Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

For Examiner's Use	
Examiner's Initials	
Question	Mark
1	
2	
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6	
7	
8	
TOTAL	

General Certificate of Education
Advanced Level Examination
June 2013

Environmental Studies ENVS3

Unit 3 Energy Resources and Environmental Pollution

Tuesday 18 June 2013 9.00 am to 10.30 am

You will need no other materials.
You may use a calculator.

Time allowed
- 1 hour 30 minutes

Instructions
- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 80.
  Two of these marks are for the Quality of Written Communication.
- You will be marked on your ability to:
  – use good English
  – organise information clearly
  – use specialist vocabulary where appropriate.
- Question 8 should be answered in continuous prose.
  Quality of Written Communication will be assessed in this answer.

A

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ANSWER IN THE SPACES PROVIDED

Answer **all** questions in the spaces provided.

1 The table shows details of some laws and procedures used to control pollution.

Complete the table.

Law / Procedure	**Details**
Kyoto Protocol	
Critical Group Monitoring (CGM)	
Montreal Protocol	
Critical Pathway Analysis (CPA)	Predicting the movements of pollutants by studying environmental features such as winds, water currents and geology.
	Financial charges made for the disposal of waste in landfill sites.
Clean Air Act (1956)	

(5 marks)

5

Turn over for the next question

2 The photographs show two vertical axis wind turbines that have different shaped blades.

Turbine A

Turbine B

Turbine A, with the helical blades, rotates more smoothly than **Turbine B**. It suffers lower stresses, so it does not need to be as strong and can be lighter than **Turbine B**.

2 (a) Suggest how making lighter turbines may reduce environmental damage.

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(2 marks)

2 (b) Suggest why wind power is particularly suitable for electricity generation in remote areas.

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(2 marks)

2 (c) Outline the factors that influence the *per capita* energy consumption in different countries.

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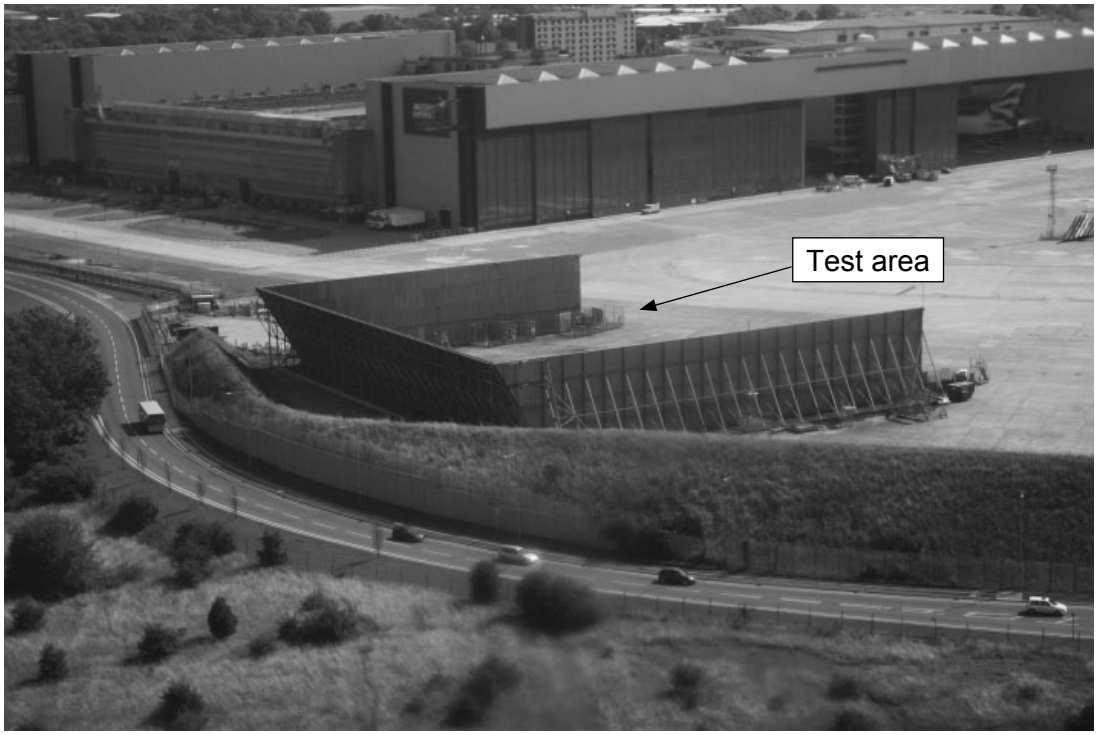
(6 marks)

10

Turn over for the next question

3 The photograph shows an area used to test aircraft engines at an airport.



The test area is surrounded by acoustic screens and is located away from nearby housing.

3 (a) Outline **two** other ways in which airport noise pollution is reduced.

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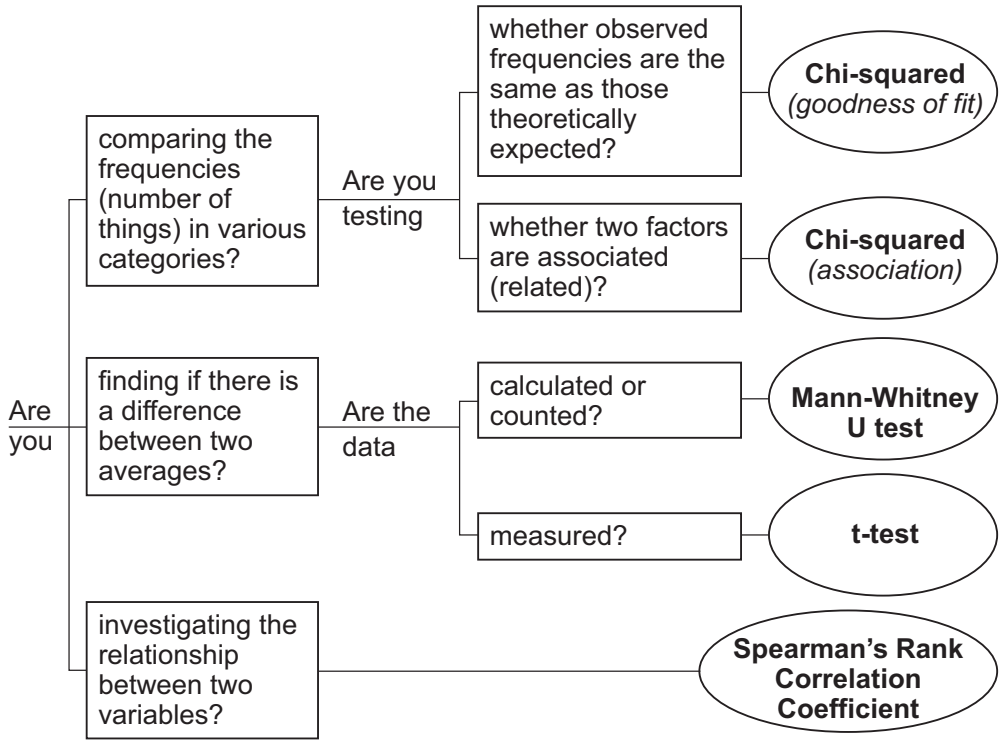
(4 marks)

3 (b) The table shows the mean test scores found during a study of the effect of noise levels on the educational performance of about 11 000 Year 6 children.

		Noise level / dB						
		<54.0	**54.0 – 56.9**	**57.0 – 59.9**	**60.0 – 62.9**	**63.0 – 65.9**	**66.0 – 68.9**	**69.0 – 71.9**
Mean Test Score	English	60.4	56.2	59.2	56.2	60.3	55.9	53.9
	Mathematics	46.4	43.8	44.8	45.0	43.8	43.1	35.6
	Spelling	6.6	6.4	6.4	6.6	6.8	6.7	5.4
	Creative writing	21.6	20.9	21.3	20.2	22.0	20.5	21.5

3 (b) (i) Use the flow diagram to select a suitable test to assess the statistical significance of the effect of noise on educational performance in English.



Suitable test .....

(1 mark)

3 (b) (ii) It was concluded that the relationship between noise levels and performance in mathematics was statistically significant at the p = 0.05 level, but that the relationship between noise levels and creative writing was not.

Explain what is meant by the term *statistically significant at the p = 0.05 level.*

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(1 mark)

Turn over ▶

3 (b) (iii) All scientific studies should be planned to use standardised techniques that produce reliable results.

Suggest other variables that should be taken into account to assess whether the results were only caused by exposure to noise.

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(4 marks)

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Turn over for the next question

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4 The table shows details of some of the radioisotopes present in radioactive waste from nuclear power stations.

Radioisotope	Half-life	Type of radiation emitted
Iodine 131	8 days	beta and gamma
Caesium 137	30 years	beta and gamma
Plutonium 239	24 400 years	alpha

4 (a) (i) Suggest how the half-life of iodine 131 may make it a greater risk to public health than plutonium 239.

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(1 mark)

4 (a) (ii) Outline the difference in the risks to public health of exposure to alpha and gamma radiation.

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(2 marks)

4 (b) Exposure to radiation is affected by the distance from the source and can be calculated using the Inverse Square Law.

$$\text{Dose} = \frac{1}{\text{distance}^2}$$

The table shows the doses received at varying distances from a radioactive source.

Distance / cm	Dose received / arbitrary units
1	1
2	$\frac{1}{4}$
3	$\frac{1}{9}$
4	$\frac{1}{16}$
5	$\frac{1}{25}$

Use the trend shown in the table to calculate the distance that would reduce the dose to 1/100 of that received at 1 cm.

……cm
(1 mark)

Question 4 continues on the next page

4 (c) Explain the differences between the following terms that are used to describe the effects of ionising radiation on human health.

4 (c) (i) Gonadic and somatic effects

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(2 marks)

4 (c) (ii) Acute and chronic effects

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(2 marks)

4 (d) Outline **one** method that is used for the storage of high level radioactive waste from nuclear power stations.

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(2 marks)

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5 The table shows features of some methods used to treat sewage effluent.

Complete the table.

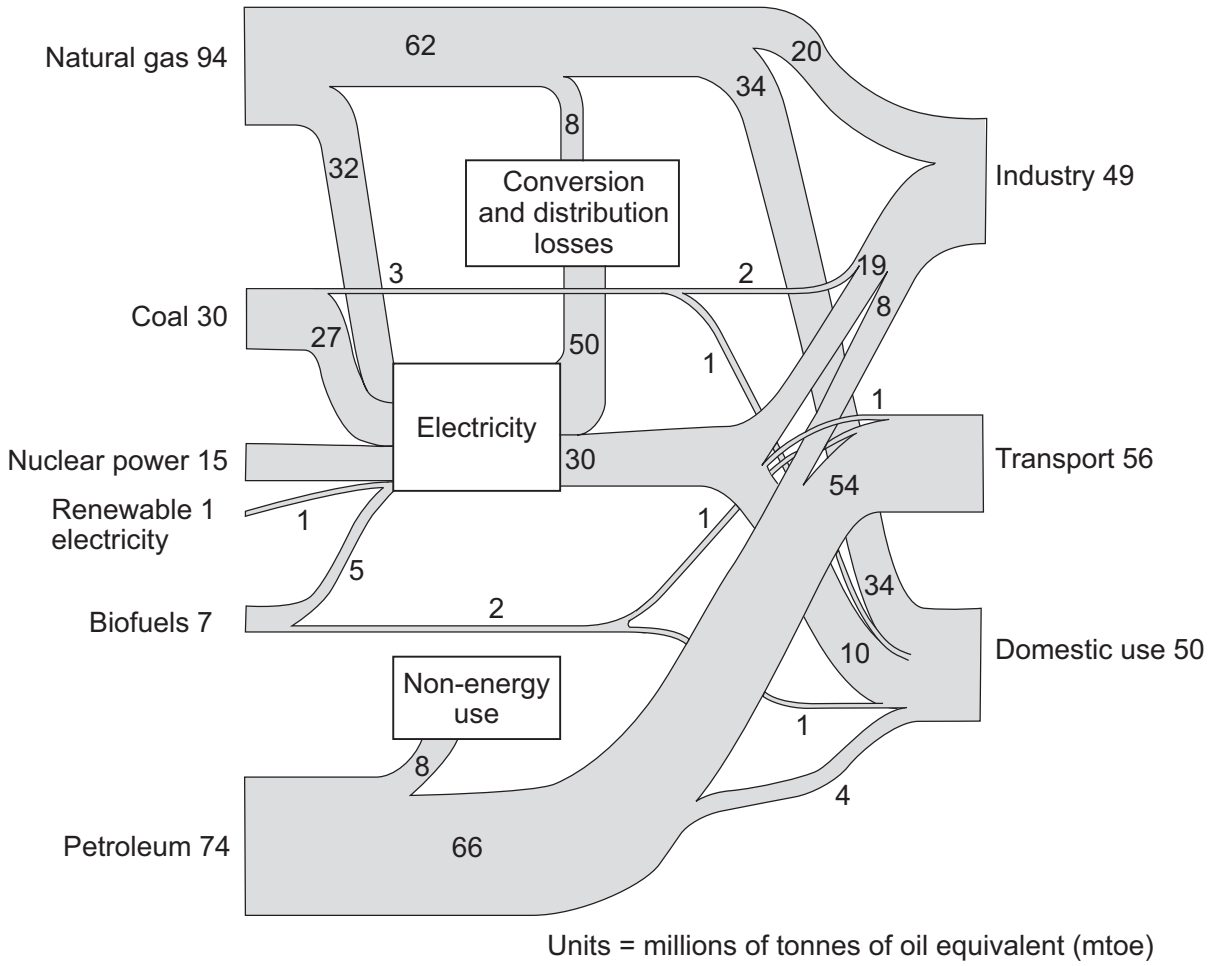
Process	Purpose	Principle of operation
Screening		Effluents flow through metal grills or mesh
Primary sedimentation		Effluents remain static or move very slowly for several hours
Aeration		Pumping of air or oxygen into fluid effluent
Tertiary treatment		Addition of iron sulfate
Anaerobic digestion		Action of anaerobic bacteria

(5 marks)

5

Turn over for the next question

6 The diagram shows an energy flow diagram for the UK in 2010.



Units = millions of tonnes of oil equivalent (mtoe)

6 (a) Use the diagram to calculate:

6 (a) (i) the percentage of the primary fuel supply provided by non-fossil fuel energy resources
Show your working.

……%
(2 marks)

6 (a) (ii) the percentage of the energy used in power stations that is lost as waste heat during energy conversion.
Show your working.

……..%
(1 mark)

6 (b) Describe **one** way in which the overall energy efficiency of power stations has been increased.

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(2 marks)

6 (c) Explain why it would be difficult to use coal to replace petroleum.

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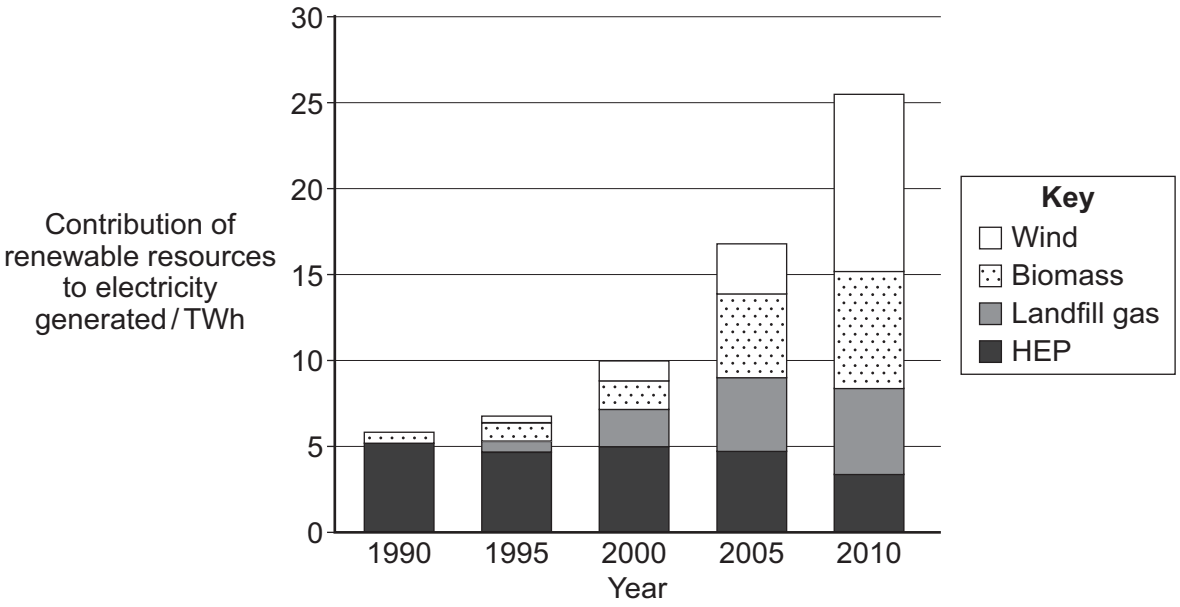
(1 mark)

Question 6 continues on the next page

6 (d) The bar chart shows the growth in energy supply from renewable energy resources in the UK from 1990 to 2010.



State **one** major factor that affects the maximum potential for future expansion of the following renewable energy resources.

6 (d) (i) Wind

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(1 mark)

6 (d) (ii) HEP

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(1 mark)

6 (d) (iii) Landfill gas

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(1 mark)

6 (d) (iv) Biomass

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(1 mark)

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Turn over for the next question

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7 The photograph shows Portcullis House, which is an office block in Westminster, London.

Portcullis House was designed to have a low environmental impact during its lifetime, with energy use being particularly important. It was designed to have a much longer usable life than normal office buildings, so the environmental impact of the embodied energy of its materials is less important than the energy used during its lifetime.

The construction materials have a high thermal mass, which helps to maintain the internal temperature at 22 °C ± 2 °C without the need for additional energy use. Thermal insulation helps to retain heat from equipment and heat in the building. When extra heating is needed in very cold weather, groundwater at 14 °C from a borehole is used for partial heating, with gas boilers being used to raise the temperature further. Borehole water can also be used for cooling in the summer.

Window design aids passive solar gains, with reflective shelves on the windows reflecting light onto the ceilings so that the light in rooms is not too bright. This avoids the 'blinds down, lights on' problem. Where artificial lights are needed, they dim automatically when sunlight becomes brighter. The windows are triple glazed, with a low emissivity coating, and are filled with argon gas.

The windows do not open, which reduces the entry of polluted air from the streets. Warm stale air rises up chimneys on the outside of the building, aided by solar heating, which creates convection currents in the chimneys. The air leaves through heat exchangers in the roof, which reduce ventilation heat losses by 85%. The solar-driven convection current can also be used for fresh air cooling in hot weather.

7 (a) What is meant by the term *embodied* energy (line 4)?

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(2 marks)

7 (b) Explain how heat exchangers work to reduce energy losses (lines 22–23).

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(3 marks)

7 (c) Explain how the use of solar energy reduces the need for additional energy inputs to Portcullis House.

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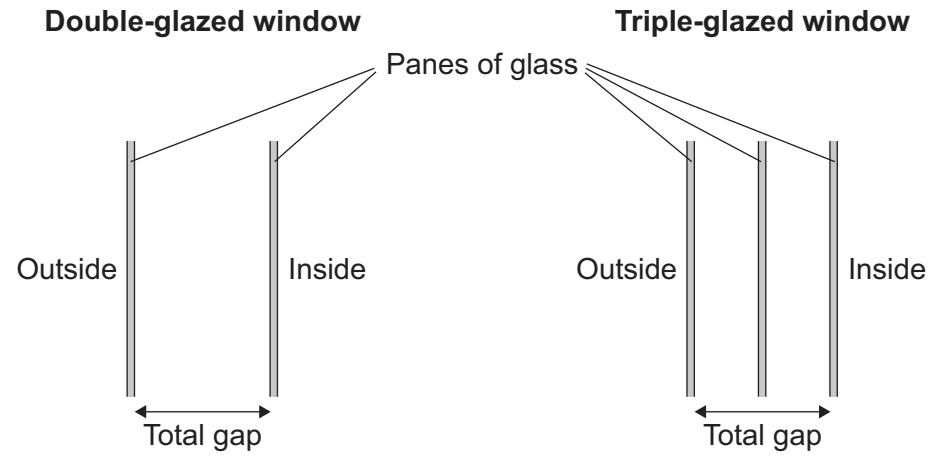
(2 marks)

Question 7 continues on the next page

7 (d) The diagram shows cross-sections through double-glazed and triple-glazed windows.



Explain why triple-glazed windows have a lower rate of heat loss than double-glazed windows with the same total gap.

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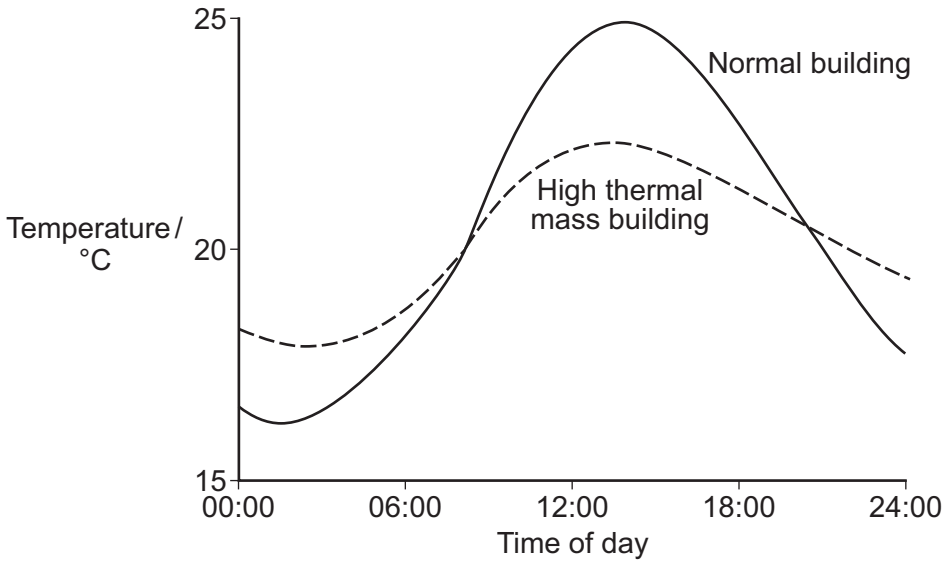
(1 mark)

7 (e) The graph shows changes in the internal temperature of a building with a high thermal mass and in that of a normal building.



Explain how having a high thermal mass may reduce the energy inputs needed to maintain a suitable temperature.

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(2 marks)

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Turn over for the next question

8 Write an essay on **one** of the following topics. Credit will be given for your understanding of the relationship between different areas of the subject, also for the organisation and presentation of the essay and for grammar, punctuation and spelling. You should answer this question in continuous prose.

EITHER

8 (a) Discuss the technological methods that are used to reduce the environmental damage caused by the burning of fossil fuels. *(20 marks)*

OR

8 (b) Discuss the advantages **and** disadvantages of nuclear power **and** the methods used to increase safety. *(20 marks)*

OR

8 (c) Discuss how the features of energy resources affect their usefulness in meeting the demands of society. *(20 marks)*

Write the number of the question you have chosen in the box below.

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(20 marks)

Extra space for Question 8.....

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20

END OF QUESTIONS

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