Surname		Other Names	
Centre Number			Candidate Number				
Candidate Signature									

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General Certificate of Education
June 2006
Advanced Subsidiary Examination

ASSESSMENT and QUALIFICATIONS ALLIANCE

SCIENCE FOR PUBLIC UNDERSTANDING SPU2
Unit 2 Issues in the Physical Sciences

Friday 9 June 2006 9.00 am to 10.15 am

You will need no other materials.
You may use a calculator.

Time allowed: 1 hour 15 minutes

Instructions
- Use blue or black ink or ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- Answer the questions in the spaces provided.
- Do all rough work in this book. Cross through any work you do not want marked.
- Show your working in **all** calculations.

Information
- The maximum mark for this paper is 60.
- The marks for questions are shown in brackets.
- You are reminded of the need for good English and clear presentation in your answers. Questions 2(c)(iii) and 3(b)(iii) should be answered in continuous prose. Quality of Written Communication will be assessed in these answers.

For Examiner's Use			
Number	Mark	Number	Mark
1			
2			
3			
4			
5			
Total (Column 1) →			
Total (Column 2) →			
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Examiner's Initials			

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

1 An international report, World Energy Assessment Overview, was published in 2004. The information in this question comes from the report.

Figure 1

Figure 1 cannot be reproduced here due to third-party copyright constraints.

(a) Human Development Index, HDI, is a measure of general health, welfare and quality of life in a country. **Figure 1** shows the relationship between per capita energy consumption and HDI for a range of countries.

(i) What does *per capita energy consumption* mean?

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(1 mark)

(ii) For countries with an HDI of above 0.9 what is the range of per capita energy consumption?

.....

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(1 mark)

(iii) It has been claimed that there is a correlation between a country's per capita energy consumption and its HDI. Discuss the extent to which the data support this conclusion, by making reference to countries with lower and higher per capita energy consumption.

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(3 marks)

Question 1 continues on the next page

Figure 2

World primary energy use by energy source in 2001

Primary energy source	Share of total
Oil	35.1%
Coal	22.6%
Natural gas	21.7%
Traditional biomass	9.3%
Other sources including nuclear, hydro and other renewables	11.4%

(b) (i) The world average annual energy consumption has been calculated as 1670 kgoe per capita. It would seem fair that everyone in the world should be able to increase their energy consumption to this value.

Give **two** reasons why this increased consumption might not be sustainable using the mix of primary sources shown in **Figure 2**.

.....

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(2 marks)

(ii) In sub-Saharan Africa traditional biomass, which is mainly wood, provides 60% of the fuel. Name **two** problems associated with the use of wood for fuel in developing countries.

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(2 marks)

(c) The report concludes that it is possible to raise the HDI of the poorer countries without harming the standard of living in the industrial countries. It claims that this can be done in a sustainable way using available resources and technical options. It does not claim that this will be easy.

(i) A developed industrial country like the US or the UK could make changes that would contribute to the achievement of a fairer and more sustainable use of the world's energy resources.
Describe **two** such changes.

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(2 marks)

(ii) Give **one** energy technology that could be adopted to improve the HDI in a low income country such as Mozambique (see **Figure 1**). Explain how it would do this.

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(2 marks)

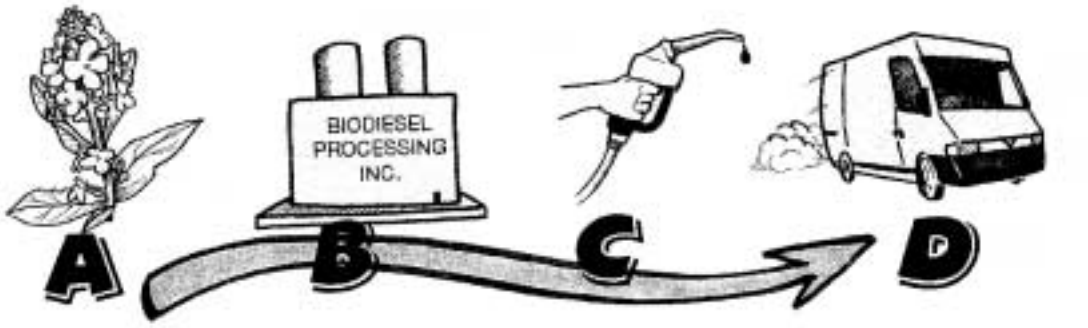
13

Turn over for the next question

2 Biodiesel can be made from plant oils as an alternative to fossil fuel diesel. Biodiesel can be burned in normal diesel engines.

Figure 3 shows the whole process.

Figure 3



(a) (i) Where does the energy for plant growth come from?

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(1 mark)

(ii) What has happened to all this energy after stage D?

.....

(1 mark)

(iii) Explain why biodiesel is a renewable fuel.

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(2 marks)

(b) Biodiesel releases carbon dioxide when it burns but its use does not result in an overall increase in the amount of carbon dioxide in the atmosphere.

(i) At which of the stages shown in **Figure 3** is carbon dioxide removed from the atmosphere?

.....

(1 mark)

(ii) Where will the carbon in the carbon dioxide be found when it has been removed from the atmosphere?

.....

(1 line)

(c) In Britain it is predicted that transport will release 27% of all greenhouse gas emissions by 2010. This is about 35 million tonnes of carbon from transport. The EU has suggested that, by 2010, 6% of transport fuels should be biodiesel or other plant-derived fuels. However, factors other than emissions may also need to be considered.

(i) Land use is one issue. To meet the EU targets, Britain would need to plant biodiesel crops on between a quarter and a half of all the farmland now used for food crops. The alternative is to import palm oil from tropical countries. Give **one** advantage and **one** disadvantage of importing palm oil for biodiesel.

Advantage

.....

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Disadvantage

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(2 marks)

(ii) **Figure 4** shows estimates of how much it would cost to prevent the emission of one tonne of carbon using different transport technologies.

Figure 4

transport technology	**extra cost per tonne of carbon emission prevented**
biodiesel	£400
hydrogen powered vehicles (hydrogen from renewables)	£550
more efficient hybrid engines	£380

Many people might argue that they could not afford these extra transport costs. However, these technologies may prove cheaper than allowing climate change to continue. Give **two** potential financial costs of climate change.

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(2 marks)

Question 2 continues on the next page

(iii) Do you think that Britain should actively encourage the use of biodiesel as one of its contributions to the reduction of carbon dioxide emissions? Your explanation should compare the use of biodiesel to other possible approaches.

You may be awarded up to 2 additional marks for the quality of written communication in your answer.

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(4 marks)

Quality of written communication *(2 marks)*

16

Turn over for the next question

3 Many towns in Britain have introduced traffic calming, using road humps to reduce speed to below 20 mph. The aim is to reduce the number and seriousness of accidents.

- At 40 mph a pedestrian hit by a car has only a 15% chance of surviving.
- At 30 mph survival chances rise to 55%.
- At 20 mph survival chances are 95%.

Traffic calming also affects exhaust emissions as they are very dependent on speed.

- At speeds below 20 mph emissions of carbon monoxide and hydrocarbons rise steeply.
- At higher speeds carbon monoxide is replaced by carbon dioxide in the emissions.
- At speeds above 50 mph the emission of nitrogen oxides rises steeply.
- The speed at which overall exhaust emissions are minimised is around 50 mph.

(a) (i) In what way is carbon monoxide bad for human health?

.....

(1 mark)

(ii) Give one harmful effect of nitrogen oxides.

.....

(1 mark)

(iii) Why does a car engine produce nitrogen oxides?

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(2 marks)

Figure 5

	% change in emissions from individual cars				**% reduction in number of cars**
	carbon monoxide	**hydrocarbons**	**nitrogen oxides**	**carbon dioxide**	
Scheme A	+22	+24	–12	+9	–35
Scheme B	+9	+13	–3	+4	–8

(b) **Figure 5** shows the results of research into the effects of road humps on emissions. It shows data for two traffic calming schemes A and B. In both, speeds were reduced to below 20 mph.

(i) Suggest **one** possible reason why the measured changes in emissions for the two schemes are so different.

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(1 mark)

(ii) Despite the differences, we can draw several general conclusions from **Figure 5**. Give **two** of these.

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(2 marks)

(iii) Would you want to have road humps in your area? Does the reduction of some risks justify an increase in other risks? Use the information in the introduction and in **Figure 5** to justify your answer.

You may be awarded up to 2 additional marks for the quality of written communication in your answer.

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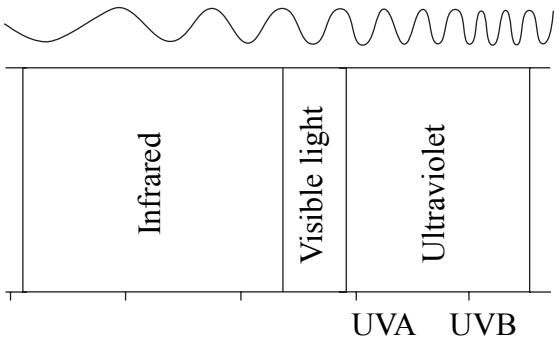
(4 marks)

Quality of written communication *(2 marks)*

13

4 Electromagnetic radiation from the Sun reaches us on Earth. As well as visible light the radiation contains infrared and ultraviolet radiation, UV, as shown in **Figure 6**.

Figure 6



(a) (i) Which of the three components of sunlight shown in **Figure 6** is the most likely to cause chemical changes when it shines on our skin? Explain the reason for your choice.

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(2 marks)

(ii) What is the other effect on our skin when sunlight is absorbed?

.....

(1 mark)

(b) In the 1970s it was found that there is a correlation between exposure to UV and the incidence of skin cancer. Suncreams were developed to block out the Sun's UV radiation. A scale of effectiveness of these creams was adopted. This was the Sun Protection Factor, SPF. SPF is a measure of how long it takes skin to develop sunburn relative to unprotected skin.

(i) Independent tests have shown that the SPF scale is not consistent across different brands of suncream. Suggest **one** reason why it has proved difficult to make reliable measurements of SPF.

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(1 mark)

(ii) The SPF scale chosen measures protection against sunburn not protection against skin cancer. Suggest **one** reason why protection against sunburn was chosen as the basis of the scale.

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(1 mark)

(c) Suncreams are widely used but cases of melanoma, the most dangerous form of skin cancer, are now rising faster than any other cancer. In Britain 1600 people a year die from the disease.

Suncreams were designed to absorb the higher energy UVB (see **Figure 6**). This is the part of the UV spectrum that causes sunburn. Suncreams have very limited effect on UVA.

Researchers are now studying the possible role of UVA in melanoma. In laboratory tests on skin they have found that UVA can also cause mutations in skin cells.

Two headlines reporting this new research are shown below.

Headline X

Suncream is no protection against skin cancer

Headline Y

Cancer warning over suncreams

(i) Choose **one** of these headlines and comment on how well it reflects the current understanding.

Headline chosen .....

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.....

(2 marks)

Question 4 continues on the next page

(ii) Write your own headline of not more than 10 words which you think would be both eye-catching and responsible.

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(2 marks)

(d) Even when they know the risk, people still expose themselves to the Sun and enjoy being tanned. Give **two** reasons why they may do this.

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(2 marks)

11

5 When asked "What is the one thing everyone should learn about science?", two eminent scientists gave the following replies:

"Science is not about truth, but it is about trying to get closer to the truth . . . "

Professor Kathy Sykes

"Science is about uncertainty. We do not yet know the answers to most of the important questions . . . but if we are patient, and not in too much of a hurry, then science gives us a good way to find the answers."

Many people however do think that science is about truth.

(a) At the time of Galileo most people thought that the Earth was at the centre of the solar system and Universe. Give **two** pieces of evidence that they used to support their view that this was the *truth*.

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(2 marks)

(b) Since the acceptance of the heliocentric model of the solar system there have been many further changes in our scientific understanding of the Universe. Give another example of a change in which one explanation was replaced by a different one. Explain why this might make us unsure that our understanding today is the *truth*.

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(2 marks)

Question 5 continues on the next page

(c) We tend to think that science is getting closer to the truth when a new scientific explanation fulfils one of the following:

- it accounts for a wider range of observations
- it leads to predictions that are in agreement with what we later observe.

Give **one** example of a development in our scientific understanding of the Universe that seems to be *getting closer to the truth*.
Explain briefly why it is reasonable to think so.

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(2 marks)

(d) Name **one** *important question* in the study of the Universe or solar system that we do not yet know the answer to.

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(1 mark)

7

END OF QUESTIONS