OCR
RECOGNISING ACHIEVEMENT

H

# GENERAL CERTIFICATE OF SECONDARY EDUCATION
# TWENTY FIRST CENTURY SCIENCE
# SCIENCE A

A212/02

Unit 2 Modules B2 C2 P2
(Higher Tier)

*CUP/T62829*

Candidates answer on the question paper
A calculator may be used

**OCR Supplied Materials:**
None

**Other Materials Required:**
- Pencil
- Ruler (cm/mm)

**Thursday 15 January 2009**
**Afternoon**

**Duration:** 40 minutes

*A212/02*

| Candidate Forename | | Candidate Surname | |
|---|---|---|---|

| Centre Number | | | | | | Candidate Number | | | | |
|---|---|---|---|---|---|---|---|---|---|---|

**INSTRUCTIONS TO CANDIDATES**

- Write your name clearly in capital letters, your Centre Number and Candidate Number in the boxes above.
- Use black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure that you know what you have to do before starting your answer.
- Answer **all** the questions.
- Do **not** write in the bar codes.
- Write your answer to each question in the space provided, however additional paper may be used if necessary.

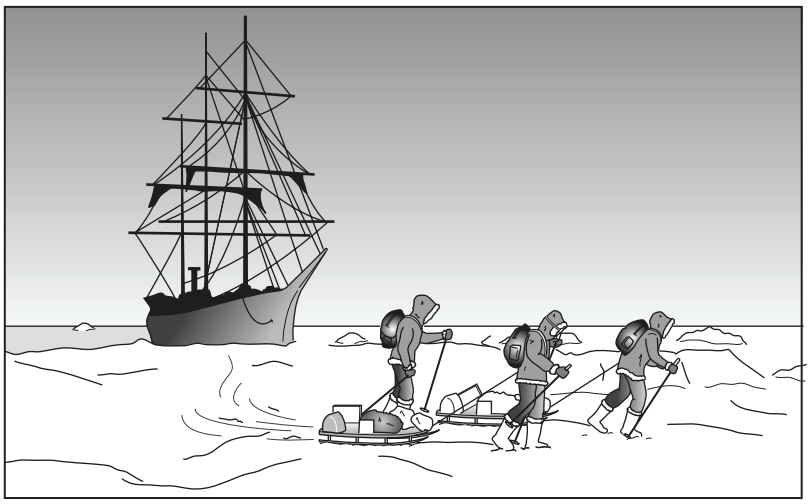
**INFORMATION FOR CANDIDATES**

- The number of marks is given in brackets **[ ]** at the end of each question or part question.
- The total number of marks for this paper is **42**.
- This document consists of **16** pages. Any blank pages are indicated.

| FOR EXAMINER'S USE | | |
|---|---|---|
| **Qu.** | **Max.** | **Mark** |
| 1 | 7 | |
| 2 | 7 | |
| 3 | 6 | |
| 4 | 7 | |
| 5 | 4 | |
| 6 | 5 | |
| 7 | 6 | |
| TOTAL | 42 | |

Answer **all** the questions.

**1** Many explorers travelling to the North and South Poles had problems keeping warm.
They wore woollen clothing.



Modern synthetic materials like **fleece** have better insulating properties.

Anna and Ben test the insulating properties of fleece.
They cover a beaker with fleece.
They fill the beaker with hot water and time how long it takes the temperature of the water to fall by 20°C.
They repeat the test six times.
Here are their results.

| **test** | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| **time in min** | 7 | 18 | 31 | 47 | 10 | 18 |

**(a)** Anna says that these results vary widely.

What is the most likely reason for this?

Put a tick (✓) in the box next to the **best** answer.

All the results are outliers. ☐

The starting temperatures were different. ☐

The beaker was left in different places on the table. ☐

They need to measure the time more accurately. ☐

**[1]**

**(b)** Anna and Ben change their experiment to make the results more reliable.
Here are the new results.

| **test** | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| **time in min** | 35 | 34 | 37 | 38 | 32 | 34 |

**(i)** What is the range of these new results? ..... to ..... **[1]**

**(ii)** Ben says they must find the mean of these results.
Work out the mean of these new results. .....min **[1]**

**(iii)** Why does Ben work out the mean?
Put a tick (✓) in the box next to the **best** answer.

The measurements are not accurate. ☐

The mean gives only one result. ☐

The mean gives the best estimate of the true value. ☐

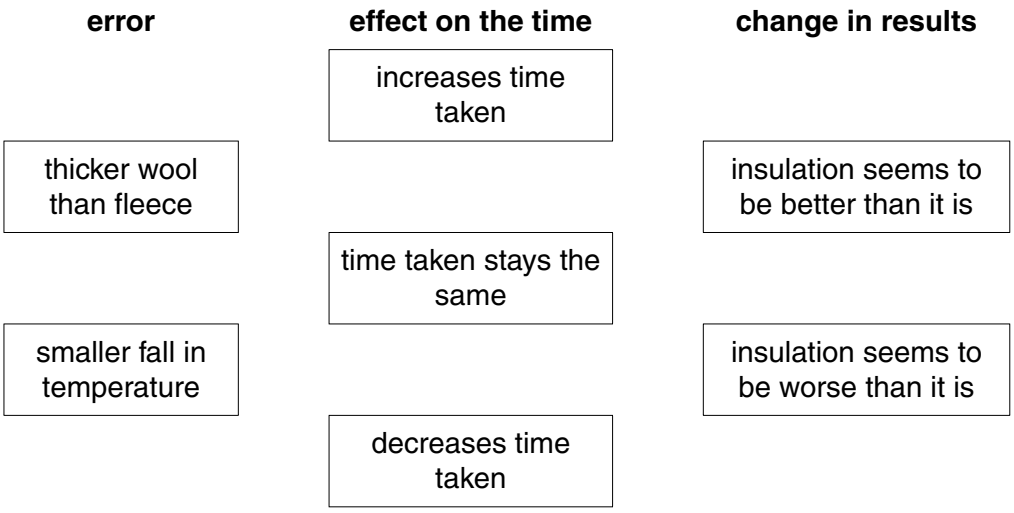
The mean makes sure that the test is a fair one. ☐

**[1]**

**(c)** Anna and Ben now test wool.

**(i)** The diagram below shows two errors in controlling the tests, the effect this has on the time taken for the temperature to fall and the change to their results.

Draw a straight line from each **error** to the **effect on the time** and then to the **change in results**.




**[2]**

**(ii)** Ben and Anna test a third material, felt.

They work out the mean and the range of their results for wool and felt.

| | **wool** | **felt** |
|---|---|---|
| **mean** | 32 min | 36 min |
| **range** | 28 – 37 min | 31 – 39 min |

Does this data suggest there is a real difference between the insulating properties of fleece and wool?

Put a tick (✓) in the box next to the correct answer with the correct explanation.

There is a difference because the mean values are different. ☐

There is a difference because the ranges overlap. ☐

There is a difference because the ranges do not overlap. ☐

There is **no** difference because the mean values are similar. ☐

There is **no** difference because the ranges overlap. ☐

**[1]**

**[Total: 7]**

**2** The table shows the properties of three polymers.

| polymer | strength | flexibility | melting point in °C |
|---|---|---|---|
| low density poly(ethene) (ldpe) | weak | very flexible | 90 |
| high density poly(ethene) (hdpe) | strong | slightly flexible | 135 |
| PVC | strong | not flexible | 185 |

**(a) (i)** Which **two** statements below when put together explain the difference in melting points between low density poly(ethene) and high density poly(ethene)?

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

There are stronger forces within each molecule of hdpe. ☐

There are stronger forces between the molecules of hdpe. ☐

There is cross-linking between molecules of ldpe. ☐

hdpe can absorb more energy. ☐

The amount of energy needed for the molecules to break out of the solid structure is higher in hdpe. ☐

The amount of energy needed for the molecules to break out of the solid structure is lower in hdpe. ☐

**[2]**

**(ii)** What modification to low density poly(ethene) could have been made to give a polymer with the properties of high density poly(ethene)?

..... **[1]**

**(b)** PVC can also be made in a form that is much more flexible than that listed in the table.
PVC that is **not** flexible is used to make gutters and drainpipes for houses.
PVC that is flexible is used to make clothes.

**(i)** To make PVC that is flexible you add a substance called a .....**[1]**

**(ii)** What will make the **largest** difference in the Life Cycle Assessment (LCA) for the two products?

Put a tick (✓) in the box next to the **best** answer.

| | |
|---|---|
| the energy required to make the PVC | ☐ |
| the resources of crude oil needed to make PVC | ☐ |
| how long the PVC is in use | ☐ |
| the disposal of the PVC | ☐ |

**[1]**

**(iii)** Dumping in landfill, burning in incinerators or recycling are different ways of polymer disposal. Many scientists think burning polymers in an incinerator is better than dumping them in landfill.

Which **two** of the following statements when **put together** explain why incineration might have less environmental impact than landfill?

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

| | |
|---|---|
| No toxic gases are made. | ☐ |
| The high temperature of incineration heats the atmosphere. | ☐ |
| The energy released when they burn can be used. | ☐ |
| The waste has to be collected. | ☐ |
| Building incinerators uses energy. | ☐ |
| The need for burning other fuels is reduced. | ☐ |

**[2]**

**[Total: 7]**

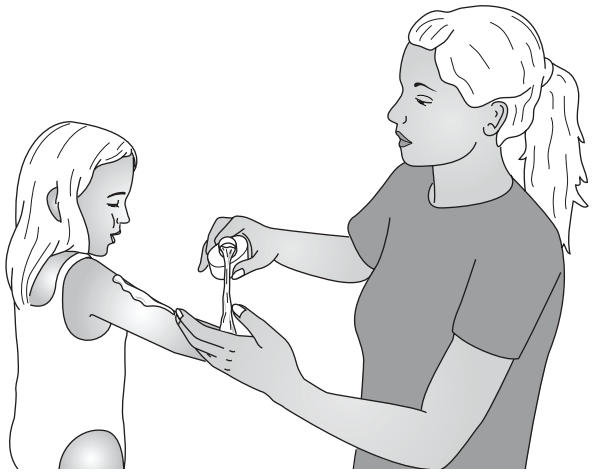
**3** Read this article on sunscreens.

**Sunscreens' weakness brought to light**

Sunscreens might not protect you as well as you think.

People expect sunscreens to prevent skin damage from the sun's harmful ultraviolet (UV) radiation.

Sunscreens contain chemicals that act as UV filters.



Most sunscreens contain two chemical filters. One absorbs lower-energy UVA photons and the other absorbs higher-energy UVB photons. Sunscreens also contain a white powder such as titanium dioxide which reflects UV.

Two of the most widely used UV filters in commercial sunscreens, cinnamates (for UVB) and dibenzoylmethanes (for UVA), break down in sunlight. The reaction is caused by UV radiation and forms products that do not have the filtering properties needed for sunscreen. When these two common filters are mixed together, they are more sensitive to light than either of the compounds alone.

'These results are important for the evaluation of how efficient these compounds are as protectors against UV radiation, and also how fast they disappear from the skin surface,' said an expert in photochemistry. 'It's a factor that is often ignored in the application of sunscreens.'

**(a)** Write down the following:

**(i)** A chemical which absorbs higher-energy ultraviolet radiation.

.....

**(ii)** The name for the study of changes to materials caused by light.

.....

**[2]**

**(b)** Ultraviolet radiation can cause skin cancer. The following statements explain how this happens. They are not in the correct order.

**A** The photons break up molecules.

**B** Ultraviolet radiation is absorbed by skin cells.

**C** The altered genes make the cell develop differently.

**D** Uncontrolled reproduction of a cell produces a tumour.

**E** The molecular fragments take part in chemical reactions.

**F** Chemical changes in the genetic material of the cell take place.

Use the letters **A to F** to fill in the boxes below, putting the stages in the correct order. One has been done for you.

| | | | | | |
|---|---|---|---|---|---|
| B | | | | | |

**[2]**

**(c)** Fruit pickers are at risk because they need to work long hours in the sun.
Recent research shows that thin cotton, as used in tee-shirts, does not absorb much ultraviolet radiation.
Here are some suggested ways of reducing the risk of skin cancer to fruit pickers.

**1** Never pick fruit when the sun is out.

**2** Always use sunscreen and wear a tee-shirt.

**3** Use sunscreen with the highest Sun Protection Factor.

**4** Put fresh sunscreen on exposed skin every hour and wear thick cotton clothes.

**5** Sunscreen does not work, so leave it off, but wear thick cotton clothes.

**6** Do not pick fruit between 10 am and 3 pm.

Choose from the suggestions **1**, **2**, **3**, **4**, **5** or **6** to answer the following questions.

**(i)** Which is the **best** example of the **ALARA** (As Low As Reasonably Achievable) **principle**?

.....

**(ii)** Which is an example of the **precautionary principle**?

.....

**[2]**

**[Total: 6]**

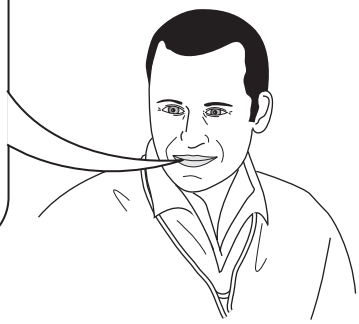
**4** Two scientists are discussing global warming.

**Dr Round**

The Earth's atmosphere warmed up until 1940. Since 1940 it has been cooling down.

I think that people who say the atmosphere has warmed up since 1940 have not interpreted the data correctly.

I think the data from satellites show cooling.



**Professor Price**

The temperature of the Earth's atmosphere is increasing.

There is significant scientific evidence that greenhouse gas emissions, particularly carbon dioxide, are making the temperature rise.

I don't think early satellite data are reliable.

**(a)** Who has made the following claims?
Put a tick (✓) in the **one** correct box next to each statement.

| statement | only Dr Round | only Prof Price | neither scientist | both scientists |
|---|---|---|---|---|
| Carbon dioxide is responsible for global warming. | | | | |
| There is evidence for changes in the temperature of the Earth's atmosphere. | | | | |
| Reducing carbon dioxide emission will prevent global warming in the future. | | | | |

**[3]**

**(b)** This scientist agrees that the Earth's atmosphere is getting hotter, but he's not sure if it's due to carbon dioxide.

**Dr Legrande**

The amount of carbon dioxide in the atmosphere is increasing. Burning fuels makes this carbon dioxide.

I am not sure how carbon dioxide affects climate.

Other factors such as industrial and agricultural dust in the atmosphere have also increased as the Earth's atmosphere has warmed. These may be more important than carbon dioxide.

Some factors and outcomes are linked by **correlation**.
Some factors **cause** an outcome.
What does Dr Legrande say about the following factors and outcomes?
Put a tick (✓) in **each** correct box.
Each row may have one tick, two ticks or no ticks at all.

| factor | outcome | there is a correlation | the outcome is caused by the factor |
|---|---|---|---|
| burning fuel | carbon dioxide increase in the atmosphere | | |
| carbon dioxide increase in the atmosphere | global warming | | |
| industrial and agricultural dust in the atmosphere | global warming | | |

**[3]**

**(c)** Which of the following scientific developments is the best way to convince scientists like Dr Round and Dr Legrande that carbon dioxide causes global warming?
Put **one** tick (✓) in the correct box.

- accurate information about the amounts of fossil fuels burnt since 1940 ☐
- more data on carbon dioxide levels in the Earth's atmosphere since 1940 ☐
- reduction in the amount of agricultural and industrial dust in the atmosphere to check whether changes in temperature result ☐
- more reliable satellite data on the temperatures of the Earth's atmosphere confirming an increase since 1940 ☐
- clear scientific theory predicting the actual changes in temperature in the atmosphere from the measured carbon dioxide levels ☐

**[1]**

**[Total: 7]**

**5** This question is about how our body defends itself against disease.

**(a)** Complete the sentences

**(i)** Antibodies are part of the body's defence system.

It is called the ..... system.

**(ii)** Some microorganisms are engulfed and digested by ..... .

**[2]**

**(b)** Jon is infected by a disease-causing microorganism for the first time.
Use straight lines to join the boxes to make a sentence to describe what happens.

| | | | |
|---|---|---|---|
| | the microorganism is recognised quickly | and antibodies are produced quickly | |
| When Jon is infected by a microorganism for the first time, | the microorganism is recognised slowly | and antibodies are produced slowly | so Jon suffers symptoms of disease and then gets better. |
| | the microorganism is not recognised | and antibodies are not produced | |

**[2]**

**[Total: 4]**

**6** A new study about heart disease has been published in a scientific journal. A study on 260 women claims that hormone replacement therapy (HRT) can reduce the risk of heart disease.

**(a)** A peer review has been done on these new scientific findings.

Put ticks (✓) in the **two** boxes next to the answers which **best** describe the process of peer review.

**Other scientists …**

| | |
|---|---|
| … evaluate the methods used. | ☐ |
| … repeat results to confirm findings. | ☐ |
| … evaluate the analysis of the results. | ☐ |
| … put questions to scientists who wrote the report. | ☐ |
| … find out about hormone replacement therapy. | ☐ |

**[2]**

**(b)** A spokeswoman for the British Heart Foundation said 'uncertainties remain so further research is vital'.

Use straight lines to link each **description of further research** to its **benefit** in removing uncertainty.

| description of further research | benefit |
|---|---|
| continuing the study for a longer time period | results are less likely to be affected by chance |
| increasing the number of women in the study | more likely to detect long term side effects |
| using a control group of women | similar results would make scientists more likely to accept new claim |
| repeating the study in a different area of the country | to be more confident that the effects are due to HRT |

**[3]**

**[Total: 5]**

**7** Read the article.

> **Hope for speedier TB treatment**
>
> About one third of the population of the world is infected by a microorganism causing tuberculosis (TB).
> A four year trial using two antibiotics has been started in Africa.
> Doctors hope to reduce the time it takes to treat TB patients.

**(a)** Which type of disease-causing microorganisms **cannot** be killed by antibiotics?

..... **[1]**

**(b)** **(i)** Here are five statements about testing drugs. They are in the wrong order.

**A** give drug to healthy volunteers to check there are no serious side effects

**B** look at the effect of drug on human cells grown in the laboratory

**C** look at the effect of giving drug to animals

**D** give drug to a large number of people with the illness

**E** give drug to a small number of people with the illness

Fill in the boxes to show the correct order.
The first one has been done for you.

| | | | | |
|---|---|---|---|---|
| B | | | | |

**[1]**

**(ii)** Healthy volunteers are used in drugs testing.
What is the best reason for using healthy volunteers in drug tests?
Put a tick (✓) in the box next to the correct answer.

**reason**

They will clearly show symptoms of the disease. ☐

They are healthy so will be less affected by the disease or new drugs. ☐

They will clearly show any side effects of the new drug. ☐

They will show side effects of the new drug and symptoms of the disease. ☐

**[1]**

**(iii)** Drug trials are often double blind trials.

Use a straight line to link the correct **description** of a double blind trial to the correct **reason** for using double blind trials.

| description | reason |
|---|---|
| the patient, but not the doctor, knows who is taking the real drug | so that the doctor can look carefully for drug side effects |
| both the patient and the doctor know who is taking the real drug | so that the patient does not worry about the possible drug side effects |
| both the patient and the doctor know who is taking the placebo | so that the control group don't imagine that they are suffering side effects |
| only the doctor knows who is taking the real drug | so that the doctor and the patient report changes to symptoms reliably |
| neither the doctor nor the patient knows who is taking the real drug | so that the trial is open and fair to both the doctor and patient |

**[2]**

**(c)** New antibiotics have to be developed.
Put a tick (✓) in the box next to the **best** reason why new antibiotics are needed.

| | |
|---|---|
| Antibiotics are very effective against all diseases so the more the better. | ☐ |
| Antibiotic use produces resistance in disease-causing microorganisms. | ☐ |
| Not enough people finish their antibiotic treatments. | ☐ |
| Genetic mutations can result in microorganisms that are resistant to antibiotics. | ☐ |
| Antibiotics are used to protect farm animals from disease. | ☐ |

**[1]**

**[Total: 6]**

**END OF QUESTION PAPER**

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