Rewarding Learning

ADVANCED

General Certificate of Education

2017

Centre Number

Candidate Number

Environmental Technology

Unit A2 1
Building and Managing a Sustainable Future

A2EA1

[A2EA1]
THURSDAY 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.
Complete in black ink only. **Do not write with a gel pen.**
Answer **all** questions.

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 **3(b)**, **7(a)** and **9**.

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

Examiner Only	
Marks	Remark

1 **(a)** Describe the concept of embodied energy.

_____

_____

_____

_____ [2]

(b) In **Fig. 1** below identify **A** and **B** in the stages associated with anaerobic digestion.

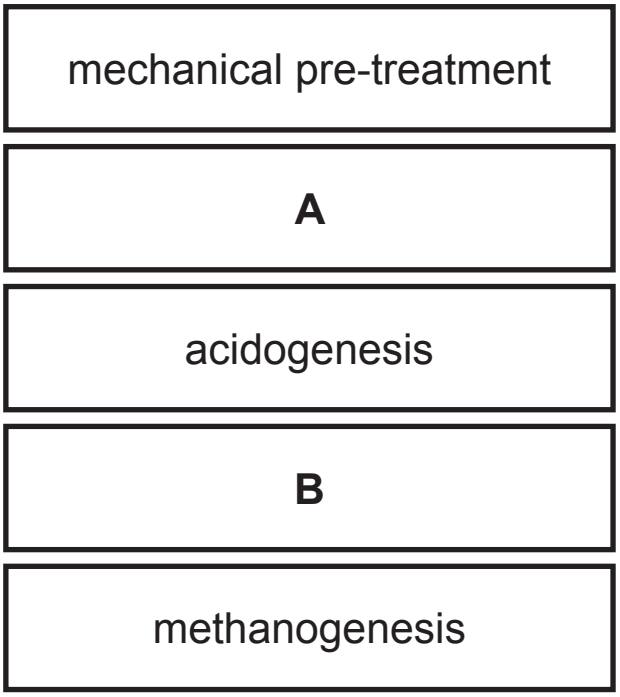

Fig. 1 © *Principal Examiner*

A: _____

B: _____

[2]

(c) Explain what happens during the acidogenesis and methanogenesis stages associated with anaerobic digestion.

Acidogenesis: _____

_____

_____

_____

Methanogenesis: _____

_____

_____

_____ [4]

Examiner Only	
Marks	Remark

2 Rural communities in Northern Ireland experience a number of challenges in order to remain sustainable in an increasingly urbanised and technologically advanced world. In the face of these challenges, discuss **four** different issues that underpin the development of sustainable rural communities.

Examiner Only	
Marks	Remark

1. _____

2. _____

3. _____

4. _____

[8]

Examiner Only	
Marks	Remark

3 **(a)** Explain how in situ bioreactors are used to treat contaminated soil.

[3]

(b) With reference to copper, discuss the similarities and differences between phytoremediation and phytoextraction. You should discuss **four** points in your answer.

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

[6]

Examiner Only	
Marks	Remark

4 **(a)** Define what is meant by the term 'U value'.

_____

_____

_____

_____ [2]

(b) **Fig. 2** below shows the rear wall of a small house.

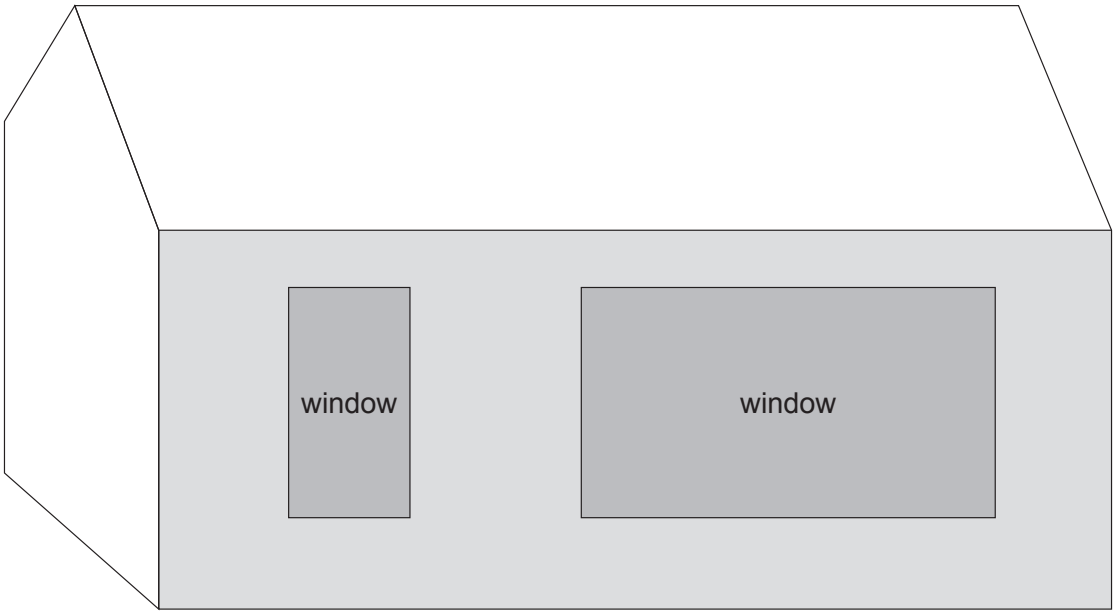

Fig. 2

In **Fig. 2** the rear wall of the house has an area (excluding the windows) of 32 m^2 and a U value of 0.23 $Wm^{-2}K^{-1}$. The windows have a combined area of 14.4 m^2 and are double glazed. When the temperature inside the house is 19°C and the temperature outside is −1°C, the total rate of heat flow through the rear wall and windows is 838.4 W.

If the owner of the house in **Fig. 2** replaces the existing windows with new triple glazed windows (which have a U value of 0.8 $Wm^{-2}K^{-1}$) of the same area, and if the internal and external temperatures remain at 19°C and −1°C respectively, calculate the reduction in the total rate of heat flow through the rear wall and windows. Show your working out in the space below.

[5]

Examiner Only	
Marks	Remark

Examiner Only	
Marks	Remark

(c) **Fig. 3** below shows the Zero Carbon Homes hierarchy.

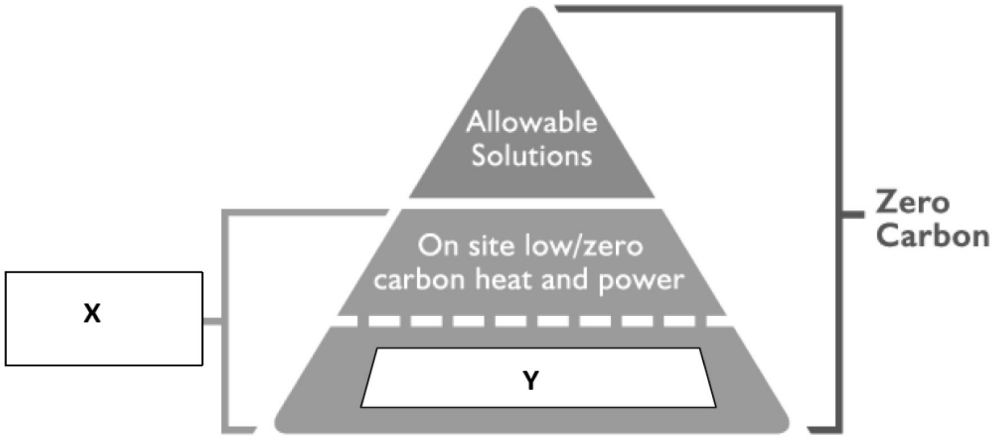

Fig. 3

Identify **X** and **Y** in **Fig. 3**.

X: _____

_____

Y: _____

_____ [2]

(d) Name **two** of the main environmental building performance measurement systems for buildings in the UK.

_____

_____ [2]

BLANK PAGE

(Questions continue overleaf)

Examiner Only	
Marks	Remark

5 **(a)** You are employed as a sustainability advisor by an organisation and have been asked to provide advice on One Planet Living. Name and outline **three** of the principles of One Planet Living which your organisation could adopt.

1. _____

_____

_____

_____

2. _____

_____

_____

_____

3. _____

_____

_____

_____ [6]

(b) It is generally agreed that someone living in a developed country will have a larger ecological footprint than someone living in a developing country. Explain why this may be the case.

_____

_____

_____

_____

_____

_____

_____

_____ [4]

(c) Explain the linkage between a carbon footprint and an ecological footprint.

Examiner Only	
Marks	Remark

_____

_____

_____

_____

_____

_____ [2]

Examiner Only	
Marks	Remark

6 Biohydrometallurgy (biorefining) involves using bacteria such as *Thiobacillus ferrooxidans* to extract metals from low grade ore.

(a) Identify **two** metals that *Thiobacillus ferrooxidans* extracts.

1. _____ [1]

2. _____ [1]

(b) Explain **two** advantages of using biohydrometallurgy over traditional metal smelting technologies.

_____

_____

_____

_____

_____

_____

_____

_____ [4]

(c) Describe how suitable sites are identified and prepared for biorefining.

(i) Identification:

_____

_____

_____

_____ [2]

(ii) Preparation:

_____

_____

_____

_____ [2]

BLANK PAGE

(Questions continue overleaf)

Examiner Only	
Marks	Remark

7 (a) A Department of Trade and Industry (DETI) report into offshore wind and marine renewable energy in 2009 concluded that offshore renewables (such as wave and tidal power) could make a significant contribution to the proposed 40% target for renewable energy in Northern Ireland.

Discuss the constraints on developing wave and tidal power from the seas around Northern Ireland.

Your answer should focus on the following areas:

- research and development/commercial viability
- conflict with other sea users
- availability of suitable sites
- impact on marine life and habitat
- visual and noise pollution.

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

Examiner Only

Marks	Remark

[10]

(b) Define what is meant by a 'smart material'.

[2]

(c) Describe **one** application of a smart system with reference to engineering, transportation or waste management.

[2]

Examiner Only	
Marks	Remark

8 Biodiesel is a renewable fuel that can be used instead of conventional diesel derived from fossil fuels. Biodiesel is manufactured from vegetable oil.

(a) Complete the diagram below by inserting the names of the relevant chemicals:

Vegetable oil + [ ] + [ ] → Biodiesel + [ ]

[3]

(b) Outline **three** advantages of using biodiesel instead of conventional diesel.

[3]

(c) Comment on the statement that the "production of biodiesel is contentious". Refer to **three** aspects of biodiesel production in your answer.

[3]

(d) Hydrogen is being developed as another alternative to fossil fuels for use in vehicles. Describe **two** challenges presented by using hydrogen as an energy source for use in vehicles.

1. _____

_____

_____

_____ [2]

2. _____

_____

_____

_____ [2]

Examiner Only	
Marks	Remark

9 The Northern Ireland Waste Management Strategy (2013) states that:

"Reducing the amount of waste that goes to landfill has been the main priority of successive waste strategies. We still rely too heavily on landfilling waste – not only is this an inefficient use of resources but it contributes to climate change and is unsustainable."

"After Waste Prevention, including re-use, the next priority is to separate waste materials for recycling. This not only reduces the environmental impact of waste, but also reduces the demand on natural resources."

Discuss the landfilling and recycling of waste, referring in detail to the following:

- The breakdown of waste in landfills;
- The design of modern engineered landfill sites such as Dry Tomb and Bioreactors;
- The process of waste recycling at a Materials Recovery Facility.

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

Examiner Only	
Marks	Remark

Examiner Only	
Marks	Remark

[15]

THIS IS THE END OF THE QUESTION PAPER