Rewarding Learning

ADVANCED SUBSIDIARY (AS)
General Certificate of Education
2017

Environmental Technology

Assessment Unit AS 1

assessing

The Earth's Capacity to Support Human Activity

[A1E11]
WEDNESDAY 17 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 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)**	Crude oil.	[1]	
	(b)	**(i)** Bioderived polyethylene.	[1]	
		(ii) A plant material such as corn/sugar cane undergoes fermentation to produce ethanol. [1] Ethanol is converted to ethylene (dehydration). [1] Ethylene then undergoes (addition) polymerisation to form BPE. [1] All relevant, valid responses will be given credit.	[3]	
	(c)	Any **two** from: • Biodegradable plastics can be used as packaging for single use items such as carrier bags, food packaging and drink and food cartons for the takeaway food industry. • Films. Biodegradable plastic agricultural films as mulch can be used to suppress weeds, increase soil temperature, prevent loss of water and minerals from the soil. It can be ploughed into the soil after use. • Improvement of soil structure when the decomposed plastic can make the soil more fertile and improve plant growth. All relevant, valid responses will be given credit. For each: award [2] for a full description and [1] for a limited description.	[4]	9
2	**(a)**	Energy can neither be created nor destroyed [1]; it can only be converted from one form to another. [1] All relevant, valid responses will be given credit.	[2]	
	(b)	Direct: **One** example from: Wind [1] or Hydroelectric [1] or Wave/Tidal. [1] Indirect: **One** example from: Solar Photovoltaic [1] or Biomass. [1] All relevant, valid responses will be given credit.	[2]	
	(c)	Power stations generate electricity at 22 kV [1]; this is stepped up to high voltage (275 kV or 400 kV) by transformers [1]; electricity is transmitted at high voltage to reduce energy losses in wires [1]; voltage is stepped down by transformers close to consumers [1]; electricity is distributed to homes at 240 V. [1] All relevant, valid responses will be given credit.	[5]	
	(d)	**(i)** A computer controlled electricity network that switches input from one energy source to another [1]; as demand for energy varies on the grid. [1] All relevant, valid responses will be given credit.	[2]	
		(ii) Any **one** from: • By using a network of intelligent meters located throughout the grid to accurately predict demand. [1] • By incorporating electricity generated by a wide range of energy sources, including renewables, in order to meet demand. [1] • By incorporating energy generated from international energy sources. [1] All relevant, valid responses will be given credit.	[1]	12

			AVAILABLE MARKS
3	**(a)**	Any **three** issues from: • Solar radiation levels of the site/roof. [1] • Shading. [1] • Proposed collector type and performance specification. [1] • Family size and hot water requirements. [1] • Lifestyle of users and hot water requirements. [1] All relevant, valid responses will be given credit. [3]	
	(b)	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]	
	(c)	70% of hot water needs = 0.7 × 6800 kWh = 4760 kWh. [1] 1 m^2 of collector provides 550 kWh. $\frac{4760}{550}$ = 8.65 [1] Must be a whole number of panels. Therefore family must install 9 m^2 of panels. [1] All relevant, valid responses will be given credit. [3]	7
4	**(a)**	**X**: Gearbox [1]; **Y**: Generator. [1] All relevant, valid responses will be given credit. [2]	
	(b)	Radius (r) = $\frac{1}{2}$ × Diameter = 3 m. [1] Swept area A = πr^2 [1] A = $\pi \times 3^2$ = 28.27 m^2 [1] All relevant, valid responses will be given credit. [3]	
	(c)	K.E. = $\frac{1}{2}$ mv^2 15680 = 0.5 × 640 × v^2 [1] $v^2 = \frac{15680}{0.5 \times 640}$ [1] v^2 = 49 v = 7 m/s [1] All relevant, valid responses will be given credit. [3]	
	(d)	A: Cut-in Speed [1]; the wind speed at which the turbine begins to turn and generate electricity. [1] B: Cut-out Speed [1]; the wind speed at which the turbine stops rotating in order to protect itself from damage. [1] Award [2] for a full explanation and [1] for a limited explanation. All relevant, valid responses will be given credit. [4]	12

				AVAILABLE MARKS
5	(a)	(i)	Anti-reflection coating: maximises the efficiency of the cell [1] by reducing the reflection of light (photons) from the surface [1]. Award [2] for a full explanation and [1] for a limited explanation. [2]	
		(ii)	When light falls on the silicon p–n junction some of the photons can create electron–hole pairs through the photoelectric effect [1]; As the electrons move this creates a potential difference with net positive and negative charge at each side of the p–n junction [1]; Contacts on either side of the cell connect to an external load and permit the electrons to travel around a loop back to neutralise the valency hole at the opposite side of the potential barrier. [1] All relevant, valid responses will be given credit. [3]	
	(b)		Any **two** ways from: • It can tilt and rotate on its own axes to achieve optimum tracking. [1] • It can track the variations in the sun's position during daylight hours (earth spinning on its axis). [1] • It can track the annual variations in the sun's position during year/seasons (earth orbiting the sun). [1] • It can adjust according to location in northern or southern hemispheres. [1] All relevant, valid responses will be given credit. [2]	
	(c)		**Advantage:** it is more efficient than other PV cells. [1] **Disadvantage:** It is more expensive. [1] All relevant, valid responses will be given credit. [2]	9

AVAILABLE MARKS

6 **(a)** Material that is derived from growing plants or animal manure.

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

(b) Combustion/burning.

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

(c) Higher moisture content results in woodchip with lower energy density [1] as energy must be used to evaporate the water before combustion occurs. [1]
Award [2] for a full explanation and [1] for a limited explanation

All relevant, valid responses will be given credit. [2]

(d) Anaerobic digestion is a biological process that results in the breakdown of organic matter [1] by naturally occurring bacteria in an environment that has an absence of oxygen. [1]
Award [2] for a full explanation and [1] for a limited explanation

All relevant, valid responses will be given credit. [2]

(e) Methane/biogas [1] fuel/electricity generation. [1]

All relevant, valid responses will be given credit. [2]

(f) Any **three** from:

- AD offers an option to treat waste and produce biogas that can be used as a fuel. [1]
- AD diverts the methane that would be released from a landfill into the generation of electricity, thereby reducing atmospheric methane levels/greenhouse gas emissions. [1]
- AD can take place at a location close to where organic/farm waste is produced therefore reducing the need for transportation/providing local jobs/providing electricity supply/providing waste management options. [1]

All relevant, valid responses will be given credit. [3] 11

7 **Indicative Content**

AVAILABLE MARKS

The role of fossil fuels in modern society:

- The major fossil fuels are coal, oil and gas;
- Fossil fuels are a source of fuel for transport/electricity generation;
- Fossil fuels also provide raw materials for plastic/pharmaceutical/fibre production;
- Fossil fuels are a valuable raw material which future generations will require;
- Combustion of fossil fuels leads to environmental damage.

Fossil fuel lifespan, location of reserves and accessibility:

- Fossil fuel reserves are estimated to last between 50 and 200 years;
- Coal reserves are the largest and most widespread but combustion of coal causes significant environmental damage, e.g. smog;
- Fossil fuel reserves can be located in areas of the world which are politically unstable/hostile, e.g. large methane deposits in Russia/large oil deposits in the Middle East and North Africa;
- Fewer new oil and gas fields are being discovered. Those that are known are smaller and more expensive to develop so it may not be economically viable;
- There are environmental and social issues surrounding extraction of fossil fuels, e.g. drilling for oil in the Arctic has been suspended following campaigning against it.

National and international environmental targets aimed at reducing greenhouse gas emissions:

- Combustion of fossil fuels leads to environmental damage, e.g. climate change caused by the release of carbon dioxide;
- The EU target for 2020 is a 20% cut in emissions of greenhouse gases to combat climate change;
- This will be achieved by a 20% increase in the amount of energy produced using renewable sources and a 20% cut in energy consumption by increasing energy efficiency of homes, appliances and vehicles;
- Renewable sources of energy produce lower level of carbon dioxide emissions which can help maintain current greenhouse gas levels;
- Renewable sources of energy will contribute to conservation of fossil fuels as the rate of use will slow down.

All relevant, valid responses will be given credit.

Response	Mark	AVAILABLE MARKS
Level 3 The candidate demonstrates very good understanding of the issues surrounding fossil fuel use and the need to find alternatives. The candidate discusses relevant factors in depth referring to where fossil fuels are found, their uses, reasons for their conservation and a range of alternative energy sources. The discussion is clear and concise. Appropriate specialist terms are used throughout. The candidate uses good spelling, punctuation and grammar and the form and style are of an excellent standard.	[11]–[15]	
Level 2 The candidate demonstrates good understanding of some issues surrounding fossil fuel use and the need to find alternatives. The candidate discusses some relevant factors referring to where fossil fuels are found, their uses, reasons for their conservation and some alternative energy sources. The discussion is good. Some appropriate specialist terms are used throughout. The candidate uses good spelling, punctuation and grammar and the form and style are of a reasonable standard.	[6]–[10]	
Level 1 The candidate demonstrates a limited understanding of some issues surrounding fossil fuel use and the need to find alternatives. Limited reference is made to where fossil fuels are found, their uses, reasons for their conservation and alternative energy sources. The discussion is limited. Little 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**