Rewarding Learning

ADVANCED SUBSIDIARY (AS)
General Certificate of Education
2016

Environmental Technology

Assessment Unit AS 1

assessing

The Earth's Capacity to Support Human Activity

[A1E11]

WEDNESDAY 25 MAY, AFTERNOON

MARK SCHEME

General Marking Instructions

These mark schemes are intended to ensure that the AS/A2 examinations are marked consistently and fairly. The mark schemes provide examiners with an indication of the nature and range of candidate responses likely to be worthy of credit. They also set out the criteria which they should apply in allocating marks to candidates' responses. The mark schemes should be read in conjunction with these general marking instructions which apply to all papers.

Quality of candidates' responses

In marking the examination papers, examiners will be looking for a quality of response reflecting the level of maturity which may reasonably be expected of 17- and 18-year-olds which is the age at which the majority of candidates sit their AS/A2 examinations.

Flexibility in marking

The mark schemes which accompany the specimen examination papers are not intended to be totally prescriptive. For many questions, there may be a number of equally legitimate responses and different methods by which the candidates may achieve good marks. No mark scheme can cover all the answers which candidates may produce. In the event of unanticipated answers, examiners are expected to use their professional judgement to assess the validity of answers. If an answer is particularly problematic, then examiners should seek the guidance of the Supervising Examiner for the paper concerned.

Positive marking

Examiners are encouraged to be positive in their marking, giving appropriate credit for valid responses rather than penalising candidates for errors or omissions. Examiners should make use of the whole of the available mark range for any particular question and be prepared to award full marks for a response which is as good as might reasonably be expected for 17- and 18-year-old candidates. Conversely, marks should only be awarded for valid responses and not given for an attempt which is completely incorrect and inappropriate.

Types of mark schemes

Mark schemes for questions which required candidates to respond in extended written form are marked on the basis of levels of response which take account of the quality of written communication. These questions are indicated on the cover of the examination paper. Other questions which require only short answers are marked on a point for point basis with marks awarded for each valid piece of information provided.

Quality of written communication

Quality of written communication is taken into account in assessing candidates' responses to all questions that require them to respond in extended written form.

		AVAILABLE MARKS
1	**(a)** Any **one** from: Coal/Oil/Gas [1]	
	(b) Any **two** from: plastics, pharmaceuticals, fibres. All relevant responses will be given credit. [2]	
	(c) **(i)** Any **three** from: • Levels of carbon dioxide have increased markedly. • There are fewer cold days, nights and frost events. • Hot days, nights and heat waves are more common. • There is an increase in ocean temperature. • There are increases in drought and heavy precipitation events. • There is an increase in hurricane activity. All relevant valid responses will be given credit. [3]	
	(ii) Any **one** from: Advantages • Carbon trading should result in less carbon entering the air so reducing the greenhouse effect. • Carbon trading should provide a government control of the carbon emitted by its industries. • Organisations which have earned unused credits can sell them. Any **one** from: Disadvantages • The market can be open to fraud and manipulation. • Some businesses could be unwilling to get involved in the trade, as they do not want to incur costs that will reduce profit margins. • Credit limits available in a country may be too high to produce a significant decrease in harmful emissions. • The measurement of carbon emissions is very difficult. All relevant valid responses will be given credit. [2]	8

			AVAILABLE MARKS
2	**(a)**	Biomass is a general term for material derived from growing plants or from animal manure. [1] All relevant valid responses will be given credit.	
	(b)	Any **one** of the following: willow, poplar, elephant grass, maize, sugar cane [1] All relevant valid responses will be given credit.	
	(c) **(i)**	Any **two** of the following: Biomass fuel is a renewable energy source/can be replaced in a human lifetime whereas coal takes millions of years to form/cannot be replaced in a human lifetime. Combustion of biomass contributes much less to atmospheric carbon dioxide levels (than coal/fossil fuels)/is carbon neutral/does not contribute (as much) to global warming. All relevant valid responses will be given credit. [2]	
	(ii)	Any **one** of the following: Biomass is more expensive to use compared to coal. Biomass is less efficient compared to fossil fuels. Biomass requires more land for production. All relevant valid responses will be given credit. [1]	
	(d)	Discussion should focus on any **two** of the following points: • Energy density: Nuclear fuels have a very high energy density (compared with coal) so very small quantities are required. This reduces transport and storage requirements. • Greenhouse gas emissions: Nuclear power stations produce little or no greenhouse gases so they do not contribute to global warming. They do not rely on combustion to release energy (unlike coal). • Cost: The cost of building (and decommissioning) nuclear power stations is very high (compared with coal fired power stations). The cost of the fuel (uranium) is low because small quantities are required. • Safety: If there is an accident, large amounts of radioactive material could be released into the environment. • Health: Nuclear power stations produce radioactive waste which is toxic and must be disposed of and stored very carefully. If this is not done correctly it can cause adverse health effects such as cancer and birth defects. Nuclear waste remains radioactive and is hazardous to health for thousands of years. All relevant valid responses will be given credit. (2 × [2]) [4]	9
3	**(a)**	Solar PV [1]; and Wind [1] [2]	
	(b)	'Pond' type ground source heat pump [1]	
	(c)	Formula Coefficient of performance = $\frac{\text{Energy output from heat pump}}{\text{Energy used by heat pump}}$ [1] [1] Calculation $2.8 = \frac{16.8\,\text{MJ}}{\text{Energy used}}$ [1] Energy used = $\frac{16.8\,\text{MJ}}{2.8}$ [1] = 6 MJ [1] [5]	8

			AVAILABLE MARKS
4	**(a)**	Because a significant portion of the available wind energy has to pass through the blades and is unavailable for energy conversion (i.e. the Betz limit) [1]; In addition there will be further energy losses within the gearing and electrical components of the turbine [1] All relevant, valid responses will be given credit. [2]	
	(b)	**Blade length** Any **two** from: • Longer blades could generate more power than short blades due to larger swept area [1] • Longer blades may need stronger winds to generate power [1] • Longer blades can increase the stresses within the turbine [1] **Strength of Materials** Any **two** from: • Lightweight blade materials may be too weak and may break [1] • Stronger, heavier blades need stronger winds to generate power [1] • Composite materials can provide a good mix of strength and weight [1] • Turbine blade materials need to resist corrosion/rust [1] **Siting requirements** Any **two** from: • Exposed locations provide stronger, more consistent wind [1] • Obstacles (buildings/trees) can reduce performance [1] • Hills facing towards prevailing winds can improve performance [1] All relevant, valid responses will be given credit. [6]	
	(c)	Any **two** from: • Wind resource assessment on the site [1] • Topography of the site [1] • Size of the turbine/blade length [1] • Visual impact of the turbine [1] All relevant, valid responses will be given credit. [2]	
	(d) **(i)**	Definition: The maximum wind speed that a turbine is designed to withstand before sustaining damage. [1]	
	(ii)	Yawing All relevant, valid responses will be given credit. [1]	12

				AVAILABLE MARKS
5	**(a)**	**(i)**	Distillation [1] Fractional Distillation [2] [2]	
		(ii)	Continues to increase [1]	
		(iii)	Any **two** from: Carbon monoxide/hydrogen cyanide/hydrochloric acid. [2]	
	(b)	**(i)**	It is manufactured to contain a chemical additive [1] which absorbs light, attacks the polymer and breaks it down. [1] [2]	
		(ii)	A Newton meter [1]	
	(c)	**(i)**	Can be broken down by micro-organisms, bacteria or other biological means. [1]	
		(ii)	Discussion should focus on the following: **Manufacture using renewable raw materials.** • Renewable raw materials are readily replaced unlike fossil fuels [1] that are used during current production, so the process is more sustainable [1] • There is greater security of supply of feedstocks [1] as there is less reliance on crude oil which can come from politically unstable regions [1] • Finite crude oil supplies are conserved for future generations' energy needs [1] and for other uses such as transport [1] **Environmental pollution.** • Biodegradable plastics break down [1] so there is less of a build-up of plastics in the environment. This benefits wildlife and reduces the impact on ecosystems [1] • The manufacture and disposal of biodegradable plastics produces fewer harmful gases and emissions [1] so there is a lower impact on global warming [1] • Less plastic in the environment reduces littering [1] and therefore reduces the clean-up costs associated with this [1] All relevant valid responses will be given credit. [4]	13

		AVAILABLE MARKS
6	**(a)** Energy supplies from renewable energy sources (e.g. wind, solar, wave, tidal) tend to be **unreliable** or **intermittent**. All relevant, valid responses will be given credit. [1]	
	(b) **(i)** **Name**: Pumped Hydro Energy Storage [1]; [1]	
	(ii) **Description**: During off-peak (low demand) times, renewable electricity from the grid is used to power pumps [1] which pump water from a lower reservoir to an upper reservoir [1]. When demand increases the water from the upper reservoir is released down a pipe under high pressure [1] this then spins turbines which drive generators to produce electricity [1] All relevant, valid responses will be given credit. [4]	
	(c) Any **three** factors from: • Availability of existing lakes/reservoirs [1] • Suitable topography – good height difference ('head') between lower and upper reservoirs [1] • Proximity to high voltage power transmission network [1] • Accessibility for construction, operation and maintenance [1] • Lack of environmental concerns/objections [1] All relevant, valid responses will be given credit. [3]	
	(d) Compressed Air Energy Storage [1] All relevant, valid responses will be given credit. [1]	10

7 Indicative Content

AVAILABLE MARKS

The amount of solar energy available for energy purposes.
- Large variation between summer and winter.
- Weather/cloud cover limiting the available energy.
- Orientation: Solar PV works best within 15 degrees of due south.
- Roof type: Solar PV works best on roof slopes of 35 degrees approximately.
- Overshadowing: by trees/other buildings.

How Planning regulations impact on domestic solar PV panel installations
- Planning permission required where panels sit higher than highest part of the roof.
- Planning permission required where panels sit higher than the plane of the roof.
- Planning permission required in conservation areas where panels are visible from the road.

The incentives available to householders for installing solar PV panels
- Reducing your energy costs.
- Receiving the Feed-in-tariff (FIT) for generating your own electricity.
- Renting your roof out to solar PV installers who get the FIT but the householder gets free electricity.

Response	Marks
Level 3 The candidate discusses relevant factors in excellent detail with reference to the issues. The discussion is clear and precise and shows a comprehensive understanding of the issues surrounding the generation of electricity from solar PV. A wide range of relevant technical terms has been used. The candidate has shown good use of spelling, grammar and punctuation and the style and form are excellent throughout.	[11]–[15]
Level 2 The candidate discusses relevant factors in good depth with reference to the issues. The discussion is reasonable and shows an adequate understanding of the issues surrounding the generation of electricity from solar PV. There is evidence of some relevant technical terms being used. The candidate uses good spelling and grammar, and form and style are of a reasonable standard.	[6]–[10]
Level 1 The candidate discusses relevant factors in limited depth with reference the issues. The discussion is basic and shows a limited understanding of the issues surrounding the generation of electricity from solar PV. The candidate shows only a basic level of spelling, punctuation and grammar, and form and style are of a basic standard.	[1]–[5]
Response not worthy of credit	[0]

All relevant, valid responses will be given credit [15] 15

Total **75**