Rewarding Learning

ADVANCED SUBSIDIARY (AS)
General Certificate of Education
2019

Environmental Technology

Assessment Unit AS 1

assessing

The Earth's Capacity to Support Human Activity

[SET11]

WEDNESDAY 15 MAY, MORNING

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 of 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 require 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)**	Fuel security refers to a nation's ability to access a continuous affordable supply of (fossil) fuels. Award [2] for a full explanation and [1] for a limited explanation. All relevant, valid responses will be given credit. [2]	
	(b)	Any **two** from: • Reduce dependency on fossil fuels [1] • Form political alliances with fuel rich countries [1] • Develop alternative indigenous fuel supplies, e.g. renewable energy, biomass [1] All relevant, valid responses will be given credit. [2]	
	(c)	1. An increasing population and longer life expectancies in emerging economies causes an increase in demand for heating and transport which use fossil fuels. [2] 2. Greater economic growth in emerging economies leads to increasing wealth in the population. This increases demand for goods and services which use fossil fuels. [2] 3. Industrial growth in emerging economies leads to increase in the manufacture of plastics, pharmaceuticals and consumer goods which use fossil fuels as a raw material and as a source of energy. [2] Award [2] for a full discussion and [1] for a limited discussion of each point. All relevant, valid responses will be given credit. [6]	10
2	**(a)**	1. Nuclear fuel does not release greenhouse gases during electricity production. This will help countries reach their targets for cutting emissions/it will slow down the rate of global warming. [2] 2. Nuclear fuel has a high energy density. Less fuel is required to generate the same quantity of electricity which reduces the number of power stations required/reduces the amount of mining required. [2] Award [2] for a full outline and [1] for a limited outline. All relevant, valid responses will be given credit. [4]	
	(b)	Any **two** disadvantages from: • Nuclear fuels are radioactive so they require careful handling and disposal. [1] • The cost of building nuclear power stations is much higher than building traditional power stations. [1] • Accidents involving nuclear fuels cause significant long term impacts on the population and the environment. [1] • Radioactive material is carcinogenic and the material remains radioactive for a long time. [1] All relevant, valid responses will be given credit. [2]	
	(c) **(i)**	Any **two** from: • Lower fossil fuel dependency [1] • Renewable [1] • Lower greenhouse gas emissions [1] • Waste may be diverted from landfill [1] All relevant, valid responses will be given credit. [2]	

					AVAILABLE MARKS
		(ii)	Any **two** from: • Requires significant quantities of land [1] • Has a lower energy density than fossil fuels/larger quantities required [1] • Biomass power plants have higher set-up costs [1] All relevant, valid responses will be given credit.	[2]	
	(d)	1.	Carbon monoxide [1]		
		2.	Hydrogen [1]	[2]	12
3	**(a)**	**(i)**	Crude oil undergoes fractional distillation to separate it into different substances including gases that can be used to make plastics. Award [2] for a full explanation and [1] for a limited explanation.	[2]	
		(ii)	The gases obtained by fractional distillation are cooled and liquefied because liquids are much easier than gases to store, transport and use. Award [2] for a full explanation and [1] for a limited explanation. All relevant, valid responses will be given credit.	[2]	
	(b)	**(i)**	Plastics cannot be broken down by micro-organisms or easily recycled so they build up in the environment creating pollution issues such as the great Pacific garbage patch. Award [2] for a full explanation and [1] for a limited explanation. All relevant, valid responses will be give credit.	[2]	
		(ii)	Any **one** from: • Additives/metal salts (such as d2w) are mixed with the plastic during manufacture to increase biodegradability. At the end of the useful life of the product these additives/salts catalyse the breakdown of the plastic in the presence of oxygen. [2] • Plastics can be manufactured to include a bond in the structure that breaks down when heated or when it absorbs uv light. This increases their thermal or photodegradability. [2] Award [2] for a full description and [1] for a limited description. All relevant, valid responses will be given credit.	[2]	8
4	**(a)**	•	'...be converted from one form to another'. [1]		
		•	'...of Conservation of Energy' [1];	[2]	
	(b)		A: Potential Energy [1] B: Electrical Energy [1]	[2]	
	(c)		Cogeneration	[1]	
	(d)		Combined Heat and Power (CHP) integrates the production of usable heat and power (electricity) [1], in one single, highly efficient process [1]. CHP generates electricity whilst also capturing usable heat that is produced in this process [1]. This contrasts with traditional ways of generating electricity where vast amounts of heat are wasted [1]. All relevant, valid responses will be given credit	[4]	9

		AVAILABLE MARKS
5	**(a)** 7 panels × 650 kWh = 4550 kWh [1] $\frac{4550}{7200}$ [1] × 100 = 63% [1] All relevant, valid responses will be given credit [3]	
	(b) **(i)** Any **one** benefit from: • Reducing environmental impact [1] • Financial benefit – reducing energy costs [1] • Improved energy security [1] All relevant, valid responses will be given credit [1]	
	(ii) Any **two** issues from: • Solar radiation levels [1] • shading [1] • roof orientation [1] All relevant, valid responses will be given credit [2]	
	(c) Any **two** methods from: • Tilts and rotates on its own axis to achieve optimum tracking [1] • Tracks the variations in the Sun's position during daylight hours (Earth spinning on its axis) [1] • Tracks the annual variations in the Sun's position during year/seasons (Earth orbiting the sun) [1] • Adjusts according to location in northern or southern hemispheres [1] All relevant, valid responses will be given credit [2]	8
6	**(a)** Swept Area [1]	
	(b) **(i)** A = πr^2 therefore if r is doubled the swept area will be quadrupled; Award [2] for a full explanation and [1] for a limited explanation [2]	
	(ii) The power output will increase [1] All relevant, valid responses will be given credit	
	(c) KE = $\frac{1}{2}$ mv^2 KE = $\frac{1}{2}$ × 580 × 11^2 [1] KE = 35 090 J [1] [2]	
	(d) **(i)** Betz Limit: The maximum amount of the wind's kinetic energy that a HAWT can convert to mechanical energy turning a rotor; Betz calculated this at 59.3% of the kinetic energy of the wind. Award [2] for a full definition and [1] for a limited definition [2]	
	(ii) Most modern wind turbines can only convert 35–45% of the wind's energy into electricity; This is because of energy losses in gearboxes, generators, etc. Award [2] for a full explanation and [1] for a limited explanation [2]	
	All relevant, valid responses will be given credit	

(e) The maximum wind speed that a turbine is designed to withstand before it will sustain damage [1]

All relevant, valid responses will be given credit [1]

(f) Where the turbine is turned to face into the wind in order to extract maximum energy from it.

Award [2] marks for a full explanation and [1] for a limited explanation
All relevant, valid responses will be given credit [2]

AVAILABLE MARKS

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7 Indicative Content

The problems associated with delivering energy from renewable energy sources and the need to develop energy storage facilities that can store energy produced by renewable sources

- Wind, wave and sun energy are not reliable sources of energy
- Wind, wave, sun and tidal are intermittent sources of energy
- Because of this unreliability/intermittency, the renewable energy may be wasted unless stored effectively
- Storage of electrical energy is difficult and it may need to be converted into another energy form for easier storage

The basic operational systems of the two main grid-scale energy storage methods and the types of location where energy storage could be cost effective

- Compressed Air Energy Storage:
  - Air compressed in underground caverns using surplus renewable energy;
  - Released air drives turbine and generates electricity when grid needs it.
- Pumped Hydro Energy Storage:
  - Water pumped up to high level reservoir using surplus renewable energy;
  - Released water drives turbine and generates electricity when required
- Suitable sites:
  - Existing underground caverns (CAES);
  - Existing high level reservoirs/suitable topography (pumped hydro);
  - Good access to power distribution networks

How energy storage can contribute to the development of a smarter, more flexible energy system

- surplus renewable energy can be stored and released into the grid at times of high demand
- this provides greater energy flexibility and allows the main power generating stations to run at a more constant and efficient output level

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

Response	Mark	AVAILABLE MARKS
Level 3 The candidate discusses relevant issues in excellent depth. The discussion is clear and precise and demonstrates excellent knowledge about the storage of energy from renewable energy sources and how this can contribute to the development of a smarter, more flexible energy system. Appropriate specialist terms are used throughout. The candidate uses very good spelling, punctuation and grammar, and the form and style are of an excellent standard.	**[11]–[15]**	
Level 2 The candidate discusses relevant issues in good depth. The discussion is good and demonstrates good knowledge about the storage of energy from renewable energy sources and how this can contribute to the development of a smarter, more flexible energy system. Some specialist terms are used. The candidate uses good spelling, punctuation and grammar, and the form and style are of a reasonable standard.	**[6]–[10]**	
Level 1 The candidate discusses relevant issues in limited depth. The discussion is limited and demonstrates limited knowledge about the storage of energy from renewable energy sources and how this can contribute to the development of a smarter, more flexible energy system. Limited use is made of specialist terms. The candidate uses limited spelling, punctuation and grammar, and the form and style are of a basic standard.	**[1]–[5]**	
Response not worthy of credit	**[0]**	15
	Total	**75**