1 Fall armyworms are native to America.

Fall armyworms eat corn plants.

(a) The binomial name for fall armyworms is *Spodoptera frugiperda*.

Fall armyworms belong to an order of insects called Lepidoptera.

The table shows a classification table for the fall armyworm.

Complete the table.

Classification group	**Name**
Kingdom	
	Arthropoda
	Insecta
Order	Lepidoptera
Family	Noctuidae
	frugiperda

(2)

Fall armyworms have been found in Africa.

By 2016 they had spread rapidly destroying corn crops.

(b) Suggest **one** reason why the fall armyworms are spreading so rapidly in Africa.

_____

_____

(1)

(c) Fall armyworms:

- are **not** worms (annelids)
- are the caterpillars of moths (arthropods).

Describe **one** way scientists could tell if a new 'worm' they found should be classified as an annelid or as an arthropod.

_____

_____

(1)

(d) In parts of Africa, aeroplanes have been used to spray insecticide on crops, to kill the worms.

Explain the advantages and disadvantages of spraying insecticide on the corn crops.

(4)

(Total 8 marks)

2 In January 2011 more than 600 000 people collected results for the UK national bird survey.

People recorded the number of each species of bird they saw in 1 hour on 1 day in their garden.

Some of the results are shown in the table below.

Species	**Mean number of birds seen per garden**	**Percentage of gardens in which the bird was seen**
House sparrow	4.1	64.5
Starling	3.9	51.3
Blackbird	3.2	95.2
Goldfinch	1.5	33.5

(a) A student looked at the table and said:

"In the UK, house sparrows are more common than blackbirds."

Suggest **three** reasons why the student's statement may **not** be true.

_____

_____

_____

_____

_____

_____

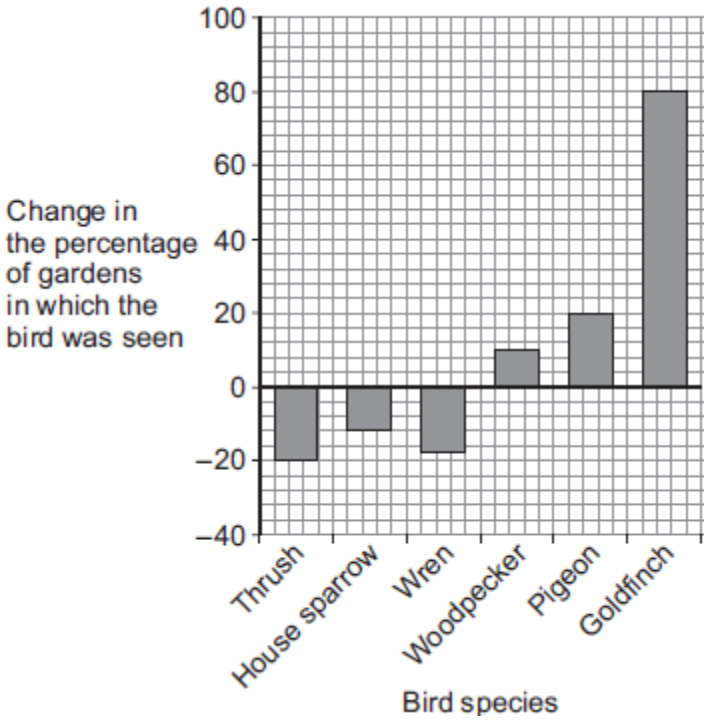
_____

_____

(3)

(b) A survey in 2012 was done in the same way as the 2011 survey.

The graph below shows changes in the percentages of gardens in which some birds were seen from 2011 to 2012.



(i) Calculate the percentage of gardens in which goldfinches were seen in 2012.

Use information from the graph and the table.

_____

_____

Answer = _____ %

(2)

(ii) Suggest **two** reasons why goldfinches were seen in more gardens in 2012 than in 2011.

_____

_____

_____

_____

(2)

(Total 7 marks)

3 In 2017, the city of Manchester began a 'City of Trees' project.

The project plans to plant 3 million trees over the next 25 years.

The trees will be used to:

- make existing woodlands larger
- link existing woodlands
- create new woodlands
- plant in parks, public gardens and along streets
- give to people to plant in private gardens.

(a) It was suggested that the council plant 3.6×10^5 trees in the first year.

The rest of the trees would be planted in equal numbers over the remaining years.

Calculate how many trees would need to be planted in each of the remaining years.

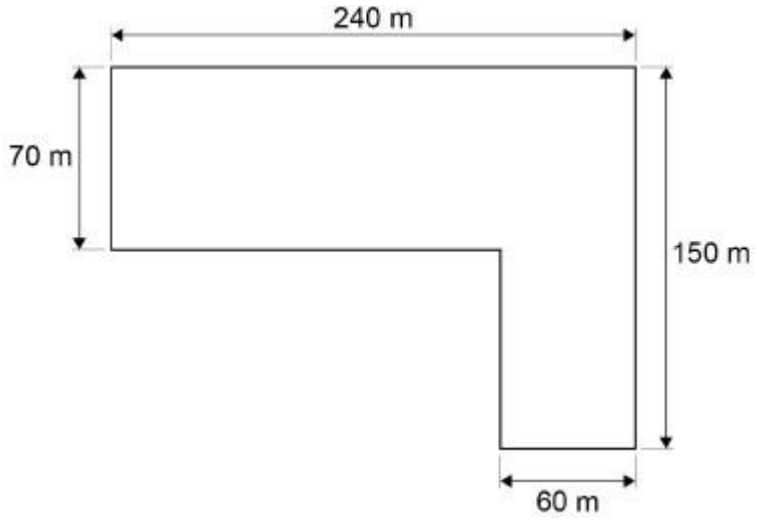
Give your answer in standard form.

Number of trees = _____ per year

(3)

(b) Students investigated the number of bluebells in one of the existing woodlands.

The diagram shows the dimensions of the woodland.



The students used a 0.25 m^2 quadrat to sample the bluebell population.

The mean number of bluebells per quadrat was 6

Estimate the population of bluebells in the woodland.

Population = _____ bluebells

(2)

(c) A Manchester resident says that this project will 'fight pollution' and 'increase biodiversity' in their city.

Explain how the 'City of Trees' project will:

- reduce pollution
- increase biodiversity.

(6)

(Total 11 marks)

4 In the last 200 years the concentration of carbon dioxide in the Earth's atmosphere has risen.

Explain how a rise in carbon dioxide concentration in the atmosphere can decrease biodiversity.

(Total 6 marks)

5 Tobacco mosaic virus (TMV) can infect many species of plant.

TMV spreads throughout the whole plant, causing discolouration of the leaves.

(a) Suggest how TMV spreads within the plant from one part to another.

(1)

(b) Describe how TMV can pass from one plant to another.

(1)

Plants can be genetically modified (GM) to be resistant to TMV.

(c) What **two** ways is the process of genetic modification different from selective breeding?

Tick **two** boxes.

- GM is faster. ☐
- GM is less dependent on chance at fertilisation. ☐
- GM is less likely to give the desired characteristics in the offspring. ☐
- GM is only used in plants, not animals. ☐
- GM requires less specialist equipment. ☐

(2)

(d) Describe the process of genetic modification that is used to produce a plant that is resistant to a disease.

(4)

(e) Fields planted with genetically modified (GM) crops may have lower biodiversity than fields planted with non-GM crops.

Why is a reduction in biodiversity more likely to result in the extinction of a species?

(2)

(f) Maintaining hedgerows around fields helps improve biodiversity.

Suggest **one** other reason why farmers maintain hedgerows around fields of crops.

_____

_____

(1)

(Total 11 marks)

6 The UK contains large areas of peat bogs that have been present for thousands of years.

(a) Peat is removed from peat bogs.

The peat can be mixed with air and added to garden compost.

The release of carbon dioxide from peat is a problem.

Give **two other** reasons why gardeners should use less peat-based compost in the future.

1. _____

_____

2. _____

_____

(2)

(b) Explain why mixing peat with air leads to the release of carbon dioxide.

_____

_____

_____

_____

_____

_____

_____

_____

(4)

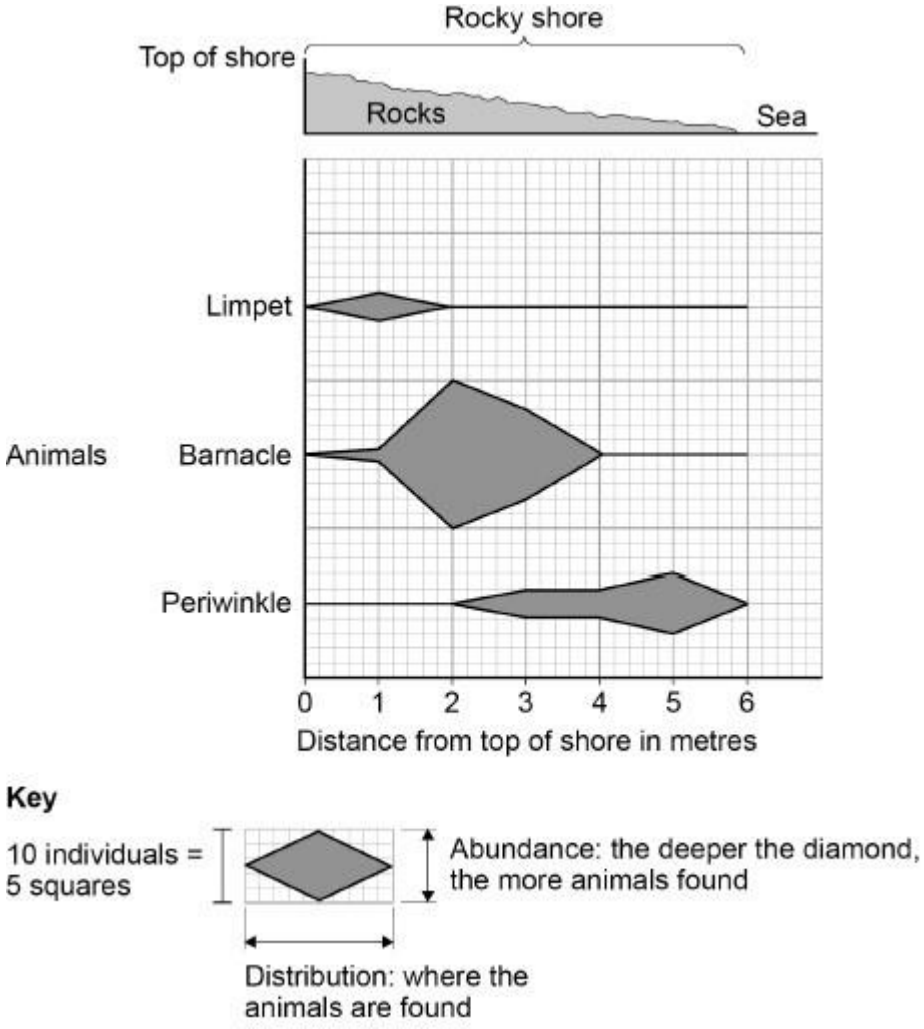
(Total 6 marks)

7 Rocky shores are a type of coastal habitat.

Limpets, barnacles and periwinkles are animals that live on rocky shores.

Students investigated the distribution of these animals on one rocky shore.

The figure shows their results.



The edge of the sea was six meters from the top of the shore.

(a) Calculate the total number of animals found one metre from the top of the shore.

_____

_____

Total number of animals = _____

(1)

(b) The greatest number of animals was found two metres from the top of the shore.

One student said that this was **not** the most biodiverse part of the shore.

Give the reason for this statement.

_____

_____

(1)

(c) Give **one** abiotic factor and **one** biotic factor that could affect the distribution of these animals on the shore.

Abiotic factor _____

Biotic factor _____

(2)

(d) Describe the method the students could have used to collect the data shown in the figure.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(Total 8 marks)

1 (a)

	Animalia
Phylum	
Class	
Genus	*Spodoptera*
Species	

1
1

(b) any **one** from:
- no / few natural predators
- no / few pathogens / diseases
- more favourable climate
- plentiful food as corn crops grown over wide areas in Africa

1

(c) any **one** from:
- compare the structural features with those of annelids and arthropods

  allow named structural features eg is it a segmented worm, does it form a pupa, does it turn into an adult with legs.
- carry out DNA analysis and compare with known annelids and arthropods
- carry out electron microscopy of internal parts to see fine structure and compare with known annelids and arthropods

1

(d)

Level 2: Relevant points (reasons/causes) are identified, given in detail and logically linked to form a clear account.	3-4
Level 1: Relevant points (reasons/causes) are identified, and there are attempts at logical linking. The resulting account is not fully clear.	1-2
No relevant content	0
Indicative content **advantages** • killing worms will mean more corn / food for African people • so food security or no famine • it will stop the spread of the worms • so stop it reaching other countries and causing food shortages there • it will remove an invasive species • and so restore the natural ecosystem balance in the area **disadvantages** • insecticide will kill other (pollinating) insects • so will stop fertilisation of crops and lead to poor yields • insecticide will kill other insects • and upset the ecological balance in the area or reduce biodiversity in the area • insecticide may be toxic to humans • causing illness if they ingest it • insecticide may build up in the food chain • and poison / kill organisms further up the chain (ignore cost as it could be argued either way)	

4

[8]

2 (a) any **three** from:

- blackbirds seen in higher % of / more gardens
- multiplying mean number by percentage of gardens seen in shows blackbird is higher

  *allow **1** additional mark for correct figures showing this, ie 264 sparrows: 305 blackbirds*
- only done on one day / month / hour

  eg only done in January
- only done in gardens (one bird may prefer a different habitat)
- problem of (correct) identification
- may re-count same ones

  if neither point 5 or 6 given allow 1 mark for idea of error / miscounted
- people may quote false numbers / may make it up

3

(b) (i) 60.3

*award **2** marks for correct answer, irrespective of working*

*award **1** mark for 33.5 + (33.5 × 80 / 100) or equivalent with no answer or incorrect answer **or** award **1** mark for 26.8*

2

(ii) any **two** from:

- change in temperature

  a comparison is required

  eg cooler / warmer / less frost (in 2012)
- fewer predators
- more food **or** less competition for food
- more nesting space **or** less competition for nesting space
- less disease (in 2012)

  allow idea that people may be better / worse at identifying birds / goldfinches

  allow idea of movement to gardens (due to poor food supply elsewhere)

2

[7]

3 (a) 2 640 000 (in remaining 24 years)

1

110 000 in each remaining year

or

2.64×10^6 in remaining 24 years

1

1.1×10^5

*an answer of 1.1×10^5 scores **3** marks*

1

(b) (area of woodland =) 21 600

allow 16 800 + 4 800

or 9 000 + 12 600

or 4 800 + 4 200 + 12 600

1

518 400 (bluebells)

allow their area × 4 × 6

*an answer 518 400 (bluebells) scores **2** marks*

1

(c)

Level 3: Relevant points are identified, given in detail and logically linked to form a clear account.	5-6
Level 2: Relevant points are identified, and there are attempts at logically linking. The resulting account is not fully clear.	3-4
Level 1: Relevant points are identified and stated simply, but their relevance is not clear and there is no attempt at logical linking.	1-2
No relevant content	0
Indicative content **reducing pollution** • trees take in carbon dioxide • which will lower atmospheric greenhouse gases and reduce global warming (allow consequences of global warming) • trees act as noise absorbers • which will reduce noise pollution in the city • roots of trees will bind the soil • which will reduce local flooding and soil erosion • leaves on trees will trap PM2.5 / tiny particulates • which will reduce asthma/breathing difficulties of people **increasing biodiversity** • new woodlands or new trees in parks / gardens will provide new habitats • for new species of plants and animals • linking woodlands • will allow animals to move into new areas • planting many new species of trees • will provide food and shelter for new species of insects/birds • could extend the scheme • to reintroduce species of plants or animals which no longer live in that area • could protect wildlife in the area • by legislation or community projects	

6

[11]

4

Level 3 (5–6 marks):
A full explanation is given that is coherent and logically structured, linking effect of increase in carbon dioxide to climate change and effects on biodiversity.

Level 2 (3–4 marks):
An attempt is made to link the effects of rising carbon dioxide levels to climate change and biodiversity. The logic may be inconsistent at times but builds towards a coherent explanation.

Level 1 (1–2 marks):
Discrete relevant points made. The logic may be unclear and attempts at reasoning may not be consistent.

0 marks:
No relevant content.

Indicative content

- rise in carbon dioxide increases atmospheric temperature / causes global warming
- global warming causes extreme weather patterns
- such as rise in sea levels
- increased or decreased rainfall
- frequency of storms / droughts
- rise in sea levels means habitats will change due to flooding
- rise in sea levels could increase salt in soil
- increased rainfall will increase water levels
- severity of storms / droughts could affect photosynthesis
- consequences of changes are loss of or damage to habitats
- which will affect animal and plant distributions
- by increasing migration or species dying off
- which decreases biodiversity

[6]

5

(a) xylem / phloem

allow translocation / transpiration

1

(b) any **one** from:

- through tools or hands (after touching infected plants)
- in the soil
- infected plants in contact with healthy plants

1

(c) GM is faster

1

GM is less dependent on chance at fertilisation

1

(d) any **four** from:
- gene for resistance is cut out with enzymes
- placed into a vector (virus or plasmid)
- inserted into early stage of young plants
- that grow by mitosis
- plants grow with gene in most cells

points must be in correct order to gain credit

4

(e) any **two** from:
- a species is less likely to survive in changing conditions

allow named change such as new disease
- less links in food webs **or** populations become smaller and have less variation
- less likely have suitably adapted individuals

2

(f) any **one** from:
- habitat for predators of pests
- natural barrier against disease transmission / herbivores
- reduce wind damage

ignore references to cost

1

[11]

6 (a) reduces biodiversity

1

peat is being used faster than it forms

allow peat is non-renewable

1

(b) decay / decomposition / rotting of peat

1

by microorganisms / bacteria / microbes / fungi / decomposers introduced when peat is mixed with air

1

that respire using substances in peat as reactant

1

and using oxygen that is introduced when peat is mixed with air

1

[6]

7 (a) 6

1

(b) only one species present

1

(c) (abiotic)

any **one** from:

- temperature
- exposure to the air / moisture / water / tides
- waves / wind
- rock type / substrate

1

(biotic)

any **one** from:

- competition
- predators
- food

1

(d) select location for transect at random / to be representative

1

transect / tape measure / line from top of shore / beach to sea

1

counting which species touched transect / regular use of quadrat along transect to count species

ignore repeat unqualified

1

repeat at other locations on same beach/shore

allow repeat at another time of year

or *repeat at low / high tide*

1

[8]