



## **General Certificate of Education**

# **Science for Public Understanding 5401**

**SPU2      Issues in the Physical Sciences**

## **Mark Scheme**

*2008 examination - June series*

Mark schemes are prepared by the Principal Examiner and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation meeting attended by all examiners and is the scheme which was used by them in this examination. The standardisation meeting ensures that the mark scheme covers the candidates' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for the standardisation meeting each examiner analyses a number of candidates' scripts: alternative answers not already covered by the mark scheme are discussed at the meeting and legislated for. If, after this meeting, examiners encounter unusual answers which have not been discussed at the meeting they are required to refer these to the Principal Examiner.

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**GCE Science for Public Understanding, SPU2, Issues in the Physical Sciences**

<b>Question 1</b>				
a	i	<ul style="list-style-type: none"> <li>0.1 x 36.4</li> <li>3.6(4)</li> </ul>	<i>any 1 for 1 mark</i>	1
	ii	<ul style="list-style-type: none"> <li>domestic heating</li> <li>car use</li> <li>holiday flights</li> <li>electrical appliances/an example/use more electricity</li> </ul>	<i>any 2 for 1 mark</i>	1
c	i	<ul style="list-style-type: none"> <li>uses less electricity/energy for same light</li> <li>less fuel needed to generate electricity</li> </ul> <p>need to link energy use to CO<sub>2</sub> for second mark</p>	<i>for 1 mark each</i>	2
	ii	<ul style="list-style-type: none"> <li>tree removes carbon dioxide from air</li> <li>carbon becomes part of tree/carbon locked up in tree/growth of tree/photosynthesis</li> </ul>	<i>for 1 mark each</i>	2
c		<p>use standard scheme points might include:</p> <ul style="list-style-type: none"> <li>we should not export our problems to developing countries</li> <li>most schemes contribute very small proportion of total to be saved</li> <li>at least 2 examples of a measure family could take to reduce emissions</li> <li>some people willing to pay rather than change</li> <li>raises awareness of family's C emissions</li> <li>developing country emits less per capita already</li> <li>trees take very long time</li> <li>some projects would have happened anyway so no real saving</li> <li>who loses the land that is planted with trees?</li> <li>land may be needed for farming</li> <li>better wood stove health benefits too</li> <li>solar panels useful but will probably be new electricity not saving of fossil fuel</li> <li>financial incentives</li> </ul>	<i>for up to 6 marks</i>	6
				<b>12</b>

Question 2				
a		<ul style="list-style-type: none"> <li>• sulphur + oxygen</li> <li>• elements combine/chemical reaction</li> <li>• <u>new compound</u> sulphur dioxide</li> </ul>	<i>any 2 for 1 mark each</i>	2
b	i	<ul style="list-style-type: none"> <li>• 400 – 600(<math>\mu\text{g} / \text{m}^3</math>)</li> </ul>	<i>for 1 mark</i>	1
	ii	<ul style="list-style-type: none"> <li>• increase in death rate correlates with increase in sulphur dioxide</li> <li>• correlates with increase in smoke</li> <li>• no way of distinguishing between the two/ possible other variables</li> <li>• correlation does not equal causation</li> <li>• deaths do not drop to original value</li> <li>• suggests SO<sub>2</sub>/smoke <u>may</u> cause</li> </ul> <p><b>max. 1 if they claim evidence proves causation</b></p>	<i>ay 2 for 1 mark each</i>	2
c	i	<ul style="list-style-type: none"> <li>• switch to gas/nuclear generation</li> <li>• less coal being used</li> <li>• more efficient power stations</li> <li>• tighter regulations</li> <li>• technology to remove SO<sub>2</sub>/ flue gas desulphurisation</li> <li>• central heating instead of coal fires</li> </ul> <p><b>renewable or catalytic converter not given mark</b></p>	<i>any 2 for 1 mark each</i>	2
	ii	<p>use standard mark scheme points that might be used to support an argument include:</p> <ul style="list-style-type: none"> <li>• electricity needed for development</li> <li>• renewables all more expensive than coal</li> <li>• technology is available to reduce emissions now/scrubbers</li> <li>• poor health/environment will hinder development</li> <li>• cost of environment damage may be greater than cost of removing SO<sub>2</sub></li> <li>• suggestions for other sources</li> <li>• improve efficiency</li> </ul> <p>burning less coal means less CO<sub>2</sub> as well</p>	<i>for up to 6 marks</i>	6
				<b>13</b>

Question 3				
a	i	<ul style="list-style-type: none"> <li>atom with same number of protons/same atomic number/ same element</li> <li>different number of neutrons/ different atomic mass</li> </ul> penalise different number of electrons	<i>any 1 for 1 mark</i>	1
	ii	<ul style="list-style-type: none"> <li>unstable atom/nucleus</li> <li>emits <u>ionising</u> radiation/any 2 named</li> <li></li> </ul>	<i>any 1 for 1 mark</i>	1
	iii	<ul style="list-style-type: none"> <li>half life is time taken to reduce radiation by half</li> <li>iodine (almost) all decayed</li> <li>most caesium still emitting/Cs still present/ radioactive</li> </ul> penalise Cs all gone after 30 years	<i>any 2 for 1 mark each</i>	2
	iv	<ul style="list-style-type: none"> <li>falls on grass/taken up in grass/in rain</li> <li>eaten by cows</li> <li>passed into milk</li> </ul> not 'breathed in'	<i>any 2 for 1 mark each</i>	2
b	i	<ul style="list-style-type: none"> <li>dose received - individual dose depends on lifestyle/ exact location</li> <li>relationship between dose and risk – may not be linear at lower doses than in Japan</li> <li>different from Japan because long term exposure - different isotopes/different population</li> </ul> <b>Note that this is about the estimates from model, not measured deaths</b>	<i>any 1 for 1 or 2 marks</i>	2
	ii	<ul style="list-style-type: none"> <li>cancer deaths in exposed population compared to a control group</li> </ul> <b>issue here is use of control group rather than what is measured</b>	<i>for 1 mark</i>	1
	iii	<ul style="list-style-type: none"> <li>difference very small</li> <li>may be due to normal variation/ other factors/people moving</li> <li>large sample size needed</li> <li>hard to find suitable control group</li> <li>long time scale/ large area</li> </ul>	<i>any 2 for 1 mark each</i>	2
c		<ul style="list-style-type: none"> <li>vested interest/ prior beliefs/ example of reason for bias</li> <li>data collection/interpretation biased /</li> <li>there is scientific disagreement over linear relationship/ predictions based on imperfect models</li> <li>effect of normal variability in data/ different techniques used/ different time frame</li> </ul>	<i>any 2 for 1 mark each</i>	2
d		<ul style="list-style-type: none"> <li>Chernobyl imposed risk</li> <li>smoking/obesity voluntary /familiar</li> <li>particular fear of radiation/ publicity for Chernobyl</li> </ul>	<i>any 2 for 1 mark each</i>	2
				<b>15</b>

Question 4				
a	i	<ul style="list-style-type: none"> <li>limited number of repeat measurements</li> <li>systematic error in measurement/ measured in different ways</li> <li>temperature varies widely across world</li> <li>limited spread of measurements around Earth</li> </ul> not poor instruments	<i>any 1 for 1 mark</i>	1
	ii	<ul style="list-style-type: none"> <li>better instruments</li> <li>more instruments around Earth</li> <li>more repeat measurements</li> </ul>	<i>any 1 for one mark</i>	1
	iii	<ul style="list-style-type: none"> <li>less fluctuation</li> <li>rise is higher than any fluctuations observed</li> <li>longer period of rise</li> <li>less uncertainty in temperature data</li> </ul> must have comparison with earlier implied in some way	<i>any 1 for one mark</i>	1
b	i	<ul style="list-style-type: none"> <li>incoming radiation and re-radiation</li> <li>greenhouse gases reducing outgoing radiation/greenhouse gases absorb outgoing radiation/ re-radiation back to Earth</li> <li>aerosols reducing incoming radiation/ reflect incoming back</li> </ul>	<i>any 3 for 1 mark each</i>	3
	ii	<ul style="list-style-type: none"> <li>all models show similar effect</li> <li>uncertainty less than effect</li> <li>natural effects (much) less than greenhouse gas/human caused ones</li> <li>net effect agrees well with observation</li> </ul>	<i>any 2 for 1 mark each</i>	2
	iii	<ul style="list-style-type: none"> <li>cloud cover – affects incoming and outgoing radiation</li> <li>plant growth – feedback effects on carbon dioxide levels</li> <li>aerosols from pollution – some cooling effect/ poorly understood</li> <li>land use – changes may affect reflection and absorption of radiation</li> <li>solar activity</li> <li>role of oceans – ocean currents transfer heat / amount of CO<sub>2</sub></li> <li>allow <b>1 mark</b> for unexplained effect e.g. hurricanes, ice age but <b>not</b> for inability to predict weather</li> </ul>	<i>any 1 for 1 or 2 marks</i>	2
				<b>10</b>

<b>Question 5</b>				
a		<ul style="list-style-type: none"> <li>• A Earth in centre, 2 named bodies circling,</li> <li>• B Sun in centre, 2 (named) planets</li> </ul> If only Earth and Sun labelled correctly in centres give 1	<i>for 1 mark each</i>	2
b		<ul style="list-style-type: none"> <li>• model becoming very complex/ epicycles</li> <li>• predictions not very accurate helio. Led to more accurate predictions</li> <li>• lack of explanation for complex motion</li> </ul>	<i>any 2 for 1 mark each</i>	2
c	i	<ul style="list-style-type: none"> <li>• mountains on moon - not a perfect sphere as predicted</li> <li>• Sun spots - not a perfect sphere as predicted</li> <li>• moons of Jupiter – bodies do not all orbit Earth</li> <li>• phases of Venus – geo predicts same phase at all times</li> <li>• allow comet that pierced ‘crystal sphere’ 1 max.</li> </ul>	<i>any 1 for 1 or 2 marks</i>	2
	ii	<ul style="list-style-type: none"> <li>• Church undermined by challenge to its authority/against religion/ against popular belief</li> <li>• Church claimed that geo fitted Bible/ humanity at centre/ displaced God</li> <li>• Galileo claimed that helio was the truth</li> <li>• Galileo’s book appeared to mock the Pope</li> <li>• written for the public to understand</li> </ul>	<i>any 2 for 1 mark each</i>	2
d		<ul style="list-style-type: none"> <li>• science more respected/ valued</li> <li>• people less religious</li> <li>• more money/more scientists working on problem</li> <li>• better technology</li> <li>• more evidence for the new theories than in Galileo’s time</li> </ul>	<i>any 2 for 1 mark each</i>	2
				<b>10</b>

<b>Level</b>	<b>Descriptor</b> <i>an answer will meet most of the criteria given in the level descriptor</i>	<b>Mark range</b>
<b>3</b>	<p><b>Good</b></p> <p>claims supported by an appropriate range of evidence</p> <p>good use of information or ideas about science, going beyond those given in the question</p> <p>argument well structured with minimal repetition or irrelevant points</p> <p>accurate and clear expression of ideas with only minor errors of grammar, punctuation and spelling</p>	<b>5-6</b>
<b>2</b>	<p><b>Modest</b></p> <p>claims partially supported by evidence</p> <p>good use of information or ideas about science given in the question but limited beyond this</p> <p>the argument shows some attempt at structure</p> <p>the ideas are expressed with reasonable clarity but with a few errors of grammar, punctuation and spelling</p>	<b>3-4</b>
<b>1</b>	<p><b>Limited</b></p> <p>valid points but not clearly linked to an argument structure</p> <p>limited use of information or ideas about science</p> <p>unstructured</p> <p>errors in grammar, punctuation and spelling or lack of fluency</p>	<b>1-2</b>
<b>0</b>	<b>Incorrect or no response</b>	<b>0</b>