Rewarding Learning

**ADVANCED SUBSIDIARY (AS)**
**General Certificate of Education**
**2018**

# Environmental Technology

## Assessment Unit AS 1

*assessing*

## The Earth's Capacity to Support Human Activity

**[SET11]**

**WEDNESDAY 16 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 produced. 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 and 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 bass 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)** A: Heat energy [1];
B: Kinetic energy [1].

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

**(b)** The steam from the turbine passes to the condenser which may be a cooling tower or lake [1] and this changes it back to water before returning it to the boiler to be reheated [1].

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

**(c)** Coefficient of performance = $\frac{\text{Energy output from heat pump [1]}}{\text{Energy used by heat pump [1]}}$

$3.1 = \frac{\text{Energy Output}}{6.0\,\text{MJ [1]}}$

Energy Output = $3.1 \times 6.0\,\text{MJ [1]} = 18.6\,\text{MJ [1]}$

All relevant, valid responses will be given credit. [5] 9

**2** **(a)** Burning coal to produce electricity releases carbon dioxide gas which is a greenhouse gas [1]. It is implicated in causing global warming and climate change. To reduce greenhouse gas emissions, countries will have to burn less fossil fuel. [1]
Award [2] for a detailed explanation and [1] for a limited explanation

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

**(b)** Any **two** points from the following:

- Habitat degradation [1] caused by e.g. rising sea levels, desertification and polar icecaps melting. Plants and animals cannot adapt to the new environment and do not survive in it. [1]
- Impact on biodiversity; [1] loss of species results in less food for other species so there is a knock-on effect on biodiversity. [1]
- Air quality reduction; [1] combustion of fossil fuels produces sulfur dioxide and nitrogen oxides which form acid rain. Combustion also produces soot particulates which cause breathing difficulties. [1]
- Land and water contamination; [1] disturbing the geology of a region to extract fossil fuels leads to water becoming contaminated with e.g. toxic metals. This water is not safe to drink. Land contamination can come from the process of extraction and also disposal of the waste from fossil fuels after combustion. [1]

Award [2] for a detailed description and [1] for a limited description

All relevant, valid responses will be given credit. [4]

**(c)** **(i)**

- A *carbon trade* is an exchange of carbon credits between countries. [1]
- Countries are assigned maximum carbon emission levels. [1]
- If a country exceeds its maximum level it is penalised. [1]
- Countries that have higher *carbon emissions* can buy the right to release more *carbon* dioxide into the atmosphere from countries that have lower *carbon emissions*. [1]

All relevant, valid responses will be given credit. [4]

| | | | AVAILABLE MARKS |
|---|---|---|---|
| | **(ii)** Any **one** from:<br>The market is open to fraud. [1]<br>Businesses may not participate. [1]<br>Credit limits may be too high. [1]<br>It is difficult to measure emissions. [1]<br><br>All relevant, valid responses will be given credit. | [1] | 11 |
| **3** | **(a)** **A**: Protective glass cover [1];<br>**B**: Absorber plate [1].<br><br>All relevant, valid responses will be given credit. | [2] | |
| | **(b)** The Sun's energy is captured by the absorber plate [1] and transferred to the water which heats up a tank in the house. [1]<br>Award [2] for a detailed explanation and [1] for a limited explanation<br><br>All relevant, valid responses will be given credit. | [2] | |
| | **(c)** Evacuated tube solar collector. [1]<br><br>All relevant, valid responses will be given credit. | [1] | |
| | **(d)** Parabolic Trough. [1]<br><br>All relevant, valid responses will be given credit. | [1] | |
| | **(e)** Concentrating Solar Power (CSP) plants use mirrors to focus the Sun's energy for conversion into high grade heat (steam) [1]; the steam drives a turbine which turns a generator creating electricity. [1]<br><br>All relevant, valid responses will be given credit. | [2] | |
| | **(f)** Any **two** from:<br>• Main glazed 'dayrooms' to be oriented towards South (or within 15 degrees of south) [1]; Non-habitable rooms (bathrooms, stores etc.) oriented towards North [1];<br>• Windows to be appropriately sized to provide good day-lighting [1] and also prevent excessive heat loss/heat gain [1];<br>• Use low emissivity/double/triple glazing [1] to reduce heat loss through windows [1];<br>• Provide eaves overhangs/bris-soleil [1] to reduce summer heat gain through windows [1];<br>• Heavy construction/high thermal mass [1]; will absorb heat in winter to even out temperature fluctuations [1];<br>• High levels of thermal insulation [1]; will reduce the heat loss of the building [1].<br>Award [2] for a detailed description and [1] for a limited description<br><br>All relevant, valid responses will be given credit. | [4] | 12 |

| | | | | AVAILABLE MARKS |
|---|---|---|---|---|
| 4 | (a) | Biomass is material derived from growing plants or from animal manure. Award [2] for a detailed explanation and [1] for a limited explanation | [2] | |
| | (b) | Any **two** from:<br>• Percentage moisture content; [1]<br>• Calorific value/energy density; [1]<br>• Particle size. [1] | [2] | |
| | (c) | Any **one** from:<br>• Organic materials; [1]<br>• Agricultural crops; [1]<br>• Agricultural and municipal wastes. [1] | [1] | |
| | (d) (i) | The biological breakdown of organic matter [1] in the absence of oxygen [1]<br><br>All relevant, valid responses will be given credit. | [2] | |
| | (ii) | methane; [1] carbon dioxide.[1]<br><br>All relevant, valid responses will be given credit. | [2] | 9 |
| 5 | (a) | Energy supplies from renewable sources (wind/solar/wave/tidal) tend to be **unreliable** and/or **intermittent**. [1]<br><br>All relevant, valid responses will be given credit. | [1] | |
| | (b) (i) | Compressed Air Energy Storage. | [1] | |
| | (ii) | At times of low demand (off-peak) electrical energy from a renewable energy source [1] compresses air for storage in an underground store/cavern [1]. At times of high demand air is released to the surface and heated using gas to expand its volume [1], and is then used to drive a turbine creating electricity [1].<br><br>All relevant, valid responses will be given credit. | [4] | |
| | (c) | Any **two** factors from:<br>• Availability of existing underground caverns; [1]<br>• Availability of natural gas supply; [1]<br>• Proximity to high voltage power transmission network; [1]<br>• Accessibility for construction, operation and maintenance; [1]<br>• Lack of environmental concerns/objections. [1]<br><br>All relevant, valid responses will be given credit. | [2] | |
| | (d) | Pumped Hydro Energy Storage. [1]<br><br>All relevant, valid responses will be given credit. | [1] | 9 |

AVAILABLE MARKS

**6** **(a)** Any **two** from the following:
Carbon monoxide [1]; hydrogen cyanide [1]; hydrogen chloride. [1]

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

**(b)** Any **three** factors such as:

- The manufacturing process is energy intensive and releases pollutants into the environment. [1] Alternative manufacturing processes are required which have less of an environmental impact.[1]
- The lack of biodegradability [1] means that plastics accumulate in the environment causing damage to marine and land habitats and the organisms they support. [1]
- They are made from non-renewable raw materials (crude oil) [1] so alternative, renewable feedstocks will need to be found as crude oil is expected to run out. [1]
- Disposal of plastics is an issue. [1] Many plastic items are used for a short time before they are disposed of. Some plastics can be recycled but many cannot. Therefore there is a large accumulation of waste plastic in the environment. [1]

All relevant, valid responses will be given credit. [6]

**(c)** Any **one** from:

- Compostable plastics can be used to improve soil composition [1]. They break down in the environment to provide useful soil nutrients. [1]
- They can be used as weed suppressant [1] as they can cover ground around plants preventing weed growth.[1]
- They can be used as mulch [1] keeping soil temperatures raised in winter/conserving moisture. [1]

Award [2] for a detailed description and [1] for a limited description

All relevant, valid responses will be given credit. [2] 10

**7 Indicative Content**

AVAILABLE MARKS

**Issues affecting energy output:**

- Available wind resource – faster, more powerful winds generate more energy – link to wind survival speed;
- Orientation of site – to take advantage of prevailing winds;
- Topography/clear terrain with no obstacles to wind;
- Relationship between rotor swept area (i.e. blade length);
- Turbine: hub height; blade length, materials, efficiency.

**Cost Issues:**

- Installation costs – more expensive out at sea and in mountains;
- Costs of connection to power transmission networks;
- Servicing/maintenance costs;
- Accessibility – cost of making/upgrading access roads;
- Refurbishing turbines at end of working life.

**Environmental and social Issues:**

- Potential for noise pollution;
- Aesthetic/visual issues;
- Potential impact on local communication networks;
- Environmental impact assessment of windfarm and access roadways and infrastructure on habitat (bogland, hillsides, seabeds) and wildlife (birds, bats, marine life);
- Likelihood of objections.

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

| Response | Mark | AVAILABLE MARKS |
|---|---|---|
| **Level 3**<br>The discussion is clear and precise and demonstrates excellent knowledge of the issues to be considered when planning and siting a wind farm venture. A wide range of specialist terms is used throughout. The candidate uses excellent spelling, punctuation and grammar, and the form and style are of an excellent standard. | [11]–[15] | |
| **Level 2**<br>The discussion is reasonable and demonstrates good knowledge of the issues to be considered when planning and siting a wind farm venture. 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**<br>The discussion is limited and demonstrates limited knowledge of the issues to be considered when planning and siting a wind farm venture. 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** |