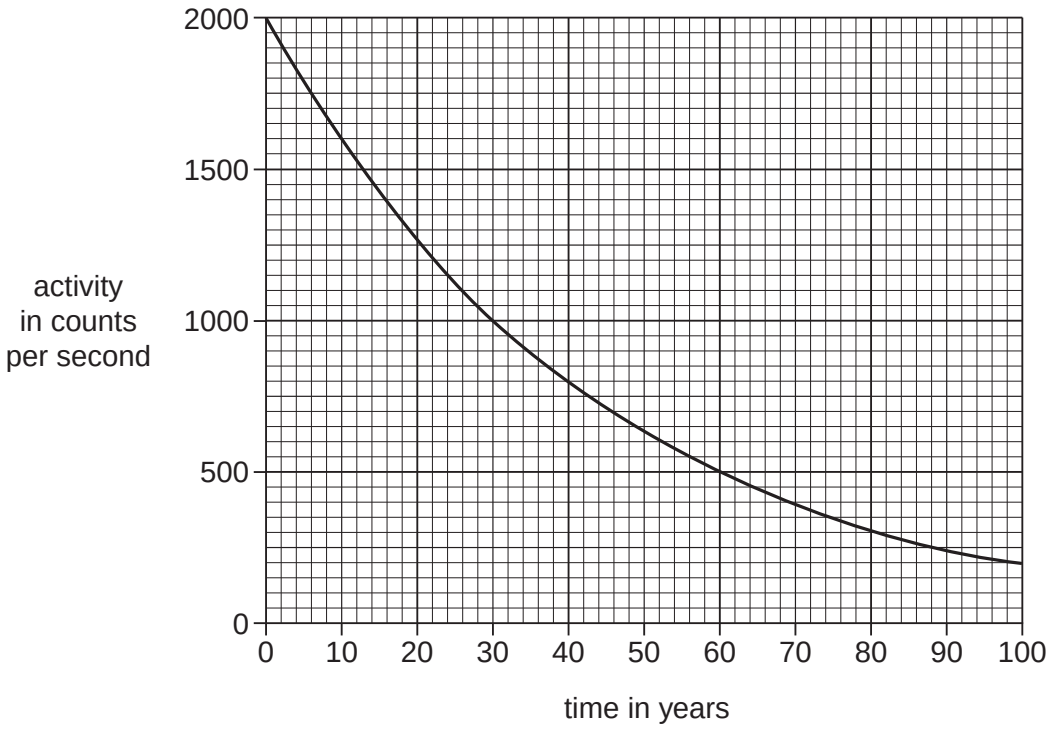
[1]

**[Total: 5]**

**6** This question is about nuclear waste.

**(a)** Two of the commonest radioactive isotopes in nuclear waste are strontium-90 and caesium-137. These have very similar half-lives.

The activity of caesium-137 is shown in this graph.




**(i)** Use the graph to describe what happens to the activity of caesium-137 with time.

.....

.....

..... [2]

**(ii)** Use the graph to find the half-life of caesium-137.

Show your working on the graph or in this space.

half-life of caesium-137 = ..... years [1]

**(b)** One long-lived isotope produced in nuclear fission is technetium-99, which has a [illegible] of 200 000 years.

Calculate the time taken for the activity of a sample of technetium-99 to drop to one-eighth (12.5%) of its original activity.

You should show your working.

time taken = ..... years [2]

**(c)** Intermediate level waste produced in nuclear power stations may be radioactive for thousands of years.

Governments of countries producing nuclear waste have to make decisions about how to dispose of this intermediate level waste.

Methods that have been suggested include

- firing it into space in rockets
- burying it deep underground
- keeping it in storage containers at ground level.

Choose **one** of these disposal methods and give arguments for and against it.

You should include whether it **can** be done and whether it **should** be done.

.....

.....

.....

.....

.....

..... [3]

**[Total: 8]**

**7** Stem cell research is a rapidly advancing field of science.

It uses cells taken from embryos that are only a few days old.

The stem cells can be used to treat illnesses such as Parkinson's disease.

**(a)** What feature of embryonic stem cells makes them useful?

.....

.....

..... [1]

**(b)** Read these statements, made by five different people.

| | |
|---|---|
| **A** | An embryo has the same human rights as any person. |
| **B** | Stem cell research could provide valuable treatments for millions of people with incurable diseases. |
| **C** | Stem cell research is a very interesting area of science. |
| **D** | The embryos used are those left over from fertility treatments so they would be discarded anyway. |
| **E** | Most human embryos do not develop beyond two weeks. |

Which of these statements, **A**, **B**, **C**, **D** or **E** suggests that

**(i)** the right decision is the one which leads to the best outcome for the majority of people involved,

..... [1]

**(ii)** certain actions are never justified because they are wrong.

..... [1]

**(c)** Identical twins are natural clones.

Scientists can also clone whole animals artificially.

Describe how the process of artificial cloning is carried out.

.....

.....

.....

.....

..... [2]

**[Total: 5]**

**8** Microorganisms may enter the body and cause illness.

Vaccinations provide protection against these microorganisms.

A vaccination is when a safe form of the disease-causing microorganism is put into someone's body.

**(a)** Describe how vaccinations provide protection from microorganisms in the body.

.....

.....

..... [2]

**(b)** Read this article.

**Number of measles cases soars due to fears over MMR jab**

The number of new cases of measles in the UK has risen to almost 20 times higher than a decade ago. Measles is a highly infectious illness which can cause severe disability or death.

This rise is thought to be due to the relatively low uptake of the combined measles, mumps and rubella (MMR) vaccine over the last decade. A large number of children are not fully vaccinated against these diseases and measles is spreading easily amongst these children. There is now the real risk of a measles epidemic.

Earlier research had suggested a link between the MMR jab and the developmental disability autism, although this link has now been disproved.

Use the article to help you answer the following questions.

**(i)** Suggest one reason **for** and one reason **against** having your child immunised with the MMR jab.

.....

.....

..... [1]

**(ii)** Explain why the article says 'There is now the real risk of a measles epidemic'.

.....

.....

..... [1]

**(iii)** For society as a whole, there is huge benefit if all children receive the vaccination.

Suggest why governments may **not** make the MMR vaccination compulsory for all children.

.....

..... [1]

**(c)** The article mentions a link between the MMR vaccination and autism.

The graph shows the number of cases of autism in children and the percentage of children receiving the MMR vaccination over the same time period.


Suggest whether this graph shows a correlation between the MMR vaccination and autism.

Explain your answer.

.....

.....

..... [2]

**(d)** HIV is the virus which causes AIDS. Why is it difficult to develop an effective vaccine against the HIV virus?

.....

.....

..... [2]

**9** In 1831, Charles Darwin sailed around the world on the ship HMS Beagle. The journey lasted 5 years.

During this time, he looked at many different plants and animals.

Darwin later proposed ideas to explain his observations.

**(a)** Which of the following statements are data, **D**, and which are explanations, **E**?

Write the correct letter, **D** or **E**, in the box next to each statement.

| | **D** or **E** |
|---|---|
| All living things change over time by a process called evolution. | |
| Fossils in older rocks are different from those in younger ones. | |
| Individuals of the same species are all different. | |
| Some species become extinct. | |

[2]

**(b)** Darwin proposed that evolution happens by a process called natural selection.

Describe the process of natural selection.

Use the following terms in your answer.

- competition
- reproduction
- variation

.....

.....

.....

.....

..... [3]

**[Total: 5]**