



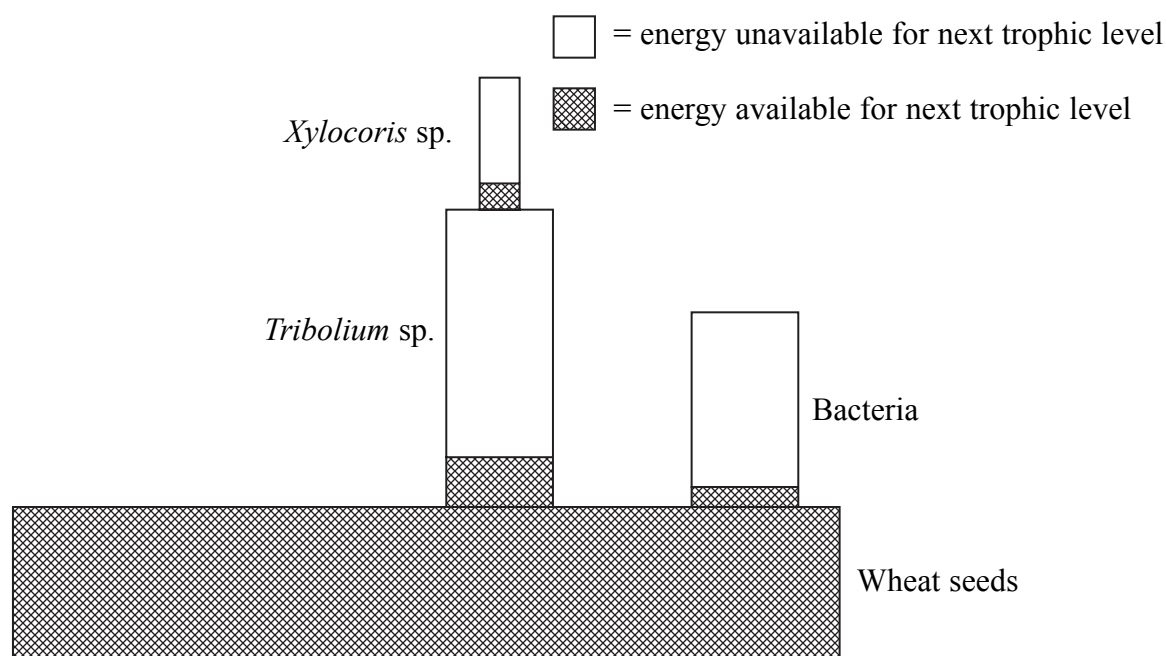
**Answer ALL questions in the spaces provided.**

1. After harvesting, wheat seeds may be stored for several months.

During storage, a proportion of the seeds will be lost. Most of this loss is due to two causes. The flour beetle, *Tribolium* sp., feeds on live dormant seeds and bacteria decompose dead seeds.

Many of the flour beetles are eaten by carnivorous insects called *Xylocoris* sp.

The diagram below shows the relative energy flow within a wheat store.



- (a) State a suitable unit used to record the energy content of the wheat seeds.

..... (1)

- (b) Using the information above, complete the table below by writing appropriate terms in the spaces.

Organism	Trophic level	Mode of nutrition
Wheat seeds		
<i>Tribolium</i> sp.	Primary consumer	Heterotrophic
<i>Xylocoris</i> sp.	Secondary consumer	
Bacteria		Heterotrophic

(2)



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(c) (i) Explain why some of the energy that passes to *Tribolium* sp. from the wheat seeds is not available to be passed on to *Xylocoris* sp.

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(ii) Suggest why all of the energy in the wheat seeds is available to be passed on to the next trophic level.

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(Total 8 marks)

Q1



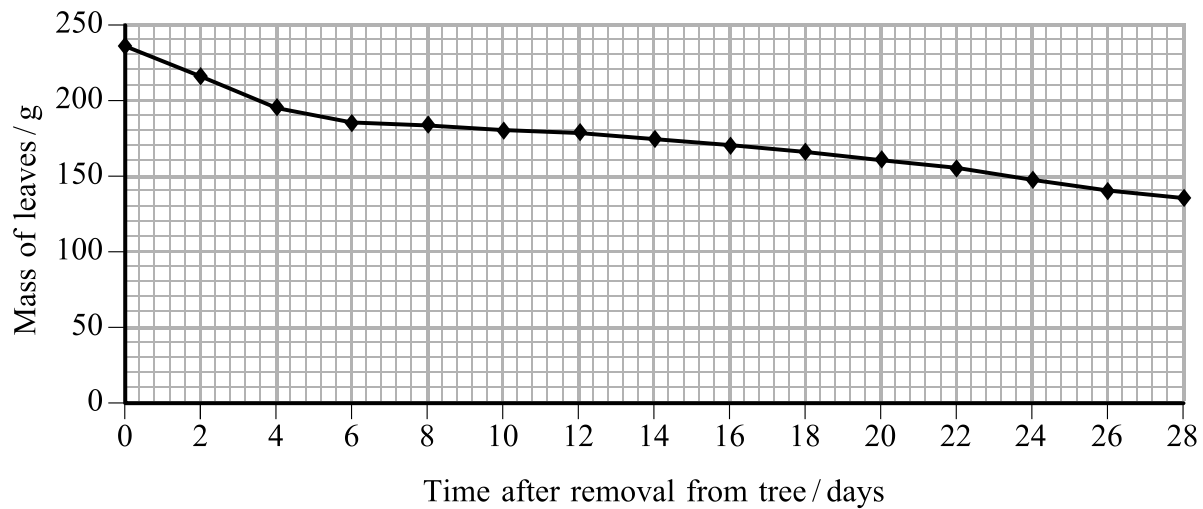
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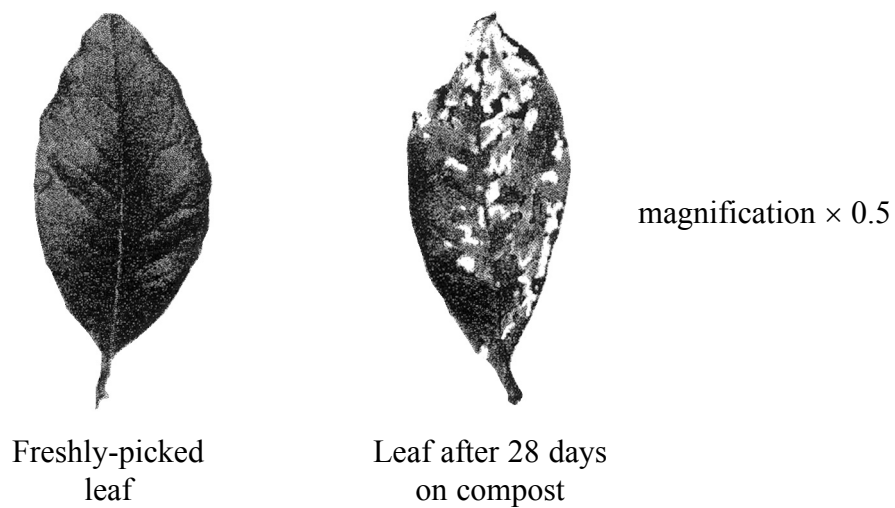


2. In an investigation, several leaves were removed from a Magnolia tree. These leaves were weighed and then placed on the surface of some moist compost in an incubator set at 25 °C. At two-day intervals for a period of 4 weeks, the leaves were weighed and then replaced on to the surface of the compost.

**Figure 1** – Graph of mass of leaves against time after removal from the Magnolia tree



**Figure 2** – Photograph of a freshly-picked Magnolia leaf compared with a Magnolia leaf that has been on the surface of the compost for 28 days



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(a) (i) Describe the changes in the mass of the leaves during the first 14 days of the investigation.

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(ii) Suggest why it is unlikely that the activity of saprobiontic microorganisms in the compost caused these changes in mass during the first 14 days.

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(iii) Suggest a possible reason for the changes in mass in the first four days.

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(b) State **one** difference in appearance of the two leaves in Figure 2, and suggest how saprobiontic microorganisms brought about this change.

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(c) When leaves are added to compost heaps, explain why it is important that the compost is not allowed to become waterlogged or compacted.

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**(Total 11 marks)**

**Q2**

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3. Armenia, a small country in Asia, experienced considerable political and economic changes during the last part of the twentieth century. One of the major problems for Armenia is the supply of energy resources for both domestic and industrial use. From 1990 to 1993, as a result of increased demand for energy, tens of thousands of hectares of Armenian forest were cut down for use as fuel.

The main native species of trees that were removed during this period were beech, oak and hornbeam. These are relatively slow-growing species that cannot be replaced quickly. Beech, oak and hornbeam produce high quality wood, usually used in the construction industry. The extensive deforestation during this period has led to considerable environmental problems such as soil erosion.

Since 1994, a project has been in progress in Armenia to evaluate the use of biomass from fast-growing poplar trees as an energy source for domestic fuel and for the generation of electricity. In the project, different forms of poplar, known as hybrids, were grown at several sites in different regions of the country. For each hybrid, the growth rate was recorded.

Some of the results of this study are shown in Figure 1.

**Figure 1** – Growth rates of poplar hybrids at four different sites

Site	Poplar hybrid	Growth rate /tonnes ha <sup>-1</sup> year <sup>-1</sup>
Yerevan	DN-55	3.13
	Jacometti	8.08
	Eugenei	7.08
	Tripolo	16.85
Hrazdan	DN-55	3.73
	Jacometti	6.30
	Eugenei	9.08
	Tripolo	1.83
Tsovinar	DN-55	9.15
	Jacometti	2.93
	Eugenei	1.15
	Tripolo	10.85
Yeghegnute	DN-55	0.85
	Jacometti	1.78
	Eugenei	0.93
	Tripolo	1.55

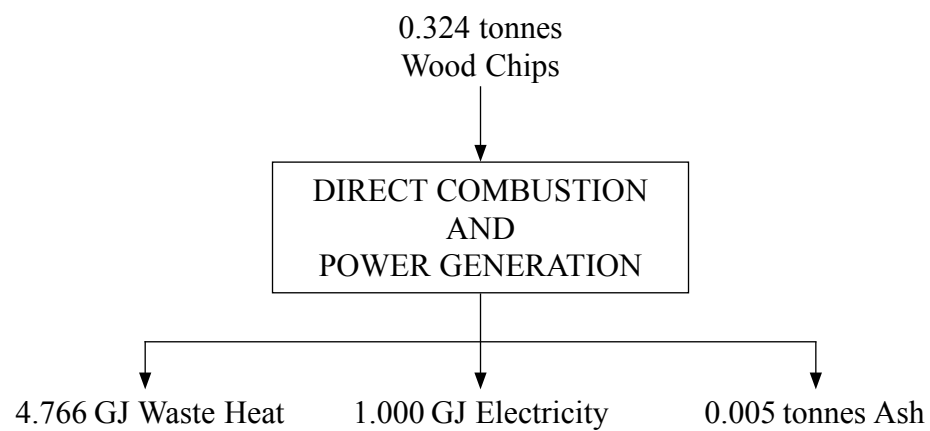
In order to generate electricity, the poplar wood biomass must be prepared as a fuel to drive steam turbines. The first stage in this process is to produce finely-divided woodchips.

The heat to drive the turbines can be generated in two different ways. The wood chips can be burned directly or gas can be released from the wood chips through a process called gasification. This gas is then burnt to release heat.

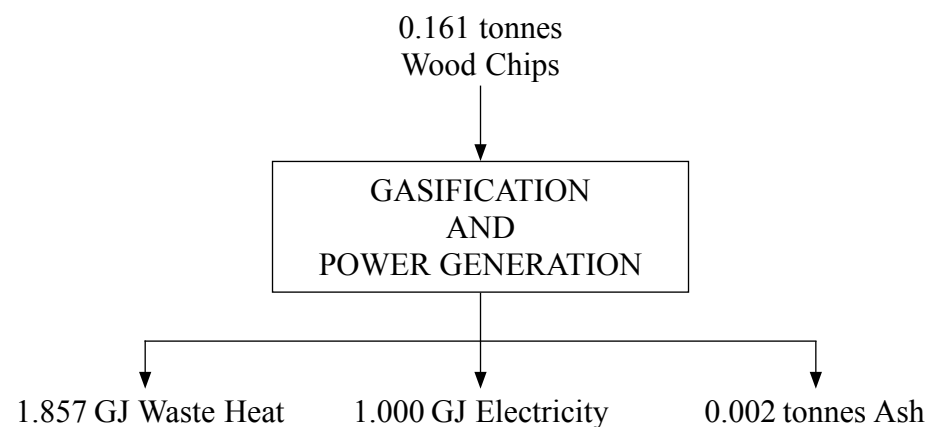


Figures 2 and 3 show the mass of wood chips required to produce 1 GJ of electricity by these two processes.

**Figure 2** – Flow Chart for the Generation of Electricity by direct Combustion of Wood Chips



**Figure 3** – Flow Chart for the Generation of Electricity by Gasification of Wood Chips



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(a) State what is meant by the term **biomass**.

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(b) Suggest why poplars were used in this project in Armenia, rather than the native species such as beech, oak or hornbeam.

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(c) (i) Using information from Figure 1, suggest which of the four sites does not seem suitable for the production of fast-growing biomass using poplars. Give an explanation for your answer.

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(ii) Suggest **two** reasons why this site may not be as suitable as the other sites in the project.

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(d) Explain how the extensive deforestation between 1990 and 1993 might have led to soil erosion.

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(e) The quantity of electricity generated by direct combustion of 1 tonne of wood chips is 3.09 GJ.

(i) Calculate the quantity of electricity generated by gasification of 1 tonne of wood chips. Show your working

Answer .....

**(2)**



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(ii) Using your answer to (e)(i) and the data from Figures 2 and 3, compare these two processes of electricity generation.

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(f) Explain how other organisms could be affected by the planting of poplars instead of the native species.

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**QUESTION 3 CONTINUES ON THE NEXT PAGE.**



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(g) Another example of fast-growing biomass being used as an energy resource is the production of ethanol using sugar cane. Describe how the motor fuel, gasohol, is produced using ethanol.

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Q3

(Total 19 marks)

**TOTAL FOR PAPER: 38 MARKS**

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