Biodiversity and Natural Resources -3

Name: _____

Class: _____

Date: _____

Time:

Total Marks Available:

Total Marks Archived:

Level: Edexcel A level Biology

Subject: Biology

Exam Board: Pearson Edexcel Level 3 GCE AS and A level Biology A (Salters-Nuffield) and also Pearsons Edexcel AS and A Level Biology B (9BI0) - Is however suitable for use by AS and A level Biology Students of other Boards

Topic: Biodiversity and Natural Resources -3

Type: Topic Questions

To be used by all students preparing for Edexcel AS and A level Biology A and Biology B - Students of other Boards may also find this useful

Questions

Q1.

Wasps are insects that live in groups.

One species of wasp (*Vespula germanica*) has been shown to knock its body repeatedly against a hard surface. This signals the presence and quality of food to other wasps.

When threatened by another animal, it may use its stinger to inject a venom to protect itself.

bugguide.net

Complete the table by giving the name of the type of adaptation.

(2)

Description of adaptation	Type of adaptation shown by the wasp
knocking its body to signal food	
the stinger	

(Total for question = 2 marks)

Q2.

Plant fibres and oil-based plastics have both been used to make ropes.

Describe one advantage and one disadvantage of using ropes made from plant fibres rather than ropes made from oil-based plastics.

(2)

.....

.....

.....

.....

.....

.....

(Total for question = 2 marks)

Q3.

In the 18th century, William Withering trialled the use of an extract of foxglove plants to treat a heart condition.

Give **four** reasons why a contemporary drug testing protocol is an improvement on the trial used by William Withering.

(4)

.....

.....

.....

.....

.....

.....

(Total for question = 4 marks)

Q4.

Answer the questions with a cross in the boxes you think are correct ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

Moving a limb involves the interaction of muscles, tendons and ligaments. Tendons and ligaments are important structures in elbow and knee joints.

(i) Which of the following identifies the structures that join bones to bones in an elbow joint?

(1)

☐ **A** ligaments only

☐ **B** ligaments and tendons

☐ **C** tendons only

☐ **D** neither ligaments nor tendons

(ii) One type of joint injury is a torn ligament. This may be treated by adding a piece of tendon to the ligament. This is because after a period of time, the tendon tissue changes and responds in the same way as a ligament.

Which of the rows in the table correctly describe the changes in this piece of tendon? **(1)**

Row	Piece of tendon shows a change in its	The change is
1	genotype	an anatomical adaptation
2	genotype	a physiological adaptation
3	phenotype	an anatomical adaptation
4	phenotype	a physiological adaptation

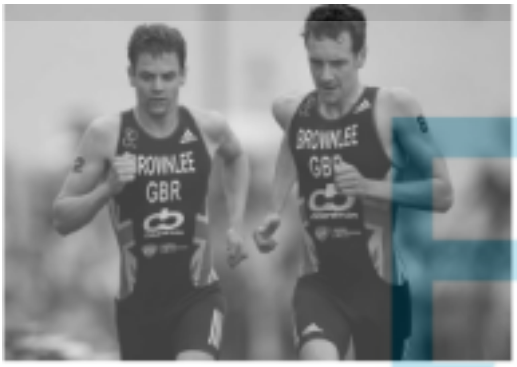
☐ **A** row 1 only

☐ **B** row 3 only

☐ **C** rows 1 and 2

☐ **D** rows 3 and 4

*(iii) The photograph shows athletes competing in the modern triathlon.

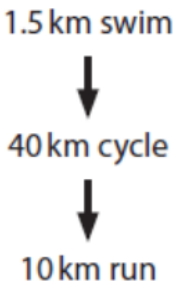


The modern triathlon involves three sports: swimming, cycling and running.

An investigation was carried out to compare the level of demand on the body of these three sports during a triathlon.

The investigation involved 12 athletes who were all males of the same age.

Each athlete carried out the triathlon as shown in the flow diagram. There was no rest period between each sport.



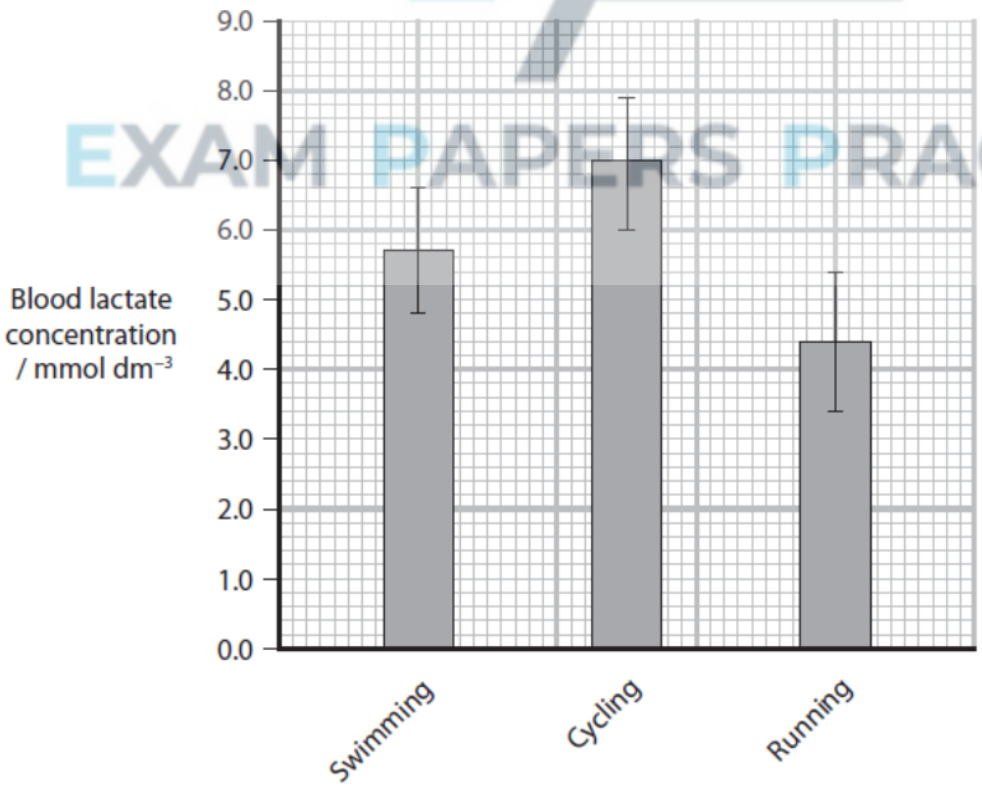
The heart rate for each athlete was measured as they completed each sport.

The mean heart rate for each sport was then calculated and is shown in the table.

Sport	Mean heart rate / bpm
Swimming	163
Cycling	165
Running	159

The blood lactate level for each athlete was also measured as they completed each sport. Means for lactate level after each sport were calculated.

The results are shown in the graph.



It was concluded that cycling was the most demanding of the three triathlon sports. This was followed by swimming and then running.

Evaluate the validity of this conclusion.

(6)

(Total for question = 8 marks)

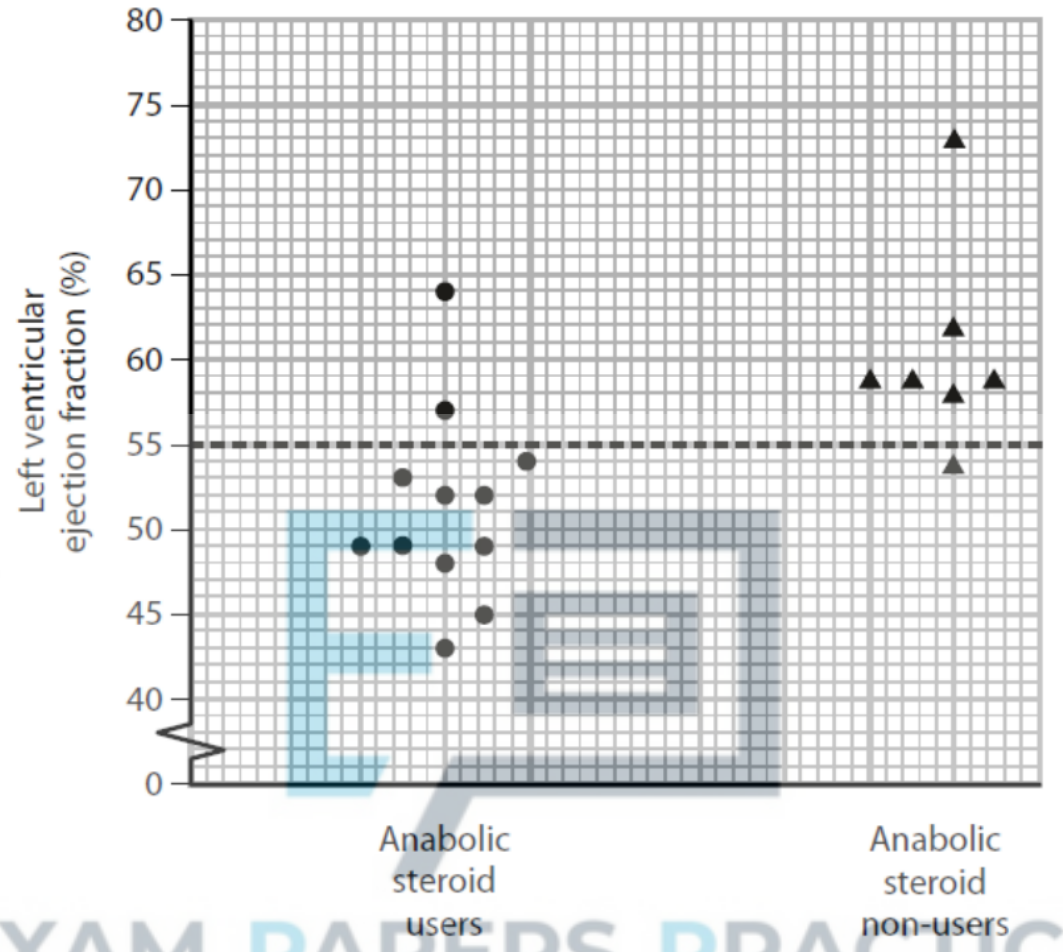
Q5.

Anabolic steroids stimulate muscle development.

Some athletes use anabolic steroids in an attempt to improve their performance. The effect of long-term anabolic steroid use on heart function has been investigated.

The left ventricular ejection fraction is the percentage of blood that leaves the left ventricle when it contracts.

The left ventricular ejection fraction for a healthy heart should be greater than 55%. The results of a small study are shown in the graph.



(i) Analyse the data to determine the effect of anabolic steroid use on heart function.

(2)

.....

.....

.....

.....

.....

.....

.....

(ii) Some drugs used to treat cancer have also been shown to reduce the ventricular ejection fraction.

Describe how the safe dose of a cancer drug could be determined.

(3)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(Total for question = 5 marks)

Q6.

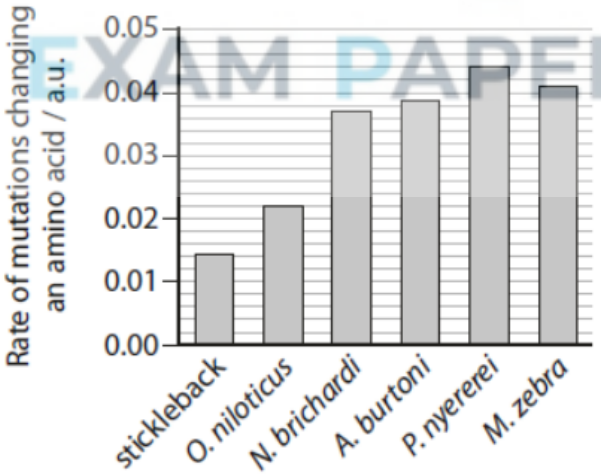
The genomes of some species of cichlid fish have been sequenced and analysed. The data collected included:

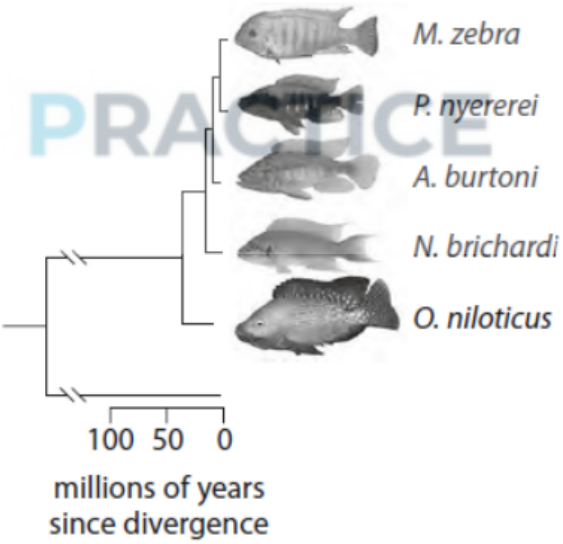
- the rate at which genes have been duplicated to produce additional copies of genes on a chromosome
- the frequency of mutations in transcription factor binding sites
- the rate of mutations that result in a change of an amino acid in a protein.

This information was used to produce a phylogenetic tree.

A comparison was made with a stickleback, which is a slowly evolving fish.

Speed of evolution	Fish	Rate of gene duplication / a.u.	Number of mutations in transcription factor binding sites (compared to *O. niloticus*)
Rapidly evolving cichlid fish	*O. niloticus*	45	0
	N. brichardi	45	214
	A. burtoni	55	140
	P. nyererei	45	129
	M. zebra	60	142
Slowly evolving fish	stickleback	10	0





Phylogenetic tree

Analyse all the data provided to discuss how several species of cichlid fish have evolved over a short period of time.

(9)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(Total for question = 9 marks)

Q7.

Tuberculosis (TB) is an infectious disease caused by mycobacteria.

Individuals infected with M. tuberculosis can be treated with antibiotics.

Four of the antibiotics used to treat TB are shown in the table.

Antibiotic	Mechanism of action
Isoniazid	Inhibits the synthesis of a fatty acid needed to make bacterial cell walls
Rifampicin	Inhibits bacterial RNA polymerase
Streptomycin	Binds to bacterial ribosomes to prevent the binding of tRNA
Pyrazinamide	Not yet known, but not the same mechanisms as the other three antibiotics

In one clinical trial lasting six months, the effect of treating TB with these antibiotics was investigated.

All patients were treated with all four antibiotics for two months. Then they were treated with different pairs of antibiotics or isoniazid alone for a further four months.

All patients were free of any signs of active TB at the end of the clinical trial.

The design of the trial and the percentage of these patients with TB three years after the trial ended are shown in the diagram.

Two months	Group	Four months	Percentage of patients with active TB after three years (%)
Isoniazid + Rifampicin + Streptomycin + Pyrazinamide	1	Rifampicin + Pyrazinamide	9
	2	Isoniazid + Rifampicin	11
	3	Isoniazid + Pyrazinamide	32
	4	Isoniazid	30

Analyse the data to comment on the effectiveness of these antibiotics for the treatment of TB.

(6)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(Total for question = 6 marks)

Q8.

In a drug trial, people with a heart condition were given one of three drug treatments. The table shows the recorded improvement in their condition for each of the three treatments.

Treatment	Concentration of drug / mg	Recorded improvement / arbitrary units
1	0	18.8
2	400	24.8
3	600	30.9

It was concluded that the drug treatment improved the condition of the patients. Analyse the data to comment on this conclusion.

(3)

.....

.....

.....

.....

.....

(Total for question = 3 marks)

Q9.

Extracts of the plant St John's wort have also been used to treat depression.

A double blind trial compared the effectiveness of treating depression using a SSRI, an extract of St John's wort, and a placebo.

Depression was measured using the Hamilton Rating Scale for Depression (HRSD). The higher the HRSD score the greater the depression.

The table shows the results of this trial.

Time / weeks	HRSD score		
	SSRI	St John's wort	Placebo
0	16	16	17
1	14	15	15
2	13	14	12
3	12	13	12
4	10	13	12
5	9	12	11
6	8	12	11
7	7	11	12
8	6	12	12

(i) State what is meant by the term **double blind**.

(1)

.....

.....

(ii) Analyse the data in the table to compare the effectiveness of these three treatments for depression.

(3)

.....

.....

.....

.....

.....

.....

(iii) Double blind trials give scientists confidence in the results collected.

Explain **two** ways the design of this trial could be improved in order to increase confidence in the results.

(4)

.....

.....

.....

.....

.....

.....

.....

.....

.....

(Total for question = 8 marks)

Q10.

The photograph shows a plant called lantana (*Lantana camara*).

(Source: © Peter Vrabel/Alamy Stock Photo)

The leaves of lantana contain chemicals known to have antimicrobial properties.
The antimicrobial activity of lantana leaf extracts prepared using three different solvents, A, B and C, was compared.

Fresh lantana leaves were dried and powdered. The dried leaf material was mixed with the solvent and then the extract was purified and dried.

The mass of extract obtained from 5 g of powdered leaf, using each solvent, was measured.

Solvent used	Mean mass of extract ± SD / μg
A	501.3 ± 3.5
B	721.3 ± 1.5
C	245.6 ± 4.0

The mass of dried and powdered lantana leaves is 10.5% of the mass of fresh leaves.
Calculate the mass of fresh leaves needed to produce 1 mg of extract using solvent A.
Give your answer to three significant figures.

(2)

..... g

(Total for question = 2 marks)

Q11.

The photograph shows a plant called lantana (*Lantana camara*).

(Source: © Peter Vrabel/Alamy Stock Photo)

The leaves of lantana contain chemicals known to have antimicrobial properties.

The antimicrobial activity of lantana leaf extracts prepared using three different solvents, A, B and C, was compared.

Fresh lantana leaves were dried and powdered. The dried leaf material was mixed with the solvent and then the extract was purified and dried.

The mass of extract obtained from 5 g of powdered leaf, using each solvent, was measured.

Solvent used	Mean mass of extract ± SD / μg
A	501.3 ± 3.5
B	721.3 ± 1.5
C	245.6 ± 4.0

The antimicrobial properties of the extracts produced using these solvents are shown in the table.

Solvent used to prepare extract	Dry mass of extract /μg	Bacteria tested	
		Klebsiella pneumoniae (Gram negative)	*Micrococcus luteus* (Gram positive)
		Mean diameter of the zone of inhibition /mm	
A	5.0	8.3	7.1
	10.0	10.5	7.0
B	5.0	14.5	12.2
	10.0	18.1	18.0

(i) Deduce the effect of using different solvents on the effectiveness of the extracts against these two bacteria.

(2)

.....

.....

.....

.....

.....

.....

.....

.....

(ii) Devise a method that could be used to collect the data in the table.

(4)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(Total for question = 6 marks)

Q12.

Lipids and carbohydrates are found in both plants and animals.

The carbohydrate content of vegetables ranges from 3 to 35%. However, meat contains little to no carbohydrate. Milk is the only food source from animals that contains a significant amount of carbohydrate.

Although plant material contains a higher proportion of carbohydrate than animal tissues, it has been claimed that carbohydrates are more important to animals than they are to plants.

Assess the relative importance of carbohydrates to plants and animals.

(9)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(Total for question = 9 marks)

Q13.

All known organisms can be placed into one of the three domains of life.

The table shows some information about the three different domains.

Feature	Archaea	Bacteria	Eukaryota
DNA is circular	Yes	Yes	No
DNA is single-stranded	No	.....	No
Growth inhibited by the antibiotic streptomycin	No	Yes	No
Name of the link between fatty acids and glycerol in lipids	Ether	Ester	Ester
Presence of cell wall	Some	Yes	.....
Methionine required for starting protein synthesis	Yes	No	Yes
Transcription factors required for transcription	Yes	No	Yes

Complete the table to show the features in Bacteria and in Eukaryota.

(2)

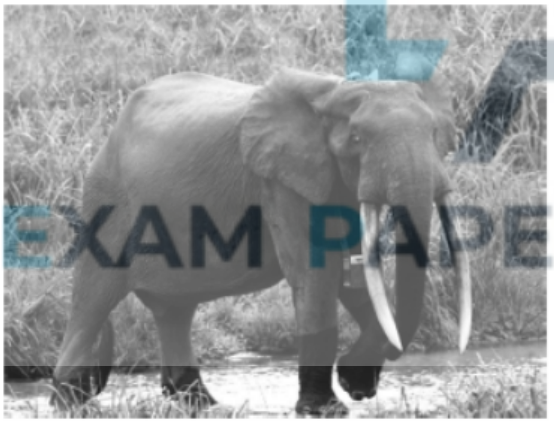
(Total for question = 2 marks)

Q14.

Scientists have studied behavioural, anatomical and genetic variation in elephants. The table shows some information about two populations of African elephants.

Population	Location	Feeding behaviour	Anatomical differences
Forest elephant	tropical forest of central and West Africa	feeds on leaves and fruits of high-growing plants such as shrubs and trees	• lower jaw longer and narrower • tusks straighter and downward facing • overall a much smaller size
Savannah elephant	African savannah	feeds on grass and leaves of low-growing shrubs	• lower jaw shorter and wider • tusks more curved and upward facing • overall a larger size

The photographs show elephants from the two populations.



Forest elephant

Savannah elephant

DNA samples were collected from these two populations of elephants.

One of the genes showing variation was the GBA gene. The table shows the frequency of the alleles of the GBA gene in the two populations.

GBA allele	Frequency of allele in the elephant population	
	Savannah elephant	Forest elephant
J	0.05	0.43
K	0.00	0.57
L	0.95	0.00

(i) State what is meant by the term **allele**.

(1)

.....

.....

.....

(ii) Use the Hardy-Weinberg equation to show that more than 50% of the forest elephant population are homozygous for the GBA gene.

(3)

Answer .....

(Total for question = 4 marks)

Q15.

Madagascar is an island rich in biodiversity.

Lemurs are a diverse group of primates endemic to Madagascar.

Scientist suggest there may be as many as 100 different species of lemur. (i) State what is meant by the term **endemic**.

(1)

.....

.....

.....

(ii) Describe what is meant by **biodiversity**.

(2)

.....

.....

.....

.....

.....

.....

(iii) Explain how the biodiversity of lemurs in two different parts of Madagascar could be compared.

(3)

.....

.....

.....

.....

.....

.....

.....

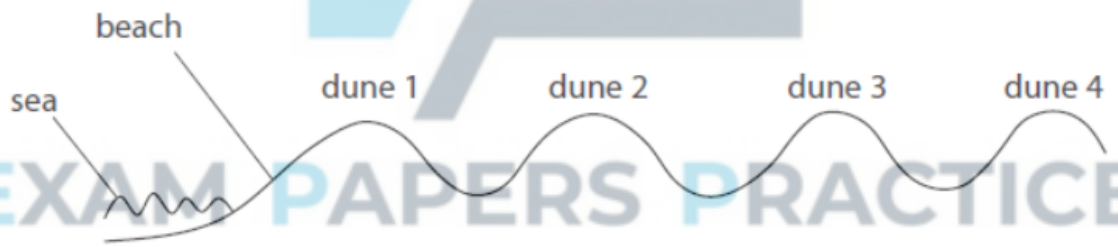
.....

.....

.....

Q16.

Sand dunes are a habitat that can often be found by the edge of the sea. An investigation was carried out to study the variety of plant species found on sand dunes. Four adjacent sand dunes from the sea to further inland were selected, as shown in the diagram.



Each species of plant present on dune 1 was recorded along with the total number of each species of plant present. This was repeated for dunes 2, 3 and 4 and the results are shown in the table.

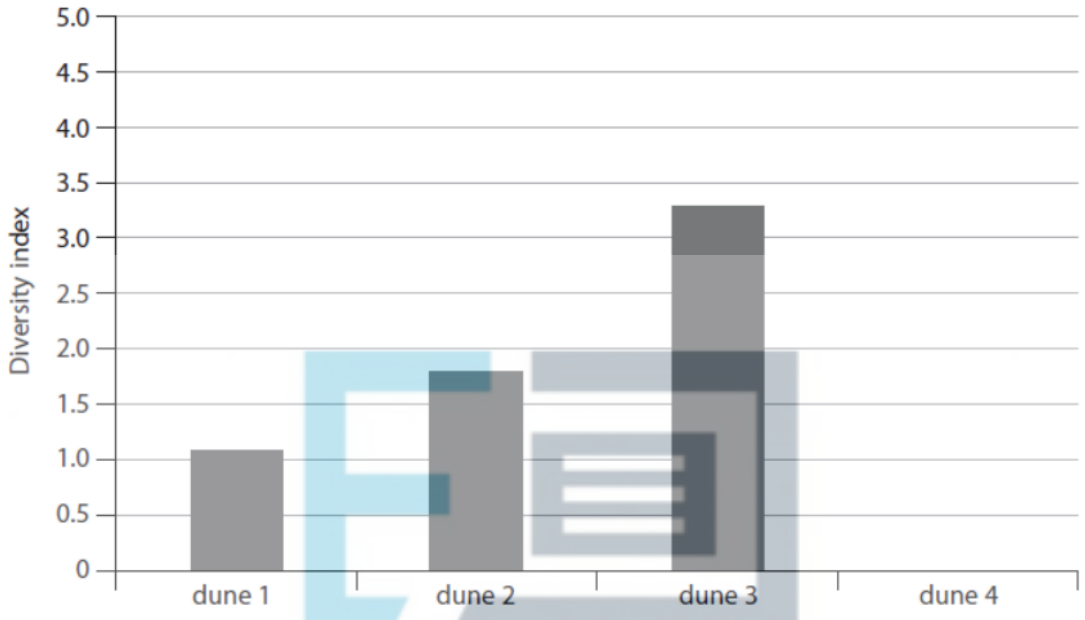
Plant species	Number of each plant species present			
	dune 1	dune 2	dune 3	dune 4
A	169	9	0	0
B	5	123	19	0
C	0	0	126	182
D	1	44	0	0
E	0	0	5	2
F	0	0	20	10
G	0	0	86	35
H	0	0	0	62
I	0	0	32	17
J	0	0	0	119

(i) The diversity index was calculated for dunes 1, 2 and 3 using this equation.

$$\text{Diversity index } (D) = \frac{N(N-1)}{\Sigma n(n-1)}$$

Where N is the total number of all individuals of all species in each dune. Use the table and diversity index equation to calculate the diversity index for dune 4.

Plot your answer on the bar chart.



(3)

(ii) Explain how the data demonstrate the process of succession.

(5)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

Q17.

A biodiversity hotspot is a region that is both highly diverse and threatened with destruction.

Biodiversity hotspots have at least 1500 endemic plant species.

These hotspots have lost at least 70% of their natural vegetation.

Explain how protection of these hotspots can affect global biodiversity.

(2)

.....

.....

.....

.....

.....

.....

.....

(Total for question = 2 marks)

Q18.

Biofuels are being developed to reduce the effect of greenhouse gases on global warming. (a) The list below shows some of the gases found in the atmosphere:

- carbon dioxide
- helium
- methane
- nitrogen
- oxygen

Place a cross ☐ in the box next to the number of greenhouse gases in this list.

(1)

☐ **A** 1

☐ **B** 2

☐ **C** 3

☐ **D** 4

(b) Biofuels are produced from crop plants.

Bioethanols are produced from carbohydrates, such as corn starch and sugar.
Biodiesels are produced from lipids, such as soybean oil and rapeseed oil. (i)
Describe the structure of lipids.

(2)

.....

.....

.....

.....

.....

.....

(ii) The table below gives some information about the **production** of biofuels from four different crop plants.

Crop plant	Carbon dioxide emissions from the production of biofuels / kg per MJ of energy produced	Level of resources used in production of biofuels		
		water	fertilisers	pesticides
Corn	81 to 85	High	High	High
Sugar cane	4 to 12	Medium to low	High	Medium
Soy	49	High	Low to medium	Medium
Rape	37	High	Medium	Medium

Using the information in the table, discuss the advantages of producing biodiesels instead of bioethanols.

(3)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(iii) Fertilisers contain inorganic ions. Name **three** inorganic ions that could be contained in the fertilisers and explain how these would improve the yield of the crop plants.

(4)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(Total for question = 10 marks)

Q19.

*Biological farming aims to reduce the use of fertilisers to add minerals to the soil. The following is some information on biological farming.

- Biological farming makes use of products containing fungi that can be added to soil to improve soil life.
- Soil life is essential for converting nutrients into a plant-available form.
- Fungi form a network around the roots of plants to trap water and aid absorption of mineral ions.
- Some fungi provide protection from pathogens.

Devise a procedure, using wheat seedlings, to compare the effects of a biological farming product with the use of a chemical fertiliser on the growth of plants.

(Total for question = 6 marks)

Q20.

A biodiversity hotspot is a region that is both highly diverse and threatened with destruction.
Biodiversity can be measured by the number of

(1)

- **A** different genes in a population.
- **B** different species in a habitat.
- **C** homozygotes in a habitat.
- **D** individuals in a population.

(Total for question = 1 mark)

Q21.

Forests are important habitats.

The effect of cutting down trees on the number of bird species observed in two different forest habitats was investigated.

(i) Give two biotic factors, other than cutting down trees, that could affect the number of bird species observed in a forest.

(2)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(ii) Some of the results of the investigation are shown in the table.

Forest	Number of bird species in areas of the forest where no trees are cut down	Number of bird species in areas of the forest where some trees are cut down
A	35	19
B	16	10

Calculate the Chi-squared value (χ^2) for forest B using the formula shown.

$$\chi^2 = \sum \frac{(O - E)^2}{E}$$

(3)

Answer .....

(iii) The table gives some critical values for the Chi-squared test.

Probability level	Critical value
0.05	3.84
0.01	6.64
0.001	10.83

The Chi-squared value for forest A is 4.74.

Deduce the effect of some trees being cut down on the number of species of birds in these two forests.

(2)

.....

.....

.....

.....

.....

.....

.....

.....

(Total for question = 7 marks)

Q22.

The photograph shows an orangutan. These animals inhabit the forests of Borneo and Sumatra.

They are critically endangered, largely due to habitat loss and hunting.

Managed breeding programmes in zoos are an important factor in the conservation of the orangutan.

Explain how breeding programmes in zoos maintain the genetic diversity of captive populations. **(3)**

.....

.....

.....

.....

.....

.....

.....

.....

(Total for question = 3 marks)

Q23.

All mammals have an internal skeleton that includes bone and cartilage. Bones contain calcium ions.

In humans, calcium ions are important for structure as part of bone material. These ions are also involved in physiological processes in soft tissue. Soft tissue is non-bony material.

The table shows some data relating to humans.

mean mass of an adult	80 kg
mean percentage of body mass that is bone	4%
mean mass of calcium ions per adult	1000 g
mean percentage of calcium ions present in soft tissue	1%

(i) Calculate the calcium ion concentration in the soft tissue of a human.

(3)

..... μg g^{-1}

*(ii) Calcium ions are also found in the tissue of plants.

The calcium ion concentration in one species of plant has been measured. It was found to be 170 μg g^{-1} of plant tissue.

A student made the conclusion that:

Calcium ions are more important in the tissue of plants than in animals.

Evaluate this conclusion.

(6)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(Total for question = 9 marks)

Q24.

Cystic fibrosis is a genetically inherited condition.

A couple who are both carriers for the condition have a 25% chance of having a baby with cystic fibrosis. In the UK, 1 in 2500 babies born have cystic fibrosis.

Use the Hardy-Weinberg equation to calculate the probability of babies born in the UK being carriers for cystic fibrosis.

(3)

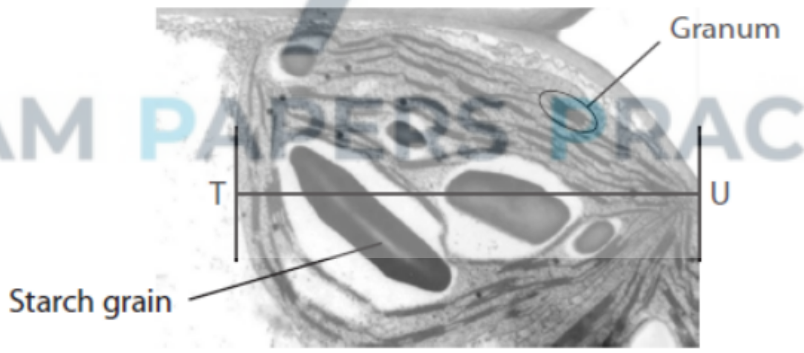
Answer .....

(Total for question = 3 marks)

Q25.

Photosynthesis is a process that occurs in all green plants.

The electron micrograph shows part of a chloroplast in a plant cell.



(i) The labelled starch grain in the chloroplast is 2.2 μm long.

Calculate the width of this chloroplast between T and U.

(2)

..... μm

(ii) Explain the relationship between the structure and functions of a granum in photosynthesis.

(3)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(Total for question = 5 marks)

Q26.

(i) A study compared the diversity of species at different places on a shore. On the upper shore the following data were obtained.

Species	Number of individuals found
Pelvetia canaliculata	10
Enteromorpha sp.	3
Patella vulgata	3
Littorina littorea	15
Gibbula sp.	14
Lichens	15

Calculate an index of diversity (*D*) for this site using the formula below.

(3)

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

n = total number of organisms of a particular species

N = total number of organisms of all species

Answer .....

(ii) On the middle shore the index was found to be 7.74 with a total individual count of 37.

Comment on the relationship between diversity and the total number of individuals on these two parts of the shore.

(2)

.....

.....

.....

.....

(Total for question = 5 marks)

Q27.

Answer the question with a cross in the box you think is correct ☐. If you change your mind about an answer, put a line through the box ☐ and then mark your new answer with a cross ☐.

Farmers grow wheat plants to produce grain that is used to make flour. Farmers can use modern technology to monitor the mass and the moisture content of the grain in a field. Wheat can be sold at a higher price when it has a lower moisture content.

The table shows some data recorded from a field of wheat.

Plot number	Moisture content of grains (%)	Mass of wheat grains / tonnes per Ha
1	0.57	0.759
2	0.58	0.523
3	0.67	4.243
4	0.94	1.954
5	1.64	1.417
6	1.93	1.170
7	2.27	1.321
8	2.53	6.289
9	4.96	3.809
10	10.36	3.404
mean		2.489

(i) Which of the following describes the relationship between the mass of wheat grain and the moisture content of the wheat grain?

(1)

- **A** inverse correlation
- **B** negative correlation
- **C** no correlation
- **D** positive correlation

(ii) Calculate the standard deviation for the mass of wheat using the formula

$$s = \sqrt{\frac{\Sigma(x - \bar{x})^2}{n - 1}}$$

(3)

Answer .....

(Total for question = 4 marks)

Q28.

All known organisms can be placed into one of the three domains of life.

The table shows some information about the three different domains.

Feature	Archaea	Bacteria	Eukaryota
DNA is circular	Yes	Yes	No
DNA is single-stranded	No	.....	No
Growth inhibited by the antibiotic streptomycin	No	Yes	No
Name of the link between fatty acids and glycerol in lipids	Ether	Ester	Ester
Presence of cell wall	Some	Yes	.....
Methionine required for starting protein synthesis	Yes	No	Yes
Transcription factors required for transcription	Yes	No	Yes

Explain how the information in the table can be used to show that the Archaea are more closely related to the Eukaryota than to the Bacteria.

(3)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(Total for question = 3 marks)

Q29.

Ebola virus disease (EVD) is a rare and deadly disease most commonly found in Africa. Following a severe outbreak in 2014, in which 11 000 people died, work has been underway to develop a vaccine.

The vaccine is still undergoing clinical trials, but was given approval for use in recent Ebola outbreaks.

(i) Describe how clinical trials of a vaccine would be conducted.

(3)

.....
.....
.....
.....
.....
.....
.....

(ii) The Ebola vaccine was given to health workers and immediate family of those with the disease.

Justify the use of this vaccine, even though the clinical trials had not been completed.

(4)

.....
.....
.....
.....
.....
.....
.....
.....
.....
.....

.....

.....

.....

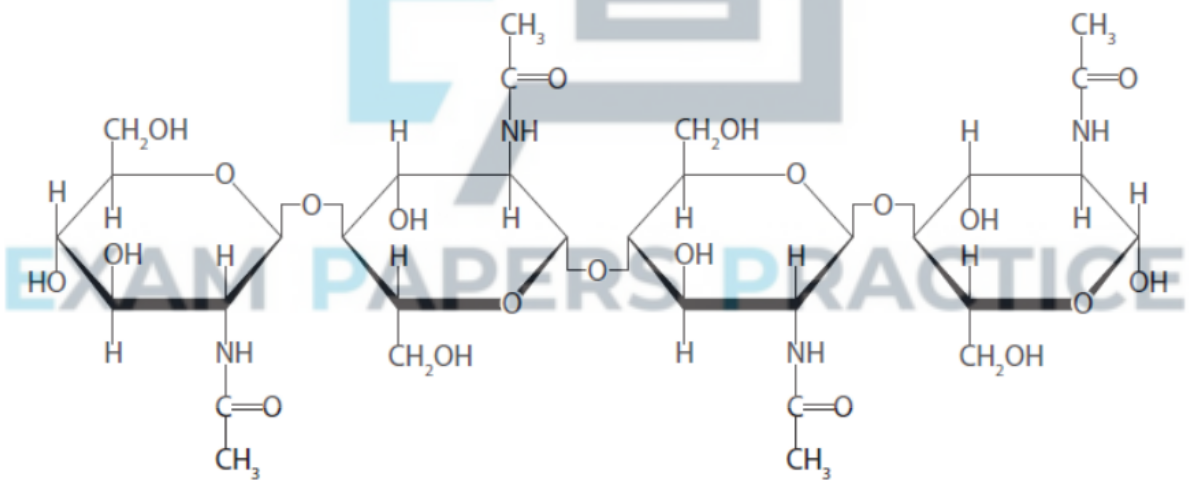
.....

.....

(Total for question = 7 marks)

Q30.

The diagram shows part of a molecule of chitin, a modified polysaccharide found in fungal cell walls.



Compare and contrast the structure of chitin with that of a cellulose molecule.

(3)

(Total for question = 3 marks)