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



General Certificate of Education  
Advanced Level Examination  
June 2010

# Science in Society

# SCIS3

## Unit 3 Exploring Key Scientific Issues

Tuesday 15 June 2010 9.00 am to 11.00 am

<p><b>For this paper you must have:</b></p> <ul style="list-style-type: none"> <li>• a calculator</li> <li>• a ruler.</li> </ul>
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### 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.
- You may use a calculator.
- 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 0 S C I S 3 0 1

**Section A**

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

**1** Schizophrenia is a complex disease which can have different symptoms in different patients.

The symptoms of schizophrenia are split into 3 groups

- *positive or psychotic* symptoms eg hearing voices, delusions, paranoia and thought disorder
- *negative* symptoms eg poor self-care, reduced motivation and social withdrawal
- *cognitive* symptoms especially in attention, working memory and decision making processes.

The causes of schizophrenia are not well understood. Research suggests that the disease is the result of a complex interaction between a large number of biological, social and psychological factors.

The main medical treatment for schizophrenia is the use of antipsychotic drugs. These reduce the positive symptoms for some patients. The drugs block one type of dopamine receptor in the brain.

**1 (a)** Suggest how antipsychotic drugs might alter the way in which information is transmitted in the brain.

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(2 marks)

**1 (b)** It often takes longer from the onset of symptoms to diagnose schizophrenia and other mental illnesses than it takes to diagnose physical diseases. Suggest **two** possible social or medical reasons for this delay in diagnosis.

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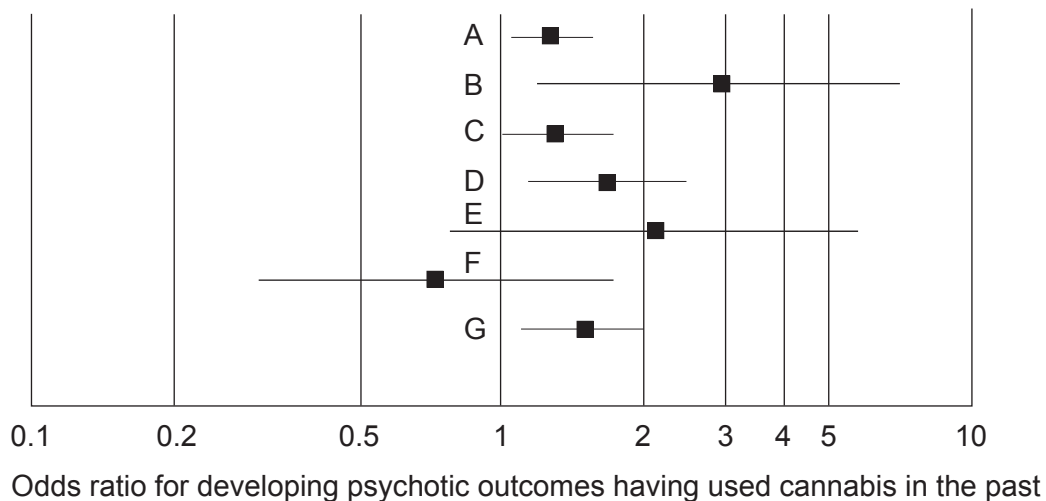
(2 marks)



- 1 (c)** There are growing concerns that the use of cannabis can be a factor in developing schizophrenia. In a survey of 1000 people between the ages of 18 and 35, 15% reported experiencing psychotic symptoms after using cannabis.

A recent study reviewed the research on cannabis use and the occurrence of psychotic health outcomes. Seven cohort studies were considered. **Figure 1** shows how the risk of experiencing psychosis was altered by previous use of cannabis in all seven studies. An **odds ratio** of 1 means that the likelihood of having psychotic symptoms is the same in the group of people who had used cannabis as in a similar group of people who had not used cannabis. An odds ratio greater than 1 means that the likelihood of psychotic symptoms is higher in cannabis users.

**Figure 1**  
**Risk of developing psychosis for people who have ever used cannabis**  
**from 7 different studies**



- 1 (c) (i)** State **two** conclusions that could be drawn from the data in **Figure 1**.

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(2 marks)

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1 (c) (ii) Explain why cohort studies are used to investigate the relationship between cannabis use and psychosis, instead of other types of medical trials.

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(2 marks)

1 (d) One of the studies above collected information on over 50 different factors including age, sex, previous psychotic episodes, other drug use, socioeconomic status, IQ, marital status and childhood behaviour. The researchers took these into account when interpreting their data.

Why did the researchers carrying out these studies consider so many different factors?

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(2 marks)

1 (e) The study concludes:

“...there is now sufficient evidence to warn young people that using cannabis could increase their risk of developing a psychotic illness later in life.”

Do you agree that this conclusion is supported by the data?

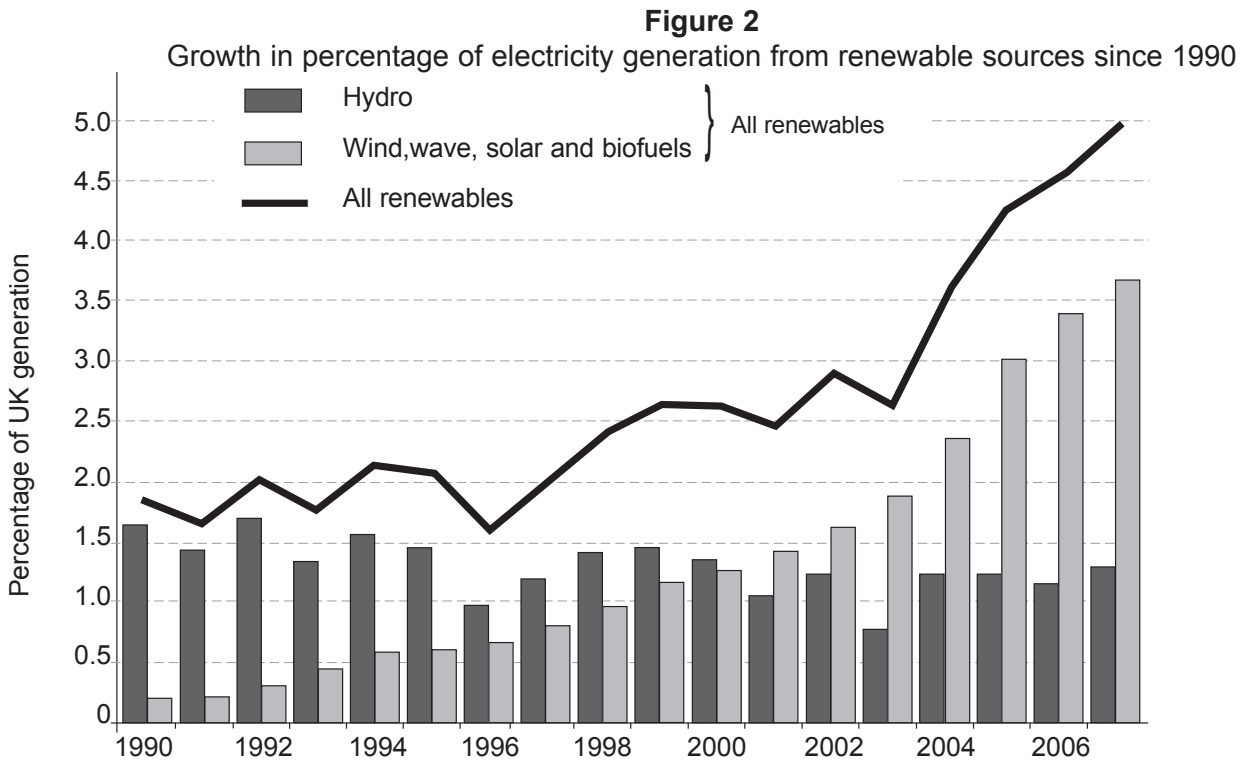
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2 The UK government wants to increase the amount of electricity generated from renewable sources. To achieve this, electricity suppliers in the UK must now produce a proportion of their supply using renewable energy sources. The target is 14% by 2015.

Figure 2 shows the percentage contribution of renewable sources to total UK electricity generation since 1990.



2 (a) (i) State **two** ways in which the share of electricity generation from renewable sources has changed from 1990.

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(2 marks)

2 (a) (ii) Suggest reasons for each of these changes.

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2 (a) (iii) Why has the government set a target for the percentage of electricity to be generated from renewable sources?

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(1 mark)

2 (a) (iv) Suggest why the target for 2015 is only 14% of the total amount of electricity generated in the UK.

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2 (a) (v) Using the data in **Figure 2** discuss how likely it is that the UK will meet its target by 2015.

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(2 marks)



**2 (b)** Wind is a potentially good source of renewable energy for the UK. In 2007 wind power contributed 27% of the electricity generated from renewable sources.

Before a wind farm can be built, the generating company must apply for planning permission.

A local authority must carry out a cost-benefit analysis before deciding whether to allow a wind farm to be built in their local area.

Complete the table below to show some of the costs **and** benefits that might be taken into account. These may be local or national issues.

You should include **six** points.

Costs	Benefits
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**3** After an accident which leads to severe brain injury, there are a number of stages of consciousness a patient may go through. These range from the patient being completely unaware of self and unresponsive to environment, to the patient being aware of self and able to respond to their environment.

If a patient has no motor function and cannot communicate in any way it is difficult to know if they are conscious.

**3 (a) (i)** Identify **two** changes that occur in the brain when it is active that can be detected by instruments outside the body.

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(2 marks)

**3 (a) (ii)** Explain why detection of activity in brain structures, on its own, provides insufficient evidence of consciousness.

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(2 marks)

**3 (b)** Researchers have suggested that fMRI might be used as a diagnostic tool to help determine the level of consciousness of brain-injured patients.

If they could detect predictable activity in specific brain structures in response to a mental imagery task, then this might provide evidence of consciousness in the patient. See **Figure 3** for examples of mental imagery tasks.

Using fMRI they carried out a study using 24 healthy male volunteers to investigate which mental tasks might be suitable. They also tested whether they could obtain reproducible results in brain activation of specific brain regions in individual subjects. The volunteers were all in their twenties.

Give **two** assumptions that the researchers made.

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(2 marks)





- 3 (c) The researchers asked each subject to imagine doing two different things, as shown in **Figure 3**. Measurements of brain activity were made during each, and also while the subject was resting.

**Figure 3**  
**Experimental tasks**

<b>Task 1</b>	<b>Task 2</b>	<b>Task 3</b>
Imagine walking round a house (spatial navigation)	Imagine hitting a tennis ball as hard as possible towards an opponent (motor imagery)	Rest

The order of the tasks was randomly assigned by computer, and the researchers did not know the order until after they had completed the experiment and analysed the data.

From the fMRI data, researchers were able to differentiate rest, spatial navigation and motor imagery with 100% accuracy in every subject tested. They were also able to identify separate areas of the brain which were activated for both mental imagery tasks when compared to rest.

What scientific and/or practical factors should be taken into account before this research could be used as a test to determine the level of consciousness of a brain injured patient.

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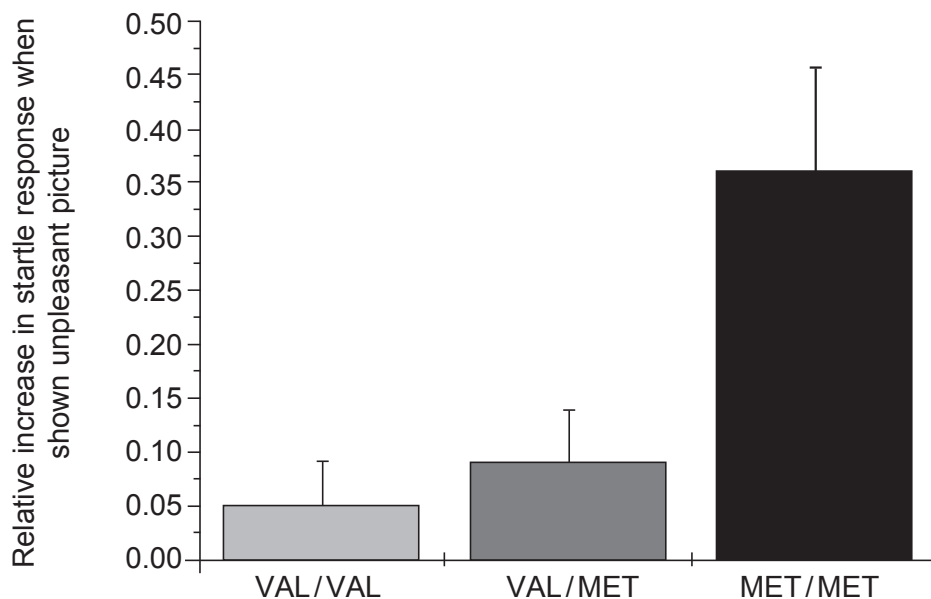


4 Anxiety disorders, which can lead to panic attacks and phobias, decrease the quality of life of those who suffer from them. Scientists have been investigating which genes may be associated with anxiety disorders. One possible candidate is the COMT gene. The gene has two common alleles called Met and Val. The Met version has been linked with anxiety in some studies, but not others.

To explore this, the scientists used the startle reflex. This is an involuntary response to sudden stimulus, such as a loud noise. It is used as a standard test of fear. It is detected by measuring the size of the eyeblink reflex.

In a recent research study, a group of 96 young women (average age 22) were shown an unpleasant picture as a means of causing mild anxiety. Whilst they were looking at the picture, a loud burst of white noise was played through headphones when they were not expecting it. The size of their startle response was measured using sensors under one eye. The researchers also measured the size of the startle response to the loud noise when there was no picture. They used this to calculate the relative size of the startle response. **Figure 4** shows the relative size of the startle response for the three different groups of the subjects.

**Figure 4**  
Size of startle response in women with different alleles of the COMT gene



4 (a) (i) Explain why there are 3 groups of women with the genotypes shown in **Figure 4**?

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(2 marks)

4 (a) (ii) Do the data in **Figure 4** provide evidence of a significant difference in startle response between the different genotypes? Explain your answer.

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- 4 (b) **Figure 5** gives part of a press release sent out by the peer-reviewed journal which published this research. The press release describes what the authors did, and comments on the significance of the results.

**Figure 5**  
**Excerpt from press release**

‘...the Met allele *may* raise levels of dopamine in the areas of the brain that support memory, emotional arousal and attention. More dopamine in these areas *could* result in Met carriers being unable to tear themselves away from something that’s arousing—even if it’s bad.

This single gene variation is potentially only one of many factors influencing such a complex trait as anxiety.’

adapted from <http://www.apa.org/releases/genes0808.html> [emphasis added]

Explain why both nature and nurture need to be taken into account when researching ‘such a complex trait as anxiety’.

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4 (c) The research was also reported by a number of different newspapers and news websites.

Figure 6 shows two of the headlines used.

**Figure 6**  
**Typical headlines reporting the startle response study**

Horror film gene that makes some scream while others laugh <i>The Telegraph</i>	Scientists discover 'scaredy-cat' gene that makes us jump during horror movies <i>Daily Mail</i>
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Discuss the headlines shown in **Figure 6** and explain how they are over-simplified or inaccurate. You should use information from **Figures 4** and **5** to help you answer this question.

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- 5 In 2007 the mean global level of carbon dioxide in the Earth's atmosphere was over 380ppm (parts per million). Carbon dioxide (CO<sub>2</sub>) emissions continue to rise each year. The pre-industrial level was about 280ppm.

There is international agreement that the level of carbon dioxide, and other greenhouse gases, must be stabilised in order to minimise climate change.

The Intergovernmental Panel on Climate Change (IPCC) has considered a number of possible categories of stabilisation which differ in the level at which CO<sub>2</sub> is stabilised. For each category, it analysed the results from models using a number of different scenarios, to predict outcomes. **Figure 7** gives details of these categories, showing the possible stabilisation values and the increase of global mean temperature compared with pre-industrial temperatures.

**Figure 7**  
**Possible CO<sub>2</sub> emission stabilisation categories**

Category	CO <sub>2</sub> concentration (ppm) when stabilised	CO <sub>2</sub> -equivalent concentration (ppm)	Global mean temperature increase above pre-industrial (°C)	No. of assessed scenarios
I	350 – 400	445 – 490	2.0 – 2.4	6
II	400 – 440	490 – 535	2.4 – 2.8	18
III	440 – 485	535 – 590	2.8 – 3.2	20
IV	485 – 570	590 – 710	3.2 – 4.0	118
V	570 – 660	710 – 855	4.0 – 4.9	9
VI	660 – 790	855 – 1130	4.9 – 6.1	5

- 5 (a) (i) CO<sub>2</sub>-equivalent concentrations are given in the table. This takes account of other gases that contribute to the greenhouse effect. It shows the amount of CO<sub>2</sub> that would have the same effect as all of the greenhouse gases in the atmosphere.

Name **one** other gas that would be taken into account in this.

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(1 mark)



5 (a) (ii) Explain, in terms of data and computer modelling, why using more than one model leads to greater confidence in the predictions.

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5 (a) (iii) Suggest why it might be better for governments to set targets in terms of CO<sub>2</sub> level, rather than global mean temperature increase.

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(2 marks)

5 (b) Geo-engineers are investigating possible ways of removing CO<sub>2</sub> from the atmosphere. This could help to stabilise CO<sub>2</sub> levels more quickly. One possible method is described below.

**Crop residue sequestration**

Some of the crop waste left after harvesting is removed from the fields. This is formed into large bales, and then sunk in deep sea, where it becomes covered with sediment over time. The biomass might not break down for thousands of years.

Research is still at an early stage.

5 (b) (i) Explain how crop residue sequestration would remove CO<sub>2</sub> from the atmosphere.

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**5 (b) (ii)** Suggest further research that should be carried out before policy makers decide if this is a suitable long-term method for removing CO<sub>2</sub> from the atmosphere.

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**5 (b) (iii)** Discuss advantages and disadvantages of using geo-engineering to remove CO<sub>2</sub> from the atmosphere compared with strategies to reduce the production of CO<sub>2</sub> in the first place.

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- 6** Ecotourism is seen by some governments as a way of providing access to the protected areas of the world, as well as providing a source of often needed income for such areas. It has been assumed that 'quiet ecotourism', such as hiking and camping, does not adversely affect plants and animals.

A study of national parks in Northern California (USA) looked at larger mammals in a number of paired areas of park. People were able to use one of the areas for recreation, but the other area was out of bounds to visitors.

The researchers gathered faeces (scats) from the 6 animal species shown in **Figure 8**. They used DNA analysis to identify which animal had left the scats.

**Figure 8**  
**Animals counted in National Park areas**

Native animals	Coyote, bobcat, grey fox
Non-native animals	Red fox, domestic dog, domestic cat

- 6 (a)** Suggest why DNA analysis was used to identify which animal had left the scats.

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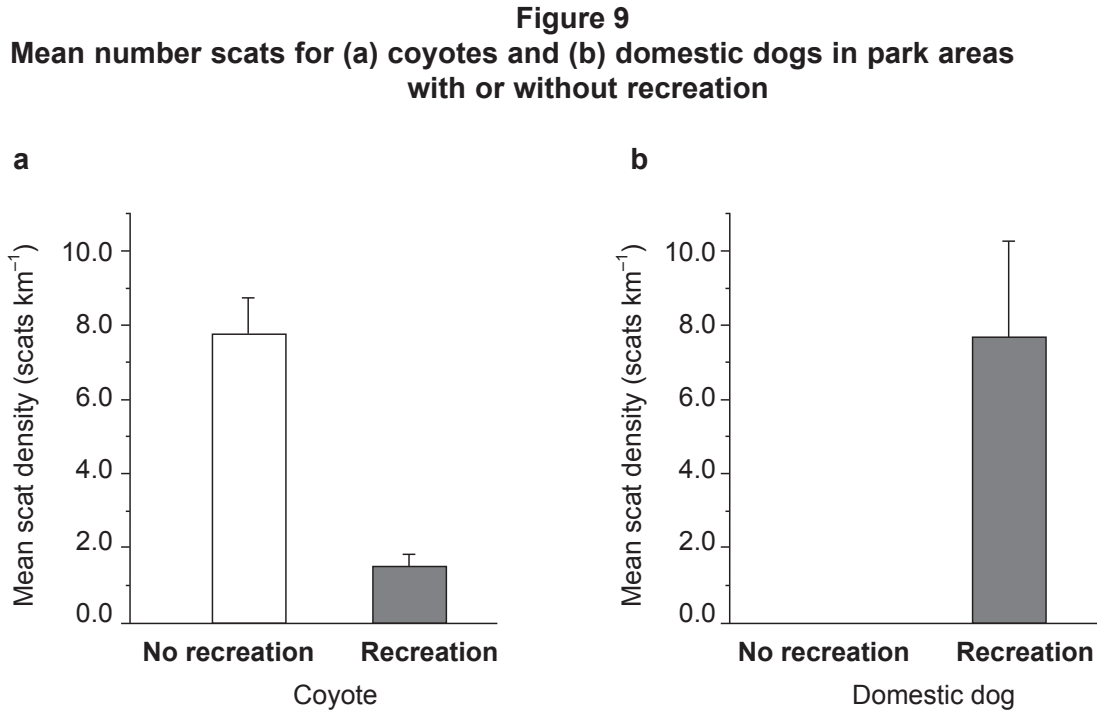
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- 6 (b) The researchers assumed that the mean number of scats found along a line through each area was directly related to the number of each animal in the area. **Figure 9** shows the mean scat density for two of the species in areas with and without recreational activity. The bars represent the standard deviation of the measurements.



- 6 (b) (i) Is the assumption that the researchers made about the relationship between number of scats and number of animals reasonable? Explain your answer.

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(2 marks)

- 6 (b) (ii) The researchers calculated the standard deviation for each set of measurements. What does this information tell the researchers?

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(1 mark)



6 (b) (iii) Suggest a reason for the distribution of scats for coyotes shown in **Figure 9**.

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6 (c) All the native species studied are predators. The searches found that they were all affected by quiet tourism in a similar way. If quiet tourism was permitted in more areas of the national parks, what effect might that have on other animal and plant species in the parks?

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6 (d) Could this research be used to draw conclusions about the effects of tourism on other protected areas of the world? Explain your answer.

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**Section B**

Answer the Question in the space provided.

- 7 “Scientists publish and share their work and results. The process of ‘peer review’ is essential both for detecting invalid claims and adding weight to valid ones. Although scientists aim to be objective, there are limits to the extent to which this can be achieved.”

Discuss the above quote, illustrating your answer with examples taken from one or more contexts that you have studied – and using ideas about ‘how science works’ that you have learned.

Quality of written communication will be assessed in your answer.

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**END OF QUESTIONS**

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Figure 4 Behavioural Neuroscience, 2008 (Montag, Hartmann, Buckholtz, Merz, Burk & Henning)

Figure 5 [www.scientistlive.com](http://www.scientistlive.com)

Figure 9 Conservation Letters Vol 1, Issue 3, August 2008 (Reed,S)

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