Questions

Q1.

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.

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(Total for question = 2 marks)

Q2.

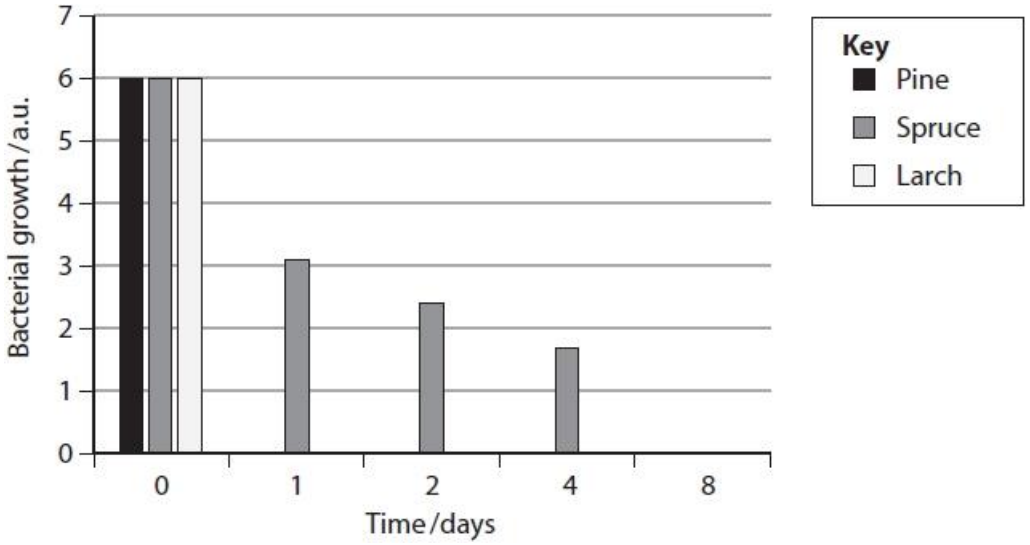
Many plants produce chemicals that have antimicrobial properties.

The suitability of using wood from three types of tree to make kitchen chopping boards was investigated.

In this investigation, 50 cm^3 of a bacterial culture was added to 100 g of wood chippings from each of three types of tree.

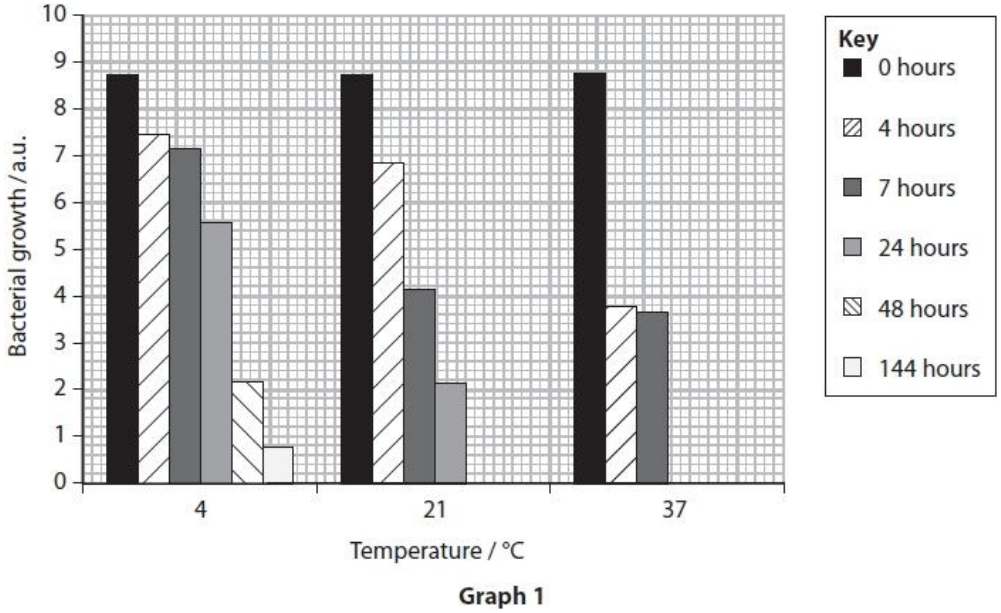
The growth of bacteria was measured at the start (Day 0), and then after 1, 2, 4 and 8 days.

The results are shown in the graph.



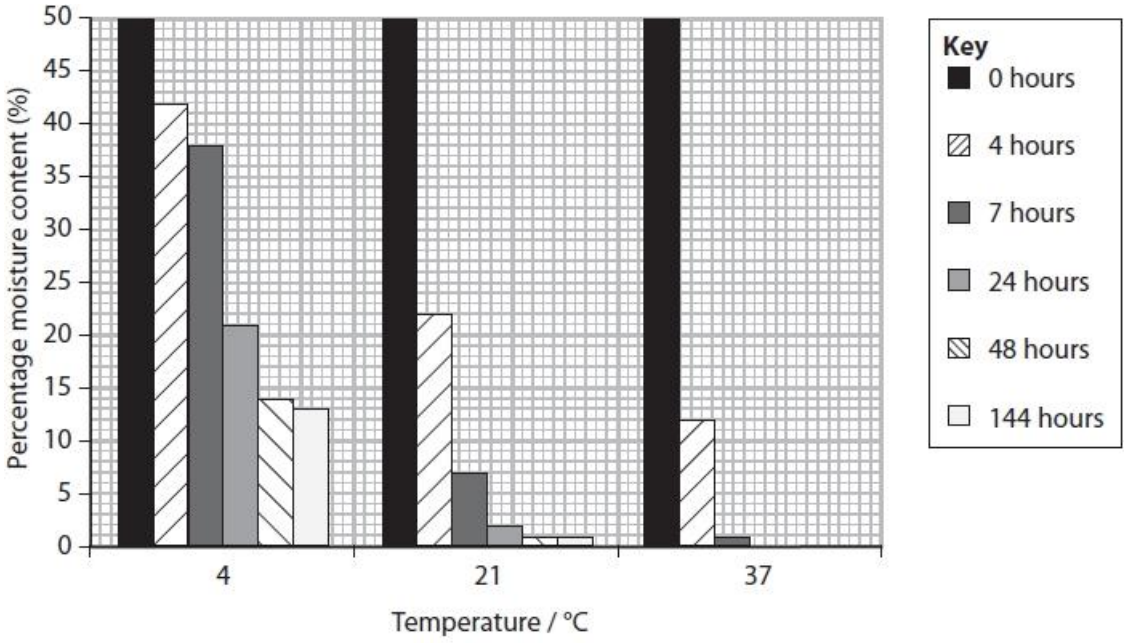
Temperature and the moisture content of wood from pine trees can affect bacterial growth.

Graph 1 shows the effect of temperature on bacterial growth.



Graph 1

Graph 2 shows the effect of temperature on the moisture content of wood.



Graph 2

Analyse the data to deduce the effects of these two factors on bacterial growth on wood from pine trees.

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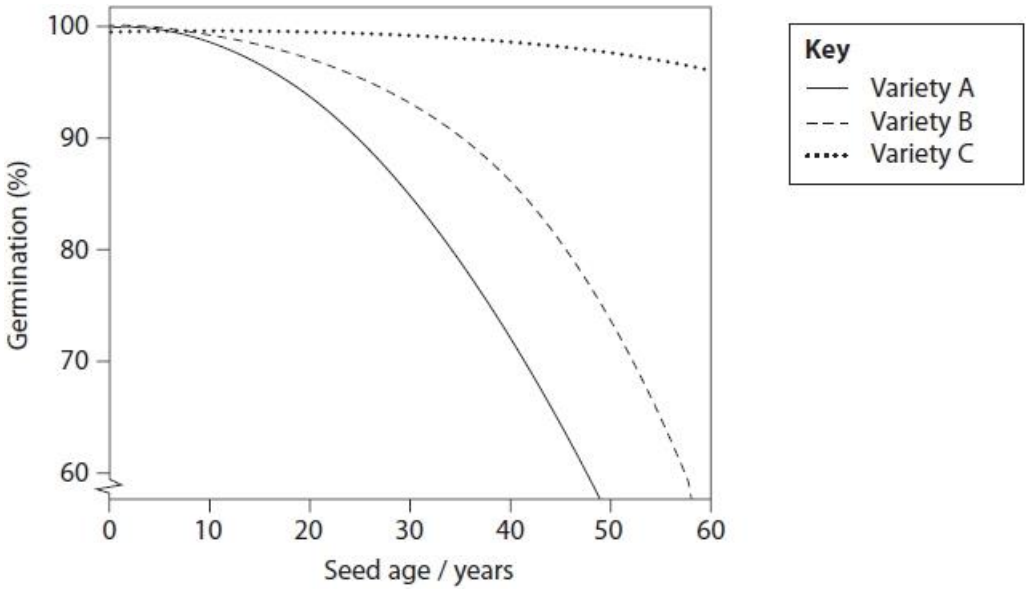
(Total for question = 4 marks)

Q3.

Svalbard Global Seed Vault (SGSV) is a seed bank. It keeps seeds from almost 4000 species of plants, focussing on food crops such as wheat, rice and maize.

The purpose of SGSV is to store seeds for use in the future, 50 or more years from now.

Seeds from three varieties of maize were tested to see the effects of long periods of storage. The results of these tests are shown in the graph.



Explain how SGSV could make use of these results.

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(Total for question = 3 marks)

Q4.

Bald's Leechbook was written in the 9th Century. This book contains details of medical treatments used over 1000 years ago.

The recipe for a 'salve', used to treat infections, is shown in the photograph.

Scientists followed the recipe to make this salve and tested it in the laboratory.

They found that the salve was very effective against *Staphylococcus aureus*. This bacterium commonly causes infections in humans.

Describe **two** aseptic techniques that should be used when working safely with bacteria.

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(Total for question = 2 marks)

Q5.

Bald's Leechbook was written in the 9th Century. This book contains details of medical treatments used over 1000 years ago.

The recipe for a 'salve', used to treat infections, is shown in the photograph.

Scientists followed the recipe to make this salve and tested it in the laboratory.

They found that the salve was very effective against *Staphylococcus aureus*. This bacterium commonly causes infections in humans.

The salve was also tested on mice.

These mice had skin wounds infected with *S. aureus*. The salve was very effective in treating these infections.

(i) Explain why some bacteria can grow rapidly in skin wounds.

(3)

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(ii) *S. aureus* can cause infections which are difficult to treat in humans.

Describe how scientists, after testing the salve on mice, could test whether the salve is an appropriate treatment for humans with wounds infected with *S. aureus*.

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(Total for question = 7 marks)

Q6.

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.

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(Total for question = 3 marks)

Q7.

Extracts from four different plants were added on separate small paper discs to agar plates containing *E. coli* bacteria.

After 48 hours, the zone of inhibition around each extract was measured.

Extract	Mean diameter of zone of inhibition / mm	Range
P	18.5	± 1.07
Q	23.5	± 0.97
R	22.2	± 0.58
S	22.9	± 1.28

(i) Calculate the area of the largest zone of inhibition for extract S.

(3)

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(ii) Comment on the antimicrobial properties of these four plant extracts.

(3)

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(Total for question = 6 marks)

Q8.

Medicinal drugs undergo clinical trials before they are licensed to be used.

In January 2016, a clinical trial of a different drug involved 128 healthy volunteers aged 18 to 55. In this trial, different doses of the drug were given to 90 of these volunteers and the others were given a placebo.

Six people, who were given the drug, became ill and had to be treated in hospital.

(i) Explain why healthy volunteers were given different doses of the drug or a placebo.

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(ii) The trial tested increasing the dose of the drug. The six people who fell ill were the first to receive higher doses over the course of several days.

Which of the following is the correct ratio of those who took the drug to those who fell ill?

(1)

- ☒ **A** 14 :1
- ☒ **B** 15 :1
- ☒ **C** 18 :1
- ☒ **D** 21 :1

(iii) Compare and contrast this drug testing protocol with that used by William Withering when he tested digitalis soup.

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(Total for question = 6 marks)

Q9.

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)

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(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.

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(Total for question = 7 marks)

Q10.

Svalbard Global Seed Vault (SGSV) is a seed bank. It keeps seeds from almost 4000 species of plants, focussing on food crops such as wheat, rice and maize.

State suitable conditions for keeping seeds in a seed bank.

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(Total for question = 2 marks)

Q11.

Anabolic steroids and testosterone have been used as performance-enhancing drugs by some athletes. These drugs can increase muscle mass and strength.

An investigation was carried out to assess the effect of doses of testosterone on muscle size.

A group of men was randomised into four groups: A, B, C and D. Groups A and B were given a placebo. Groups C and D were both given doses of testosterone. Groups A and C had no exercise training. Groups B and D were given exercise training.

The cross-sectional area of the triceps muscle of each individual was measured at the start of the investigation and after 10 weeks.

The results are shown in the table.

Muscle	Mean cross-sectional area of muscle / mm^2 ± SD			
	Group A Placebo without exercise	Group B Placebo with exercise	Group C Testosterone without exercise	Group D Testosterone with exercise
Triceps – at the start	3621 ± 213	4052 ± 262	3579 ± 260	3483 ± 217
Triceps after 10 weeks	3539 ± 226	4109 ± 230	4003 ± 229	3984 ± 239

(i) Deduce the effect of testosterone on the size of the triceps muscle.

(2)

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(ii) The purpose of the placebo is to

(1)

☒ **A** increase the accuracy of the measurements

☒ **B** increase the reproducibility of the data

☒ **C** show that exercise has an effect

☒ **D** show that testosterone has an effect

(Total for question = 3 marks)

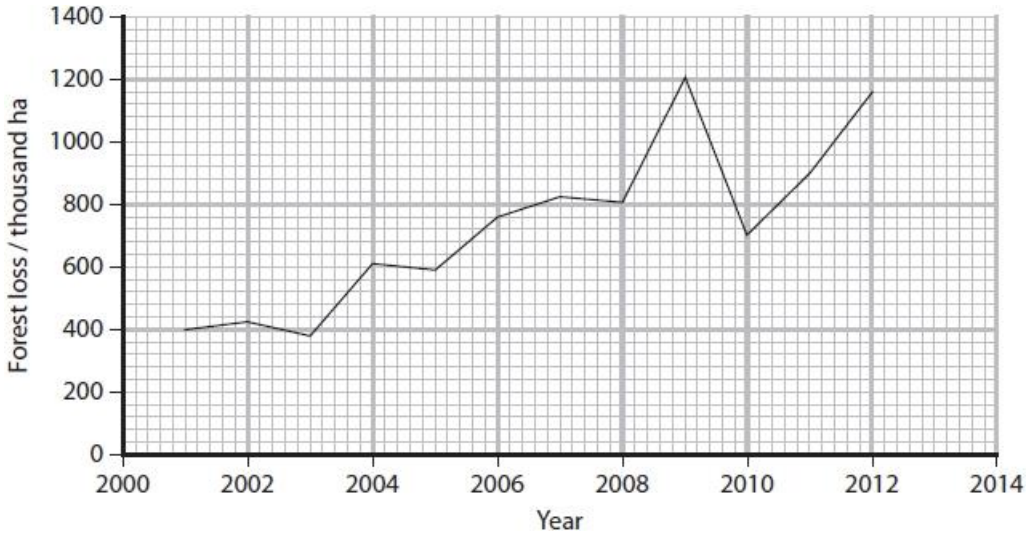
Q12.

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

The orangutan population in Borneo decreased by 60% between 1950 and 2010.

This has been linked to loss of habitat. Deforestation has resulted in the loss of natural habitat.

The graph shows the area of forest loss in Borneo from 2001 to 2012.



(2)

(i) Calculate the mean rate at which forest was lost between 2010 and 2012.

Answer .....

*(ii) Land use has changed over time in Borneo, with areas of forest being removed due to logging. The land may then be used for planting oil palms, which are not a suitable habitat for orangutans.

The following comments refer to other issues concerning the conservation of orangutans in Borneo.

- Over the past 100 years, 80% of suitable habitat for orangutans has been lost.
- Only 2% of the remaining forest suitable as orangutan habitat is protected.
- From 1999 to 2015, the orangutan population decreased by 50%.
- Captive-bred orangutans may spread human diseases into wild populations.
- When captive-bred orangutans are released, their offspring often die young because the females have not learnt parenting behaviour from older individuals.
- Large numbers of orangutans are hunted in Borneo, even though they are a protected animal.

It has been stated that habitat protection is more important than captive breeding programmes for the conservation of orangutans in Borneo.

Evaluate this statement.

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(Total for question = 8 marks)

Q13.

Sterile nutrient agar is a medium used for growing microbes.

Describe how aseptic techniques are used when handling bacterial cultures.

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(Total for question = 3 marks)

Q14.

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 ☒.

William Withering tested his digitalis 'soup' by an early form of drug testing.

Withering reported that his first patient found that the digitalis

"made him very sick, the sickness recurring at intervals for several days."

Modern drug testing protocols include four stages.

(i) In modern drug testing protocols, the first stage that patients with an illness are involved is

(1)

- ☐ **A** preclinical trials
- ☐ **B** phase 1
- ☐ **C** phase 2
- ☐ **D** phase 3

(ii) In modern drug testing protocols, side effects such as nausea will first be identified in healthy volunteers during

(1)

- ☐ **A** preclinical trials
- ☐ **B** phase 1
- ☐ **C** phase 2
- ☐ **D** phase 3

(Total for question = 2 marks)

Q15.

William Withering tested his digitalis 'soup' by an early form of drug testing.

Withering reported that his first patient found that the digitalis

"made him very sick, the sickness recurring at intervals for several days."

Modern drug testing protocols include four stages.

Modern drug testing protocols must ensure that new drugs are effective at treating patients.

Explain the role that a placebo and a double blind trial have in producing valid conclusions.

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Placebo

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Double blind trial

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(Total for question = 4 marks)

Q16.

William Withering tested his digitalis 'soup' by an early form of drug testing.

Withering reported that his first patient found that the digitalis

"made him very sick, the sickness recurring at intervals for several days."

Modern drug testing protocols include four stages.

Drug trials may last 15 years before the drug is licensed. The results of each stage are analysed before the drug trial can progress.

The results of a trial of a drug for lowering blood pressure are shown in the table.

Mean reduction in blood pressure / mmHg	
People given the drug	People given a placebo
7 ± 12	4 ± 8

Testing of this drug did not proceed beyond this stage.

Deduce why the drug trial was stopped at this stage.

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(Total for question = 3 marks)

Q17.

The effects of these plant extracts were tested on pathogenic bacteria. It was found that each extract had an effect on its own, but the effect was greater when used together.

Devise a procedure that scientists may have used to measure the effects of these extracts on pathogenic bacteria.

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(Total for question = 4 marks)

Q18.

Seed banks store seeds to conserve different varieties of plants.

Seeds are stored for long periods of time in conditions that allow them to be germinated when required.

An investigation was carried out to study the effect of storage time on wheat seeds of two different varieties.

Wheat seeds of one variety, P, were collected and divided into six groups, each with the same number of seeds. Each group of seeds was stored in an atmosphere of 80% humidity at a temperature of 42 °C.

Each group was stored in these conditions for different lengths of time. One group of seeds was germinated immediately after collection. This was the control group.

After storage, the seeds were planted in suitable conditions to allow germination. The number of seeds that germinated was found and the mean percentage germination calculated.

This was repeated using wheat seeds of a different variety, Q.

All other variables were kept constant.

The results are shown in the table.

Storage time / hours	Mean percentage germination (%)	
	Wheat variety P	Wheat variety Q
0 (control)	97	99
24	96	99
48	95	98
72	94	81
96	60	66
120	57	63

(i) Describe the effect of storage time on the germination of seeds for these two varieties of wheat.

(3)

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(ii) Explain how the results for the control were useful in this investigation.

(2)

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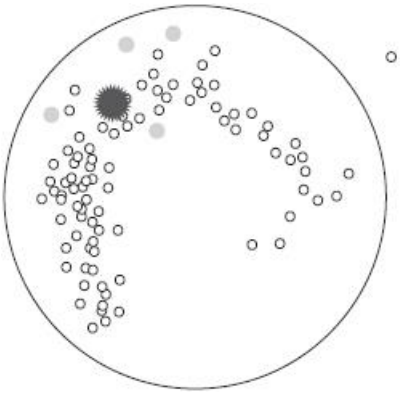
(Total for question = 5 marks)

Q19.

The diagram shows an agar plate after inoculation with a single bacterial culture.
This plate was incubated at 25 °C.

The aseptic technique was not successful.



(i) Explain how the appearance of the plate shows that the aseptic technique was not successful.

(2)

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(ii) Explain why the agar plate was incubated at 25 °C.

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(Total for question = 4 marks)

Q20.

Plant biodiversity in the Boyacá region of Colombia is amongst the highest in the world. Many of these plants have potential medical uses.

Natural vegetation is being cleared to enable the rearing of cattle.

The Royal Botanic Gardens at Kew has begun a project to conserve plant species from Boyacá, Colombia.

Seed banks preserve seeds by drying them. Predictions from initial research suggest that seeds from 80% of flora in Boyacá will survive the drying process.

(i) Explain the advantages of drying seeds before storage.

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(ii) Justify the benefits of conserving seeds from Boyacá.

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(Total for question = 5 marks)

Q21.

Sepsis is a bacterial infection in the bloodstream. Sepsis can cause tissue death in limbs. This may require parts of a limb to be removed (amputation).

Open wounds can become infected by bacteria, leading to sepsis.

Explain why bacteria are able to multiply in the bloodstream when they enter the body.

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(Total for question = 3 marks)

Q22.

Bamboo plants produce fibres that have a high tensile strength.

The photograph shows a coffee cup made from bamboo fibres.

Explain why the use of bamboo fibres to make coffee cups is sustainable.

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(Total for question = 2 marks)

Q23.

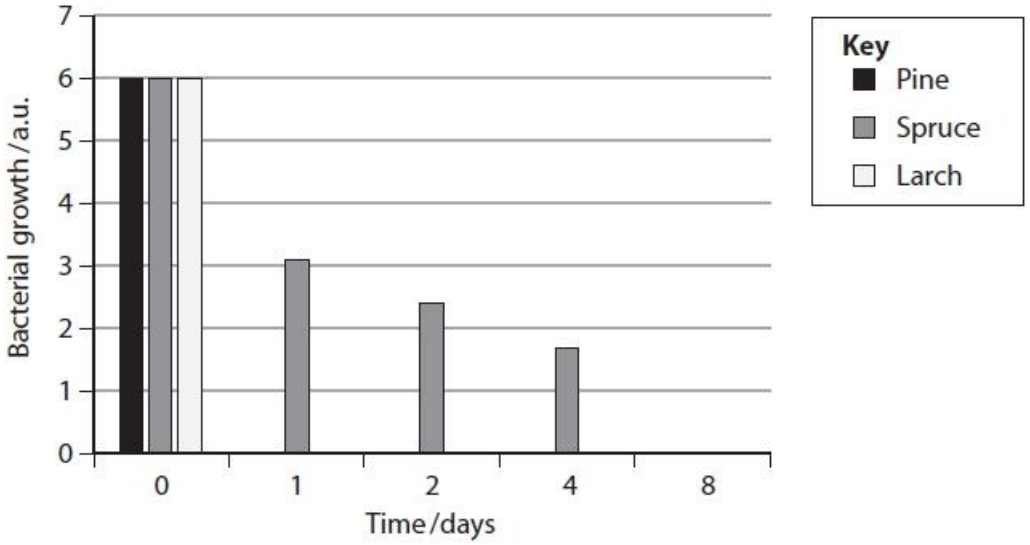
Many plants produce chemicals that have antimicrobial properties.

The suitability of using wood from three types of tree to make kitchen chopping boards was investigated.

In this investigation, 50 cm^3 of a bacterial culture was added to 100 g of wood chippings from each of three types of tree.

The growth of bacteria was measured at the start (Day 0), and then after 1, 2, 4 and 8 days.

The results are shown in the graph.



(i) Describe the antimicrobial properties of these three types of wood.

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(ii) It was concluded from this investigation that spruce caused bacterial growth to decrease at a constant rate after the first day.

Criticise this conclusion.

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(iii) Explain how this investigation could be improved to provide additional data to determine whether pine or larch have greater antimicrobial properties.

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(Total for question = 8 marks)

Q24.

Svalbard Global Seed Vault (SGSV) is a seed bank. It keeps seeds from almost 4000 species of plants, focussing on food crops such as wheat, rice and maize.

SGSV keeps seeds from more than 865 000 varieties of plant, including 200 000 varieties of wheat and rice. Some of these varieties are rare or extinct in the wild.

Since 2004, more than 410 million dollars have been spent on SGSV and other seed banks around the world.

However, it is estimated that 75% of global crop diversity is not stored in international seed banks.

Critics argue that many crop varieties stored in SGSV are not actually used for food, and that the money would be better spent supporting farmers who are growing food crops.

Justify the continued funding of SGSV.

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(Total for question = 3 marks)

Q25.

Wildlife conservation can involve keeping animals in zoos as well as protecting habitats.

Describe the roles that zoos play in animal conservation.

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(Total for question = 3 marks)

Q26.

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

Phospholipase in the venom of wasps can cause allergic reactions.
Phospholipase can affect the Golgi apparatus in cells.

(i) Give two functions of the Golgi apparatus.

(2)

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(ii) A three-phase protocol will be used when developing the phospholipase inhibitor as a new drug.

Explain the purpose of each phase of this protocol for a phospholipase inhibitor.

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(Total for question = 5 marks)

Q27.

Plant-based products provide a sustainable alternative to oil-based plastics.

In a single year, over 7600 million single-use plastic bags were given to customers by supermarkets in England.

The mean mass of each bag was 5.5 g.

Calculate the total mass in kilograms of plastic bags given out to customers.

Give your answer in standard form.

(2)

Answer ..... kg

(Total for question = 2 marks)

Q28.

Many areas of South Africa have been converted to game reserves where native species have been reintroduced.

Within each game reserve, populations of carnivores are controlled.

The table shows data for four game reserves.

Game reserve	Area / ha	Ideal population size				
		Lion	Leopard	Cheetah	Wild dog	Spotted hyena
Schotia	1 600	6	6	0	6	0
Pumba	6 500	11	4	5	0	11
Kwandwe	19 978	10	4	15	12	0
Kariega	50 000	8	0	0	0	0

(i) Calculate the difference in the number of hectares (ha) per lion in Kwandwe compared with Kariega.

(3)

Answer .....

(ii) Evaluate the statement that Pumba Game Reserve has a more successful reintroduction programme than the one at Schotia Game Reserve.

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(Total for question = 7 marks)

Q29.

Conservation programmes are used to save endangered species.

The Scottish wildcat, shown in the photograph, is a subspecies of the European wildcat, *Felis silvestris silvestris*.

The Cairngorms Wildcat Project estimates that there are 150 breeding pairs left, but the Scottish Wildcat Association believes that only 35 cats remain.

A conservation group proposed that a captive breeding programme, and the relocation of Scottish wildcats, would be necessary to prevent extinction.

Describe how the proposed conservation programme could prevent the Scottish wildcat from becoming extinct.

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(Total for question = 4 marks)

Q30.

A number of seed banks have been set up around the world.

When a seed bank receives new seeds, it processes them in several ways.
The processes can include the following stages:

- washing the seeds with disinfectant
- allowing the seeds to dry.

Explain the advantages of these two stages.

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(Total for question = 3 marks)

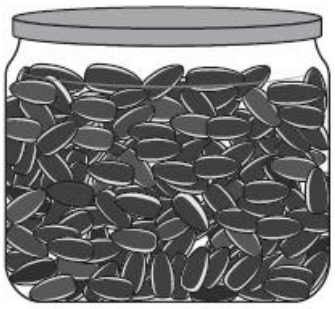
Q31.

A number of seed banks have been set up around the world.

The processed seeds are stored at minus 20 °C. At intervals, samples of seeds are removed from storage and tested for viability.

If at least 75% of the seeds in the sample germinate, the remaining seeds are described as viable.

The diagram shows a container with many seeds in it.



Sunflower Seeds
mass of 1000 seeds = 50 g

A sample of 3 g of seeds was removed from this container. These seeds were given optimum conditions for germination.

However, only 48 seeds germinated.

Determine whether the remaining seeds in the container are viable or not.

(3)

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(Total for question = 3 marks)

Q32.

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 ☒.

In 1988, the Kariega Game Reserve in South Africa was farmland.

In 1989, the following species of antelope were reintroduced: impala, blesbok, cape grysbok, bushbuck, duiker, reedbuck and springbok.

The reintroduction of springbok was unsuccessful.

The percentage of species reintroduced successfully to this area was

(1)

- ☐ **A** 14%
- ☐ **B** 15%
- ☐ **C** 85%
- ☐ **D** 86%

(Total for question = 1 mark)

Q33.

In 1988, the Kariega Game Reserve in South Africa was farmland.

In 1989, the following species of antelope were reintroduced: impala, blesbok, cape grysbok, bushbuck, duiker, reedbuck and springbok.

The reintroduction of springbok was unsuccessful.

In May 2004, two male and two female lions were released into this game reserve.

Explain why these lions were not released into this game reserve until 2004.

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(Total for question = 2 marks)

Q34.

Plant-based products provide a sustainable alternative to oil-based plastics.

A sustainable alternative is a plastic material that contains more than 30% plant-based polymers.

Potato starch is a source of these polymers.

(i) Describe the structure of starch.

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(ii) Explain why this plastic material is only partially sustainable.

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(Total for question = 5 marks)

Q35.

The stems of plants contain tissues involved in transport and in support.

Fibres can be extracted from the stems of nettle plants and used to make clothing.

Explain why the production of fibres from nettles is more sustainable than fibres produced from crude oil.

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(Total for question = 3 marks)

Q36.

Textiles are often made from plant fibres. The use of plant fibres is more sustainable than the use of synthetic fibres made from fossil fuels.

Give reasons why the use of fibres from plants is sustainable.

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(Total for question = 2 marks)

Q37.

Anabolic steroids stimulate muscle development.

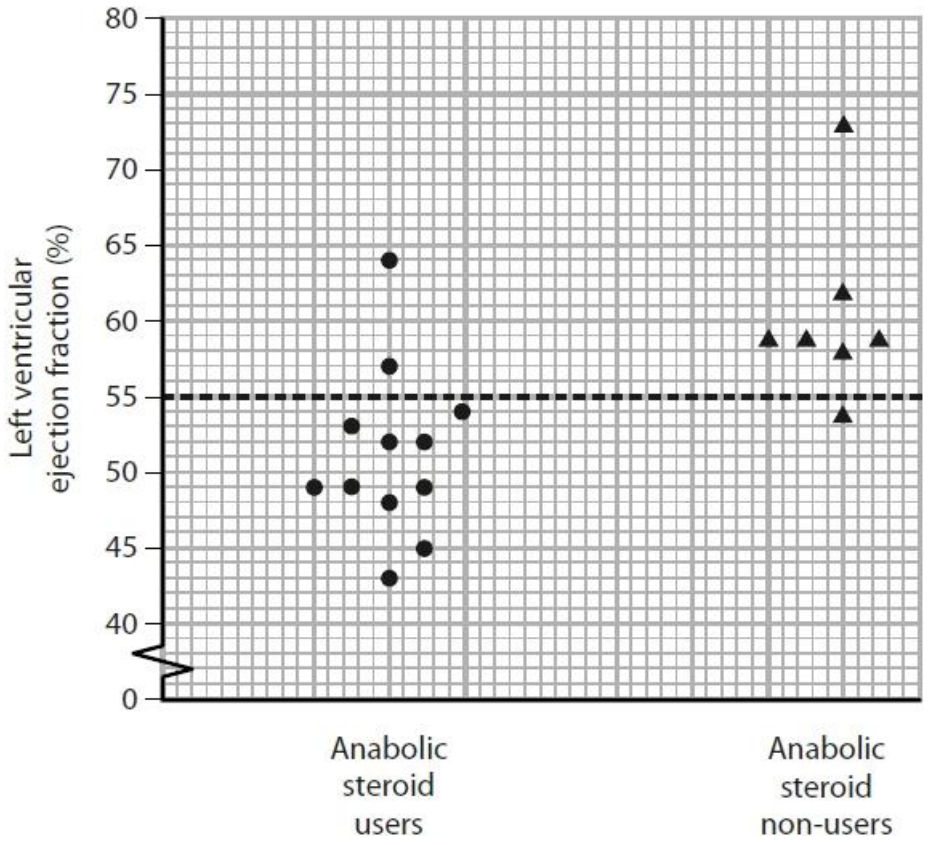
Some athletes use anabolic steroids in an attempt to improve their performance.

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)

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(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)

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(Total for question = 5 marks)

Q38.

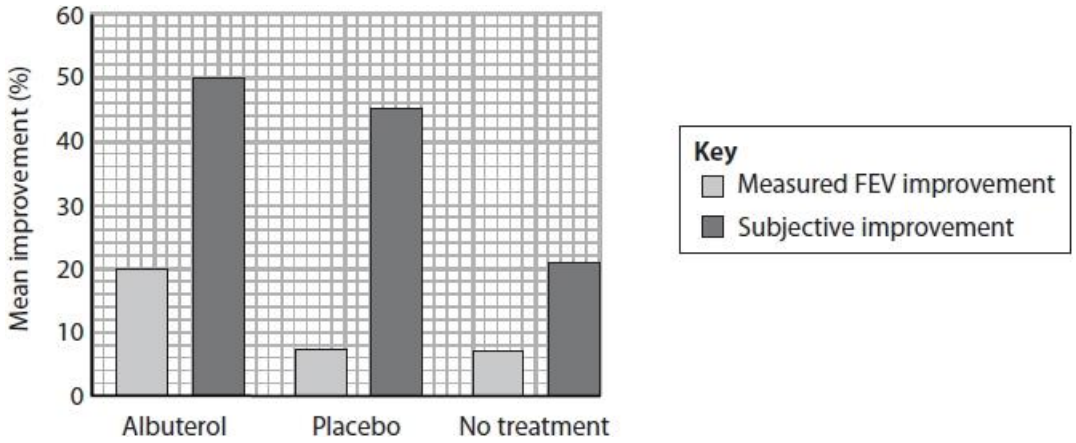
Medicinal drugs undergo clinical trials before they are licensed to be used.

Albuterol is a drug used to reduce the symptoms of asthma.

In a clinical trial, people with asthma were given either Albuterol, a placebo or no treatment.

Measured improvement (FEV improvement) can be used to indicate the effectiveness of the treatment in reducing the symptoms of asthma. FEV is forced expiratory volume. Asthma reduces FEV.

The people in the trial were also asked to describe their improvement and this was recorded as 'subjective improvement'.



Comment on the measured improvement (FEV improvement) and subjective improvement for the different treatments.

(3)

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(Total for question = 3 marks)

Mark Scheme

Q1.

Question Number	Answer	Additional Guidance	Mark
	A description that makes reference to the following: • Advantage – being sustainable / {can decompose / is biodegradable} **(1)** • Disadvantage – less strong / {can decompose/ is biodegradable } **(1)**	Biodegradable / can decompose must be qualified if given as both an advantage and a disadvantage ALLOW renewable or more plants can be grown	**(2)**

Q2.

Question Number	Answer	Additional Guidance	Mark
	An answer which makes reference to the following: • (Figure 1 shows) bacterial growth decreases faster at higher temperatures (1) • (therefore) antimicrobial properties (of pine) more active at higher temperatures (1) • (Figure 2 shows) moisture content decreases at higher temperatures (1) • loss of moisture could reduce bacterial growth (1)	ALLOW converse ALLOW converse ALLOW converse ALLOW converse or loss of moisture could cause antimicrobial chemicals to become more concentrated	**(4)**

Q3.

Question Number	Answer	Additional Guidance	Mark
	An explanation making reference to three of the following: • (some) seeds that have been kept for long periods will { not be useful / no longer grow } (1) • different types of seed lose viability at different rates (1) • therefore regular testing is needed (to ensure seeds are still viable) (1) • seeds from the seed bank can be grown to produce fresh seeds (to replace the old seeds) (1)	IGNORE germination ALLOW different seeds last for different lengths of time ALLOW use the results to {estimate / predict} when {testing / replanting} is needed	(3)

Q4.

Question Number	Answer	Additional Guidance	Mark
	A description that makes reference to the following: • one aseptic technique (1) • another aseptic technique (1)	e.g. boiling the culture medium before use { 'flaming' / disinfecting } of the instruments keeping lids off for the minimum time working in { updraught of a flame / a flow hood } disinfecting the bench (before or after working) autoclaving used plates IGNORE: 'sterilising' without a technique handwashing, gloves, etc reference to incubation temperature cross taping of plates	(2)

Q5.

Question Number	Answer	Additional Guidance	Mark
(i)	An explanation making reference to three of the following: • the temperature is warm, increasing the rate of reactions in bacteria (1) • availability of energy source from { tissue / blood } (1) • availability of water for bacterial cell functions (1) • consideration of the role of oxygen (1) EITHER oxygen availability is good, allowing (aerobic) respiration OR oxygen supply is limited, but some bacteria are able to respire anaerobically	ALLOW increasing enzyme activity IGNORE optimum temperature e.g. glucose IGNORE nutrients ALLOW named substance for growth e.g amino acids	(3)

Question Number	Answer	Additional Guidance	Mark
(ii)	A description that makes reference to **four** of the following: • salve must be applied to healthy humans (1) • treat one group of patients with the salve and another group with an existing treatment (1) • neither the doctors nor the patients involved in the trial should know which treatment is being used (1) • participants must be monitored for { side effects / adverse reactions } associated with the salve (1) • compare the outcomes of patients treated with the salve and the control group (1)	ALLOW antibiotics or named antibiotic **NOT a placebo** IGNORE 'double blind' without description	(4)

Q6.

Question Number	Answer	Additional guidance	Mark
	A description that makes reference to three of the following • animals are selected to prevent { breeding between closely related individuals / inbreeding depression } (1) • a stud book is used to { select individuals for mating / keep a record of all breeding events } (1) • exchange of { animals / gametes } between zoos (1)	ALLOW use of studbook to prevent inbreeding	(3)

Q7.

Question Number	Answer	Additional Guidance	Mark
(i)	• maximum diameter for S calculated (1) • calculation of r^2 for S (1) calculation of maximum • area for S (1)	Example of calculation 22.9 + 1.28 = 24.18 $12.09^2 = 146.17$ $\pi \times 12.09^2 = 459.2 / 459$ (mm^2) ECF if maximum diameter not calculated - 2 marks for 412 / 411.9 / 411.87 ALLOW answers where value of π is 3.14{ Correct answer without working gains full marks	(3)

Question Number	Answer	Additional Guidance	Mark
(ii)	An answer that makes reference to the following: • extract P is the least effective (1) • all extracts { inhibit / prevent } growth of bacteria (1) • no significant differences between extracts Q, R and S due to overlap of ranges (1)		(3)

Q8.

Question Number	Answer	Additional Guidance	Mark
(i)	An explanation that makes reference to two of the following: • check for side effects **(1)** • different doses to determine safe dose **(1)** • placebo to make sure that any side effects described were due to the drug **(1)**		(2)

Question Number	Answer	Mark
(ii)	**The only correct answer is B – 15:1** ***A*** *is not correct because incorrect ratio because 90 volunteers were given the drug and 6 became ill* ***C*** *is not correct because incorrect ratio because 90 volunteers were given the drug and 6 became ill* ***D*** *is not correct because incorrect ratio because 90 volunteers were given the drug and 6 became ill*	(1)

Question Number	Answer	Additional Guidance	Mark
(iii)	An explanation that makes reference to the following: • both trials used different doses (to determine safe dose) **(1)** • William Withering did not use healthy volunteers and this drug trial did **(1)** • William Withering did not use a placebo while this trial did **(1)**	ALLOW different concentrations	**(3)**

Q9.

Question Number	Answer	Additional guidance	Mark
(i)	A description that makes reference to three of the following • (small groups of) healthy volunteers are given the vaccine to test for side effects (1) • (healthy volunteers) tested for presence of antibodies to the virus (following vaccination) (1) • a group of people at risk of contracting the disease is given the vaccine (1) • the number of people who develop the viral disease (following vaccination) are monitored (1)		**(3)**

Question Number	Answer	Additional guidance	Mark
(ii)	An answer that makes reference to four of the following • large numbers of people died from the disease (1) • health workers are in close contact with people suffering from the disease (1) • the side effects of the vaccine will not be worse than contracting Ebola(1) • vaccinating immediate family will help to reduce the spread of disease(1) • if health workers were vaccinated they could care for more people (1)	ALLOW disease is (usually) fatal ALLOW health workers and family most likely to be exposed to the virus ALLOW risk from the disease is much greater than the risk from the vaccine	**(4)**

Q10.

Question Number	Answer	Additional Guidance	Mark
	An answer making reference to the following: • cold (1) • dry (1)	ALLOW frozen, low temperature, -20°C (or below) NOT 0°C IGNORE cool ALLOW desiccated, no water, no moisture IGNORE refs to humidity	**(2)**

Q11.

Question Number	Answer	Additional Guidance	Mark
(i)	An answer that makes reference to two of the following: • increase in cross sectional area with testosterone (and not with placebo) • greatest increase with testosterone and exercise • significant difference for { testosterone plus exercise / group D } as the SDs (for start and after 10 weeks) do not overlap	ALLOW increase in size (of triceps muscle)	**(2)**

Question Number	Answer	Mark
(ii)	**D** - show that testosterone has an effect *The only correct answer is **D*** ***A** is incorrect because a placebo does not make measurements more accurate* ***B** is incorrect because placebos do not make data more reproducible* ***C** is incorrect because the placebo does not show that exercise has an effect*	**(1)**

Q12.

Question Number	Answer	Additional guidance	Mark
(i)	• correct calculation of loss of area from 2010 to 2012 (1) • correct calculation of rate with relevant units (1)	<u>Example of calculation</u> 1160 - 700 = 460 $(460 \div 2) \times 1000$ $= 230\,000$ Ha yr^{-1} ALLOW Ha per year Correct answer without working gains full marks ALLOW ECF(1) eg 1160-680=240000 Ha yr^{-1} (1) 1160-690=235000 Ha yr^{-1} (1) 1160-710=225000 Ha yr^{-1} (1) 1160-720=240000 Ha yr^{-1}(1) 220 000 to 240 000 Ha yr^{-1} with no working gains 1 mark	**(2)**

Question number	Answer	Mark
***(ii)**	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. Indicative content Basic information • captive breeding will increase population size • deforestation is reducing the habitat • captive animals will be protected from hunters Evidence of linkages • orangutan numbers are declining and captive breeding will increase population size • as loss of habitat is a major reason for the decline, animals should be released into areas of forest in protected areas • more of the forest needs to be protected to reduce the rate at which habitat is being lost • captive bred animals show behaviour that may make them unable to compete in the wild • loss of habitat would lead to increased competition due to reduced food availability Evidence of sustained scientific reasoning • it is important to restrict passage of disease from humans to the wild population by minimising contact and releasing animals away from wild populations • if deforestation is not reduced – or protected areas increased – there will not be enough habitat left in which to release captive-bred orangutans • judgement on relative importance of captive breeding and habitat protection taking into account rate of deforestation and loss of suitable habitat • releasing animals if there is insufficient habitat could lead to an increased vulnerability to predation and poaching	**(6)**

Level 0	Marks	No awardable content	
Level 1	1-2	Limited scientific judgement made with a focus on mainly just one method, with a few strengths/weaknesses identified. A conclusion may be attempted, demonstrating isolated elements of biological knowledge and understanding but with limited evidence to support the judgement being made.	Captive breeding will increase numbers of orangutans Habitat loss is increasing
Level 2	3-4	A scientific judgement is made through the application of relevant evidence, with strengths and weaknesses of each method identified. A conclusion is made, demonstrating linkages to elements of biological knowledge and understanding, with occasional evidence to support the judgement being made.	Discussion of benefits of both captive breeding and habitat protection. Separate discussions of habitat loss and captive breeding. Linkages made for each aspect but not compared.
Level 3	5-6	A scientific judgement is made which is supported throughout by sustained application of relevant evidence from the analysis and interpretation of the scientific information. A conclusion is made, demonstrating sustained linkages to biological knowledge and understanding with evidence to support the judgement being made.	Conclusion that without habitat protection, captive breeding is limited as there is less suitable habitat in which to release the animals Comparative evaluation of the benefits of habitat protection and captive breeding. Reference made to the data.

Q13.

Question Number	Answer	Additional Guidance	Mark
	A description that makes reference to three of the following: • working near a Bunsen burner (to provide a convection current) (1) • sterilising work surfaces (1) • sterilising equipment with heat (1) • limiting time containers are open (1)	ALLOW using a laminar flow cabinet IGNORE Bunsen flame killing bacteria e.g. flaming of {forceps / bottle necks / inoculating loops} e.g. only partially lifting lids from Petri dishes	**(3)**

Q14.

Question Number	Answer	Mark
(i)	The only correct answer is – **C** phase 2 A is incorrect because no humans are involved in preclinical trials B is incorrect because only healthy volunteers are involved in phase 1 D is incorrect because patients had previously been involved in phase 2	**(1)**

Question Number	Answer	Mark
(ii)	The only correct answer is – **B** phase 1 A is incorrect because no humans are involved in preclinical trials C is incorrect because side effects will have been identified prior to phase 2 D is incorrect because side effects will have been identified prior to phase 3	**(1)**

Q15.

Question Number	Answer	Additional guidance	Mark
	An explanation that makes reference to the following: Placebo • because it provides a control group for comparison (1) • therefore ensuring that the { active ingredient / drug } is causing the effect (1) Double Blind Trial • because neither doctors nor patients know who has been given the actual drug (1) • therefore ensures that bias is removed from the trial (1)	ALLOW that improvement is not due to a psychological effect	**(4)**

Q16.

Question Number	Answer	Additional guidance	Mark
	An answer that makes reference to the following: • the drug did not show a significant improvement when compared with the placebo (1) • because the ranges overlapped (1) • because some people in the trial had an increased blood pressure (1)		**(3)**

Q17.

Question Number	Answer	Additional guidance	Mark
	An answer that makes reference to four of the following: • description of production of agar plates with bacteria (1) • description of method used to add plant extract to plates (1) • extracts used separately and in combination (1) • incubate for at 37 °C for an appropriate period of time (1) • measure and compare the sizes of zones of inhibition (1)	ALLOW plates { inoculated / seeded} with bacteria, production of bacterial lawn or streak plates e.g. on filter paper discs or in wells ALLOW time from 24 to 72h and a temperature from 35-38°C e.g. diameter or area ALLOW comparative statements such as the larger the area, the more effective the antimicrobial properties	**(4)**

Q18.

Question Number	Answer	Additional Guidance	Mark
(i)	A description that makes reference to three of the following: • percentage germination decreases as length of time stored increases (for both varieties) (1) • correct calculation of decrease for both varieties (1) • { little change / 1 or 2 % } in percentage germination when stored for up to 48 hours for both varieties (1) • greatest decrease in percentage germination occurred { later for P than Q / from 72 hours for P and from 48 hours for Q } (1)	ALLOW correct reference to negative correlation e.g. (from 0 to 120 hours) 40% decrease for P and a 36% decrease for Q	(3)

Question Number	Answer	Additional Guidance	Mark
(ii)	An explanation that makes reference to two of the following: • allowed a comparison between { the two varieties / stored seeds and seeds that had not been stored }(1) • to see the effect of seeds being stored at { 80% humidity / 42°C } (1) • data showed that the percentage germination success was { high / not 100% } in the control seeds (1)	ALLOW wheat seeds were viable or suitable for this investigation	(2)

Q19.

Question Number	Answer	Additional Guidance	Mark
(i)	An explanation that makes reference to the following: • colonies present with a different {shape / size / colour} (1) • therefore {belonging to different species / contaminants} (1)	e.g. presence of 'darker spots' ALLOW other {microorganisms /bacteria} present or annotation of diagram to indicate other colonies	(2)

Question Number	Answer	Additional Guidance	Mark
(ii)	An explanation that makes reference to the following: • to allow bacteria to multiply (1) • without encouraging pathogenic organisms (1)	ALLOW growth of bacteria	(2)

Q20.

Question Number	Answer	Additional Guidance	Mark
(i)	An explanation that makes reference to the following: • extends storage time of the seeds (1) • because drying prevents {germination / decomposition} of seeds (1)	ALLOW drying {reduces enzyme activity / prevents growth of bacteria and fungi}	(2)

Question Number	Answer	Additional Guidance	Mark
(ii)	An answer that makes reference to three of the following: • prevent species from becoming extinct (1) • conserving species with (potential) medicinal properties (1) • safeguarding genes that may prove useful in the future (1) • allow for reintroduction of species (in the future) (1)	ALLOW conserve genetic diversity	(3)

Q21.

Question Number	Answer	Additional Guidance	Mark
	An explanation that makes reference to three of the following: • { warm conditions / water / glucose / amino acids / ideal pH } available Plus 2 of the following: • suitable { temperature / pH } for bacterial enzymes (1) • glucose used for {respiration / energy} • amino acids used for growth	ALLOW 37°C ALLOW optimum	(3)

Q22.

Question Number	Answer	Additional Guidance	Mark
	An explanation that makes reference to two of the following: • available to future generations (1) • (because) bamboo is a renewable resource (1) • (because) more bamboo plants can be grown (1)	ALLOW bamboo { can be regrown / will grow back }	(2)

Q23.

Question Number	Answer	Additional Guidance	Mark
(i)	A description which makes reference to the following: • pine and larch { have greater antimicrobial properties / act faster } than spruce (1) • pine and larch equally effective (1)	ALLOW converse	(2)

Question Number	Answer	Additional Guidance	Mark
(ii)	An answer which makes reference to two of the following: • the conclusion is not valid (1) • time is not shown as a continuous scale (1) • no data between 4 and 8 days (1)	ALLOW description of non-linear time scale	(2)

Question Number	Answer	Additional Guidance	Mark
(iii)	An answer which makes reference to four of the following: • shorter time intervals / hourly measurements (1) • { between 0 and 1 day / within first 24 hours } (1) • because no bacterial growth in either after 1 day (1) • test with different bacterial cultures (1) • because antimicrobial properties may vary (1)		(4)

Q24.

Question Number	Answer	Additional Guidance	Mark
	An answer making reference to **three** of the following: • SGSV conserves genetic diversity of crops (1) • crop varieties kept in SGSV are protected from { natural disasters / drought / mismanagement / economic factors / effects of climate change } (which can threaten varieties grown by farmers) (1) • crop varieties in SGSV may have traits that are useful in the future, such as { drought resistance / pest resistance / disease resistance / tolerance of changing environmental conditions } (1) • SGSV helps to ensure future food security (if crop varieties currently grown were to fail) (1)	NOT increases genetic diversity ALLOW seeds for crop varieties IGNORE protection from diseases / pests IGNORE ref to medicinal uses	(3)

Q25.

Question Number	Answer	Additional Guidance	Mark
	A description that makes reference to three of the following: • description of role in protection (1) • description of role in repopulation (1) • description of role in education (1) • description of role in research (1)	E.g. protection from poachers, hunting,vet care, administering medicines E.g. increase numbers, breeding programmes, release back into the wild E.g. conservation E.g. Improving health, discovering betternutrition, breeding cycles, developing a genetic database	**(3)**

Q26.

Question Number	**Answer**	**Additional Guidance**	**Mark**
(i)	An answer that makes reference to two of the following: • modifies proteins (1) • forms vesicles (1) • removes (some) water from the protein / concentrates the { protein / glycoprotein } (1)	e.g. addition of carbohydrate to protein / formation of glycoprotein ALLOW processes protein IGNORE folds protein e.g. lysosomes / secretory vesicle / vesicle in synaptic knob ALLOW packages proteins into vesicles	**(2)**

Question Number	Answer	Additional Guidance	Mark
(ii)	An explanation that makes reference to three of the following: • (for phase 1) – to make sure the phospholipase inhibitor is not harmful (1) • (for phase 2) – to see if it is effective in { treating the condition / preventing allergic reactions to wasp venom } (1) • (for phase 3) – to gather much data / data for statistical tests / to look for rare side effects (1) • to test for side effects in { phase 1 / phase 2 } (1)	ALLOW finding safe dosage ALLOW reference to how the drug is absorbed / metabolised ALLOW double blind trials to compare effectiveness with a placebo / previous drug	**(3)**

Q27.

Question Number	Answer	Additional guidance	Mark
	• number of bags × mass in kilograms (1) • correct answer given in standard form (1)	Example of calculation $(7.6 \times 10^{9}) \times 0.0055$ 4.18×10^{7} Correct answer with no working gains full marks	**(2)**

Q28.

Question Number	Answer	Additional guidance	Mark
(i)	• number of hectares in Kwandwe divided by number of lions (1) • number of hectares in Kariega divided by number of lions (1) • value for Kariega subtracted from value for Kwandwe (1)	Example of calculation: 19978 ÷ 10 = 1997.8 50000 ÷ 8 = 6250 6250 – 1997.8 = 4252.2 ALLOW 4252 Correct answer with no working gains full marks	(3)

Question Number	Answer	Additional guidance	Mark
(ii)	An answer that makes reference to the following: • {more variety / higher number of species} (of carnivores) in Pumba (1) • Pumba has no wild dog population (1) • Schotia has a higher number of carnivores per hectare (1) • only shows data for carnivores (1)	ALLOW cheetah only found in Pumba ALLOW greater species richness in Pumba	(4)

Q29.

Question Number	Answer	Additional Guidance	Mark
	A description that makes reference to the following: • (relocating) isolates Scottish wildcats from domestic cats **(1)** • use of {studbooks/selection of mates} **(1)** • increase the number (of Scottish wildcats) **(1)** • prepared for reintroduction (to native habitat) **(1)**	ALLOW moves away instead of isolates ALLOW hacking out	**(4)**

Q30.

Question Number	Answer	Additional Guidance	Mark
	An explanation that makes reference to the following: • washing with disinfectant will kill any microorganisms (1) • drying to { reduce chance of germination / decrease enzyme action } (1) • therefore preventing { decay / infection / damage } to the seeds (1)	ALLOW bacteria and / or fungi ALLOW: for long term storage	**(3)**

Q31.

Question Number	Answer	Additional Guidance	Mark
	• correct calculation of number of seeds in the sample (1) • correct calculation of percentage that germinated (1) • therefore the remaining seeds are viable (as germination was greater than 75%) (1)	Example of calculation (1000 ÷ 50) x 3 = 60 seeds (1g = 20 seeds) (48 ÷60) x 100 = 80% (80% without working gains 2 marks)	(3)

Q32.

Question Number	Answer	Mark
	The only correct answer is – D 86% **A is incorrect because the value calculated is for unsuccessful reintroduction** **B is incorrect because the value calculated is for unsuccessful reintroduction** **C is incorrect because the value is rounded incorrectly**	**(1)**

Q33.

Question Number	Answer	Additional guidance	Mark
	An explanation that makes reference to the following: **• to allow the antelopes time to reproduce (1)** **• therefore providing a sustainable food source for the lions (1)**	**ALLOW reference to increase in population size** **ALLOW reference to antelope populations being able to survive predation**	**(2)**

Q34.

Question Number	Answer	Additional guidance	Mark
(i)	A description that makes reference to three of the following: • starch is a polysaccharide made from alpha glucose (1) • monomers in the chains are joined by 1,4 glycosidic links (1) • starch contains {unbranched chains / amylose} and {branched chains / amylopectin} (1) • branches are joined to chains by 1,6 glycosidic links (1)	ALLOW branches involve 1,6 glycosidic links	**(3)**

Question Number	Answer	Additional guidance	Mark
(ii)	An explanation that makes reference to the following: • because starch comes from plants that can be regrown (1) • however not 100% starch so some oil-based products needed (1)		**(2)**

Q35.

Question Number	Answer	Additional guidance	Mark
	An explanation that makes reference to three of the following • nettle plants can be grown so they are renewable (1) • (crude) oil (is non-renewable and) will run out (1) • use of fibres from nettles will be available to future generations(1) • clothing made of nettle fibres is biodegradable (1)	ALLOW description of renewable egwill not run out	**(3)**

Q36.

Question Number	Answer	Additional Guidance	Mark
	An answer that makes reference to the following: • more plants can be grown **(1)** • {plants / plant fibres} are a renewable resource /resource available to future generations **(1)**	ALLOW plants can be regrown	**(2)**

Q37.

Question Number	Answer	Additional guidance	Mark
(i)	An answer the makes reference to the following: • (use of anabolic steroids) reduces {ventricular fraction / ejection fraction /stroke volume / cardiac output } (1) • {83 % / 10 out of 12} of users have ventricular fraction below {55% / the healthy value} (1)	ALLOW less blood leaving the ventricle when it contracts ALLOW more users of anabolic steroids have a ventricular fraction below 55% than non-users ALLOW other valid quantitative values e.g. comparing mean values for each group 51.25 and 60.6%	**(2)**

Question Number	Answer	Additional guidance	Mark
(ii)	An answer the makes reference to the following: • test the drug on { healthy individuals / animals / cell cultures } (1) • (then) test on group of individuals with cancer (1) • (gradually increasing the dose) to determine dose that does not reduce ventricular ejection fraction (1)	ALLOW test on a group of patients ALLOW to determine the dose that does not cause side effects	**(3)**

Q38.

Question Number	Answer	Additional Guidance	Mark
	An answer that makes reference to three of the following: • Albuterol has the greatest FEV improvement **(1)** • little difference between no treatment and placebo on FEV **(1)** • placebo effect demonstrated by greater subjective improvement compared to no treatment **(1)**		**(3)**