Investing Diversity Pack

These practice questions can be used by students and teachers and is

Suitable for AQA A Level 7402 Biology Topic Question

Level: AQA A LEVEL 7402

Subject: Biology

Exam Board: AQA A Level 7402

Topic: Investing Diversity Pack

1 A student investigated the distribution of plants in a heathland.

The table below shows the number of plants he found in a sample area of 1 m^2.

Species of plant	Number counted in 1 m^2
Common heather	2
Red fescue	14
Vetch	2
White clover	8

(a) What is the species richness of this sample?

(1)

(b) Calculate the index of diversity of this sample. Show your working.

Use the following formula to calculate the index of diversity.

$$d = \frac{N(N-1)}{\Sigma n(n-1)}$$

where N is the total number of organisms of all species
and n is the total number of organisms of each species

Index of diversity = _____

(2)

(c) Suggest how this student would obtain data to give a more precise value for the index ofdiversity of this habitat.

_____

_____

_____

_____

_____

(2)

(Total 5 marks)

2 Species richness and an index of diversity can be used to measure biodiversity within a community.

(a) What is the difference between these two measures of biodiversity?

_____

_____

(1)

Scientists investigated the biodiversity of butterflies in a rainforest. Their investigation lasted several months.

The scientists set one canopy trap and one understorey trap at five sites.

- The canopy traps were set among the leaves of the trees 16–27 m above ground level.
- The understorey traps were set under trees at 1.0–1.5 m above ground level.

The scientists recorded the number of each species of butterfly caught in the traps. Thetable below summarises their results.

Species of butterfly	Mean number of butterflies		P value
	In canopy	In understorey	
Prepona laertes	15	0	< 0.001
Archaeoprepona demophon	14	37	< 0.001
Zaretis itys	25	11	> 0.05
Memphis arachne	89	23	< 0.001
Memphis offa	21	3	< 0.001
Memphis xenocles	32	8	< 0.001

(b) The traps in the canopy were set at 16–27 m above ground level. Suggest why there was such great variation in the height of the traps.

_____

_____

(1)

(c) By how many times is the species diversity in the canopy greater than in the understorey? Show your working.

Use the following formula to calculate species diversity.

$$d = \frac{N(N-1)}{\sum n\,(n-1)}$$

where N is the total number of organisms of all species and n is the total number of organisms of each species.

Answer = _____

(3)

(d) The scientists carried out a statistical test to see if the difference in the distribution of eachspecies between the canopy and understorey was due to chance. The P values obtained are shown in the table.

Explain what the results of these statistical tests show.

(Extra space)

(3)

(Total 8 marks)

3 **Table 1** shows how a bird called the bluethroat (*Luscinia svecica*) is classified by biologists.

Table 1

Taxon	Name of taxon
Domain	Eukaryota
	Animalia
	Chordata
	Aves
	Passeriformes
	Muscicapidae
Genus	
Species	

(a) Complete **Table 1** by filling the seven blank spaces with the correct terms.

(2)

A group of scientists investigated genetic diversity in different species of bird. For eachspecies, the scientists:

- collected feathers from a large number of birds
- extracted DNA from cells attached to each feather
- analysed the samples of DNA to find genetic diversity.

Table 2 summarises their results.

Table 2

Species of bird	**Number of genes examined**	**Number of genes examined that showed genetic diversity**
Willow flycatcher	708	197
House finch	269	80
Bluethroat	232	81

(b) In this investigation, what is meant by **genetic diversity?**

_____

_____

(1)

(c) The scientists concluded that the bluethroat showed greater genetic diversity than the willow flycatcher. Explain why they reached this conclusion. Use calculations to support your answer.

_____

_____

_____

_____

(2)

(Total 5 marks)

4 Ecologists investigated the size of an insect population on a small island. They used a mark-release-recapture method. To mark the insects they used a fluorescent powder. Thispowder glows bright red when exposed to ultraviolet (UV) light.

(a) The ecologists captured insects from a number of sites on the island. Suggest how they decided where to take their samples.

_____

_____

_____

_____

(2)

(b) Give **two** assumptions made when using the mark-release-recapture method.

1. _____

_____

2. _____

_____

(2)

(c) Suggest the advantage of using the fluorescent powder in this experiment.

_____

_____

_____

_____

(2)

The ecologists did **not** release any of the insects they captured 1–5 days after release of the marked insects.

The table below shows the ecologists' results.

Days after release	Number of marked insects remaining in population	Number of insects captured	Number of captured insects that were marked
1	1508	524	78
2	1430	421	30
3	1400	418	18
4	1382	284	2
5	1380	232	9

(d) Calculate the number of insects on this island 1 day after release of the marked insects.

Show your working.

Answer = _____

(2)

(e) The ecologists expected to obtain the same result from their calculations of the number of insects on this island on each day during the period 1–5 days after release. In fact, their estimated number increased after day 1.

During the same period, the number of insects they caught decreased.

The method used by the ecologists might have caused these changes.

Use the information provided to suggest **one** way in which the method used by the ecologists might have caused the increase in their estimates of the size of the insect population.

_____

_____

_____

_____

(2)

(Total 10 marks)

5 Scientists investigated the effect of different types of animal farming on the diversity and numberof dung beetles. They determined the number of dung beetle species and their total number on intensive (**I**), rough grazing (**R**) and organic (**O**) farms.

Figure 1 and **Figure 2** show some of their results.

Figure 1

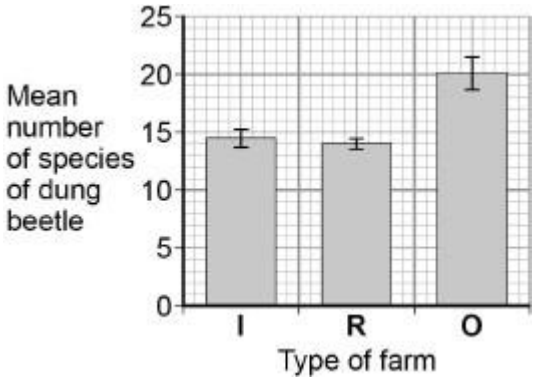
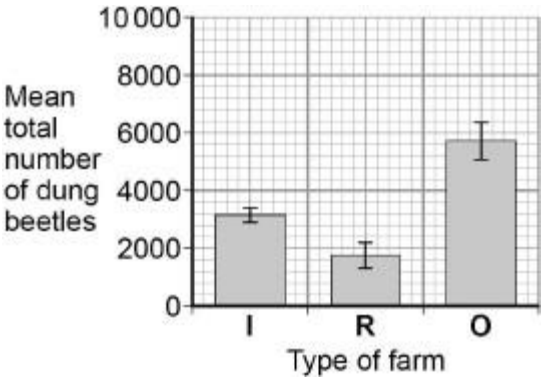


Figure 2



Key: I Standard deviation

(a) What is the mean species richness for dung beetles on the rough grazing farms?

_____

(1)

(b) In addition to the information provided in **Figures 1** and **2**, what other measurement is required to calculate an index of diversity for dung beetles?

_____

_____

(1)

(c) Explain what the standard deviations suggest about the difference in mean total number of dung beetles between the different types of farm.

_____

_____

_____

_____

_____

(2)

(d) The scientists placed traps to collect the dung beetles at sites chosen at random.

Explain the importance of the sites being chosen at random.

(1)

(e) On the intensive farms, the farmers had removed hedges to increase land for grazing. This resulted in a decrease in the diversity of birds on these farms.

Explain why the removal of hedges caused a decrease in the diversity of birds.

(3)

(Total 8 marks)

6 (a) Human papilloma virus (HPV) is the main cause of cervical cancer. A vaccine has beendeveloped to protect girls and women from HPV.

Describe how giving this vaccine leads to production of antibody against HPV.

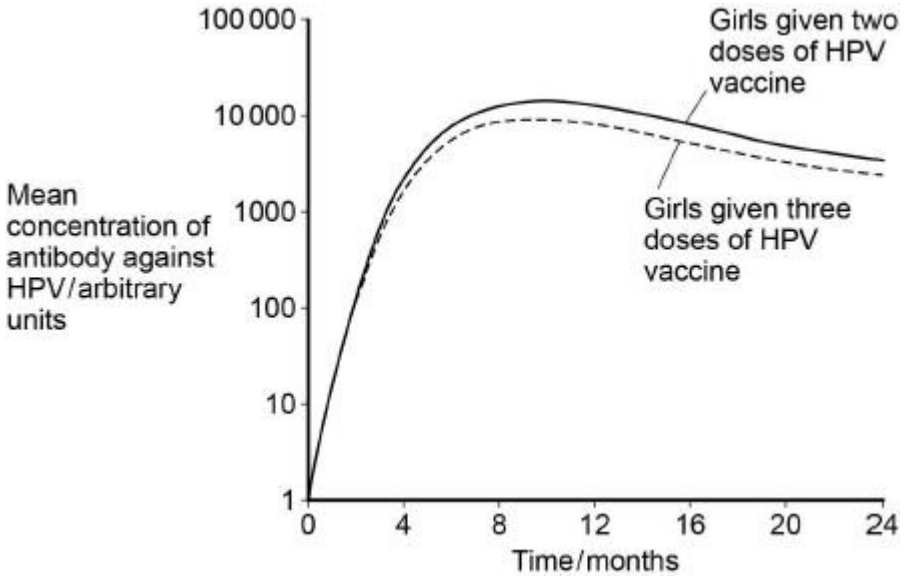
(4)

(b) Doctors investigated whether it was better to give two or three doses of the HPV vaccine. They determined the mean concentration of antibody against HPV in blood samples from girls who were given either two or three doses of the vaccine.

- Girls given two doses received an initial vaccination, followed by a second at 6 months.
- Girls given three doses received an initial vaccination, followed by a second at 1 month and a third at 6 months.

The doctors measured the concentration of antibody each month.

The results are shown below.



What do these results suggest about whether it is better to give two or three doses of the vaccine? Give reasons for your answer.

_____

_____

_____

_____

_____

(2)

(c) The doctors carried out a statistical test to determine whether the antibody concentrationswere significantly different in girls given two doses of the vaccine, compared with those given three doses. They determined the mean concentrations of antibody 9 months after the first dose of vaccine.

What statistical test should the doctors have used? Give the reason for your choice.

Test _____

Reason _____

_____

(1)

(d) There is genetic diversity within HPV.

Give **two** ways doctors could use base sequences to compare different types of HPV.

1. _____

_____

2. _____

_____

(2)

(Total 9 marks)

7 (a) Explain what is meant by a

(i) phylogenetic group

_____

_____

(1)

(ii) species.

_____

_____

_____

_____

(2)

The classification of tigers and clouded leopards is shown in **Table 1**.

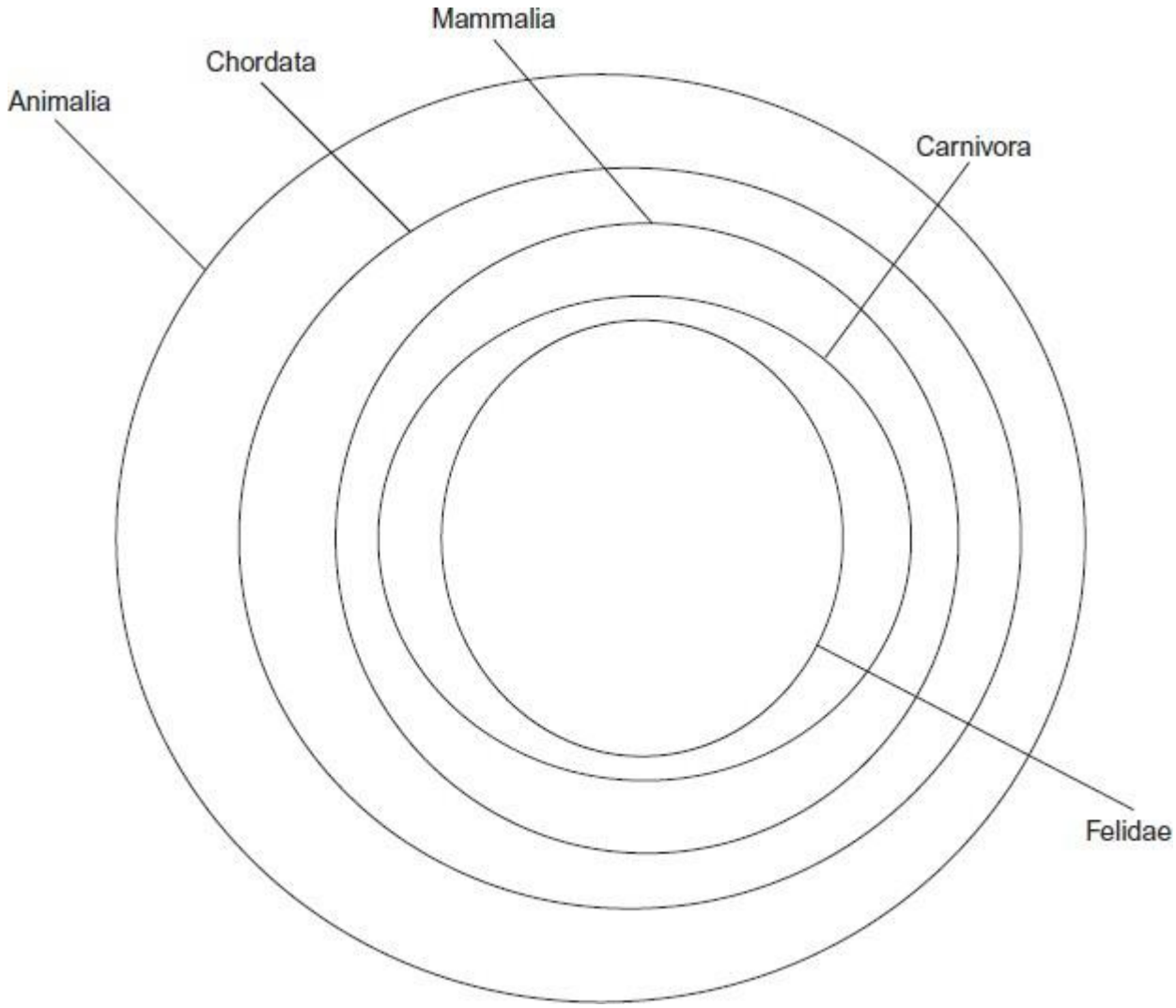
Table 1

Taxonomic group	**Tiger**	**Clouded Leopard**
Kingdom	Animalia	Animalia
	Chordata	Chordata
	Mammalia	Mammalia
Order	Carnivora	Carnivora
	Felidae	Felidae
	Panthera	Neofelis
Species	Tigris	Nebulosa

(b) Complete **Table 1** by adding the **four** other taxonomic groups to which the tiger and clouded leopard belong.

(1)

The circles in the diagram represent the hierarchy of taxonomic groups for the classificationshown in **Table 1**.



(c) Draw additional circles on the diagram and label them to include all the information about the tiger and clouded leopard shown in **Table 1**.

(2)

Table 2 shows part of the nucleotide sequence in a gene in populations of tigers living indifferent parts of the world.

Table 2

Siberian tiger	G C A C C G T
South China tiger	A C G C C G C
Sumatran tiger	A C G C C G C

(d) Explain what the information in **Table 2** suggests about the phylogenetic relationships between these tigers.

_____

_____

_____

_____

_____

(2)

(Total 8 marks)

8 Scientists investigated the presence of bacteria resistant to the antibiotic neomycin in turkeys, chickens and the farmers who kept the turkeys and chickens. They looked for *Escherichia coli* (*E. coli*) resistant to neomycin. At 46 farms, the scientists obtained samples of bacteria from faeces of turkeys, turkey farmers, chickens and chicken farmers. The turkey farmers very often used turkey food containing neomycin. The chicken farmers did not use chicken food containing neomycin very often.

The bacteria were grown on nutrient agar in cultures. The nutrient agar contained neomycin. Any resistant bacteria grew and divided to form visible colonies.

The results are shown in the table

Samples taken from	**Percentage of samples of faeces containing *E. coli* resistant to neomycin**
Turkeys	81
Turkeys farmers	57
Chickens	24
Chicken farmers	8

(a) Suggest **two** hypotheses the scientists were testing in this investigation.

Hypothesis 1 _____

_____

_____

Hypothesis 2 _____

_____

_____

(2)

(b) (i) Describe what the results in the table show.

_____

_____

_____

_____

_____

(2)

(ii) Suggest and explain **one** reason for the observed differences in percentage of neomycin-resistant *E. coli* in turkeys and chickens.

_____

_____

_____

_____

_____

(2)

(c) The scientists followed strict safety guidelines when collecting samples of faeces. Apart from the risk of contamination from *E. coli* this was especially important when collecting samples from humans.

Explain why.

_____

_____

_____

(1)

(d) Use the information provided to identify and explain **one** way in which the scientistsincreased the reliability of their method.

(2)

(e) Suggest how the scientists could use DNA to investigate whether the neomycin-resistant bacteria in farmers were identical to the strain of bacteria in the birds they kept.

(2)

(f) At one time, most animal feeds contained antibiotics that increased the rate of animal growth. In the UK, fewer animal feeds now contain antibiotics.

Suggest reasons why.

(4)

(Total 15 marks)

9 (a) What is meant by species diversity?

_____

_____

_____

(1)

(b) Give **two** pieces of information needed to calculate an index of diversity for a community.

1. _____

2. _____

(2)

(c) A scientist investigated the effect sewage entering a river had on the distribution of organisms living in the river. Where sewage entered the river, he found a high density of organisms but a low index of diversity.

Suggest how sewage entering the river could explain the scientist's findings.

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_____

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(2)

(d) A second scientist repeated the investigation of the first scientist at the same place. Thesecond scientist obtained a high index of diversity.

(i) Explain how the second set of results affects the ability of the scientists to make any conclusions about the effect of sewage on the index of diversity.

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_____

_____

_____

(2)

(ii) Suggest the additional steps that should be taken by the scientists before they are able to make any conclusions about the effect of sewage entering this river.

_____

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(1)

(Total 8 marks)

10 There are nine subspecies of giraffe. These subspecies evolved when populations of giraffe wereseparated for long time periods. Each subspecies has distinct coloured skin markings. Some biologists have suggested that up to six of these subspecies should be classified as different species.

(a) Explain how different subspecies of giraffe may have evolved from a common ancestor. Use information from the passage in your answer.

(5)

(b) Biologists compared the mitochondrial DNA of the different subspecies of giraffe. They used the results from comparing this DNA to conclude that six of the nine subspecies are separate species.

Suggest how they came to this conclusion.

(2)

(Total 7 marks)

11 (a) What **two** measurements are needed to calculate an index of diversity?

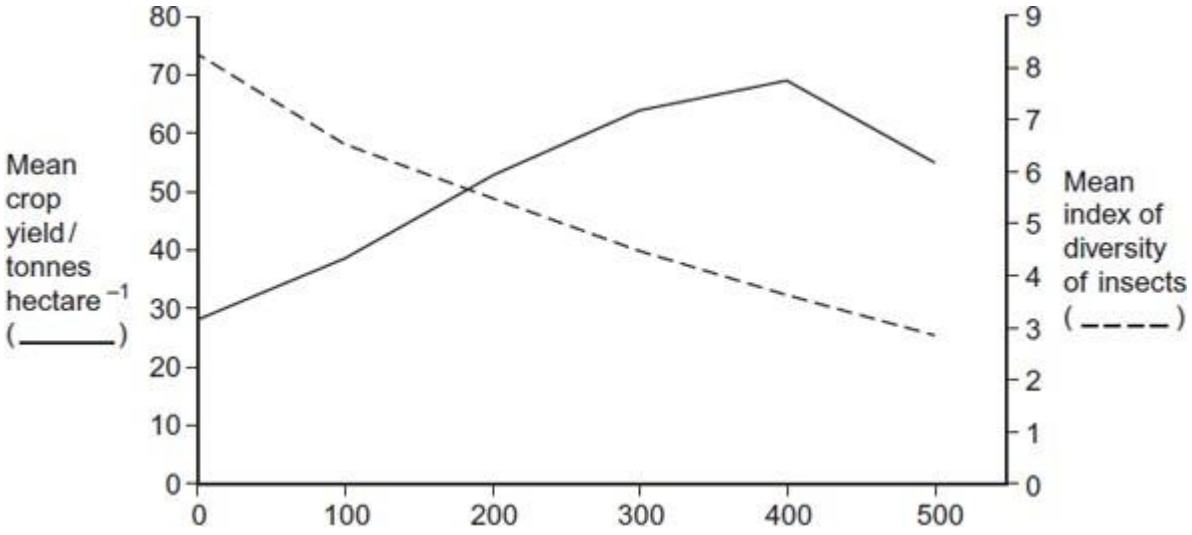
1. _____

2. _____

(2)

(b) A herbicide is a chemical used to kill weeds. Ecologists investigated the effect of a herbicide on crop yield and the diversity of insects. They sprayed different fields with the same volume of different concentrations of the herbicide. At harvest, the ecologists determined the mean crop yield and the mean index of diversity of insects for fields that had received the same concentration of the herbicide.

The figure below shows their results.



(i) Some fields acted as controls. They were sprayed with a solution that did not contain the herbicide. Explain the purpose of these control fields.

_____

_____

_____

(1)

(ii) Suggest an explanation for the relationship between the concentration of herbicide and the mean crop yield.

_____

_____

_____

(2)

(iii) Explain the relationship between the concentration of herbicide and the mean indexof diversity of insects.

_____

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_____

(Extra space) _____

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_____

(3)

(Total 8 marks)

12 During the light-independent reaction of photosynthesis, carbon dioxide is converted into organicsubstances. Describe how.

(Extra space)

(Total 6 marks)

13 Farmland previously used for growing crops was left for 30 years and developed into woodland. During this period, ecologists recorded an increase in the diversity of birds in the area.

(a) Name the process that resulted in the development of woodland from farmland.

(1)

(b) Explain the increase in the diversity of birds as the woodland developed.

_____

_____

_____

_____

_____

_____

(Extra space) _____

_____

_____

(3)

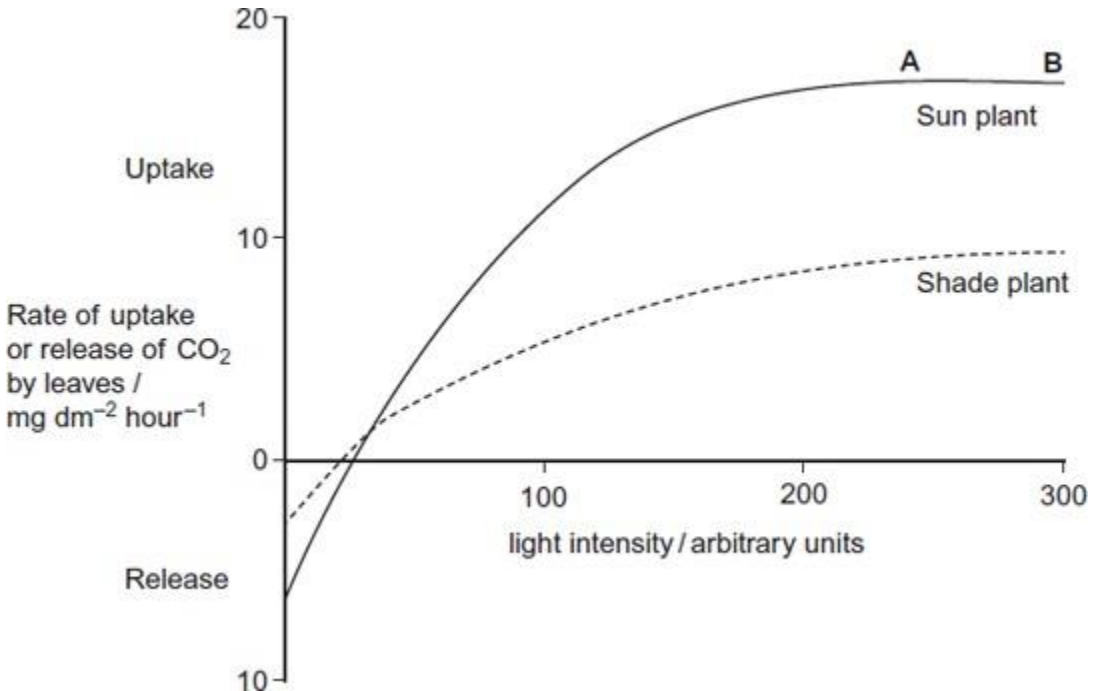
(c) The ecologists also investigated photosynthesis in two species of plant found in the woodland. One of the species was adapted to growing in bright sunlight (sun plant) and the other was adapted to growing in the shade (shade plant). The ecologists' results are shown in the figure below.

(i) Give **two** factors which could be limiting the rate of photosynthesis in the sun plant between points **A** and **B** on the figure.

1. _____

2. _____

(1)



(ii) Explain why CO_2 uptake is a measure of net productivity.

(Extra space)

(1)

(iii) Use the information in the figure to explain how the shade plant is better adapted than the sun plant to growing at low light intensities.

(Extra space)

(2)

(Total 8 marks)

14 Organisms can be classified using a hierarchy of phylogenetic groups.

(a) Explain what is meant by:

(i) a hierarchy

(2)

(ii) a phylogenetic group.

(1)

(b) Cytochrome c is a protein involved in respiration. Scientists determined the amino acidsequence of human cytochrome c. They then:

- determined the amino acid sequences in cytochrome c from five other animals
- compared these amino acid sequences with that of human cytochrome c
- recorded the number of differences in the amino acid sequence compared with human cytochrome c.

The table shows their results.

Animal	Number of differences in the amino acid sequence compared with human cytochrome c
A	1
B	12
C	12
D	15
E	21

(i) Explain how these results suggest that animal **A** is the most closely related to humans.

_____

_____

_____

_____

_____

(2)

(ii) A student who looked at these results concluded that animals **B** and **C** are more closely related to each other than to any of the other animals.

Suggest **one** reason why this might **not** be a valid conclusion.

_____

_____

_____

(1)

(iii) Cytochrome c is more useful than haemoglobin for studying how closely relateddifferent organisms are. Suggest **one** reason why.

_____

_____

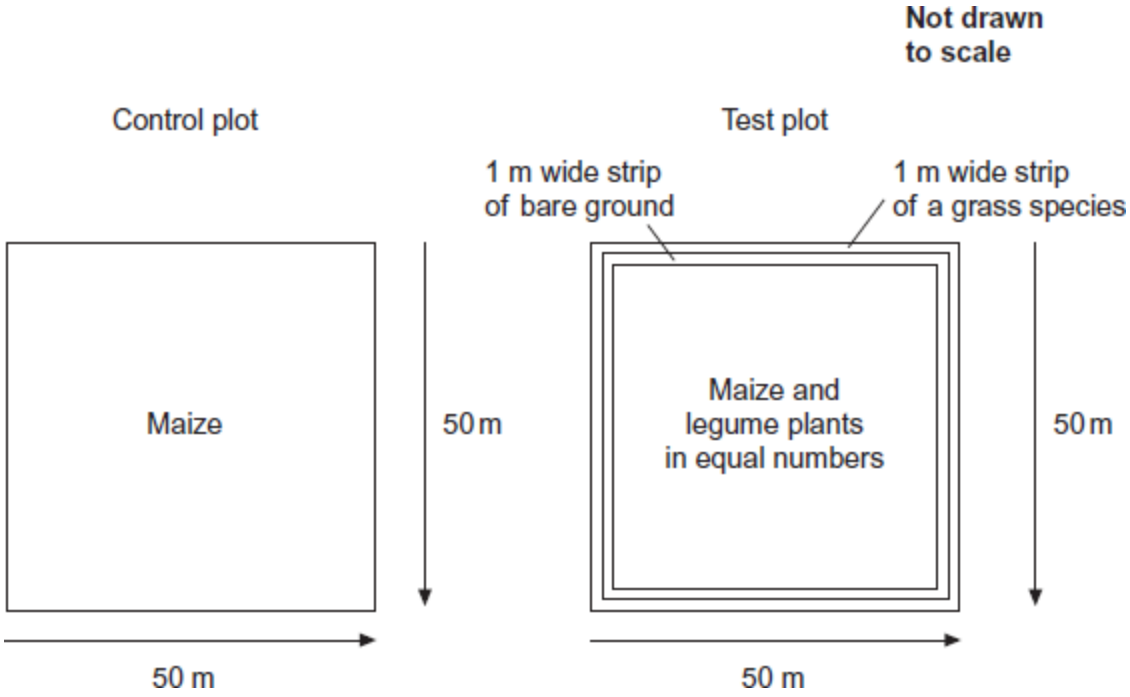
_____

(1)

(Total 7 marks)

15 Stemborers are insect pests that feed on maize plants. Scientists investigated the effect of **push-pull** stimuli on the control of these pests.

For this investigation, the scientists divided a large field into plots measuring 50 m × 50 m. They then designated each plot as a control plot or a test plot. The following figure shows what they planted in each type of plot.



The legumes planted with the maize drive stemborers away.
The grass species attracts stemborers.

The table below shows the scientists' results.

Plots	Mean percentage damage to maize plants	Mean maize grain yield / tonnes per hectare (± standard deviation)	Mean production costs per farmer / $ per hectare (± standard deviation)	Mean total income for farmer / $ per hectare (± standard deviation)
Control	29.6	1.5 (±0.2)	250 (±0.7)	329 (±5.9)
Test	6.7	3.7 (±0.3)	278 (±1.1)	679 (±10.2)

(a) In the test plot of land, identify the push stimulus and the pull stimulus.

Push stimulus _____

Pull stimulus _____

(1)

(b) When measuring the mean percentage damage to maize plants, 60 plants from each testplot were selected at random and examined.
Describe how the maize plants could be selected at random.

(Extra space)

(3)

(c) In the test plot, bare ground was left between the maize and the grass species.
Suggest an explanation why.

(2)

(d) The legume plants have nodules containing nitrogen-fixing bacteria on their roots.
Explain how nitrogen-fixing bacteria could increase the growth of the maize.

(2)

(e) A year after this investigation, the government of one country decided that their farmersshould use these **push-pull** stimuli.
How do these data support this decision?

(Extra space)

(3)

(Total 11 marks)

16 Malaria is a disease caused by a parasite. Scientists investigated the effect of malaria on competition between two species of *Anolis* lizard on a small Caribbean island. They sampled both populations by collecting lizards from a large number of sites on the island.

(a) (i) Explain the importance of collecting lizards from a large number of sites.

(1)

(ii) Describe **one** method the scientists could have used to ensure that the sites were chosen without bias.

(2)

(iii) The population number of both species of lizard varied at different times of the year.Suggest **two** reasons why.

1. _____

_____

2. _____

_____

(2)

The scientists investigated the percentage of lizards of both species that were infected with malaria at different sites on the island. They collected samples of both lizards at intervals of 3 months for 1 year. They also recorded the elevation (height above sea level) of each site. Some of their results are shown in the table.

Site	**Elevation of collection site / metres**	**Total number of *A. gingivinus* collected in one year**	**Percentage of *A. gingivinus* infected with malaria**	**Total number of *A. wattsi* collected in one year**	**Percentage of *A. wattsi* infected with malaria**
1	10	13	0	0	0
2	80	30	0	0	0
3	120	35	23	3	0
4	200	40	30	7	0
5	300	52	46	12	0
6	315	35	31	13	1
7	370	155	37	79	2
8	414	124	44	68	4

(b) When analysing their results, the scientists used the percentage of lizards infected at each site, rather than the number of lizards infected. Explain why.

_____

_____

_____

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_____

(2)

(c) A preliminary study suggested that malarial infections were more common at higherelevations. Use the information provided to evaluate this suggestion.

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_____

_____

_____

_____

(2)

(d) (i) As a result of this investigation, the scientists concluded that the presence of malaria provided a competitive advantage to *A. wattsi.* Use the information provided to explain how they reached this conclusion.

_____

_____

_____

_____

_____

(2)

(ii) The malarial parasite of *Anolis* lizards destroys both red and white blood cells.Suggest how an increase in the percentage of *A. gingivinus* infected with malaria could result in *A.wattsi* having a competitive advantage.

_____

_____

_____

_____

_____

(2)

(iii) The scientists carried out a statistical test to determine whether the correlation between the number of *A. wattsi* collected and the percentage of *A. gingivinus* infected was significant. They obtained a value for P of < 0.01.

Use the terms **probability** and **chance** to help explain what this means.

_____

_____

_____

_____

_____

(2)

(Total 15 marks)

17 Hummingbirds belong to the order Apodiformes. One genus in this order is *Topaza*.

(a) (i) Name **one** other taxonomic group to which all members of the Apodiformes belong.

_____

(1)

(ii) Name the taxonomic group between order and genus.

_____

(1)

The crimson topaz and the fiery topaz are hummingbirds.

Biologists investigated whether the crimson topaz and the fiery topaz are different species of hummingbird, or different forms of the same species.

They caught large numbers of each type of hummingbird. For each bird they

- recorded its sex
- recorded its mass
- recorded the colour of its throat feathers
- took a sample of a blood protein.

The table shows some of their results.

	Crimson topaz		**Fiery topaz**	
	Male	**Female**	**Male**	**Female**
Mean mass / g (± standard deviation)	13.6 (±1.9)	10.8 (±1.3)	14.2 (±1.6)	11.6 (±0.63)
Colour of throat feathers	Green	Grey edges	Yellowish green	No grey edges

(b) Explain how the standard deviation helps in the interpretation of these data.

_____

_____

_____

_____

_____

(2)

(c) The biologists analysed the amino acid sequences of the blood protein samples from thesehummingbirds.

Explain how these sequences could provide evidence as to whether the crimson topaz and the fiery topaz are different species.

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_____

_____

(2)

(Total 6 marks)

18 Scientists investigated the species of insects found in a wood and in a nearby wheat field. The scientists collected insects by placing traps at sites chosen at random both in the wood and in the wheat field.

The table shows the data collected in the wood and in the wheat field.

Species of insect	Number of organisms of each species	
	Wood	Wheat field
Bird-cherry oat aphid	0	216
Beech aphid	563	0
Large white butterfly	20	0
Lacewing	12	3
7-spot ladybird	36	0
2-spot ladybird	9	1
Total number of organisms of all species	640	220

(a) The scientists collected insects at sites chosen at random. Explain the importance of the sites being chosen at random.

_____

_____

_____

(1)

(b) (i) Use the formula

$$d = \frac{N(N-1)}{\sum n(N-1)}$$

to calculate the index of diversity for the insects caught in the wood, where

d = index of diversity
N = total number of organisms of all species
n = total number of organisms of each species

Show your working.

Answer _____

(2)

(ii) Without carrying out any further calculations, estimate whether the index of diversity for the wheat field would be higher or lower than the index of diversity for the wood.

Explain how you arrived at your answer.

_____

_____

_____

_____

_____

(2)

(c) A journalist concluded that this investigation showed that farming reduces species diversity. Evaluate this conclusion.

_____

_____

_____

_____

_____

(2)

(d) Farmers were offered grants by the government to plant hedges around their fields.Explain the effect planting hedges could have on the index of diversity for animals.

_____

_____

_____

_____

_____

(2)

(Total 9 marks)

19 A student investigated the rate of respiration of yeast cells. He set up a conical flask with a suspension of yeast in some apple juice. He took samples of the mixture at different times and found the number of yeast cells.

His results are recorded in the table below.

Time from start of investigation /days	Mean number of yeast cells ($\times 10^6$) percm^3
3	7.413
4	8.912
8	16.595
9	19.952
10	23.442
11	23.703

(a) The student set up a suspension of yeast in apple juice. Apple juice contains all the nutrients that yeast requires for growth. Name **two** types of nutrients present in the apple juice that are essential for the growth and reproduction of yeast cells.

1. _____

2. _____

(2)

(b) The student counted the yeast cells in a sample of the suspension.
Give **one** precaution the student should have taken to make sure he obtained a representative sample. Explain how this precaution would result in a representative sample.

_____

_____

_____

_____

_____

(2)

(c) Calculate the percentage increase of yeast cells between day 3 and day 4. *Show your working.*

Answer _____

(2)

(d) The increase in the number of yeast cells was less between days 10 and 11 than it was between days 3 and 4.
Give **two** reasons why.

1. _____

_____

2. _____

_____

(2)

(Total 8 marks)

20 (a) Scientists can use protein structure to investigate the evolutionary relationships betweendifferent species. Explain why.

(2)

(b) Comparing the base sequence of genes provides more evolutionary information than comparing the structure of proteins. Explain why.

(2)

(Total 4 marks)

21 Costa Rica is a Central American country. It has a high level of species diversity.

(a) There are over 12 000 species of plants in Costa Rica. Explain how this has resulted in a high species diversity of animals.

(2)

(b) The number of species present is one way to measure biodiversity. Explain why an index of diversity may be a more useful measure of biodiversity.

(2)

(c) Crops grown in Costa Rica are sprayed with pesticides. Pesticides are substances that kill pests. Scientists think that pollution of water by pesticides has reduced the number of species of frog.

(i) Frogs lay their eggs in pools of water. These eggs are small. Use this information to explain why frogs' eggs are very likely to be affected by pesticides in the water.

(2)

(ii) An increase in temperature leads to evaporation of water. Suggest how evaporation may increase the effect of pesticides on frogs' eggs.

(1)

(Total 7 marks)

22 (a) A student investigated the diversity of plants at several sites on a golf course. At each site she took a large number of random samples.

(i) Explain the importance of taking a large number of samples at each site.

(1)

(ii) Explain the importance of taking samples at random.

_____

_____

_____

(1)

The student collected data from one part of the golf course and calculated an index of diversity.

The table shows her data.

Species	Number of plants per m^2
Sheep's fescue	11
Creeping buttercup	6
Clover	5
Dandelion	2
Sheep's sorrel	1
Lady's bedstraw	7
Stemless thistle	4

The index of diversity can be calculated from the formula

$$d = \frac{N(N-1)}{\sum n(N-1)}$$

where

d = index of diversity
N = total number of organisms of all species
n = total number of organisms of each species

(b) Use the formula to calculate the index of diversity for the plants on this part of the golf course. Show your working.

Answer _____

(2)

(c) The golf course was surrounded by undeveloped grassland from which it had beenproduced.
The golf course had

- some areas of very short grass which was cut frequently
- some areas of longer grass which was cut less frequently
- some areas of long grass and shrubs which were never cut.

The index of diversity for the insects on the golf course was higher than that for the surrounding undeveloped grassland.

Explain the effect of developing this golf course on the index of diversity of insects.

(Extra space)

(3)

(Total 7 marks)

23 The Harvest Index is the percentage of dry biomass that is harvested and used.

Barley is a cereal. It is grown for its grain. Researchers collected data to calculate the Harvest Index of barley growing in a small field. They obtained their measurements from quadrats at different places in the field. Their results are shown in the following table.

Quadrat number	Dry biomass of barley plants / g m^{-2}	Dry biomass of barley grain harvested / g m^{-2}
1	80	42
2	75	37
3	82	41
4	93	39

(a) Use the data for quadrat number **4** in the table to calculate the Harvest Index for barley.
Show your working.

Harvest Index = _____

(2)

(b) Plant breeders are trying to produce barley plants with shorter stems.
Explain how this would increase the Harvest Index.

_____

_____

(1)

(c) The values for the biomass of the barley plants are different in each quadrat.
Suggest an explanation for this difference.

_____

_____

_____

_____

(2)

(d) The researchers measured the dry biomass of the barley plants and the barley grain. What is the advantage of using dry biomass for these measurements?

_____

_____

_____

_____

_____

(2)

(Total 7 marks)

24 Herbicides are substances that kill weeds. Three farmers wanted to know which herbicide to use to control weeds in fields of barley. They chose eleven fields of barley and used a different herbicide in each field. Four weeks later they collected, counted and weighed the weeds in each field. Their results are shown in **Figure 1** and **Figure 2**.

Figure 1

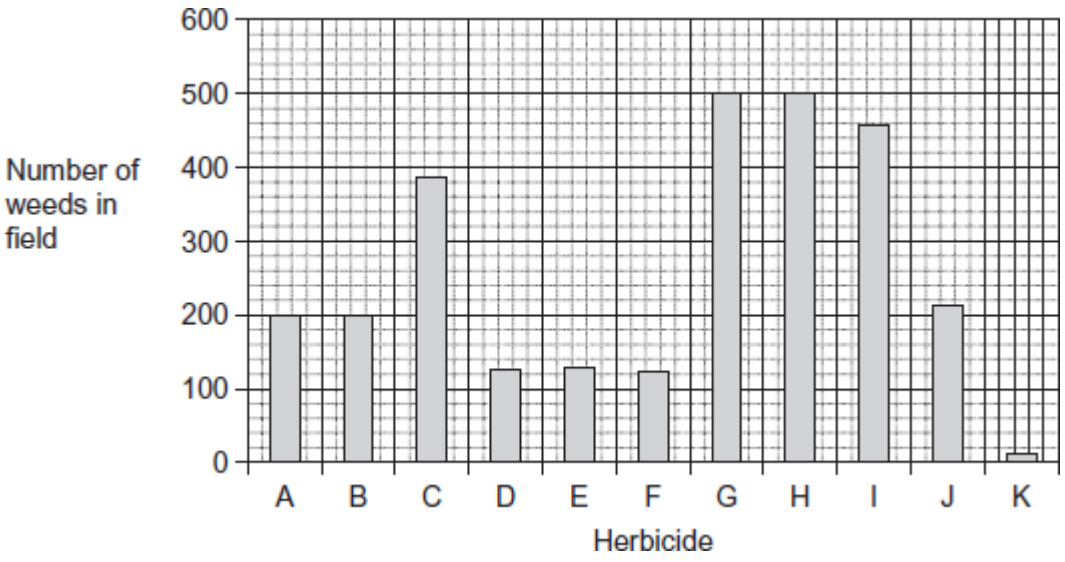
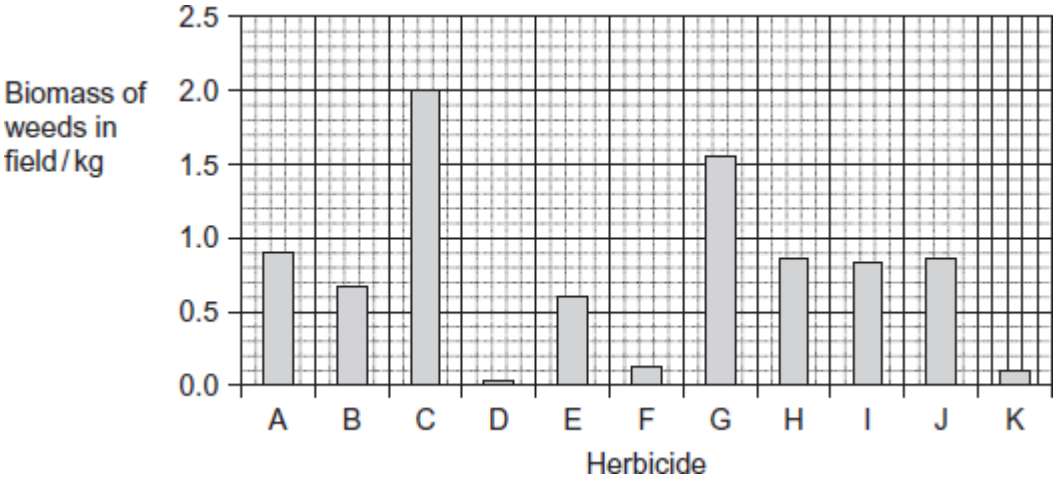


Figure 2



(a) Describe the difference in biomass of **each** of the weed plants in fields treated with herbicides **G** and **H**. Explain how you arrived at your answer.

(2)

(b) The farmers decided that **K** would be the best herbicide to use.
Explain why herbicide **K** would give a higher crop yield.

(2)

(c) The farmers carried out their investigation during the summer. Suggest **one** advantage and **one** disadvantage of carrying out this investigation during the summer.

Advantage _____

_____

Disadvantage _____

_____

(2)

(d) One of the farmers told a local newspaper reporter of their findings. The newspaper published an article with the following headline: "Local farmers show scientists the way to bigger crop yields." Was this headline justified? Explain your answer.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

Extra space _____

_____

_____

_____

_____

(5)

(Total 11 marks)

25 The body markings of cheetahs vary, in particular the pattern of bands on their tails. Cheetahsare solitary animals but the young stay with their mother until they are between 14 and 18 months old.

Scientists investigated the banding pattern on the tails of cheetahs living in the wild.

- They drove a car alongside a walking cheetah and used binoculars to study the tail pattern.
- They gave each cheetah a banding pattern score based on the width of the dark and light bands on the end of the tail.
- They scored the width of the bands on the right and left side of the tail using a 5 point scale of width.

A typical pattern on the right side of one cheetah's tail is shown in **Figure 1**.

Figure 1

Band number 1 2 3 4 5 6 7

Band width score 3 1 1 4 3 3 3

The scientists collected data from each cheetah on four separate occasions. **Figure 2** shows the data for one of the cheetahs.

Figure 2

Side of tail	**Mean band width score (± standard deviation)**						
	Band 1	**Band 2**	**Band 3**	**Band 4**	**Band 5**	**Band 6**	**Band 7**
Right	3.00 (± 0.82)	1.00 (± 0.00)	1.00 (± 0.00)	3.75 (± 0.50)	2.75 (± 0.50)	3.00 (± 0.00)	3.00 (± 0.00)
Left	3.75 (± 0.50)	3.25 (± 0.50)	2.00 (± 0.50)	3.00 (± 0.00)	2.00 (± 0.00)	2.50 (± 0.50)	3.00 (± 0.50)

(a) The scientists only used data from cheetahs which were fully grown. Suggest why.

_____

_____

(1)

(b) The scientists estimated the width of the bands on the same cheetah on four separateoccasions. They did not always get the same score.

(i) Give **two** pieces of evidence from **Figure 2** which show that the scientists sometimes obtained different scores for the same band.

1. _____

_____

2. _____

_____

(2)

(ii) The method the scientists used resulted in them getting different scores for the same band. Suggest why.

_____

_____

(1)

(c) What is the evidence from **Figure 2** that the dark and light bands do **not** form rings of equal width around the tail?

_____

_____

(1)

(d) The scientists found the difference in banding pattern between

- offspring in the same family
- cheetahs chosen randomly.

Explain how scientists could use this information to show that some variation in tail banding was genetic.

(Extra space)

(3)

(Total 8 marks)

Mark schemes

1

(a) 4:

1

(b) 2.68(6).

If answer incorrect:
Σn(n-1) = 242 = 1 mark
N(N-1) = 650 = 1 mark

2

(c) 1. Take more samples and find mean;
2. Method for randomised samples described.

Allow larger area = 1 mark

2

[5]

2

(a) Species richness measures only number of (different) species / does not measure number of individuals.

1

(b) Trees vary in height.

1

(c) 1. Index for canopy is 3.73;
2. Index for understorey is 3.30;
3. Index in canopy is 1.13 times bigger;

If either or both indices incorrect, allow correct calculation from student's values.

3

(d) 1. For *Zaretis itys*, difference in distribution is probably due to chance / probability of being due to chance is more than 5%;
2. For all species other than *Zaretis itys*, difference in distribution is (highly) unlikely to be due to chance;
3. Because P < 0.001 which is highly significant / is much lower than 5%.

3

[8]

3

(a) 1. Kingdom, Phylum, Class, Order, Family;
2. *Luscinia svecica.*

1 mark for each correct column

Allow Genus and Species if both placed in box for species but not if both placed in genus box

2

(b) Number of different alleles of each gene.

Accept number of different base sequences (found) in each gene

1

(c) 1. Has greater proportion of genes / percentage of genes showing diversity;
2. Percentage is 35% compared with 28% / proportion is 0.35 compared with 0.28.

Allow correct figures that are not rounded up, i.e., 34.9% / 0.349 and 27.8% / 0.278 **2**

[5]

4

(a) 1. Draw grid over (map of) area;
2. Select squares / coordinates at random. **2**

(b) 1. No emigration / immigration;
2. No losses to predation;
3. Marking does not affect survival;
4. Birth rate and death rate equal;
5. (In this case) all belong to one population. **2 max**

(c) 1. Only glows brightly with UV, so doesn't make insects more visible;
2. So doesn't affect / increase predation;

OR

1. Glows brightly with UV marking visible;
2. So makes it easy to pick out labelled insects. **2**

(d) 10 130.
Tolerance of ±1

$$N = \frac{M \times C}{R}$$ *= 1 marks* **2**

(e) 1. Scientists removed large numbers of insects (which were not returned) from same area / same population;
2. Affecting ratio of marked to unmarked. **2**

[10]

5

(a) 14; **1**

(b) Number (of individuals) in each <u>species</u> (of dung beetle);

Accept: population of each <u>species</u>. **1**

(c) 1. No overlap in standard deviations;

Accept: no overlap in <u>error</u> bars.

2. (Difference in mean total) significant/is not due to chance/is real; **2**

(d) No bias;

Ignore: 'representative sample'. **1**

(e) 1. Removes species/types of plant/insect;

Accept: decrease in plant/insect diversity.

2. Fewer food sources;

Ignore: less food.

Accept: less variety of food.

Accept: removes a food source.

3. Fewer habitats/niches;

Accept: loss/removal/destruction/ of a habitat.

Accept: no habitat.

Ignore: homes/shelters.

3

[8]

6

(a) 1. Vaccine/it contains antigen (from HPV);

Term 'antigen' may be first mentioned with point 2

2. Displayed on antigen-presenting cells;

Accept named example, e.g. macrophage/phagocyte/B cells

3. Specific helper T cell (detects antigen and) stimulates specific B cell;

Accept 'helper T cell with receptor on surface' for 'specific' and B cells with receptor/antibody on surface that bind to antigen for 'specific'

4. B cell divides/goes through mitosis/forms clone to give plasma cells;

5. B cell/plasma cell produces antibody;

4 max

(b) 1. Two (doses) because got more antibody;

Accept more effective in producing antibody

2. With three doses, second dose/dose at 1 month doesn't lead to production of any more antibody (than the two-dose group)/get same/similar response;

3. Three doses would be more expensive/less popular with parents/girls (and serves no purpose);

Accept 'less painful'

2 max

(c) t-test, because comparing two means;

Mark for correct test and explanation correct

Accept 'comparing the mean'

Reject 'to show that the results/means are significant'

1

(d) 1. Compare (base sequences of) DNA;

2. Look for mutations/named mutations (that change the base sequence);

3. Compare (base sequences of) (m)RNA;

1 and 3 accept triplet/codon sequences for comparisons

Ignore references to 'introns/non-coding DNA'

2 max

[9]

7 (a) (i) (Grouped according to) evolutionary links/history/relationships / common ancestry;

Ignore: closely related, factors, characteristics

Ignore: genetically similar

1

(ii) 1. Able to reproduce;

Accept: smallest taxonomic group/groups of organisms with same genes/ chromosomes/same number of chromosomes

Accept: breed for 'reproduce'

Ignore: mate

Reject: genetically identical

Ignore: similar genes/chromosomes

2. To produce fertile offspring;

Ignore: that are 'viable'

2

(b) Phylum
Class
Family
Genus;

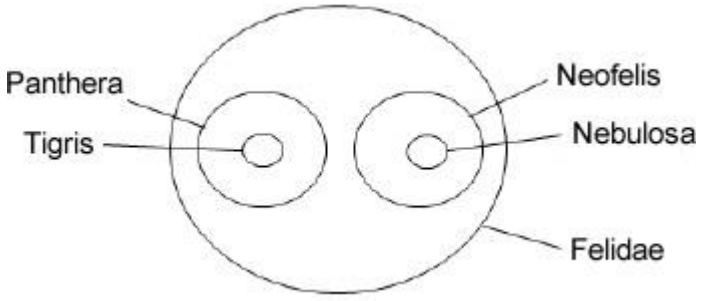
Accept: pleural answers phyla / genera / families

Accept phonetic answers phyllem/phylem/fylum/fyla/phylae/phyli /jenus/ jenera/familys

All 4 in correct order for 1 mark

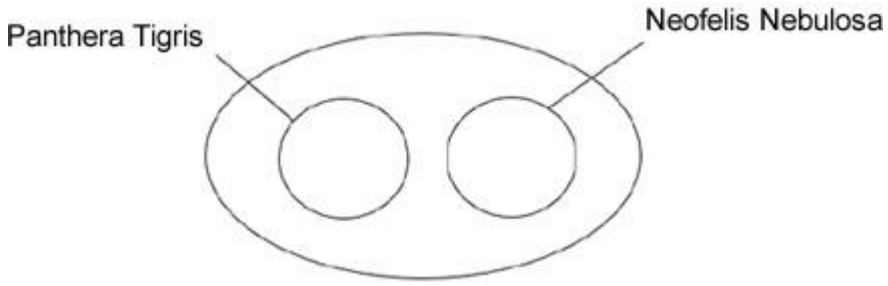
1

(c) 1. Two circles/with two inner circles with no overlap;



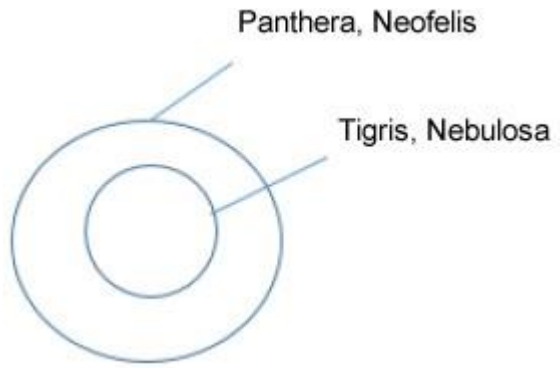
= 2 marks

OR



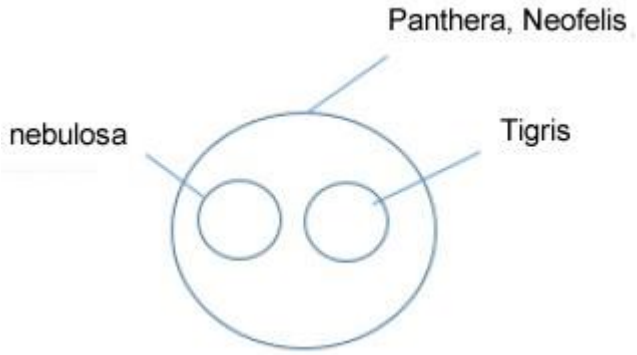
= 2 marks

OR



= 1 mark

OR



= 1 mark

2. Labels correct;

Ignore underlining / capitals

Accept: P tigris/ N nebulosa

Accept phonetic spelling

2

(d) 1. South China and Sumatran tigers share a more recent common ancestor;

Accept: more closely related (statement must be comparative)

Accept: a labelled hierarchy

2. (because) identical/same/matching (nucleotide) sequences;

Accept: converse for Siberian tiger eg Siberian is less closely related to South China AND Sumatran tigers

2

[8]

8

(a) 1. Type of feed affects (antibiotic) resistant bacteria (in animals);

Accept: null hypotheses

Accept predictions, for example

More antibiotic resistant bacteria form in animals fed with antibiotics in their food

2. (Antibiotic) resistant resistant infect /are passed on to animals/farmer / resistant resistant are passed between animals;

Accept: bird to bird/bird to human/human to human

Accept: a link (exists) between (antibiotic) resistance in animals and their keepers/farmers – as lowest level QWC

3. Incidence of (antibiotic) resistant resistant differs in chickens and turkeys;

Accept: a comparison, eg 'more resistant bacteria in chickens than turkeys'

4. Incidence of (antibiotic) resistant resistant differs in chicken farmers and turkey farmers;

Accept: a comparison, eg 'more resistant bacteria in chickens than turkeys'

Max 2

(b) (i) 1. Large(r) percentage of resistant bacteria in turkeys/low(er) percentage of resistant bacteria in chickens;

Accept: E coli for bacteria

Ignore: number, eg. ignore 'more'/'fewer' turkeys/chickens

2. Large(r) percentage of resistant bacteria in turkey farmers/low(er) percentage of resistant bacteria in chicken farmers;

2

(ii) 1. (More) antibiotic in turkey feed kills (more) non-resistant bacteria / resistant bacteria survive;

Accept: antibiotic creates selection pressure

Survive must be explicit, not implied by 'reproduce'

2. (Resistant bacteria) reproduce / pass on gene for resistance;

2

(c) (Human) faeces contain pathogens;

Accept: harmful organisms

1

(d) 1. Large number of farms / farmers (surveyed) / 46;

'Reliable' is used in the question stem

2. So results are (likely to be) representative / can identify anomalous results;

Ignore: reproducible / accurate / valid / reliable

Accept valid explanation of replicates minimising effects of chance

2

(e) 1. (DNA) hybridisation (of gene for resistance in bacteria takenfrom bird and farmer);
2. (Identical) strands separate at high(est) temperature;

OR

3. Compare base/nucleotide sequence (of gene for resistance in bacteria taken from bird and farmer);
4. (Identical strains) have identical/same base sequences

Mark in pairs, do not mix and match.

Accept: bacteria in bird and farmer/both types of bacteria have identical base sequences = 2 marks

2

(f) 1. (Antibiotic use has) increased cases of bacterial resistance;

Accept: number

2. Transfer/horizontal transmission of (resistance) gene to pathogens/harmful bacteria;

Accept: conjugation

3. (Antibiotic) resistant bacteria cause harm / medical treatments less effective;

Accept: superbug

4. Avoids side effects on animals;
5. Increased demand for organic food;
6. Antibiotic/resistant bacteria could be present in human food;
7. High cost of antibiotics;
8. Legislation has controlled antibiotic use;

Accept: EU/government guidelines

4 max

[15]

9

(a) Number of species in a community;

Accept: number of species in a habitat/area/ecosystem

Accept: species richness

Accept: all the species for number of species

Ignore: variation/diversity

Reject: in a population

1

(b) 1. Number of (organisms of) each species;

Accept: 'population' for number and accept individual for organism.

Accept: 'species richness'

2. Total number of organisms (of all species) / Total number of species;

Idea of grand total of all organisms, not just number of different species

2

(c) 1. Described effect of sewage (eg oxygen depletion/is toxic/kills);

Accept: increase in BOD

Accept: eutrophication/description of eutrophication

2. Prevents some/many species colonising/ reproducing/remaining;

Accept: only a few species survive

3. Sewage is food source for (individuals of) some/a few/species;

4. (So) increase only in their numbers;

Max 2

(d) (i) 1. Results are not repeatable / are not representative / unreliable / conflict / contradict;

Accept: different / don't agree

Ignore: not valid/not reproducible/inaccurate

2. Can't make any conclusions;

2

(ii) Do repeats to find a pattern/distribution/mean (of index of diversity);

Accept: use a different technique to obtain more reliable evidence;

Need idea of more than one repeat

Accept: calculate an average

Accept: at different times

Accept: statistical test to see if results differ significantly

1

[8]

10

(a) 1. No interbreeding / gene pools are separate / geographic(al) isolation;

Accept: reproductive isolation as an alternative to no interbreeding.

2. Mutation linked to (different) markings/colours;
3. Selection/survival linked to (different) markings/colours;
4. Adapted organisms breed / differential reproductive success;

Note: 'passed on to offspring' on its own is not sufficient for reproduction.

5. Change/increase in allele frequency/frequencies;

5

(b) 1. (Compare DNA) base sequence / base pairing / (DNA) hybridisation;

Ignore: compare chromosomes / 'genetic make-up'.

Accept: (compare) genes / introns / exons.

*Note: reference to **only** comparing alleles is 1 max.*

2. Different in six (species) /different in different species / similar in three (subspecies) /similar in same species/subspecies;

Ignore: compare chromosomes / 'genetic make-up'.

Reject: 'same alleles/ same DNA bases in three species/subspecies'.

Note: mark point 2 can be awarded without mark point 1.

2

11

(a) 1. Number of (individuals of) each species;

Accept: 'population' for 'number'

2. Total number of individuals / number of species;

Accept: 'species richness'

MP2 allows for other types of diversity index

(b) (i) (Shows) results are due to the herbicide / are not due to another factor / (to) compare the effect of using and not using the herbicide / shows the effect of adding the herbicide;

Neutral: allows a comparison

Neutral: ensures results are due to the independent variable

Reject: 'insecticide'

Accept: 'pesticide'

(ii) 1. (More) weeds killed **so** more crops / plants survive / higher yield / less competition;

2. High concentrations (of herbicide) harm / damage / kill / are toxic to crops / plants;

Accept: 'pesticide'

400+)

[7]

2

1

(iii) 1. Reduced plant diversity / fewer plant species / fewer varieties of plant;

Accept: 'weed' for 'plant'

Neutral: fewer plants

Accept: only one crop species remains

2. Fewer habitats / niches;

***Q** Neutral: fewer homes / shelters*

3. Fewer food sources / varieties of food;

Neutral: less food

12

1. Carbon dioxide combines with ribulose bisphosphate / RuBP;
2. Produces two glycerate (3-)phosphate / GP;

Accept: any answer which indicates that 2 x as much GP produced from one RuBP.

3. GP reduced to triose phosphate / TP;

Must have idea of reduction. This may be conveyed by stating m.p. 4.

4. Using reduced NADP;

***Reject**: Any reference to reduced NAD for m.p.4 but allow reference to reduction for m.p. 3.*

5. Using energy from ATP;

Must be in context of GP to TP.

6. Triose phosphate converted to glucose / hexose / RuBP / ribulose bisphosphate / named organic substance;

13

(a) Succession;

Ignore any word in front of succession e.g. secondary / ecological succession.

Neutral 'forestation'.

(b) 1. Greater variety / diversity of plants / insects / more plant / insect species;

Neutral: more plants.

2. More food sources / more varieties of food;

Neutral: more food / more / greater food source (singular).

3. Greater variety / more habitats / niches;

Accept: more nesting sites.

3

[8]

[6]

1

3

(c) (i) Temperature and carbon dioxide;

Neutral: water, chlorophyll.

1

(ii) Shows (gross) photosynthesis / productivity minus respiration / more carbon dioxide used in photosynthesis than produced in respiration;

Correct answers are often shown as: net productivity = (gross) photosynthesis – (minus) respiration.

1

(iii) 1. (Shade plant) has lower (rate of) respiration / respiratory losses / less CO2 released at 0 light intensity / in dark;

Accept use of figures.

Accept: lower compensation point.

2. Greater (net) productivity / less sugars / glucose used / more sugars / glucose available;

Neutral: any references to rate of photosynthesis.

2

[8]

14 (a) (i) 1. Groups within groups;

1. accept idea of larger groups at the top / smaller groups at the bottom

2. No overlap (between groups);

2

(ii) (Grouped according to) evolutionary links / history / relationships / common ancestry;

Neutral: closely related

Neutral: genetically similar

1

(b) (i) 1. (Only) one amino acid different / least differences / similar amino acid sequence / similar primary structure;

2. (So) similar DNA sequence / base sequence;

2

(ii) 1. Compared with humans / not compared with each other;

Accept: degenerate code / more than one triplet (codes) for an amino acid

2. Differences may be at different positions / different amino acids affected / does not show where the differences are (in the sequence);

1 max

(iii) 1. All organisms respire / have cytochrome c;

Accept: converse arguments for haemoglobin

1. Accept 'more' instead of 'all'

1. Accept 'animals' instead of organisms'

2. (Cytochrome c structure) is more conserved / less varied (between organisms);

2. Neutral: cytochrome c is conserved

1 max

[7]

15 (a) Push – legume

Pull – grass;

Both needed for mark

1

(b) 1. Set up tape measures on two sides of the plot / make grid of plot;

Allow 'Number each plant'. With this approach mp3 cannot be awarded.

2. Use random number table / calculator / generator;

Allow 'Select from a hat' idea.

3. To generate coordinates;

3

(c) 1. To prevent competition between the maize and the grass;

2. For light / nutrients / water;

OR

3. Idea of limits movement of pest (between grass and maize);

4. Only eating / damaging grass;

2 max

(d) 1. Nitrogen-fixing bacteria convert nitrogen (in the air) into ammonium compounds (in the soil) which are converted into nitrates / nitrification occurs;

Accept 'ammonia' for 'ammonium compounds'.

2. Maize uses nitrates (in soil) for amino acid / protein / ATP / nucleotide production;

2. Must be in the context of maize.
Ignore ionic formulae unless only these are given.

2

(e) 1. Reduced % damage to maize plants / increased maize grain yield;

2. Calculation to justify mp 1;

3. Standard deviation shows no overlap but need stats to show significance of this difference;

4. More profit / net income / greater income than additional cost (with push-pull);

5. $322 extra / 408% more / $401 v $79 profit;

Accept '$350 extra income compared to $28 extra spend'.

Mp5 gains credit for both mp4 and 5

3 max

[11]

16

(a) (i) Reliable / representative / for statistical tests;

Accept: identify anomalies

Neutral: accurate / valid / bias

1

(ii) 1. Find coordinates (on a grid) / split area into squares / number the sites;

1. Ignore references to tape measures, metre rulers etc

2. Method of generating / finding random numbers eg calculator / computer / random number generator / random numbers table;

2. Accept: numbers out of a hat / use of dice

2

(iii) 1. Breeding (of lizards);

Neutral: weather / climate / hurricanes / hibernation / migration / emigration / immigration

2. Food source / prey;

3. Predator;

4. Variation in malarial infection;

5. Temperature variation;

6. Availability of water eg drought / 'rainy season'

2 max

(b) 1. Number in sample varies;

2. Allow a (valid) comparison;

2

(c) 1. (Overall) positive correlation (for either / both species);

Neutral: only one study / no repeats

2. Reference to (site) 5 / 300 metres;

3. Limited results for *A. wattsi* / small sample / number / percentage infected for *A. wattsi*;.

(d) (i) 1. Fewer *A.wattsi* infected / more *A. gingivinus* infected;

2. Higher number of *A.wattsi* present when higher percentage / number of *A.gingivinus* infected / no *A.wattsi* present when *A.gingivinus* has zero infection;

(ii) 1. Reduced immunity / increased susceptibility to disease;

1. Accept: idea that energy / resources are used to combat malaria

2. Reduced oxygen transport / uptake / respiration / reduced activity / movement;

(iii) 1. There is a probability of less than 1% / 0.01;

1. Reject: probability is / equal to 1% / 0.01;

1. Reject 0.01% / 5% / 0.05 / 0.05%

2. That result(s) / correlation / it is due to chance;

2. Allow correct interpretation using above (incorrect) figures eg there is a probability of less than 5% that the results are due to chance =1 mark

OR

3. There is a probability of more than 99% / 0.99;

4. That result(s) / correlation / it is not due to chance;

Note: there is a probability of more than 5% that the results are due to chance =0 marks

3. Reject: probability is / equal to 99% / 0.99;

3. Reject 0.99% / 95% / 0.95 / 0.95%

4. Allow correct interpretation of above figures ie 0.99% / 95% / 0.95 / 0.95% but reject if less than

17 (a) (i) Kingdom / phylum / class;

Accept Animalia / animal kingdom / Chordata / Chordates / Aves

Allow phonetic spelling

(ii) Family;

1

2 max

2

2

2

[15]

1

(b) 1. Shows the spread of the data / how data varies;

1. Reject range.

Accept varies from the mean

2. Overlap = no difference / due to chance / not significant;

2. Allow converse

2

(c) 1. Different species would have different amino acid sequences;

Accept more closely related = more similar sequence

2. Amino acid sequence is the result of DNA / alleles / base sequence;

References to incorrect statements about coding negates second mark

2

[6]

18 (a) Removes bias;

1

(b) (i) 1. 1.28 / 1.29 / 1.285 / 1.3

1. Ignore more than 3dp

2. Answer incorrect but shows clear understanding of Σ

2. Σ = 318250. Allow mark if denominator written out. Incorrect denominator but evidence of understanding gains mark

2

(ii) Diversity index would be lower (NO MARK)

Assume wheat field if site unspecified

1. Fewer species / Beech aphid / Large white butterfly / 7-spot ladybird absent / only three species / species diversity lower / mostly one species / mostly bird-cherry aphid;

1. Allow species richness in context of few species

2. Fewer plant species;

2. Allow one type of food source if clearly plant

2

(c) For:

1. Data support the claim / evidence supports claim;

1. Ignore reference to correlation / causation

Against:

2. Only wheat field / only comparing with wood / one type of habitat / only insects considered;

2 max

(d) 1. Greater variety of plants;

2. Another habitat / more habitats / places to live / niches / another food source / more food types;

2. Answers referring to 'more food' should not be credited. Allow reference to either animal or plant as foods

2

[9]

19

(a) 1. Carbohydrate / sugar / named carbohydrate;

2. Minerals / named mineral ion;

Accept alternatives for mineral such as inorganic substances / ions. Accept symbol for ion. Accept incorrect symbols providing that answers are not ambiguous.

3. Amino acids / protein;

4. Vitamins;

2 max

(b) 1. Shake / stir / mix;

2. Even distribution of yeast / cells;

Accept other terms with a similar meaning for both points

2

(c) Two marks for correct answer of 20 / 20.2 / 20.22;;

One mark for incorrect answer in which student clearly shows increase as 8.912 – 7.413 or as 1.499;

Ignore references to 10^6

2

(d) 1. More competition;

2. Less oxygen;

3. Less glucose / sugar / carbohydrate / respiratory substrate;

4. Ethanol / alcohol becomes toxic / inhibits respiration / inhibits reproduction;

5. Fall in pH;

2 max

[8]

20

(a) 1. Closer the (amino acid) sequence the closer the relationship;

2. (Protein structure) related to (DNA) base / triplet sequence;

Amino acid sequence is related to (DNA) base / triplet sequence = two marks;

2

(b) 1. Reference to base triplets / triplet code / more bases than amino acids / longerbase sequence than amino acid sequence;

Different (base) triplets code for same amino acids = 2 marks;

Degeneracy of triplet code = 2 marks

2. Introns / non-coding DNA / degeneracy of code / more than one code for each amino acid;

Ignore reference to codon.

2

[4]

21 (a) Greater variety / different foods;

More habitats / niches;

Answers only referring to 'more food' should not be credited but allow 'more food sources'.

2

(b) Also measures number of individuals in a species / different proportions of species;

Some species may be present in low / high numbers;

First marking point can only be awarded if there is a reference to species.

2

(c) (i) Large surface area to volume (ratio) / permeable / thin (outer layer); Correct reference to diffusion;

Accept (Eggs) cannot move (out of water) for 1 mark

2

(ii) Concentration (of pesticide) is increased;

1

[7]

22 (a) (i) Produces a more reliable mean / average / makes sure sample was representative / reduce effect of extreme values / identify anomalies;

Ignore references to chance

1

(ii) Removes bias;

1

(b) Two marks for correct answer of 5.8;

One mark for incorrect answer that clearly shows denominator as 216;

2

(c) 1. Increase in variety of plants / shrubs / grass;

2. More habitats / niches;

3. Greater variety of food sources / more food sources;

Answers only referring to 'more food' should not be credited

3

[7]

23 (a) Two marks for correct answer, 41.9 / 42 ;;
One mark for incorrect answer of 0.42;

2

(b) Increases proportion of crop that is used / greater proportion is grain / reduces proportion of crop that is not used / is not grain;

1

(c) Quadrats from different parts of field;
Biotic / abiotic factors / named biotic / abiotic factor different;

2

(d) Water (in plants and grain);
Varies;

2

[7]

24 (a) Greater when treated with herbicide **G**;
Same number but total biomass larger;

Can be shown by figures

2

(b) Fewer weeds left to produce seeds;
Less contamination of crop (by weeds); / fewer weeds to separate from crop; / less competition (between crop and weeds);

2

(c) Advantage
Weeds growing fast / photosynthesising fast so effect will be seen /
will have large effect;

Disadvantage
No information about winter / other seasons /
weeds not growing fast /
could kill (beneficial) insects /
crop may be harvested before effects noticeable;

One mark for advantage and
one mark for disadvantage

2

(d) Limitations of investigation

1. No control / untreated field;
2. Amount of herbicide may be different;
3. May be differences between fields; Eg soil Nutrients / fertiliser added Type of weed Microclimates
4. May be different number of weeds (at start);

Limitations of results

5. No replicates / one set of data;
6. Field size may vary / not specified;

Scientific Research

7. Scientific research / example of scientific research has led to greater yield;

When marking please number the marking points

e.g. 5✓ *means a mark award for point 5*

5 max

[11]

25 (a) Banding pattern changes as cheetah gets older / difficult to judge as tail is short / fluffy;

1

(b) (i) Mean not (always) a whole number;
Standard deviation not (always) zero;

2

(ii) Movement of tail / angle of sight / confused it with another band / subjective estimation;

Accept reference to ***Figure 1***

E.g. Bands 2 and 3 have same thickness but look different

1

(c) Band width not the same on both sides of tail;

1

(d) Offspring of the same family will be more similar genetically;
As have same mother (and father) / parent;
Expect to see more differences in randomly chosen cheetahs;

3

[8]