

GENERAL CERTIFICATE OF SECONDARY EDUCATION
TWENTY FIRST CENTURY SCIENCE
SCIENCE A

UNIT 1: Modules B1 C1 P1 (Higher Tier)

TUESDAY 15 JANUARY 2008

Afternoon
 Time: 40 minutes

Candidates answer on the question paper.

Additional materials (enclosed):

None

Calculators may be used.

Additional materials: Pencil
 Ruler (cm/mm)



Candidate
Forename

Candidate
Surname

Centre
Number

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Candidate
Number

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INSTRUCTIONS TO CANDIDATES

- Write your name in capital letters, your Centre Number and Candidate Number in the boxes above.
- Use blue or 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.
- Do **not** write outside the box bordering each page.
- Write your answer to each question in the space provided.

INFORMATION FOR CANDIDATES

- The number of marks for each question is given in brackets [] at the end of each question or part question.
- The total number of marks for this paper is 42.

FOR EXAMINER'S USE

Qu.	Max	Mark
1	5	
2	9	
3	6	
4	2	
5	6	
6	8	
7	6	
TOTAL	42	

This document consists of **18** printed pages and **2** blank pages.

Answer **all** the questions.

- 1 Sam has been watching a TV programme on continental drift.

He is trying to explain it to his friend Jo, but he has forgotten some of the information in the programme.



Sam

The crust of the Earth is made of tectonic plates which all fit together. The mantle is liquid. The plates are on top of the mantle.

The tectonic plates move about. At their edges, plates collide, or move apart, or scrape past each other.

Volcanoes and earthquakes happen at edges where tectonic plates meet, but mountains build up near the centre of the plates. Where plates move apart under the oceans, they make new seafloor.

- (a) Sam makes a number of statements of fact. Some of them are mistakes.

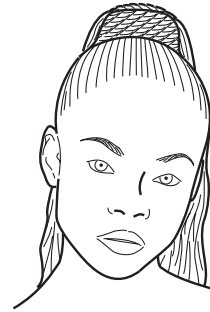
Write **T** in the box next to each **true** statement and **F** in the box next to each **false** one.

	T (true) or F (false)
The crust of the earth is made of tectonic plates.	<input type="checkbox"/>
The mantle is liquid.	<input type="checkbox"/>
The plates are on top of the mantle.	<input type="checkbox"/>
The tectonic plates move about.	<input type="checkbox"/>
Volcanoes and earthquakes happen where tectonic plates meet.	<input type="checkbox"/>
Mountains build up near the centre of the plates.	<input type="checkbox"/>

[4]

(b) Jo needs to be convinced of these ideas.

Jo
I'm not sure if I believe that the crust of the Earth is made of moving plates.
What's the evidence for it?



Here are some scientific observations.

Put a tick (✓) in the box next to **each** statement which provides evidence for continental drift.

The Earth has a hot core of molten iron.

Rocks of the ocean floor are magnetised by the Earth's field.

There are ridges of solidified magma near the centres of many oceans.

Volcanoes and earthquakes are common in coasts and islands along the edges of the Pacific Ocean.

[1]

[Total: 5]

- 2 When astronomers look at the night sky through telescopes, they see many stars and spiral nebulae.



© R. Jay GaBany

In 1920, astronomers did not know what 'spiral nebulae' were, nor how far away they were. There was a great debate between two astronomers.



Harlow Shapley

Our Milky Way is the only galaxy there is: it's the whole Universe. It is huge: 300 000 light years across.

Spiral nebulae are clouds of gas and dust inside the Milky Way.

Our Sun is far from the centre of the Milky Way.

Heber Curtis

You're wrong about the size of the Milky Way - it's ten times smaller than that.

Our Sun is very near the centre of the Milky Way.

These spiral nebulae are galaxies just like our Milky Way. They are much further away from us than the edge of the Milky Way galaxy.



(a) The statements below were made by one or both of these astronomers.

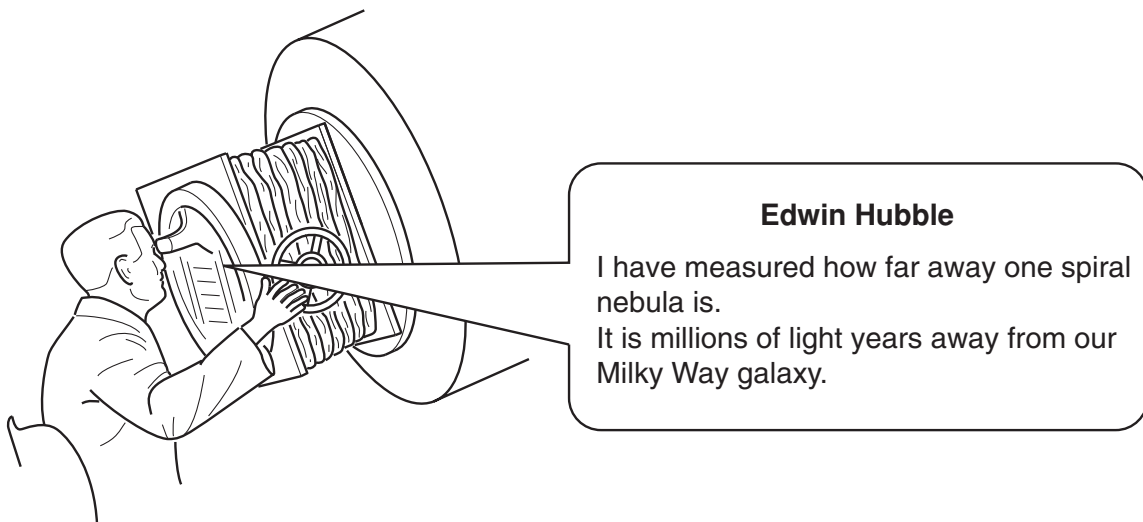
Who made each statement?

Put a tick (✓) in **each** correct box.

	Shapley	Curtis	both Shapley and Curtis
The Milky Way is the only galaxy.			
Spiral nebulae are part of the Milky Way.			
The Milky Way has our Sun close to its centre.			
The Milky Way is thousands of light years in size.			

[4]

(b) Another astronomer made more accurate measurements on stars and spiral nebulae.



Hubble's measurements helped to solve part of the debate between Shapley and Curtis.

Put a tick (✓) or a cross (X) in **each** box to show whether Hubble's observation supported Shapley's theory or Curtis's theory.

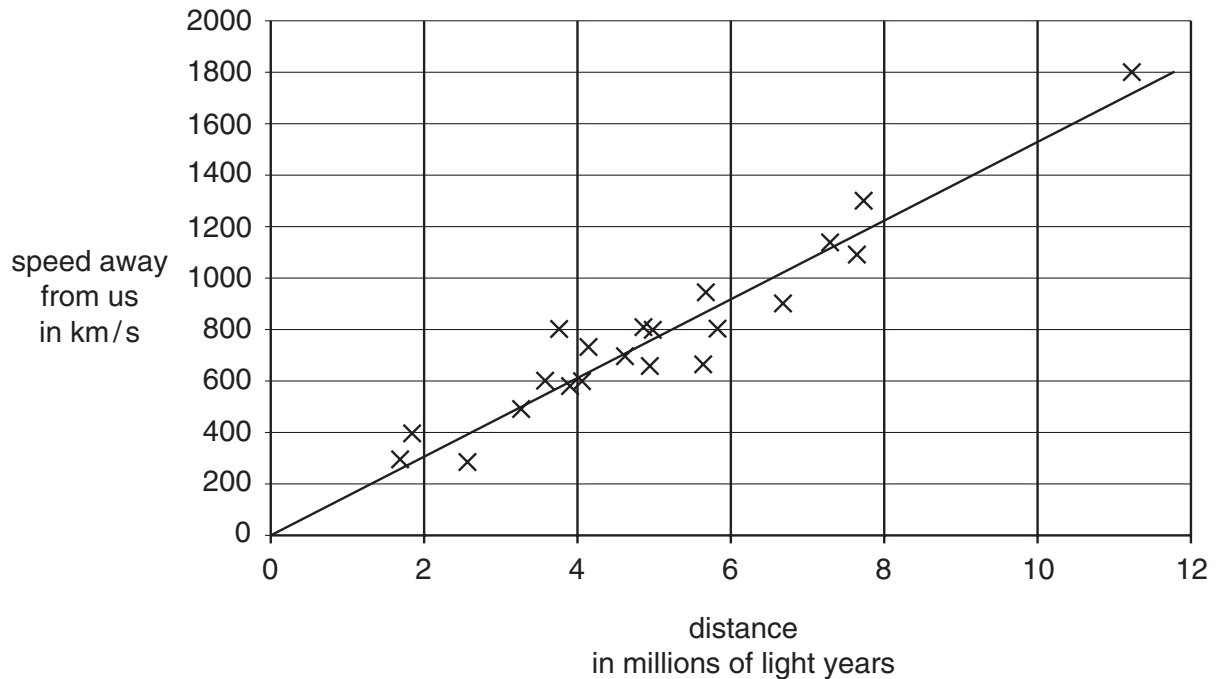
Key:
 ✓ – supports theory
 X – does **not** support theory

	supports Shapley	supports Curtis
the size of the Milky Way		
where spiral nebulae are found		

[2]

- (c) Edwin Hubble made many more measurements of spiral nebulae. He measured their speeds and the distances to them.

Here is a graph of his data.



Put a tick (✓) in the box next to **each** correct statement supported by this graph.

All the spiral nebulae in this graph are moving away from us.

A spiral nebula eight million light years away from us has exactly twice the speed of one which is four million light years away from us.

The graph supports the theory that Space is expanding.

The increase in speed of a more distant spiral nebula is caused by its greater distance from us.

There are no spiral nebulae further from us than 12 million light years.

There is a correlation between speed and distance.

[3]

[Total: 9]

3 Read the newspaper article below.

Three sisters unite for surrogate birth

Laura, who is infertile, has a baby boy thanks to her two sisters.

Her sister Rebecca had an operation to remove an egg.

This was fertilised using sperm from Laura's husband, Simon.

The embryo was implanted into another of Laura's sisters, Hannah.

Hannah became pregnant and gave birth to a healthy boy, Jake.

(a) Jake is a boy. His sex is determined by his sex chromosomes.

Write down the sex chromosomes Jake must have inherited.

answer [1]

(b) Which statement best explains who Jake is most like?

Put a tick (✓) in the correct box.

Rebecca, because she donated the egg.

Hannah, because she was pregnant with Jake for 9 months.

Rebecca, because all of Jake's genes came from her.

Hannah, because half of Jake's genes came from her.

[1]

(c) Read the quotes below from the doctor and the three sisters Laura, Rebecca and Hannah.



Hannah, who gave birth to Jake

A
I was afraid that I would miss the baby.

B
Everywhere I went, all I saw was women pushing prams.

C
Rebecca had to have an operation to remove the eggs. I was worried about that.



Laura, the infertile sister who wanted a baby

D
I am very grateful to my sisters.

E
I was worried the baby would not love me.



Rebecca, the sister who donated an egg

F
I don't remember much about the operation.

G
There is only a 25% chance of success in this type of treatment.

H
The treatment cost £3000.



the doctor who supervised the treatment

Complete the table. Write either **yes** or **no** in each box.
The first two have been done for you.

quote	explains why this procedure does not happen very often	identifies a risk taken
A	yes	no
B	no	no
C		
D		
E		
F		
G		
H		

[2]

(d) Laura and Rebecca are identical twins.

Draw a straight line from each **statement** to its best **explanation**.

statement

explanation

Rebecca and Laura are clones.

They both grew from stem cells.

Mutations occur during development due to environmental factors.

No two sperm are ever exactly the same.

Sexual reproduction produces new variations.

Rebecca and Laura will not have exactly the same DNA.

Two eggs were released and fertilised with sperm from the same father.

During its development, an embryo split into two groups of cells.

No two eggs are ever exactly the same.

[2]

[Total: 6]

4 This article appeared on a website.

Watchdog backs more embryo checks

There are new guidelines for tests on embryos. Couples with family histories of breast cancer can now have their embryos tested.

Breast cancer does not usually affect people until they are over thirty.

Individuals with the genes linked to breast cancer have about an 80% chance of developing breast cancer.

Testing will not be allowed for conditions like asthma which can be treated with medicine.

Testing will not be allowed for schizophrenia which is not caused by a single gene.

Adapted from BBC News at <http://news.bbc.co.uk>, 10 May 2006

(a) There are **two major changes** to the tests on embryos which should be allowed.

Put ticks (✓) in the boxes next to the **two** tests which will be allowed by the new guidelines.

tests for genes causing asthma

tests for genes that increase the chance of cancer

tests for conditions caused by many genes, e.g. schizophrenia

tests for genes which do not usually affect individuals until they reach the age of thirty

[1]

(b) Schizophrenia is probably caused by a combination of several inherited genes and environmental factors.

Who is **most** likely to suffer from schizophrenia?

Choose from the following people.

individual	genes present	environmental factors present
Andy	yes	yes
Briony	no	yes
Chloe	yes	no
David	no	no

answer [1]

[Total: 2]

5 Read the article below.

Blood, Bones and Stem Cells

Mesenchymal stem cells can be extracted in large numbers from bone marrow and have the ability to grow into bone, cartilage, muscle and fat.

These adult stem cells from the bone marrow of patients may be used in the future to help mend broken bones.

Mesenchymal stem cells will be taken from the patient, grown and using genetic techniques directed into producing bone and cartilage. This new bone and cartilage will help repair bone defects such as osteoporosis and fractures.

(a) Choose from this list of words to answer the questions below.

- conclusion
- fact
- prediction
- theory

(i) Which term **best** describes the **first** sentence in the article?

answer [1]

(ii) Which term **best** describes the **second** sentence in the article?

answer [1]

(b) The use of Mesenchymal stem cells described in the article is different from treatment based on cloning embryonic stem cells.

Put ticks (✓) in the boxes next to the **two** statements which **best** describe these differences.

It is legal.

There is no nuclear replacement.

The stem cells are from the patient.

Mesenchymal stem cells are already specialised.

Only the nucleus used comes from the patient's cells.

Adult stem cells can grow into any type of specialised cell.

[2]

(c) Stem cells can also be obtained from embryos (embryonic stem cells).
Embryonic stem cell research is controversial.
Read these statements about the use of embryos in stem cell research.

- 1 Embryos are living human beings.
- 2 Embryos younger than 14 days have no nervous system.
- 3 Human beings have rights.
- 4 In normal pregnancies, many embryos die at an early stage of development.
- 5 Millions of people with incurable diseases could benefit from stem cell research.
- 6 The embryos used in stem cell research are left over from fertility treatments and would die.

(i) Which **two** statements, taken together, support the argument that the use of embryos is ethically wrong?

answer [1]

(ii) Which **three** statements, taken together, support the argument that the use of embryos is justified, because it may lead to the best outcome for the majority of people involved?

answer [1]

[Total: 6]

- 6 In the UK, older cars must have an MOT test every year to check that they are working properly.

One part of the test is to check that the amount of each pollutant gas in the exhaust emissions is within legal limits when the engine is running at a particular speed.

The table shows the results for the test on a car.

	Limits	Actual value
engine speed	2500-3000 rpm	2829 rpm
carbon monoxide	less than 0.3%	0.03%
hydrocarbons	less than 200 ppm	28 ppm

- (a) Why is it important that the amounts of gases are measured at a particular engine speed?

Put ticks (✓) in the correct boxes.

The limits have been set to a particular engine speed.

All cars can travel at an engine speed of 2500-3000 rpm.

At very low engine speeds no pollutants are produced.

Engine speed is a factor that may affect the outcome of the test.

The percentages of pollutant gases may vary at different engine speeds.

Cars travel at different engine speeds.

[2]

- (b) Exhaust emissions also contain sulfur dioxide and nitrogen oxides as well as carbon monoxide.

The molecules of these gases are formed in the engine.

Where have the atoms come from which produce these gases?

Put a tick (✓) in the correct box for each gas.

gas	atoms in the fuel alone	atoms in the air alone	atoms in both the fuel and the air
carbon monoxide			
sulfur dioxide			
nitrogen oxides			

[2]

- (c) Liz uses an electronic sensor to take five measurements of the percentage of carbon monoxide in the car exhaust.

These are her results.

test	percentage of carbon monoxide (%)
1	0.12
2	0.03
3	0.04
4	0.03
5	0.02

- (i) Liz treats test 1 as an **outlier**.

Why does she do this?

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

The first test is just a rough trial.

This result is higher than the mean of the other results.

This result lies well outside the range of the other results.

This result is not a best estimate.

[1]

(ii) Complete the sentence about the true value of the percentage of carbon monoxide.

The true value lies in the range [1]

(iii) Why does Liz repeat the test five times?

Put ticks (✓) in the **two** boxes next to true reasons for repeating the test.

She is looking for a correlation.

The electronic sensor may not work reliably.

The data is more accurate.

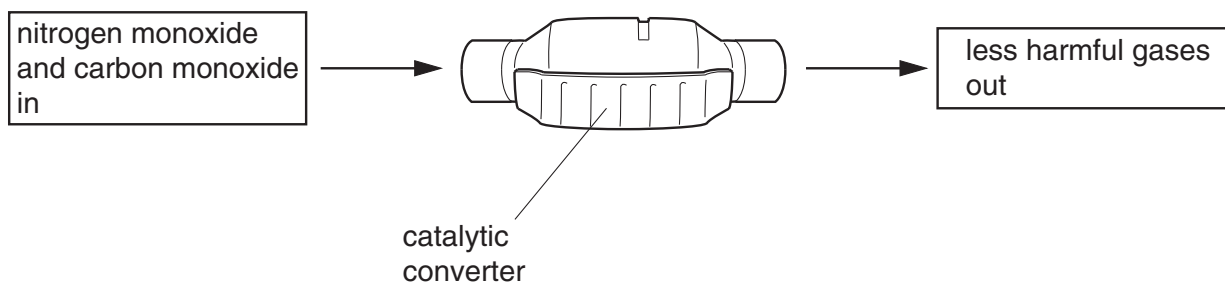
It is important to control other factors when measuring.

The percentage of carbon monoxide in the exhaust may vary.

[2]

[Total: 8]

- 7 Nitrogen monoxide and carbon monoxide are gases that affect air quality. Catalytic converters reduce the emission of these gases from cars.



- (a) Complete the sentences to explain how the catalytic converter works.

Choose from this list.

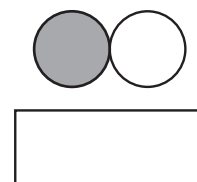
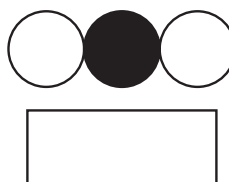
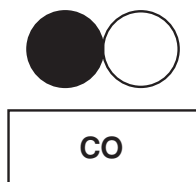
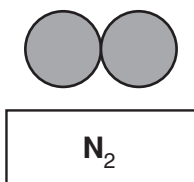
- carbon
- carbon dioxide
- hydrocarbon
- nitrogen
- nitrogen monoxide
- sulfur dioxide

In the converter, carbon monoxide is converted into carbon dioxide by reacting with molecules of

The products of this reaction are carbon dioxide and [2]

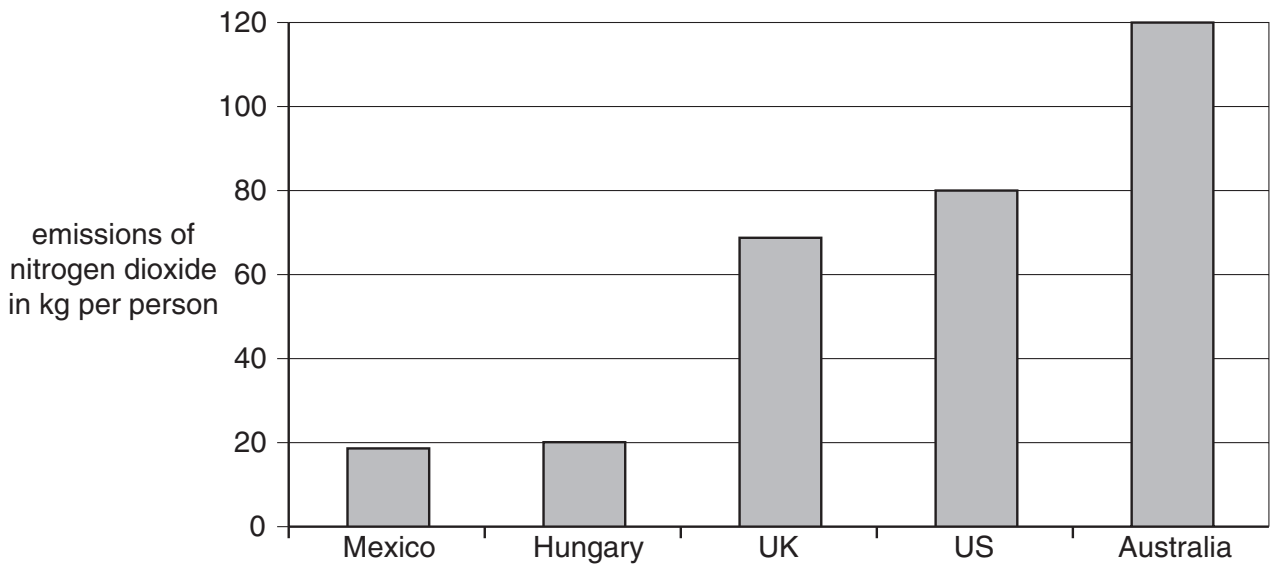
- (b) The diagrams show some of these molecules.

Write the missing formulae in the boxes.



[2]

(c) Here is some information about nitrogen dioxide emissions.



Which of the following conclusions can be drawn from this graph?

Write **T** in the box next to each **true** statement and **F** in the box next to each **false** one.

- | | T (true)
or
F (false) |
|--|-----------------------------|
| Australia has the highest population of people. | <input type="checkbox"/> |
| Australia produces more nitrogen dioxide than the US. | <input type="checkbox"/> |
| Every individual person in the UK produces less nitrogen dioxide than any person living in the US. | <input type="checkbox"/> |
| On average, each person in Hungary produces less nitrogen dioxide than each person in the UK. | <input type="checkbox"/> |

[2]

[Total: 6]

END OF QUESTION PAPER

18
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19
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Acknowledgements:

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Q.4 Article adapted from *Watchdog backs more embryo checks*, 10 May 2006, © BBC News, <http://news.bbc.co.uk>

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