



General Certificate of Education

Science for Public Understanding 5401

SPU2 Issues in the Physical Sciences

Mark Scheme

2006 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.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of candidates' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

SPU2 Issues in the Physical Sciences

Question 1				
(a)	(i)	<ul style="list-style-type: none"> • (total) energy consumed divided by population • (average) energy consumed by individual in country 	any 1 for 1 mark	1
	(ii)	<ul style="list-style-type: none"> • $3000 \pm 500 \rightarrow 12500 \pm 500$ range between 8500 - 10500	for 1 mark	1
	(iii)	<p>yes</p> <ul style="list-style-type: none"> • example of any 1 country at top or bottom of HDI with data • 2 named countries from top and bottom • data for 2 appropriate countries <p>but max 2 marks if no counter examples from below</p> <p>no</p> <ul style="list-style-type: none"> • 1 named extreme exception, Iceland/Russia/Ukraine • 2 named countries with same HDI/per cap energy compared e.g. Italy & Ukraine • no correlation above 0.9 HDI/3000 per cap energy • below 1000kgoe/0.7 HDI large range in HDI with minimal/no increase in energy/data not clear at very low HDI/2 named examples e.g. Zimbabwe & Nigeria • non-linear relationship 	any 3 for 1 mark each	3
(b)	(i)	<ul style="list-style-type: none"> • fossil fuels/oil/gas will run out/non renewable • world population is increasing/main increase would be in fossil fuel use • climate change/carbon dioxide emissions 	any 2 for 1 mark each	2
	(ii)	<ul style="list-style-type: none"> • deforestation/loss of ecosystem/soil erosion • low energy density (must be clear that density is meant) • fumes harmful to health (general pollution too vague) • deforestation increases CO₂ (not burning wood releases CO₂) • long replacement time 	any 2 for 1 mark each	2

(c)	(i)	<ul style="list-style-type: none"> more efficient vehicles/more public transport/walking/cycling/reduce food miles more efficient use of energy/an example use/research more renewable energy/named renewable/nuclear better building design/any technology for conservation transfer of suitable energy technology to developing country <p>no marks for measures that merely increase fossil fuel use in developing countries</p>	any 2 for 1 mark each	2
	(ii)	<ul style="list-style-type: none"> electricity generation from renewable/solar/wind/hydro electricity generation (not nuclear) more small industry/education /health care/communication/work or study at night 	any 2 for 1 mark each	2
				Total 13

Question 2				
(a)	(i)	Sun/photosynthesis	for 1 mark	1
	(ii)	<ul style="list-style-type: none"> heat (in van and surroundings) energy transferred to environment <p>not lost, wasted or used</p>	for 1 mark	1
	(iii)	<ul style="list-style-type: none"> more plants can be produced in short time/plants can be replaced primary source is Sun/Sun constantly available/photosynthesis 	for 1 mark each	2
(b)	(i)	<ul style="list-style-type: none"> A 	for 1 mark	1
	(ii)	<ul style="list-style-type: none"> plant material/A <p>not biodiesel</p>	for 1 mark	1

<p>(c) (i)</p>	<p>advantages</p> <ul style="list-style-type: none"> • export crop for low income country • more efficient to grow plants in high sunlight • leaves land for UK food crops or other named use <p>disadvantages</p> <ul style="list-style-type: none"> • may compete with production of food • destruction of habitat to provide land • CO₂ from transport (not more expensive to import) • reliant on foreign supplier 	<p>any 1 adv and any 1 disadv for 1 mark each</p>	<p>2</p>
<p>(ii)</p>	<p>cost of:</p> <ul style="list-style-type: none"> • extreme weather • rising sea levels • agricultural change/failure/drought • temperature change • more tropical disease • environment/species loss (even if not economic) <p>not trivial cost</p>	<p>any 2 for 1 mark each</p>	<p>2</p>
<p>(iii)</p>	<ul style="list-style-type: none"> • good short term solution/can use existing vehicles • conserves fossil fuel/renewable • cheaper than hydrogen/electric car/photovoltaic • improves farm income • does not reduce other exhaust pollutants/example • land use/monoculture • more expensive than hybrid • hydrogen fuel less polluting • comparison with other renewables/example of other renewable • encourage energy saving/reduce use of fuel for transport/ example of any energy saving measure <p>many other points that relate to ways of reducing CO₂ emissions would be accepted</p> <p>no marks for discussion of need to reduce CO₂</p> <p>Quality of Written Communication</p>	<p>any 4 for 1 mark each</p> <p>for 1 or 2 marks</p>	<p>4</p> <p>2</p>
			<p>Total 16</p>

Question 3			
(a)	(i)	<ul style="list-style-type: none"> prevents respiration/binds to haemoglobin 	any 1 for 1 mark 1
	(ii)	<ul style="list-style-type: none"> asthma/breathing difficulties photochemical smog acid rain 	any 1 for 1 mark 1
	(iii)	<ul style="list-style-type: none"> nitrogen and oxygen in air combine/chemical reaction (conditional on 1st mark) high temperature/pressure in engine 	any 2 for 1 mark each 2
(b)	(i)	<ul style="list-style-type: none"> different conditions/speed before scheme different measuring equipment different humps <p>note that data is per car so number of cars not relevant</p>	any 1 for 1 mark 1
	(ii)	<ul style="list-style-type: none"> schemes reduce traffic level schemes increase carbon monoxide schemes increase hydrocarbons schemes decrease nitrogen oxides schemes increase carbon dioxide 	any 2 for 1 mark each 2
	(iii)	<p>data from question</p> <ul style="list-style-type: none"> decrease in fatal accidents reduction in number of cars/noise pollution reduction in nitrogen oxides increase in overall pollution/example of gas number of cars down therefore decrease in overall pollution <p>general points</p> <ul style="list-style-type: none"> comparison of consequences of accidents versus pollution e.g. short term –long term need for compulsion to reduce speed harm to cars other suggestion e.g. specific location of humps/improved car design to reduce slow speed emission/ other ways of reducing speed <p>Quality of Written Communication</p>	any 4 for 1 mark each 4 for 1 or 2 marks 2
			Total 13

Question 4				
(a)	(i)	<ul style="list-style-type: none"> UV higher energy/shorter wavelength/higher frequency 	for 1 mark each	2
	(ii)	<ul style="list-style-type: none"> heating 	for 1 mark	1
(b)	(i)	<ul style="list-style-type: none"> difficult to decide level of sunburn sunburn depends on skin type depends on UV frequencies used in test 	any 1 for 1 mark	1
	(ii)	<ul style="list-style-type: none"> shorter time needed to do study/cancer develops over years/other variables influence cancer need for large sample for cancer easily monitored 	any 1 for 1 mark	1
(c)	(i)	<p>X</p> <ul style="list-style-type: none"> only true UVA exaggeration/does protect against UVB results not confirmed in real life/only laboratory tests so far/no indication of repeated tests <p>Y</p> <ul style="list-style-type: none"> implication that cream causes cancer warning does imply a possible risk results not confirmed in real life/only laboratory tests so far/no indication of repeated tests 	any 2 for 1 mark each	2
	(ii)	<ul style="list-style-type: none"> uncertainty over protection - e.g. 'suncream may not protect' need for new understanding - e.g. 'possible explanation for rising skin cancer rates' involvement of UVA - e.g. 'suncreams do not keep out dangerous UVA' <p>award 1 mark for any headline that does not misrepresent the research data such as by implying certain cause</p> <p>a second mark for the information it conveys</p> <p>max 1 mark if > 12 words</p>	any 1 for 1 or 2 marks	2
(d)		<ul style="list-style-type: none"> short term benefit/example of benefit/benefits outweigh risks delayed risk/belief that they will be the lucky one/familiarity sense of personal control vitamin D/psoriasis treatment 	any 2 for 1 mark each	2
				Total 11

Question 5			
(a)	<ul style="list-style-type: none"> • Earth does not feel as if it is moving • planets/stars/Sun seem to move • no wind from movement • no parallax observed • object thrown upwards not left behind • bible/religious teaching <p>must be evidence or observation, not explanation of the theory</p>	any 2 for 1 mark each	2
(b)	<ul style="list-style-type: none"> • example: Newton's universe replaced by Einstein/steady state universe replaced by Big Bang/discovery of more planets • if these apparent truths/well established theories replaced/amended then our 'truths' may similarly be changed (this can be awarded independently of first mark) <p>note that the question asks about explanations not observations any scientific theory accepted, does not have to be astronomy must compare 2 science theories, not God</p>	for 1 mark each	2
(c)	<ul style="list-style-type: none"> • Big Bang - red shift of galaxies/background microwave • discovery of Neptune - application of Newton's laws to motion of Uranus <p>must be a widely accepted theory, not speculation accept any example here, not necessarily from cosmology</p>	any 1 for 1 or 2 marks each	2
(d)	<ul style="list-style-type: none"> • start of Big Bang • dark matter/energy • life elsewhere in Universe • fate of Universe • size of Universe 	any 1 for 1 mark	1
			Total 7