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For Examiner's Use	
Examiner's Initials	
Question	Mark
1	
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TOTAL	



General Certificate of Education
Advanced Level Examination
June 2013

Science in Society

SCIS3

Unit 3 Exploring Key Scientific Issues

Friday 14 June 2013 1.30 pm to 3.30 pm

For this paper you must have:

- a calculator
- a ruler.

Time allowed

- 2 hours

Instructions

- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information

- The marks for questions are shown in brackets.
- The maximum mark for this paper is 90.
- You will be marked on your ability to:
 - use good English
 - organise information clearly
 - use specialist vocabulary where appropriate.



J U N 1 3 S C I S 3 0 1

Section A

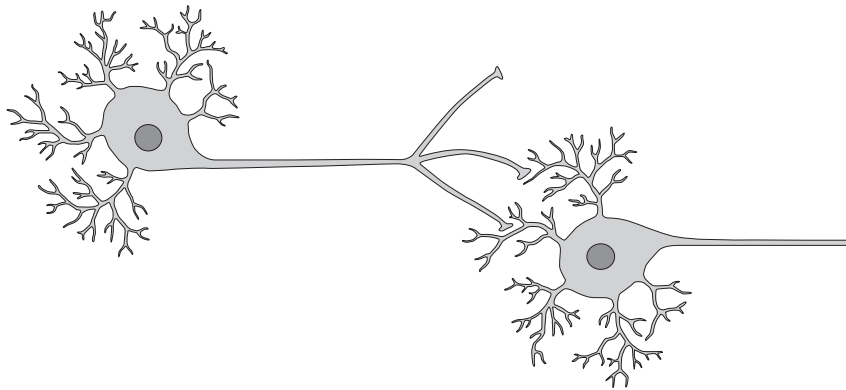
Answer **all** questions in the spaces provided.

- 1** Some people show impulsive behaviour in response to strong emotions. This personality trait has been linked to over-consumption of alcohol, smoking, gambling, illicit drug use, aggression and risky sexual behaviour.

There is some evidence that levels of neurotransmitters such as serotonin, dopamine and GABA may play a role in the impulsive behaviour. GABA, unlike the others, is an inhibitory neurotransmitter. It acts to reduce the signalling between neurons.

Figure 1

Connections between neurons



- 1 (a) (i)** On **Figure 1** label a **cell body**, an **axon**, a **dendrite** and a **synapse**.

(2 marks)

- 1 (a) (ii)** On **Figure 1** insert an arrow to show one region where the **action of neurotransmitters** takes place.

(1 mark)



- 1 (b)** A brain scan technique called magnetic resonance spectroscopy (MRS) allows researchers to investigate levels of the neurotransmitter GABA in different brain regions.

Twelve young men were given a set of questions about their behaviour to evaluate their personality traits, including impulsive behaviour. Five regions of their brains were scanned using MRS.

Researchers found a relationship between impulsive behaviour and GABA levels in one region of the cortex, the DLPFC. This region is shown highlighted in **Figure 2**.

Figure 2

Diagram of the cortex showing the DLPFC region

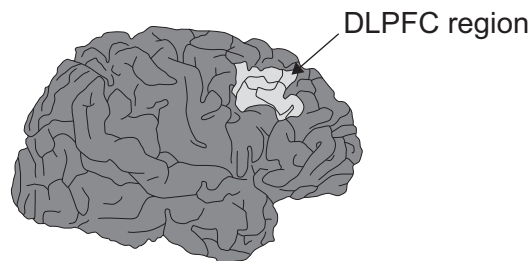


Figure 2 shows the cortex. What is the role of the cortex in the brain?

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(2 marks)

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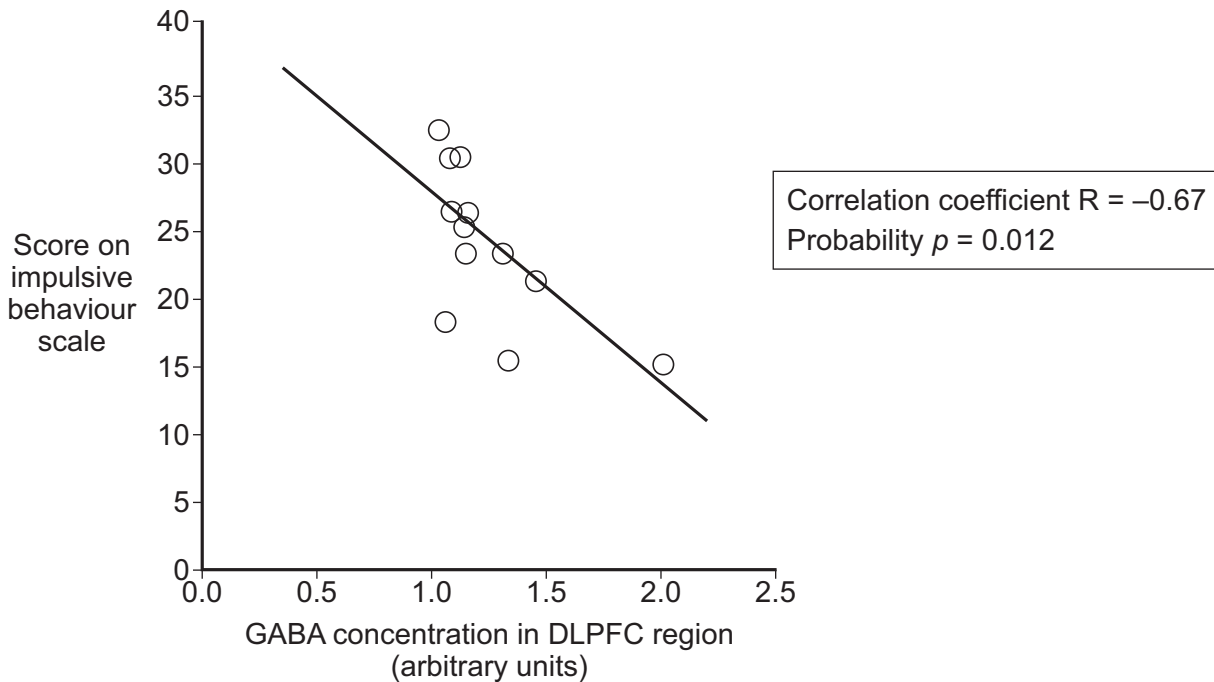
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- 1 (c) Having located a region of interest researchers repeated the questions and the scans with a second group of 13 young men. Some of the results from this group are shown in **Figure 3**.

Figure 3

The relationship between impulsive behaviour and GABA concentration in the DLPFC region



- 1 (c) (i) Describe the relationship, shown in **Figure 3**, between impulsive behaviour and GABA concentration in the DLPFC region.

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(2 marks)

- 1 (c) (ii) What does *Probability* $p = 0.012$ tell us about the relationship shown in **Figure 3**?

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(1 mark)



1 (d) The scientists wrote a paper on their work. This contained 85 references to previous studies. Why is it important for scientists to read the recent scientific literature when planning their research?

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(2 marks)

1 (e) A press release describing the research was issued in August 2011. By chance this was shortly before serious riots took place in several English towns.

The press release included the following:

‘The reason why some men are more impulsive, act aggressively, drink and take drugs could lie in the fact that they have lower levels of a naturally occurring substance in a specific part of their brain, university research has uncovered.

Using the latest brain imaging techniques scientists have identified a new link between impulsiveness and levels of GABA, a very common neurotransmitter, in a very specific part of the brain’.

Newspapers, however, reported the research under headlines such as:

“Brain chemical lack ‘spurs rioting’”

and

“Rioters have lower level of brain chemical that keeps impulsive behaviour under control”.

1 (e) (i) Give **two** reasons why these headlines are not justified by the research.

Reason 1

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Reason 2

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(4 marks)

Turn over ▶



1 (e) (ii) The scientists who did the research wrote an article expressing concern at the misrepresentation of their work. They argued that much damage is done when science is misrepresented in the press.

Suggest how the sort of headlines quoted in part 1(e) might do damage.

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(2 marks)

16



2 The term Autism Spectrum Disorder (ASD) refers to a range of conditions characterised by:

- poor social interaction
- poor communication
- restricted interests and repetitive behaviours.

People with ASD range from those with slightly unusual personalities to the severely disabled. The more severe symptoms are described as autism, the less severe as Asperger's syndrome. Causes of ASD are still not understood. A recent scientific article commented:

'Everyone agrees that autism stems from a disruption of brain development caused by a combination of genes and environment.'

2 (a) The brain increases in size as it develops. Briefly describe **two** other changes that happen as part of normal brain development during the first few years of life.

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- 2.....
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(2 marks)

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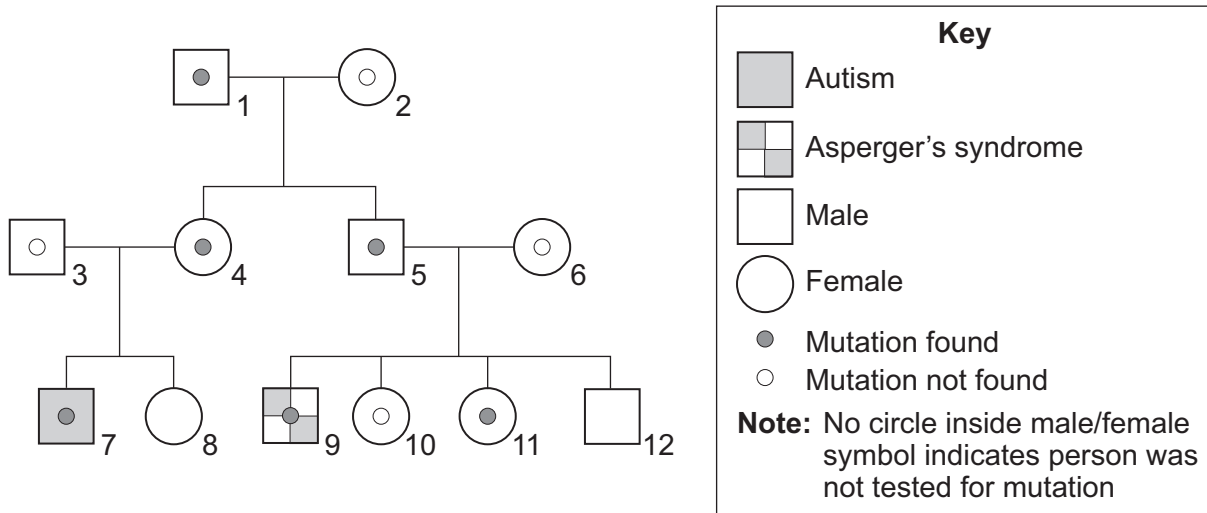
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- 2 (b) A research project studied the genomes of members of families where more than one person showed ASD symptoms. One such family with typical patterns of links between inherited mutations and ASD symptoms is shown in **Figure 4**.

Figure 4

Mutations identified in an ASD family



Give **two** conclusions about the links between inherited mutations and ASD symptoms that might be drawn from **Figure 4**. Explain how you used the evidence to reach each conclusion.

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(4 marks)



2 (c) This sort of research could lead to genetic tests for ASD.
Give **one** benefit and **one** drawback of having genetic tests for ASD.

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(4 marks)

2 (d) The prevalence of ASD rose from 1 in 2500 children in 1963 to 1 in 110 children in 2009 and is continuing to rise. There are two main hypotheses to account for this increase, which do not exclude each other:

- a greater proportion of children with some form of ASD is now receiving a formal diagnosis of the disorder
- some, as yet unknown, new environmental factor is causing at least part of the increase in the incidence of ASD.

Would it be possible to show convincingly that a new environmental factor was **not** a cause of the increase? Explain your answer.

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(3 marks)

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2 (e) Pressure groups have run campaigns claiming environmental causes of autism. One claimed environmental cause, now discredited, was the MMR vaccine. These campaigns usually include public demands for more research:

- to investigate a particular environmental cause.

Other pressure groups support more research:

- into the genetics of the condition
- into new treatments.

There is a limited amount of money available for research into a disease. Choices have to be made about how to spend the money.

Discuss some of the advantages and disadvantages of giving members of the public a role in such decision making.

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(4 marks)

17



3 Radiation output from the Sun is known to fluctuate over cycles with periods ranging from 11 to 1000 years. The mean surface temperature of the Earth is determined by the balance between incoming solar radiation and radiation going out to space.

One group of scientists modelled the impact of solar radiation on temperature over the last 150 years. They used a well-established climate model and included the following variables:

- amount of solar radiation
- amount of volcanic ash in the atmosphere
- concentrations of greenhouse gases.

3 (a) (i) Explain how and why changes in the amount of volcanic ash affect the mean surface temperature of the Earth.

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(2 marks)

3 (a) (ii) Explain how and why changes in the concentrations of greenhouse gases affect the mean surface temperature of the Earth.

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(2 marks)

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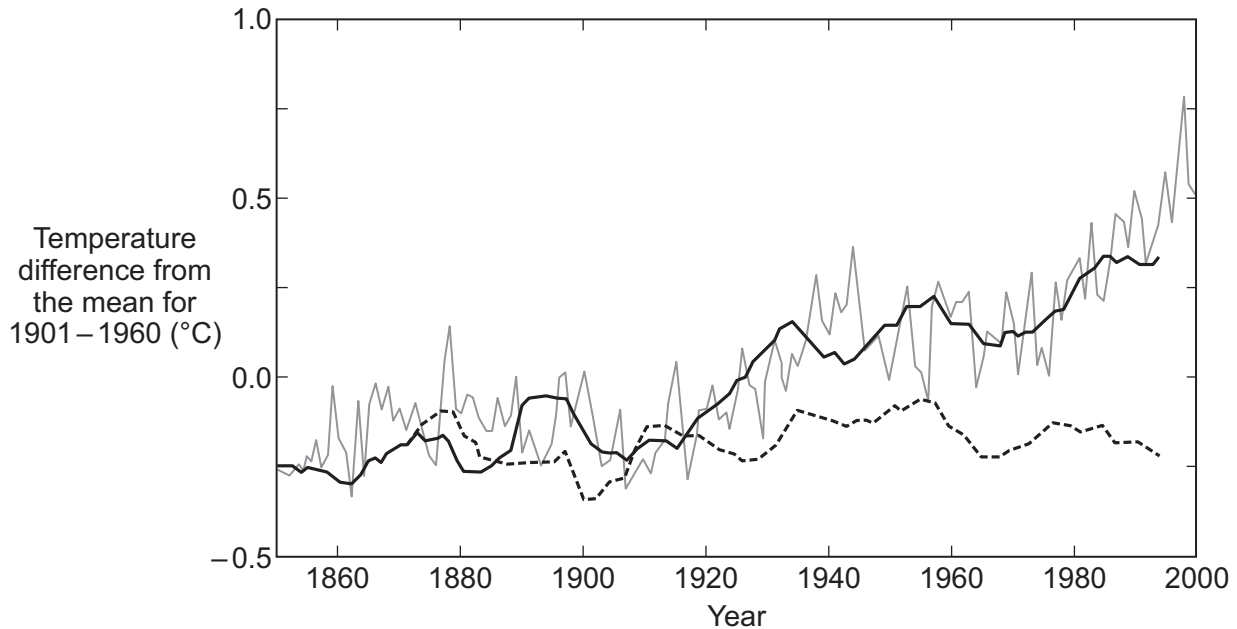
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- 3 (b) The temperatures predicted by the model were compared to measured temperatures. Some of the results are shown in **Figure 5**.

Figure 5

**Comparison of model simulations with global mean temperature measurements
1850–2000**



Key

- Measured temperature differences
- All three variables
Temperature differences predicted from model run using known levels of solar radiation and volcanic ash (natural variables) and greenhouse gases each year
- Natural variables only
Temperature differences predicted from model run using known levels of solar radiation and volcanic ash (natural variables) but keeping levels of greenhouse gases constant at 1870 values



3 (b) (i) The model used estimated values for solar radiation in the years before 1979. Since then solar radiation has been measured directly.
 Explain how the output of the model, shown by the solid black line in **Figure 5**, gives us confidence that these estimated values of solar radiation before 1979 are reasonably accurate.

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 (1 mark)

3 (b) (ii) The researchers used the model to distinguish between the effects on climate of natural variables and greenhouse gases.
 Explain how they did this. Refer to the graph and key in **Figure 5** in your answer.

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 (2 marks)

3 (c) Some ‘climate change deniers’ do not believe that rising greenhouse gas concentrations are the main cause of the current change in the climate. They believe that variations in solar radiation are the more significant cause. They use temperature fluctuations over the past 1000 years as evidence.

Use the data in **Figure 5** to counter this argument.

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 (4 marks)

11

Turn over ▶



4 World electricity generation is predicted to rise by at least 2.4% a year over the years 2000–2030. Policy makers face difficult decisions about which technologies to use to generate electricity.

4 (a) Suggest **two** reasons why worldwide use of electricity is expected to rise so much.

Reason 1

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Reason 2

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(2 marks)

4 (b) Nuclear power stations are one way to generate electricity with low greenhouse gas emissions.

4 (b) (i) What happens to the atoms in nuclear fuel as it releases energy?

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(1 mark)

4 (b) (ii) Nuclear power stations do not emit greenhouse gases while they generate electricity. However, they are responsible for emissions if the whole life cycle of the power station and its fuel is considered.

The life cycle of a product includes design, the manufacture or extraction of all the resources needed, and the building, running and eventual disposal of everything involved.

Name **three** processes that emit significant amounts of carbon dioxide over the whole life cycle of a nuclear power station and its fuel.

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(3 marks)



- 4 (c) The life cycle emissions of nuclear power can be compared to life cycle emissions of electricity generation from renewables. **Figure 6** shows three such comparisons made by three different groups of researchers, labelled **A, B, C**.

Figure 6

Life cycle greenhouse gas emissions of different technologies for generating electricity

Technology	Life cycle greenhouse gas emissions (grams of carbon dioxide equivalent per kWh)		
	Research group A	Research group B	Research group C
Nuclear	10–120	7–22	9–70
Wind	13–40	5–10	3–7
Photovoltaic	53–220	32–58	19–59
Hydroelectric	6–44	10–30	17–22
Natural gas (for comparison)	490–660	390–500	no data

- 4 (c) (i) Suggest **two** reasons why the three groups have produced such different upper values in their estimates of life cycle emissions for nuclear power stations.

Reason 1

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Reason 2

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(2 marks)

- 4 (c) (ii) The three research groups give very different values. Despite this it is possible to draw conclusions about the relative emissions from the different technologies. State **two** such conclusions that can be drawn from the data in **Figure 6**.

Conclusion 1

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Conclusion 2

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(2 marks)

Question 4 continues on the next page

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4 (d) Reduction in greenhouse gases is not the only factor to be considered in making decisions about how to generate electricity.

4 (d) (i) Name **two** other factors, apart from cost, which you think are particularly important.

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(2 marks)

4 (d) (ii) Discuss which **one** of the technologies in **Figure 6** you think should be favoured by the UK government. Use the data in **Figure 6** and the two factors you have named in part (d)(i) to justify your choice.

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(4 marks)

16



5 *Ecosystems* in the sea are under threat. In 2002 the Convention on Biological Diversity set the ambitious target of protecting 10% of the world's oceans by 2012.

Since 2002, Marine Protected Areas (MPAs) have been set up in some coastal and open ocean areas. These activities are prohibited in MPAs:

- fishing
- harvesting other plants and animals
- extraction of minerals.

5 (a) (i) Explain the meaning of the term ecosystem.

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(2 marks)

5 (a) (ii) Name **two** threats to a marine or coastal ecosystem that are **not** prevented by the creation of MPAs.

1.....
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(2 marks)

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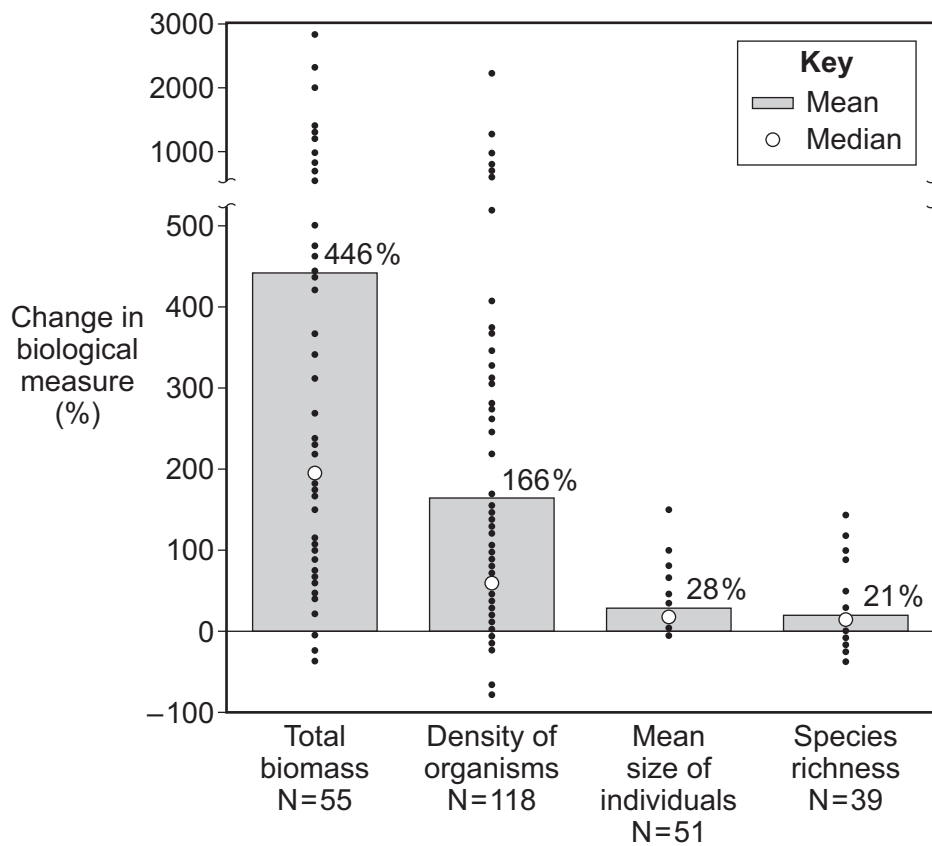
5 (b) A review of published research into the effectiveness of MPAs used the following biological variables as indicators of effectiveness:

- total biomass
- density of organisms
- mean size of individuals
- species richness.

The percentage change of each variable relative to a control was calculated for a large number of MPAs. Each black dot in **Figure 7** shows the result for one MPA.

Figure 7

Percentage changes in four biological variables in MPAs



5 (b) (i) **Figure 7** shows both the mean and the median of the values obtained.
Explain each of these terms.

Mean

.....

Median.....

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(2 marks)

5 (b) (ii) The data for total biomass show a very large difference between the mean and median percentage changes. Explain why.

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(2 marks)

5 (b) (iii) What do the results in **Figure 7** suggest about the effectiveness of MPAs as a way of preserving a marine ecosystem?

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(4 marks)

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5 (b) (iv) Each of the studies shown in **Figure 7** used a control against which to measure change.

The two possible controls were:

A	the same area of sea before the creation of the MPA
B	a similar environment immediately outside the MPA, measured at the same time as inside the MPA

Give **one** advantage and **one** disadvantage of using control **A** rather than control **B** in terms of the validity of the data.

Advantage.....
.....

Disadvantage.....
.....

(2 marks)

5 (c) MPAs represent a real achievement in international cooperation. However, by 2011 only about 1% of the ocean was within a Marine Protected Area.

Suggest **two** reasons why reaching international agreement might be difficult in such situations.

Reason 1
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Reason 2
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(4 marks)



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