Rewarding Learning

ADVANCED SUBSIDIARY (AS)
General Certificate of Education
2015

Environmental Technology

Assessment Unit AS 1

assessing

The Earth's Capacity to Support Human Activity

[A1E11]

FRIDAY 29 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)**	Microgeneration – small scale generation of heat and power. [1]	
	(b)	Any **two** from: • Reduced energy costs • Contribution to environmental targets • Enhanced security of supply • Financial incentives All relevant, valid responses will be given credit [2]	
	(c)	X: Vertical Y: Horizontal All relevant, valid responses will be given credit [2]	
	(d)	Heat from the outside air causes refrigerant to turn into a gas in the evaporator [1]; The gas is pumped through a compressor which raises its temperature [1]; The gas turns back to a liquid in the heat exchanger/ condenser [1] transferring its heat to the heating circuit of the house [1] All relevant, valid responses will be given credit [4]	9
2	**(a)**	Any **two** from: • VAWT can operate with wind in any direction whereas HAWT must yaw to face into the wind. • VAWT can operate at low wind speeds whereas HAWT requires higher wind speeds • VAWT rotates at a low RPM whereas HAWT rotates at higher RPM • VAWT has rotor in vertical direction; HAWT has rotor in horizontal direction • VAWT is less noisy than HAWT • VAWT has less vibration than HAWT All relevant, valid responses will be given credit [2]	
	(b)	Betz Limit: The maximum amount of the wind's kinetic energy that a HAWT can convert to mechanical energy turning a rotor [1]; Betz calculated this at 59.3% of the kinetic energy of the wind [1]. Most modern turbines however can only convert 35–45% of the wind's energy into electricity [1]; This is because of energy losses in gear boxes etc. [1] All relevant, valid responses will be given credit [4]	
	(c)	**(i)** **air density**: when air density is lower the power output is less or when air density is higher the power output increases [1]	
		(ii) **temperature**: when temperature is lower the turbine power output is greater or when temperature is higher the turbine power output reduces [1] All relevant, valid responses will be given credit [2]	

		AVAILABLE MARKS
(d) **(i)** X = Wind turbine tower [1]		
(ii) Existing mass (10 tonnes) is proportional to R^3 [1] If we double blade length to 2R then New mass (X) is proportional to $(2R)^3$ [1] Which is $8R^3$ [1] If R corresponds to a mass of 10 tonnes then 2R corresponds to a mass of 80 tonnes [1] All relevant, valid responses will be given credit [4]		13
3 **(a)** Any **two** from: • Parabolic Troughs • Fresnel Reflectors • Solar Dishes All relevant, valid responses will be given credit [2]		
(b) Concentrating Solar Power plants produce electricity by converting the sun's energy into high-temperature heat (steam) using various mirror configurations [1]. The steam is then sent through a generator to produce electricity [1] All relevant, valid responses will be given credit [2]		
(c) Any **two** descriptions from the following: • Orientation [1]; Main glazed 'dayrooms' orientated South (or within 15 degrees of South) Non-habitable rooms towards North [1] • Windows to be appropriately sized [1]; to provide good day-lighting and prevent excessive heat loss/heat gain [1] • Use low emissivity glazing [1] to reduce heat loss through windows [1] • Provide eaves overhangs/ bris-soleil [1] to reduce summer heat gain through windows [1] • Heavy construction / high thermal mass [1]; will absorb heat in winter and even out temperature fluctuations [1] • High levels of thermal insulation [1]; will reduce the heat loss of the building [1] All relevant, valid responses will be given credit [4]		
(d) Any **two** from: • Green Deal [1]; Financial assistance towards cost of installing solar panels [1] • Feed-in-Tariff for Solar PV [1]; Where homeowners are paid for the amount of electricity they generate and feed back into the grid [1] • Renewable Heat Incentive [1]; – where homeowners are paid for the amount of heat they generate using their own solar thermal panels [1] All relevant, valid responses will be given credit [4]		12

				AVAILABLE MARKS
4	**(a)**	**(i)**	Cogeneration [1] All relevant, valid responses will be given credit. [1]	
		(ii)	**A** Combustion of fuel [1] to produce steam [1] **B** Steam driving a turbine [1] which is connected to a generator to produce electricity [1] All relevant responses will be given credit. [4]	
	(b)		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 responses will be given credit. [4]	9
5	**(a)**		Any **one** from: • Intermittency of wave energy sources • Reliability of wave energy sources All relevant responses will be given credit. [1]	
	(b)		Energy from a renewable energy resource can be stored during periods of low energy demand (off-peak) [1]. Air is compressed by an electrically powered compressor [1] and stored in mass quantity in an underground cavern [1] for use in meeting periods of higher demand (peak load) [1].When there is demand the compressed air is released to drive a turbine connected to a generator to produce electricity. [1] All relevant responses will be given credit. [5]	6
6	**(a)**	**(i)**	% in the range of 90% [1]	
		(ii)	Any **two** from the following: • Willow • Poplar • Elephant grass • Maize • Sugar cane All relevant responses will be given credit. [2]	
	(b)		Any **two** of the following: • Moisture content • Porosity • Bulk density • Energy density All relevant responses will be given credit. [2]	
	(c)		Biomass is converted into a mixture of carbon monoxide [1] and hydrogen [1], commonly known as syngas [1]. All relevant responses will be given credit. [3]	

AVAILABLE MARKS

(d) Any **three** from the following:

- used in the production of ammonia [1]
- used in the production of methanol [1]
- used as an intermediate in producing synthetic petroleum [1]
- or can be used as a lubricant in chemical processes [1]
- Syngas is combustible and often used as a fuel of internal combustion engines [1]

All relevant responses will be given credit. [3]

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7 Indicative content

- **The trends in fossil fuel use globally:**
  - Recognise the increasing trends (demands) for fossil fuel (coal, oil, gas) use in industrialised western countries both for energy provision and as a raw material in for example, the manufacture of plastics.
  - Discussion of links to the industrial economy, in key emerging economies (for example Brazil, Russia, India and China) in relation to demand for fossil fuels from industry for energy provision and manufacture of plastics.
  - Discussion of the impact of increasing global population resulting in increasing demands for fuel for heat, electricity, transport etc.
  - In emerging economies, the population has greater lifestyle expectations resulting in greater demands for energy and products which use fossil fuels in their manufacture and production.

- **The concept of fuel security:**
  - Explanation of fuel security and its impact on a country's economy. For example, Northern Ireland currently imports 92% of its energy. Leaving the region 'insecure' in terms of continuity of energy supply/ price variations and currency fluctuations.
  - Discussion of fuel security and geopolitics. For example, gas supply cut-off in Russia etc.

- **The environmental impact of fossil fuel use:**
  - Global warming
  - Habitat degradation
  - Impact on biodiversity
  - Air quality reduction
  - Land and water contamination
  - Reduction in world's natural resources.

Response	Marks	AVAILABLE MARKS
Level 3 The candidate discusses relevant factors in depth with reference to at least each of the three issues. The discussion is clear and precise and demonstrates very good knowledge of the issues surrounding society's reliance on fossil fuels. Appropriate specialist terms 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 discusses relevant factors in satisfactory depth with reference to at least each of the three issues. The discussion is reasonable and demonstrates an adequate knowledge of the issues surrounding society's reliance on fossil fuels. Some 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 discusses relevant factors in limited depth with reference to at least each of the three issues. The discussion is limited and demonstrates a limited knowledge of the issues surrounding society's reliance on fossil fuels. Little use 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**