



*Rewarding Learning*

**ADVANCED SUBSIDIARY (AS)  
General Certificate of Education  
2022**

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## **Environmental Technology**

**Assessment Unit AS 1**

*assessing*

**The Earth's Capacity to Support  
Human Activity**

**[SET11]**

**WEDNESDAY 18 MAY, AFTERNOON**

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**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.

### **COVID-19 Context**

Given the unprecedented circumstances presented by the COVID-19 public health crisis, senior examiners, under the instruction of CCEA awarding organisation, are required to train assistant examiners to apply the mark scheme in case of disrupted learning and lost teaching time. The interpretation and intended application of the mark scheme for this examination series will be communicated through the standardising meeting by the Chief or Principal Examiner and will be monitored through the supervision period. This paragraph will apply to examination series in 2021-2022 only.

1 (a) Oil, gas [2]

(b) Any **two** of the following:  
Fossil fuels are a source of fuel for transport/electricity generation.  
Fossil fuels also provide raw materials for plastic/pharmaceutical/fibre production. [2]

**All relevant, valid responses will be given credit.**

(c) Lifespan of Reserves:  
Fossil Fuels are a finite resource, meaning they will eventually run out unless they are conserved.  
Fossil fuel reserves are estimated to last between 50 and 200 years. [2]

Location of Reserves:  
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. [2]

Accessibility:  
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. [2]

**All relevant, valid responses will be given credit.**

**Award [2] for each full reason and [1] for a limited reason.**

2 (a) (i) The rotor collected energy refers to the energy in the wind utilised by the turbine blades. [1]

(ii) The energy can be lost through inefficiencies such as energy loss between components in the turbine. [2]

The rated energy output of a turbine can be limited by the size of the generator. [2]

**All relevant, valid responses will be given credit.**

**Award [2] marks for a full reason and [1] for a limited reason.**

(b) (i) Any **two** of the following:  
Wind speed is higher as height increases from ground level. Wind velocity has a crucial impact on the power output of the wind turbine.  
A larger hub height will allow for a larger blade diameter and therefore a larger swept area giving a greater power output.  
A higher hub height prevents the air flow from becoming disturbed by any obstructions such as trees or buildings. [4]

**All relevant, valid responses will be given credit.**

**Award [2] marks for a full discussion and [1] for a limited discussion.**

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(ii)  $KE = \frac{1}{2}mv^2$  [1]  
 $KE = \frac{1}{2} \times 2400 \times 27^2$  [1]  
 $KE = 1200 \times 729$   
 $KE = 874800$  joules [1]

[3]

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3 (a) Any **two** of the following:

In emerging economies there is a high demand for fossil fuels from industry for energy provision and manufacture.

The impact of increasing 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. [4]

**All relevant, valid responses will be given credit.**

**Award [2] for a full description and [1] for a limited description.**

(b) Habitat Degradation – Habitats can be destroyed through the mining and transportation of fossil fuels. If the mining is long-term then workers often build roads and housing in an area which was earlier untouched, therefore changing the use of the land. [2]

Air Quality Reduction – The burning of fossil fuels creates emissions such as carbon dioxide, sulphur dioxide and nitrogen oxides. This air pollution can create acid rain which can weaken plant species and alter the pH of soils. [2]

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**All relevant, valid responses will be given credit.**

**Award [2] for a full explanation and [1] for a limited explanation.**

- 4 (a) (i) Biomass is material derived from growing plants or from animal manure. [1]
- (ii) Any **one** from:  
 organic materials [1]  
 agricultural crops [1] [1]
- All relevant, valid responses will be given credit.**
- (iii) Greater than 90% [1]
- (b) (i) Syngas [1]
- (ii) Biomass is heated in the presence of oxygen and steam. This causes the biomass to break down into a mixture of carbon monoxide and hydrogen gas. This process is called gasification. [2]
- Award [2] for a full explanation and [1] for a limited explanation.**
- All relevant, valid responses will be given credit.**
- (c) 1. Percentage moisture content. Higher moisture content results in woodchip with lower energy density as energy must be used to evaporate the water before combustion occurs.
2. Bulk density. Higher bulk density results in woodchip with higher energy densities as this woodchip has more material per unit volume. [4]
- Award [2] for a full discussion of each and [1] for a limited discussion of each.**
- All relevant, valid responses will be given credit.**

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5 (a) (i) Bioderived polyethylene [1]

**All relevant, valid responses will be given credit.**

(ii) A starchy substance such as maize or corn is treated with yeast to produce ethanol by fermentation. Ethanol is purified and undergoes dehydration to form ethene. Ethene undergoes addition polymerisation to form bioderived polyethylene. [2]

**Award [2] for a full description and [1] for a limited description.**

**All relevant, valid responses will be given credit.**

(b) Any **two** from:  
Hydrogen cyanide [1]  
Hydrogen chloride/Hydrochloric acid [1]  
Carbon monoxide [1] [2]

**All relevant, valid responses will be given credit.**

(c) Sustainable manufacture

Current manufacture uses non-renewable crude oil. Sustainable manufacture means moving to renewable raw materials such as plant materials. [2]

Lack of biodegradability leads to build-up of plastic in the environment. Manufacturing processes need to be modified to enhance the degradability of plastics. [2]

Sustainable use

Global pollution problems – increase in use of single-use plastics globally means an increase in pollution. Sustainable use must include strategies for reducing, reusing and recycling. [2]

**Award [2] for a full discussion and [1] for a limited discussion.**

**All relevant, valid responses will be given credit.**

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- 6 (a) 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]  
The steam can be heated directly or indirectly using a working fluid such as salt. [1] [3]

**All relevant, valid responses will be given credit.**

- (b) 1. monocrystalline [1]  
2. polycrystalline [1]  
3. thick-film [1]  
4. thin-film [1]
- (c) The anti-reflective coating maximises the efficiency of the cell and hence the panel by reducing the reflection of light from the surface of the cell. [2]

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**Award [2] for a full explanation and [1] for a limited explanation.**

**All relevant, valid responses will be given credit.**

## 7 Indicative content

The main phases in the large-scale generation of electricity from fossil fuels;

- The fossil fuel (usually coal) is burned and used to heat water.
- This produces steam which is used to turn a turbine which powers a generator where kinetic energy is turned into electrical energy.

Describe how electricity is distributed throughout the National Grid;

- Transformers are necessary to step up the voltage of the electricity as it leaves the power station.
- This reduces losses through sound, resistance and heat as the electricity travels through the wires.
- Transformers are also needed to step down the voltage to ensure it is safe to be used by the consumer.

The concept of a smart grid;

- A smart grid is a network which facilitates the distribution of energy from one place to another as required by the users of the grid.
- A smart grid incorporates traditional energy generation and renewable systems.
- A smart grid relies on a computerised control system to divert energy from one renewable source to replace another as demand for energy varies on the grid.
- A smart grid also makes use of energy storage systems such as CAES or Pumped Hydro to ensure that minimal energy is wasted.
- Energy can be stored at off-peak times, e.g. in the middle of the night when demand is low, and stored until peak times such as breakfast time.

The long-term benefits of the development of a smart grid using Irish, UK and European interconnections;

- Interconnections between the UK, Ireland and Europe will increase energy security in Northern Ireland.
- Interconnections allow more control over the supply and distribution of energy, allowing energy from renewables to be used most efficiently. This in turn should lower reliance on fossil fuel power stations, benefitting the environment.

- Flexibility: Different locations are favourable for different types of renewable. Interconnections allow each country to use the methods which suit their terrain best, e.g. Ireland is suitable for wind farms, Norway is suitable for hydroelectric energy etc.
- More competitive pricing.
- Northern Ireland could use the wind resource to produce energy which could be sold to other countries, thus creating an income.

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<b>Response</b>	<b>Mark</b>
<p><b>Level 3</b> The candidate discusses relevant factors in depth with reference to the four issues. The discussion is clear and precise and demonstrates very good knowledge of the issues surrounding large scale electricity generation, distribution, smart grid and interconnections. Appropriate specialist terms used throughout. The candidate uses very good spelling, punctuation and grammar, and the form and style are of an excellent standard.</p>	[11]–[15]
<p><b>Level 2</b> The candidate discusses relevant factors in satisfactory depth with reference to the four issues. The discussion is reasonable and demonstrates an adequate knowledge of the issues surrounding large scale electricity generation, distribution, smart grid and interconnections. Some specialist terms are used throughout. The candidate uses good spelling, punctuation and grammar, and the form and style are of a reasonable standard.</p>	[6]–[10]
<p><b>Level 1</b> The candidate discusses relevant factors in limited depth with reference to the four issues. The discussion is limited and demonstrates a limited knowledge of the issues surrounding large scale electricity generation, distribution, smart grid and interconnections. Little use made of specialist terms. The candidate uses limited spelling, punctuation and grammar, and the form and style are of a basic standard.</p>	[1]–[5]
Response not worthy of credit	[0]

[15]

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**Total**

**75**