



UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE
NAME

CENTRE
NUMBER

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TWENTY FIRST CENTURY SCIENCE

0608/04

Paper 4

October/November 2012

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.

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1	
2	
3	
4	
5	
6	
7	
8	
9	
Total	

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



1 Scientists investigate the acidity of rain water in two locations.

Location **A** is near a coal-burning power station.

Location **B** is in countryside far from the nearest city.

The scientists collect several samples of rain water at each location. They measure the pH of each sample.

Their results are shown in the table.

pH of rain water							
	sample 1	sample 2	sample 3	sample 4	sample 5	sample 6	best estimate
location A	5.7	5.6	5.5	4.7	5.8	5.4	
location B	7.2	5.9	7.0	6.9	7.1	7.3	7.1

(a) (i) Show that the best estimate for the pH of rain water from location **A** is 5.6.

[2]

(ii) The scientists conclude that there is a real difference in the pH of the rain water at the two locations.

Explain how their results show this.

.....

.....

..... [1]

(b) Coal contains small amounts of sulfur compounds.

The scientists think that the acidity of rain water at location **A** is caused by pollution from the coal-burning power station.

(i) Explain how the burning of coal in the power station could cause acidity in rain water.

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.....

..... [2]

(ii) The pollution from the power station causes harm to humans indirectly.

Explain how.

.....

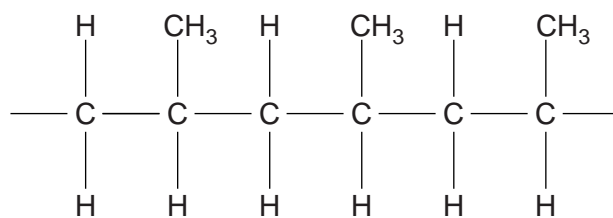
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[Total: 7]

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- 2 The diagram shows a small section of the polymer poly(propene).



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- (a) Draw the structural formula of the monomer that is polymerised to make poly(propene).

[3]

- (b) The chain length of the poly(propene) molecules is decreased.

This makes the polymer more flexible, and it melts at a lower temperature.

- (i) Explain how reducing the chain length causes these changes.

Use ideas about forces in your answer.

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..... [2]

- (ii) The properties of a polymer can be changed by altering its crystallisation.

Describe and explain one of these changes.

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..... [2]

[Total: 7]

3 Farmers grow crops in their soil and then harvest them.

(a) If the same crop is grown on the same ground, the yield decreases each year.

Explain the reason for this decrease in yield.

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.....
.....
..... [2]

(b) To maintain crop yield, synthetic fertilisers can be applied to the soil.

(i) Synthetic fertilisers are used extensively in some countries but not in others.

Suggest why they are not used in these other countries.

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.....
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..... [2]

(ii) Using synthetic fertilisers is not sustainable.

Explain how crop yield can be maintained by more sustainable methods.

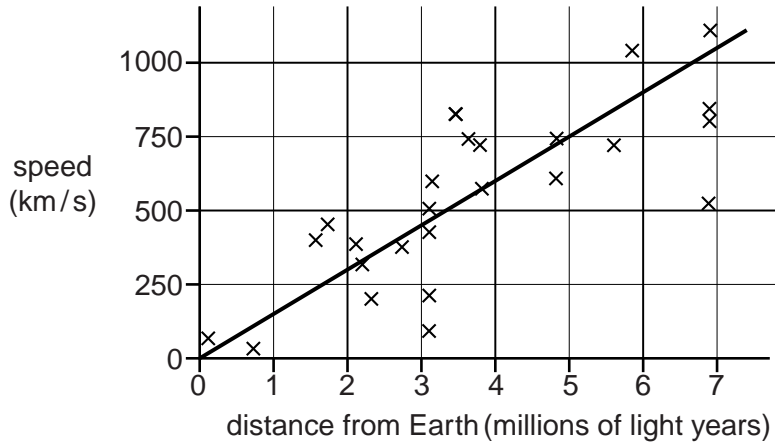
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..... [2]

[Total: 6]

4 This question is about galaxies.

The astronomer Edwin Hubble studied the movement of distant galaxies.

This graph shows Hubble's results.



(a) Describe the relationship shown in this graph.

.....

.....

..... [2]

(b) The gradient of the straight line in the graph is the Hubble constant.

Modern measurements of galaxies show that the Hubble constant is about 22 km/s per million light years.

Show that Hubble's own data gives a value which is about seven times too big.

[2]

(c) Hubble had difficulty measuring the distances to these galaxies.

Were his measurements of distance too big or too small?

Explain your answer carefully using data from the graph.

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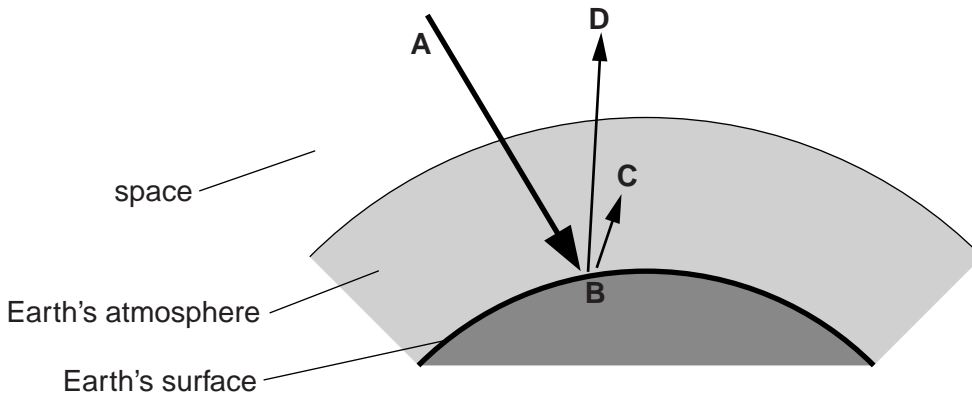
..... [2]

[Total: 6]

QUESTION 5 BEGINS ON PAGE 8.

5 This question is about radiation from the Sun reaching the Earth.

(a) The diagram shows what happens to some of this radiation. It can be used to explain the greenhouse effect.



Use the diagram to explain the greenhouse effect.

In your answer, you should include

- names of the gases in the atmosphere which cause this effect,
- an explanation of what these gases do to electromagnetic radiation.

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.....
.....
..... [3]

(b) Most scientists agree that global warming is due to the greenhouse effect.

(i) Give **one** reason why global warming has increased over the past two hundred years.

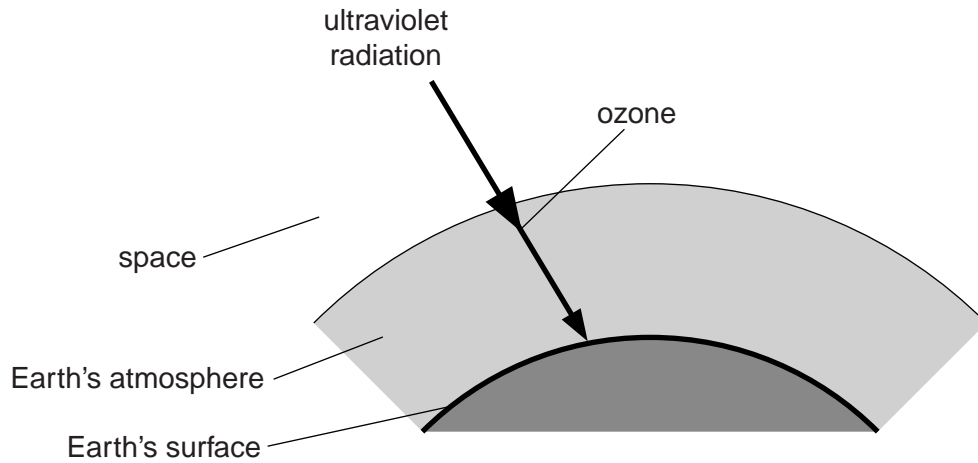
.....
..... [1]

(ii) Write down **one** possible consequence of continued global warming.

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

(c) A different radiation from the Sun, ultraviolet radiation, is partially absorbed by ozone high in the atmosphere, as shown in this diagram.

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Explain how the molecules of ozone in the upper atmosphere absorb ultraviolet radiation, and why the amount of ozone there stays almost constant.

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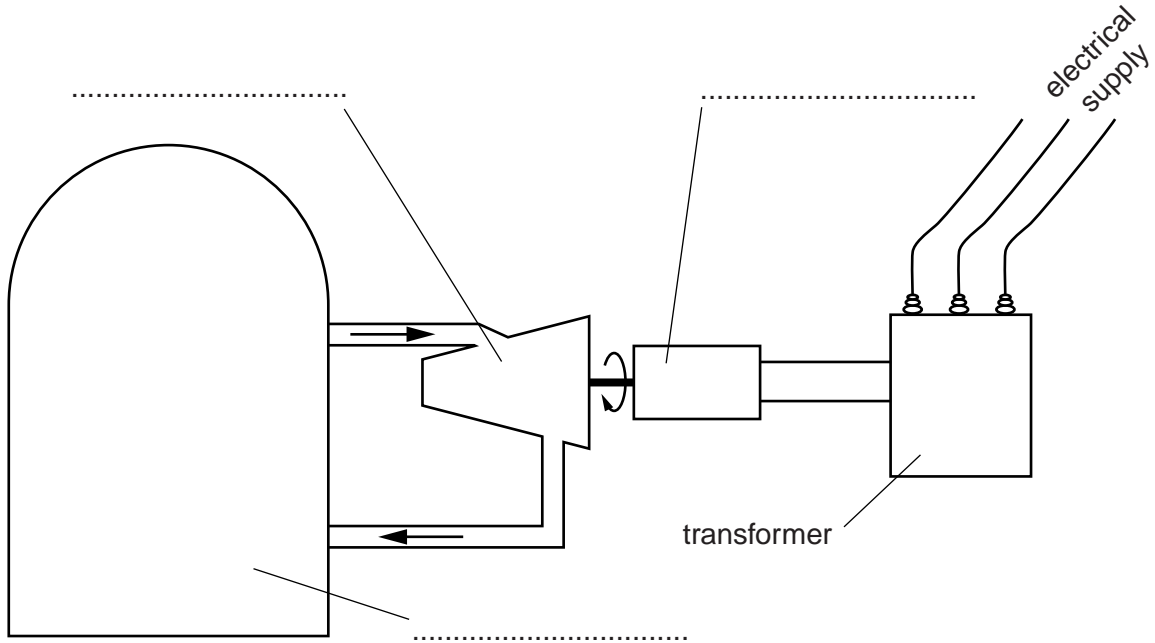
..... [2]

[Total: 7]

6 This question is about nuclear power.

(a) The block diagram shows a nuclear power station.

Label the three stages on the dotted lines provided.



[1]

(b) The energy in a nuclear power station is released by the process of nuclear fission.

Describe what happens in this process.

.....
.....
.....
.....
..... [2]

(c) The table below shows the energy produced by two different types of power station.

type of power station	energy released from 1 kg of fuel/MJ	electrical energy generated by 1 kg of fuel/MJ
coal-burning	36	12
nuclear	3 600 000	1 000 000

(i) Use the data to explain why the supply of fuel to a coal-burning power station has different problems from the supply of fuel to a nuclear power station.

.....
 [1]

(ii) Use the equation below to calculate the efficiency of the **coal-burning** power station in terms of the conversion of the energy released from the fuel (input) to the electrical energy generated (output).

$$\text{efficiency} = \frac{\text{useful energy output}}{\text{total energy input}} \times 100\%$$

efficiency = % [2]

(d) People who work in a nuclear power station have a greater health risk from exposure to radiation than people who do not work there.

The managers of the power station need to make sure that the workers are as safe as possible.

Suggest and explain **one** way in which the risk to the workers can be reduced.

.....
 [1]

[Total: 7]

7 Blood is carried around the body in blood vessels.

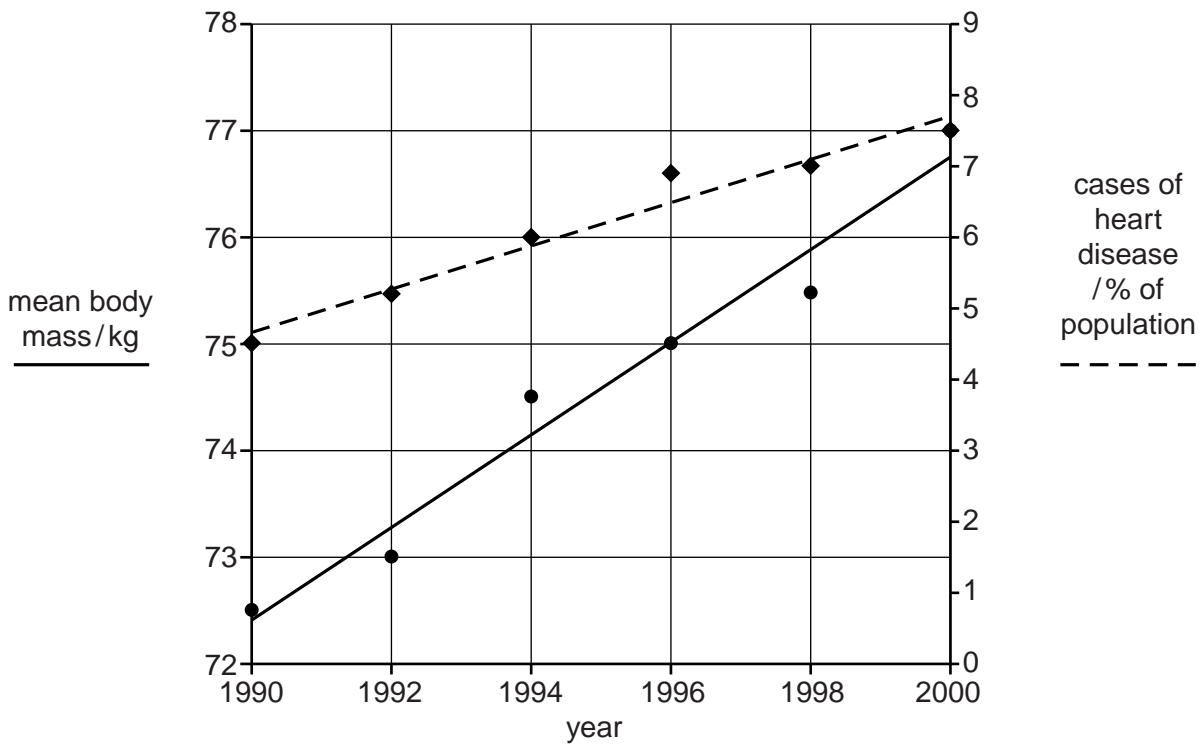
Some blood vessels carry blood directly to the heart muscle.

(a) Suggest why the heart muscle needs its own blood supply.

.....
 [1]

(b) The graph shows the mean body mass of a population over a ten year period.

It also shows the percentage of the same population who were affected by heart disease during the same ten year period.



(i) Describe the correlation between body mass and heart disease shown by the graph.

.....

 [1]

(ii) A doctor uses these data to tell overweight patients they will get heart disease.

Suggest whether you agree with the doctor. Explain your answer.

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.....
.....
..... [2]

(iii) It is likely that the graph represents a population living in an industrialised country such as the USA.

Suggest reasons why.

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..... [2]

[Total: 6]

8 (a) In 1859, Charles Darwin proposed his theory of evolution.

He suggested that the many different species of living things on Earth all developed gradually over time from very simple living things.

Suggest **two** reasons why many people refused to accept his theory.

.....
.....
..... [2]

(b) Earthworms are small organisms found living in the soil.



Arsenic is a poisonous element.

In the early 19th century, some arsenic mines were dug in the south of England.

Over time, the amount of arsenic in the soil near to the mines increased. This arsenic killed most of the earthworms living in the soil.

However, a small number of live earthworms were found in the soil. These earthworms were different in appearance from the original earthworms, and were not killed by the arsenic.

Scientists believe that these earthworms are a new species. The species appears to be resistant to arsenic due to mutation.

Explain how this mutation has resulted in the resistant species of earthworm.

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..... [3]

(c) New species can be created by the process of **selective breeding**.

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Describe how this process is carried out.

.....

.....

..... [2]

[Total: 7]

9 Jack and Jill work for the same employer.

He asks them to undergo a genetic test for alleles that cause genetic diseases.

Jill does not want to have the test because she might have a genetic disease.

She knows that the results of the test may be shared with her employer and her insurance company.

(a) Explain why Jill might be unhappy for the information to be shared with her employer and with her insurance company. Give **two** reasons in each case.

employer

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.....
.....
.....

insurance company

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..... [4]

(b) Jack's father is a carrier of sickle cell anaemia.

Suggest one reason why Jack is willing to undergo the genetic test.

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..... [1]

(c) Describe how a person inherits sickle cell anaemia.

.....
.....
..... [2]

[Total: 7]

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