



Centre Number

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Candidate Number

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Environmental Technology

Unit A2 1

Building and Managing a
Sustainable Future



AET11

[AET11]

FRIDAY 8 JUNE, MORNING

TIME

2 hours.

INSTRUCTIONS TO CANDIDATES

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.

Write your answers in the spaces provided in this question paper.
Answer **all** questions.

For Examiner's use only	
Question Number	Marks
1	
2	
3	
4	
5	
6	
7	
8	
9	

INFORMATION FOR CANDIDATES

The total mark for this paper is 100.

Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.
Quality of written communication will be assessed in Questions **6(b), 7 and 9**.

Total Marks

1 (a) List **four** priority waste streams identified in the Northern Ireland Waste Management Strategy.

1. _____ [1]
2. _____ [1]
3. _____ [1]
4. _____ [1]

(b) Northern Ireland currently sends 40% of all municipal waste to landfill. The Northern Ireland Waste Management Strategy aims to reduce the quantity of waste going to landfill.

Explain **two** reasons why the Northern Ireland Waste Management Strategy seeks to end the over-reliance on landfill.

1. _____

_____ [2]
2. _____

_____ [2]

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(Questions continue overleaf)

2 **Table 1** below shows data for two metals, copper and aluminium.

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Table 1

Material	Embodied energy (MJ/kg)
Copper obtained from ore	57.0
Copper obtained by recycling of scrap metal	16.5
Aluminium obtained from ore	218.0
Aluminium obtained by recycling of scrap metal	29.0

(a) (i) Explain what is meant by the term **embodied energy**.

[2]

(ii) Using data from the table above, compare the embodied energy of copper and aluminium and the two production methods shown.

[2]

(b) Discuss **one** advantage and **one** disadvantage of waste incineration.

Advantage:

[2]

Disadvantage:

[2]

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Marks	Remark

3 (a) A family wants to reduce its home heating bills. Outline **two** different measures which could be taken to improve the energy efficiency of the family home.

Measure 1: _____

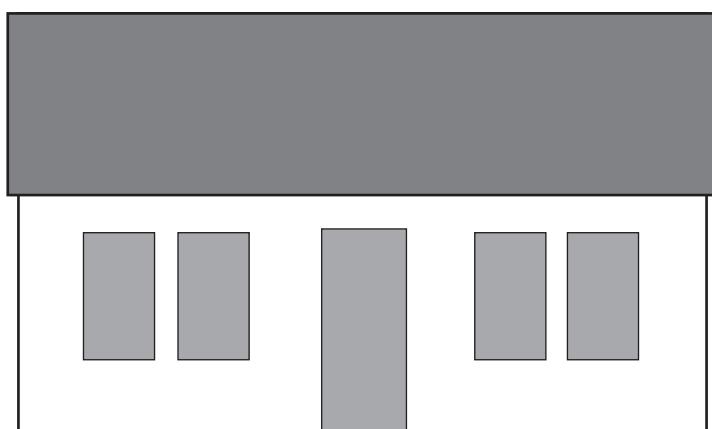
Measure 2: _____

[4]

(b) At present the family cannot afford to finance any physical measures to improve energy efficiency. Describe **one** behavioural change which the family members might make, in the meantime, in order to minimise their energy consumption for home heating.

[2]

(c) **Fig. 1** below shows the front of a small bungalow which was built in the 1970s.



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Fig. 1

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In **Fig. 1** the front wall has an area (excluding windows and door) of 30 m^2 . The windows and door have a combined area of 7.5 m^2 . When the temperature inside the bungalow is 19°C and the outside temperature is -1°C the total rate of heat flow through the front wall, door and windows is 1170 W .

An identical bungalow built in 2015 uses different materials and building techniques. The new wall will have a U value of $0.3\text{ W m}^{-2}\text{ K}^{-1}$ and the windows and door will have a U value of $2.6\text{ W m}^{-2}\text{ K}^{-1}$.

Calculate the **reduction** in the total rate of heat flow (through the front wall, door and windows) that will result from using these new materials and building techniques. (Assume that the temperature inside the bungalow is 19°C and the outside temperature is -1°C). Show your working out in the space below.

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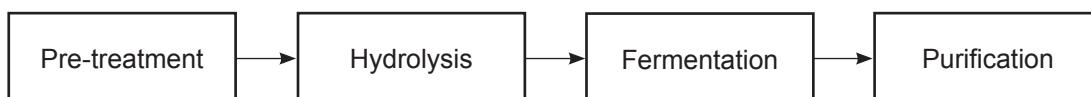
Reduction in total rate of heat flow = _____ W [5]

4 (a) List **two** different strategies used by policy makers to reduce transport demand.

1. _____ [1]

2. _____ [1]

(b) Some vehicles are being developed that use bioethanol as a fuel, either pure or mixed with petrol. The diagram below outlines the key steps involved in the production of bioethanol.



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Explain what occurs in each step.

Pre-treatment

[2]

Hydrolysis

[2]

Fermentation

[2]

Purification

[2]

Examiner Only	
Marks	Remark

5 (a) Outline **two** of the principles of One Planet Living.

1. _____

2. _____

[4]

(b) A common way of comparing environmental impacts is by using the Ehrlich Equation **I=PAT** (where I = impact; P = population; A = affluence; T = damage caused by technology). For each of the following terms from this equation, outline **two** environmental impacts of the growing global need for resources.

Population:

1. _____

2. _____

Affluence:

1. _____

2. _____

Damage caused by Technology:

1. _____

2. _____

[6]

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Marks	Remark

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(Questions continue overleaf)

6 (a) Wave and tidal energy have the potential to make a significant contribution to future energy needs in the British Isles. However, there can be environmental impacts associated with obtaining this energy. Outline **two** environmental impacts which can occur when wave or tidal energy devices are installed at a particular marine location.

1. _____
2. _____

[2]

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(b) **Fig. 2** below shows a type of wave energy convertor. With reference to **Fig. 2** name the type of wave energy convertor shown and describe the processes involved in its operation.

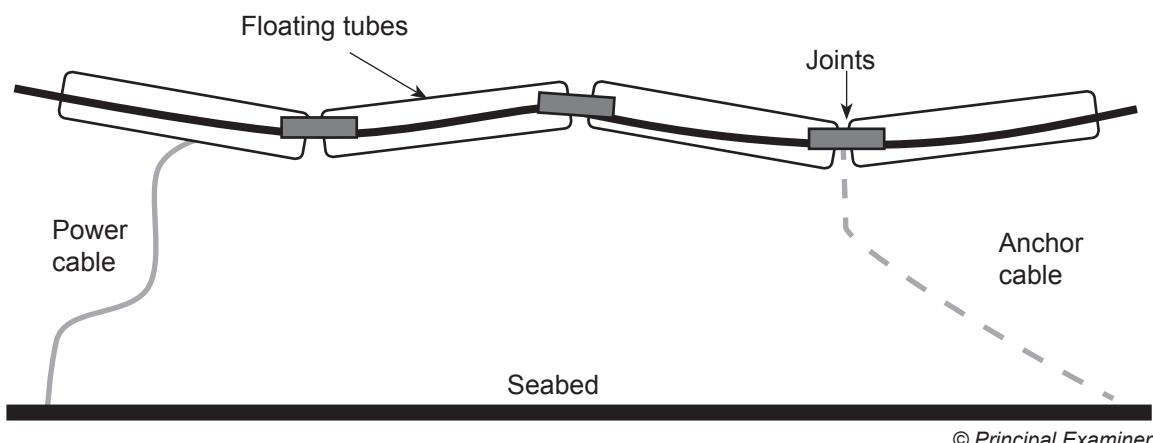


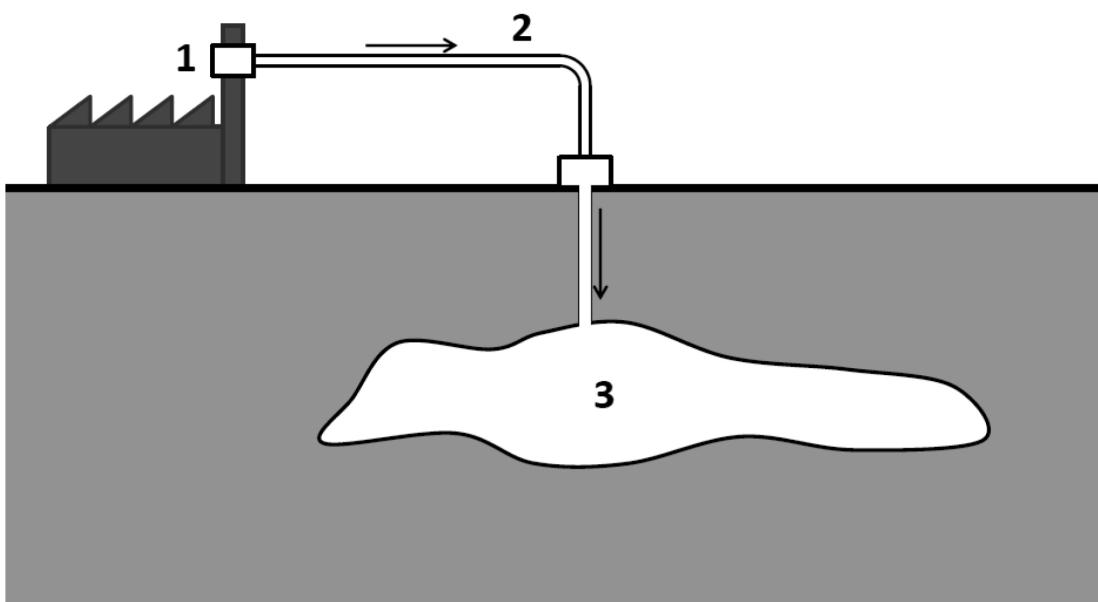
Fig. 2

The quality of written communication will be assessed in this question.

[5]

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(c) Fig. 3 below shows a schematic diagram which has been labelled to indicate the three phases of a typical Carbon Capture and Storage installation.



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Fig. 3

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With reference to **Fig. 3** describe the three phases of the carbon capture and storage process.

Phase 1

Phase 2

Phase 3

[6]

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7 In 1950 only 30% of the world's population lived in urban areas (according to the United Nations World Urbanisation Prospects 2014). This was projected to increase to 66% by 2050. With this trend in mind, discuss the main characteristics of a sustainable urban development. Your answer should include specific reference to the following issues:

- energy use for heating and cooling/the provision of versatile buildings;
- integrated and flexible transport facilities/micro-generation (including the use of smart grid technology);
- brownfield sites/waste management systems;
- sustainable urban drainage/dealing with water shortage;
- the environmental and other benefits of green spaces for people and wildlife.

The quality of written communication will be assessed in your answer.

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Marks	Remark

8 Micro-organisms can be used to remove pollutants from contaminated land.

(a) What term is given to the treatment of contaminated land with micro-organisms?

_____ [1]

(b) Identify a pollutant that the following micro-organisms can be used to treat:

1. *Pseudomonas aeruginosa*

_____ [1]

2. *Dehalococcoides ethenogenes*

_____ [1]

(c) Describe **two** benefits associated with the use of the type of contaminated land treatment named in **part (a)** above.

1. _____

_____ [2]

2. _____

_____ [2]

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(d) Living organisms have other useful industrial applications. What name is given to the following processes?

(i) The use of plant species to extract metals from metal ore mine tailings.

[1]

(ii) The use of bacteria to extract metals from low-grade metal ore.

[1]

(e) Assess the advantages and limitations of using plants such as alpine pennygrass to decontaminate soil. Your answer should include **two** advantages and **one** limitation.

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9 In May 2016 the UK Government's Office for Low Emissions Vehicles (OLEV) announced funding to encourage businesses to switch to hydrogen-fuelled vehicles. Hydrogen-fuelled vehicles use hydrogen fuel cells such as the PEM fuel cell.

Discuss the use of hydrogen as a transport fuel. Your discussion should focus on the following:

- Three methods used for the bulk production of hydrogen fuel.
- How a PEM fuel cell works, including relevant chemical equations.
- The challenges presented by using hydrogen as an energy source for transport.

The quality of written communication will be assessed in this question.

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