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ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Education

Science for Public Understanding 5401

SPU2 Issues in the Physical Sciences

Mark Scheme

2005 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)	• reduction in coal • increase in gas • reduction in oil **not change in nuclear**	any 2 for 1 mark each	**2**
(b) (i)	• fuel replaced/will not run out (not 'renewed') • ultimately from sun • example of one renewable first 2 points could be in context of an example **not 'can be used again'**	for 1 mark each	**2**
(ii)	**wind** • moving air/wind turns • turbine to generate electricity **wave/tidal** • moving water/waves/tide • turns turbine/generator **biomass** • heat from burning • boils water • steam turns turbine/generator **photovoltaic** • radiation from sun • PV converts directly to electricity **maximum 1 for any non-renewable account**	any 2 for 1 mark each	**2**
(iii)	• requires large land area/large number of turbines/limited number of sites • variable supply/unreliable • fuel cannot be stored • local environmental issues/public opinion/example **no mark for cost**	any 2 for 1 mark each	**2**
(iv)	• mixed sources (can be implied) **for each source** • cost (consistent with figures in table) • capacity • reliability • an environmental advantage • an environmental disadvantage • renewable/conservation of fossil fuels (but only award once) **maximum 3 if only 1 source given or if total capacity <100TWh** **maximum 2 for gas/nuclear alone** **not energy conservation measures** **not pollution unless named**	any 4 for 1 mark each	**4**

Quality of Written Communication	**2**

Question 2 (a) (i)	• 3.0 – 3.1 • ± 2.0% accept ± 1.5 – 2.0	for two marks	**2**
(ii)	• for any value 20 μg or lower • low risk or value from graph • how achievable/ALARA/recognition of time scale required • comparable to other risks	any 1 for 1 or 2 marks each	**2**
(iii)	• smoking • age • temperature • other **named** air pollutant • **named respiratory** disease **not general fitness or diet**	any 2 for 1 mark each	**2**
(iv)	• control **group** • keep other variable constant/monitor value of other variables • separate data for smokers and non-smokers/only study • non-smokers • compare matched populations (with high and low PM 2.5) • use of very large groups	any 2 for 1 mark each	**2**
(b)	• set targets/legislate for lower levels • tax incentives for low pollutants • replace old diesel engines/more efficient engines/catalytic converters • use of less polluting fuels/LPG • improve public transport/discourage car use/car share/congestion charge • regulate/reduce factory emissions • air monitoring system • encourage cycling/walking **not face masks**	any 3 for 1 mark each	**3**

Question 3 (a)	• **hydrocarbon** named example/carbon from coal • reaction with **oxygen** → carbon dioxide + water • combustion (not burned) • any correct equation (for 2 marks)	for 1 mark each	**2**
(b) (i)	• 340 + 2 incoming/100 + 1 + 240 outgoing • 342-341 • = 1 W (2 marks)	any 2 for 1 mark each	**2**
(ii)	• heat/global warming (not climate change)	for 1 mark	**1**
(iii)	• sun is hotter/earth is cooler	for 1 mark	**1**
(iv)	• incoming/short wavelength/UV radiation passes through atmosphere • long wavelength/re-radiated/IR radiation absorbed by atmosphere/greenhouse gases	for 1 mark each	**2**
(c) (i)	• 1 * on arrow next to 'heat returned to earth'/on reradiated arrow within atmosphere band 2 * on arrow next to 'reflected energy from atmosphere'	for 1 mark	**1**
(ii)	**removing CO_2** • minimal change in lifestyle/public acceptance • no change in technology • has been tried and seems to work o vehicles still emit CO_2 o does not conserve resources o short term solution o discourages investment in renewables o stores may not be stable/is there enough space? **reflectors** • minimal change in lifestyle/public acceptance • no change in technology • reduces skin cancer o does not conserve resources o short term solution o discourages investment in renewables o unforeseen consequences/an example **reduction in FF use** • conserves resources reduces other pollutants too • more certain long term approach • more equitable o higher fuel costs from renewables o change in lifestyle **must include a comparison with FF for full marks**	any 4 for 1 mark each	**4**

Quality of Written Communication	**2**

Question 4 (a)	• atom/nucleus unstable/decays • emits α, β, or γ/**ionising** radiation • new element formed	any 2 for 1 mark each	**2**
(b)	• radioactive decay releases energy/radiation α, β, γ • released radiation absorbed/stopped • absorption of radiation produces heat	any 1 for 1 mark	**1**
(c)	• after 100,000 years (only give if followed by one of points below) • the amount of the isotope/number of radioactive atoms is reduced by half • number of emissions per second/radiation/radioactivity halves	any 2 for 1 mark each	**2**
(d)	• radiation dose above average/risk of cancer close to waste site • risk of accident/sabotage/leak • possible contamination (via water or airborne particles) • low risk but serious consequence • radiation unseen • long timescale/problems of **long term** storage • imposed risk • role of media/people think nuclear industry contributes higher proportion of total	any 3 for 1 mark each	**3**
(e)	**the science of radiation** • ability to understand technical information • example of information • necessary to understand risks **risks** • need to know how likely harm is/level of risk involved • reasonable cost depends on level of risk • equity of who is to bear risk **management** • poor management or monitoring can ruin good plan/good management measures • no plan fool-proof, checks essential • allows us to campaign for adequate checks • information allows us to make choices	any 2 for 1 mark each	**2**

Question 5 (a)	• universe started from single point • release of energy/explosion (but not for explosion of pre-existing matter) • continuing expansion • matter formed later	any 3 for 1 mark each	**3**
(b) (i)	• Hubble's measurements/speed of galaxies • background radiation	any 1 for 1 mark	**1**
(ii)	• further away a galaxy, the faster it is moving	for 1 mark	**1**
(iii)	• Big Bang theory • general relativity • steady state theory	for 1 mark	**1**
(iv)	• any other example from (iii)	for 1 mark	**1**
(v)	• use of Big Bang theory to predict existence of background radiation	for 1 mark	**1**
(vi)	• the background radiation predicted by Big Bang	for 1 mark	**1**
(vii)	• Einstein believed the universe was stable and modified his equations • any scientist in 1950s who believed in steady state must imply a scientist not a theory	any 1 for 1 mark	**1**