UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER				

TWENTY FIRST CENTURY SCIENCE **0608/05**

Paper 5 **October/November 2010**

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	
Total	

This document consists of **14** printed pages and **2** blank pages.

Section A

For Examiner's Use

Read this newspaper article.

Photochemical Smog

What is smog?

Non-polluted air contains nitrogen, oxygen, carbon dioxide and argon, as well as water vapour. Air can be polluted by a variety of gases.

Photochemical smog forms when sunlight hits various pollutants in the air. These include nitrogen dioxide, volatile organic compounds (VOCs), airborne particles (particulates) and ground-level ozone. Smog may also contain sulfur dioxide and carbon monoxide. Both sulfur dioxide and nitrogen dioxide also cause acid rain.

Nitrogen oxides are produced when nitrogen and oxygen in the air react together under high temperature in car engines and coal fired power plants. VOCs are released from petrol, paints, solvents and pesticides.

Where and when is smog formed?

Photochemical smog is present in all modern cities, but it is more common in cities with sunny, warm, dry climates and a large number of motor vehicles. Because it travels with the wind, it can affect less populated areas as well.

Smog is worse during periods of warmer, sunnier weather when the upper air is warm enough to prevent circulation. It is particularly bad in areas surrounded by hills or mountains. Smog often stays for a long time over densely populated cities and can build up to dangerous levels.

A danger to health

Smog is a danger to human health, especially for people with medical conditions such as emphysema, bronchitis, and asthma. It can cause shortness of breath, pain when inhaling deeply, and coughing. It can cause eye and nose irritation and interferes with the body's ability to fight infection, increasing susceptibility to illness. Hospital admissions and respiratory deaths often increase during periods when smog levels are high.

Canadian research found that smog is responsible for 9500 premature deaths in Ontario each year.

American Cancer Society research found that repeated exposure to smog increases the likelihood of premature death from respiratory disease.

Measuring smog

The severity of smog is often assessed by measuring the level of particulates in air. The World Health Organisation (WHO) has set a target for particulates of not more than 50 micrograms per cubic metre.

Beijing is a Chinese city that suffers from photochemical smog. The chart shows levels of particulates recorded over a 28 day period in Beijing.

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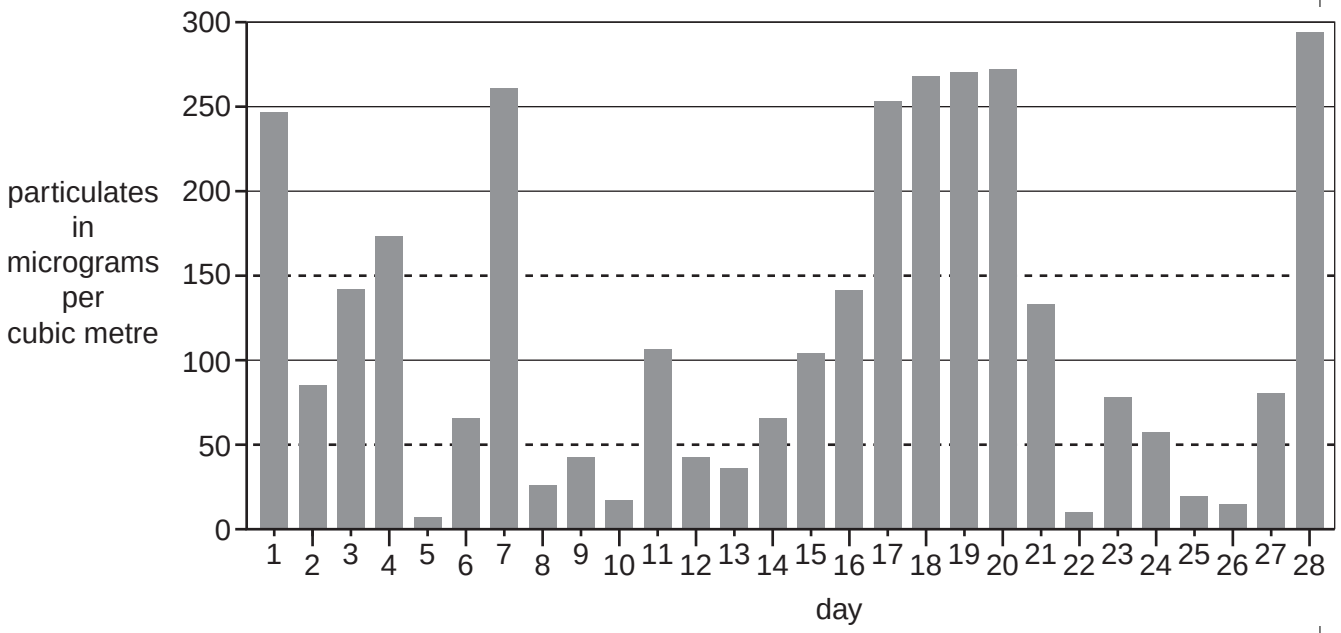

During this period the WHO's target was frequently exceeded.

City smog comparison

Scientists measured the particulate level in the air on the same day in two different cities. In each city they tested six samples. Their results are shown in **Table 1**.

Table 1

	particulate level (micrograms per cubic metre)						
	sample 1	sample 2	sample 3	sample 4	sample 5	sample 6	mean
city **A**	48	53	52	49	51	53	
city **B**	49	47	51	50	32	48	49

Scientists measured the particulate level in a City **C** on five different days. They calculated the mean particulate level for each day and compared this with the number of people dying from asthma. Their results are shown in **Table 2**.

Table 2

mean particulate level (micrograms per cubic metre)	number of deaths from asthma
48	4
69	6
84	7
115	10
164	14

Use information from the article 'Photochemical Smog' to help you answer question 1.

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1 (a) Other than water, the main gases in non-polluted air are nitrogen, oxygen and argon.

Complete the table to show the percentage of each of these gases in dry air.

gas	percentage in dry air
	78
	21
	1

[2]

(b) (i) Use words from the article to complete this sentence about the way that smog is formed.

Smog is formed by the action of ..... on .....

and volatile ..... compounds in the atmosphere. [3]

(ii) Some of the nitrogen dioxide in the air results from the burning of petrol in cars.

The formation of this nitrogen dioxide involves two reactions, one in the car engine and one in the air.

Use ideas about these two reactions to explain how the burning of petrol in a car engine results in the addition of nitrogen dioxide to the air.

.....

.....

.....

.....

.....

..... [4]

(iii) Write a balanced symbol equation for the reaction in the car engine.

..... [2]

(iv) Much of the nitrogen dioxide in the air does not form photochemical smog.

Like sulfur dioxide, this nitrogen dioxide does not stay in the air.

Explain what happens to this nitrogen dioxide.

.....

.....

.....

..... [3]

(c) The article says that photochemical smog is particularly bad in areas surrounded by hills or mountains.

Suggest why.

.....

..... [1]

(d) **(i)** Smog can be a danger to people who already have certain medical conditions.

Three of these medical conditions are mentioned in the article.

Name these three medical conditions.

1 .....

2 .....

3 ..... [1]

(ii) Many doctors believe that photochemical smog causes the death of some people.

What research mentioned in the article supports this theory?

.....

.....

.....

..... [2]

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(e) The severity of smog is often assessed by measuring the level of particulates in air. The World Health Organization (WHO) has set a target for particulates of not more than 50 micrograms per cubic metre.

Look at the chart showing levels of particulate matter recorded over a 28 day period in Beijing.

On what percentage of these days was the number of particulates higher than the WHO target?

Give your answer to the nearest whole number.

Show your working.

percentage = ... % [3]

(f) Look at **Table 1** in the article.

(i) The scientists calculated the mean to use as a best estimate of the particulate level for City **B**.

Explain why they did not use the measurement for sample 5.

.....

..... [1]

(ii) Calculate the best estimate for the particulate level in City **A**.

Show your working.

particulate level in City **A** = ... micrograms per cubic metre [2]

(iii) The scientists decide that the measurements for City **A** are reliable.

What evidence from **Table 1** supports this?

.....

..... [1]

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(iv) The mean particulate level for City **A** is above the WHO target and the mean particulate level for City **B** is below the WHO target.

But the scientists conclude that they cannot say that the air in City **A** had worse smog on this day than the air in City **B**.

Use the data in **Table 1** to explain why.

.....

.....

..... [2]

(v) The data in **Table 2** shows a trend between the level of particulates and the number of deaths from asthma.

1. Describe this trend.

.....

.....

2. What is this type of trend called?

..... [2]

(vi) What further information, in addition to more data, is needed to say that smog causes deaths from asthma?

.....

..... [1]

[Total: 30]

Section B

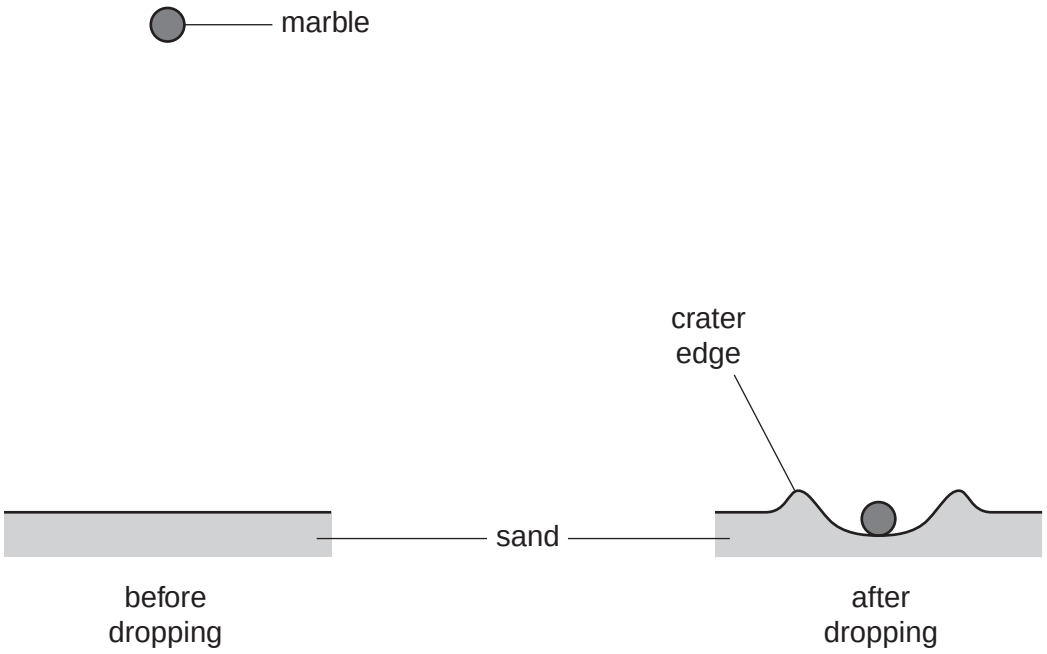
For Examiner's Use

2 When asteroids crash onto Earth, they make large craters.

Jake and Imran are investigating craters by dropping marbles (small glass balls) into sand from different heights.

They want to find out how the diameter of the crater depends on the height from which the marble is dropped.

The diagram below shows **before** and **after** views of the marble and the sand.



(a) You are going to investigate how the diameter of the craters depends on the height from which the ball is dropped.

(i) Here is a list of pieces of apparatus.
Put a (ring) around the piece of apparatus you would need for this experiment.

balance (scales) **measuring cylinder** **ruler** **thermometer**

[1]

(ii) Write down the two things you will measure in the experiment.

1 .....

2 ..... [2]

(iii) Describe how you would use your apparatus to get an accurate set of readings of crater diameter for different heights.

.....

.....

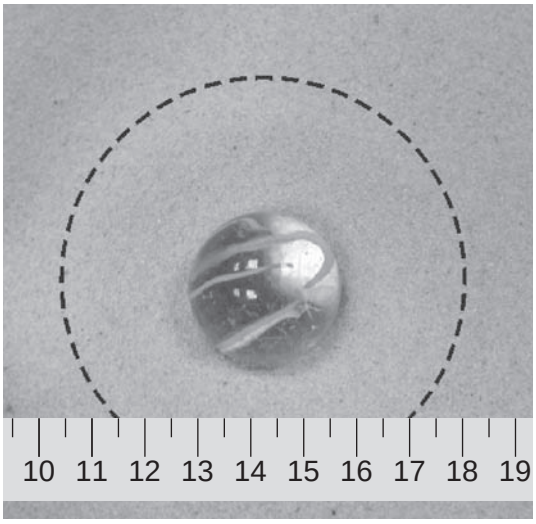
.....

.....

..... [2]

(b) The photograph shows a crater from the experiment, seen from above.

The black dotted circle has been drawn to show the edge of the crater. The ruler is marked in centimetres.



Here is Jake's calculation to find the diameter of this crater.

diameter = 17.1 cm – 11.45 cm = 5.65 cm

Write down the mistakes Jake has made in his measurement, and explain how he should have made measurements to get a good estimate of the diameter of this crater.

.....

.....

.....

.....

..... [3]

(c) Imran obtains this set of data:

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height (in cm)	40	60	80	100
diameter of crater (in cm)	2.0	4.0	5.5	6.0

Imran makes two conclusions from his results.

What are these conclusions?

1. .....

.....

2. .....

..... [2]

[Total: 10]

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QUESTION 3 IS ON PAGE 12

3 Reuben compares the structure of two blood vessels, **A** and **B**, each about 1 cm in diameter.

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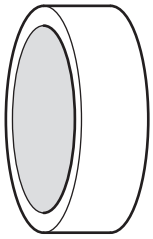
He uses a 3 mm section of each blood vessel, as shown in the diagram.



He also uses the following apparatus.

- stand
- clamp
- mass holder
- 20 g masses
- 30 cm ruler with divisions every 5 mm

The table shows how much each blood vessel section stretches when loaded with different masses.

	stretch of each blood vessel section at each load (in mm)				
mass (in g)	20	40	60	80	100
blood vessel **A**	1	3	4	6	7
blood vessel **B**	2	5	10	20	25

(a) Describe how Reuben used the apparatus to obtain these measurements.

.....

.....

.....

.....

.....

.....

..... [3]

(b) Reuben realises that one piece of apparatus he is using is not very accurate.

(i) Identify this piece of apparatus.

..... [1]

(ii) Suggest an alternative piece of apparatus that would be more accurate.

.....

..... [1]

(c) Reuben's teacher suggests that Reuben needs to repeat his experiment.

Why is it important for Reuben to repeat his experiment?

..... [1]

(d) One of the blood vessels is an artery.

Identify which blood vessel, **A** or **B**, is an artery. Explain your choice.

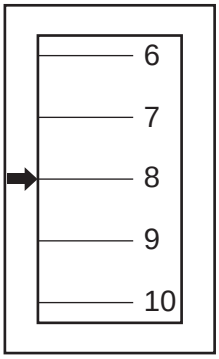
.....

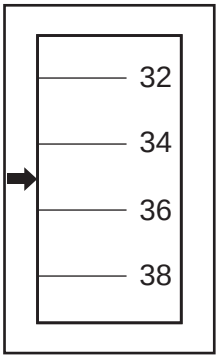
.....

..... [2]

(e) In a further experiment, Reuben uses a force-meter to measure the force required to break the blood vessels.

Write the readings in the spaces below the diagrams.





Reading for blood vessel **A** = ... N

Reading of blood vessel **B** = ... N

[2]

[Total: 10]

For Examiner's Use

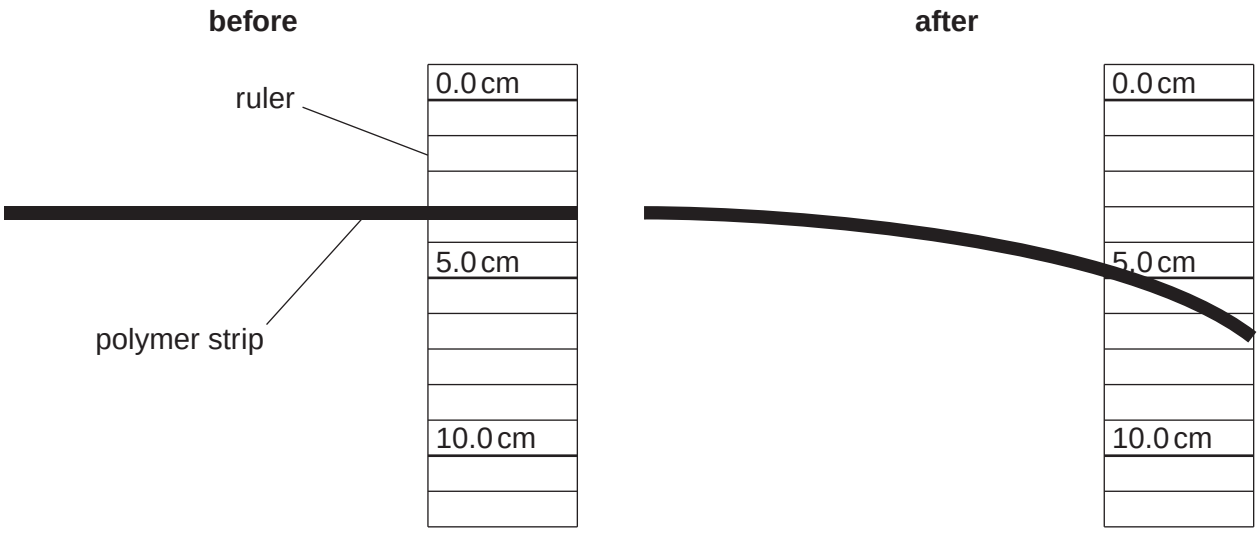
4 Plasticisers can be added to polymers to increase their flexibility.

Scientists test the effect of a plasticiser on the flexibility of a polymer.

They measure how much a strip of polymer bends when a mass is hung on the end of it.

This procedure is repeated with samples of this polymer containing different amounts of plasticiser.

(a) The diagram shows a strip of polymer with 0.5% of plasticiser, before and after the mass is hung from it.



(i) Record below measurements from the diagram. Take your measurements from the top of the polymer strip.

before = ... cm

after = ... cm [2]

(ii) How far has the polymer strip bent?

..... cm [1]

(b) The scientists decide that this is not an accurate best estimate of the distance bent by the polymer with 0.5% plasticiser.

(i) Other than using a ruler with finer divisions, how can they obtain a more accurate best estimate?

.....

..... [1]

(ii) Explain why this best estimate is more accurate than the measurement in **(a)**.

.....

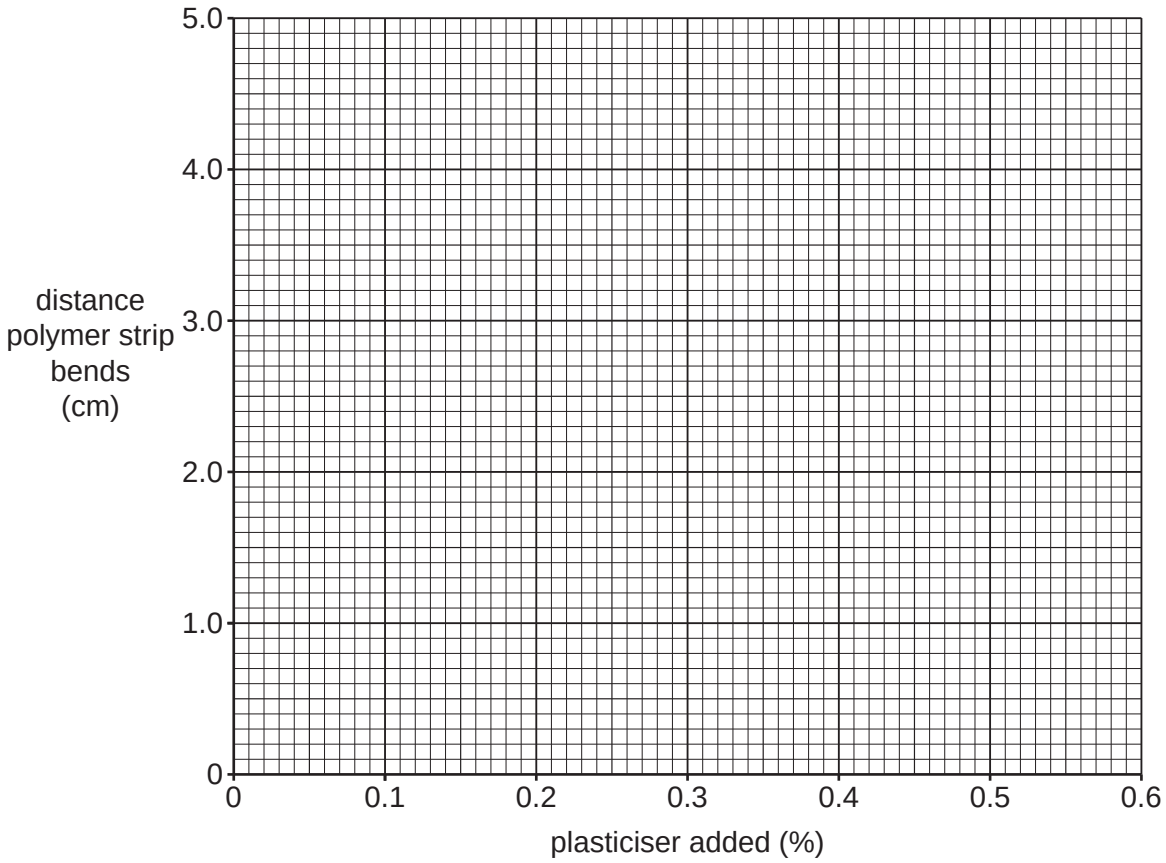
..... [1]

(c) The table shows accurate best estimates of the distance the polymer bends with different amounts of plasticiser added.

plasticiser added (%)	0.0	0.1	0.2	0.3	0.4	0.5
distance strip bends (in cm)	0.0	0.7	1.5	2.2	3.0	3.7

(i) On the grid below plot the results shown in the table. [2]

(ii) Draw a line of best fit for the points you have plotted. [1]



(iii) Extrapolate the line on your graph to find the best estimate for the distance the polymer strip bends when 0.6% plasticiser is added.

..... cm [1]

(iv) Draw a conclusion for the effect of this plasticiser on the flexibility of the polymer.

.....

..... [1]

[Total: 10]

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