



SHORE

Exam Number:

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Year 12

Biology

Trial Examination

2019

General instructions

- Reading time – 5 minutes
- Working time – 3 hours
- Write using black or blue pen
- Draw diagrams using pencil
- Board approved calculators may be used
- Write your Student Exam Number where required
- **Note:** Any time you have remaining should be spent revising your answers

Total marks – 100**Part A - 20 marks**

- Attempt Questions 1 - 20
- Allow about 35 minutes for this section

Part B - 80 marks

- Attempt Questions 21 - 39
- Allow about 2 hour and 20 minutes for this section

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PART A – 20 marks**Attempt Questions 1-20****Allow about 35 minutes for this part.**

Use the multiple-choice answer sheet for Question 1-20.

- 1 Which one of the rows below best lists some broad differences between internal and external fertilisation.

	Internal fertilisation	External fertilisation
(A)	• Many eggs • More parental care • Higher survival rate of offspring	• Few eggs • Less parental care • Lower survival rate of offspring
(B)	• Many eggs • Less parental care • Lower survival rate of offspring	• Few eggs • More parental care • Higher survival rate of offspring
(C)	• Few eggs • Less parental care • Lower survival rate of offspring	• Many eggs • More parental care • Higher survival rate of offspring
(D)	• Few eggs • More parental care • Higher survival rate of offspring	• Many eggs • Less parental care • Lower survival rate of offspring

Refer to the following information to answer questions 2 and 3.

In 2018, health workers conducted a year-long study of 20 000 people to examine the incidence, prevalence and mortality rates of a particular non-infectious disease.

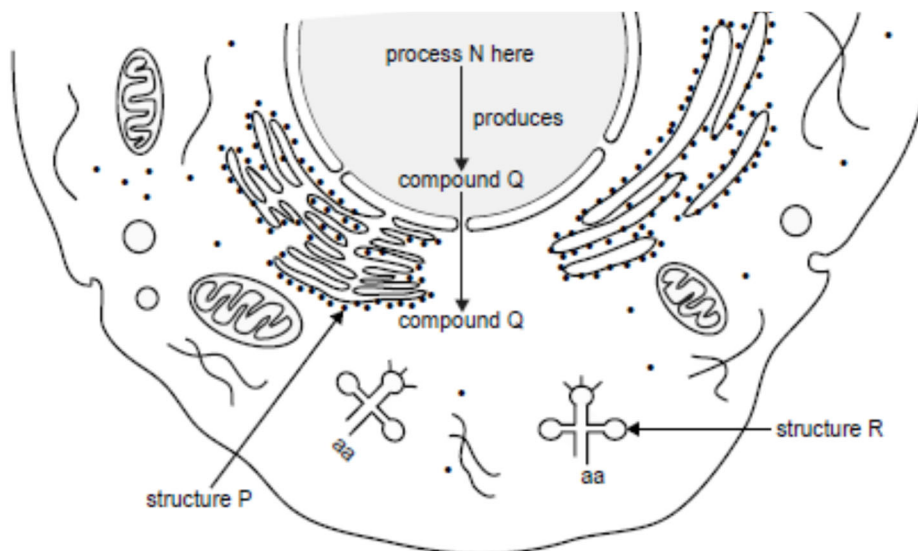
1200 people were identified with the disease at the beginning of the study and 165 new cases of the disease were diagnosed over the course of the year. There were 35 deaths from the disease recorded throughout the duration of the study.

- 2 What is the prevalence of the disease in the study population?
- (A) 175 per 100 000 persons
 (B) 1330 per 100 000 persons
 (C) 1365 per 100 000 persons
 (D) 6650 per 100 000 persons
- 3 What is the mortality rate of the disease for the study population?
- (A) 175 per 100 000 persons
 (B) 6825 per 100 000 persons
 (C) 825 per 100 000 persons
 (D) 878 per 100 000 persons

- 4 Transmission of messages within the nervous system
- (A) proceeds in both directions along a nerve axon.
 - (B) involves both electrical impulses and chemical messages.
 - (C) is slower via a myelinated axon than a non-myelinated axon.
 - (D) relies on the active transport of a neurotransmitter across a synaptic gap.
- 5 Illness in animals is often accompanied by fever, which is a rise in body temperature. Fever is caused by the resetting of the temperature control centre. This control centre is located in the
- (A) skin.
 - (B) hypothalamus.
 - (C) pituitary gland.
 - (D) thyroid gland.

Use the following information to answer question 10.

The figure shows portion of a cell engaged in protein synthesis. The various parts of the cell are not drawn to scale.

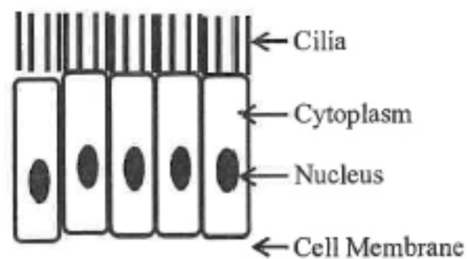


- 6 It is reasonable to conclude that
- (A) process N is translation.
 - (B) structure P is made of t-RNA.
 - (C) compound Q is messenger RNA.
 - (D) structure R is the site of protein synthesis.

- 7 Which of the following is a common physiological adaptation that helps endotherms to maintain a stable body temperature?
- (A) Seeking shade and sweating.
 - (B) Vasoconstriction and vasodilation.
 - (C) A high or low surface area to volume ratio.
 - (D) Licking paws to induce evaporative cooling.
- 8 Which of the following correctly describes one of the main functions of the hormone progesterone?
- (A) Progesterone kills sperm that enters the vagina.
 - (B) Progesterone causes the ovaries to release an ovum.
 - (C) Progesterone prepares and maintains the uterus for pregnancy.
 - (D) Progesterone produces the female sexual characteristics, such as breasts.

Refer to the following information to answer questions 9 and 10

The diagram below illustrates the cells found in the lining of the human respiratory system.



- 9 What is the role of these cells in the immune system?
- (A) To move back and forward to increase gas exchange.
 - (B) To exchange oxygen and carbon dioxide.
 - (C) To trap foreign material before entering the body.
 - (D) To phagocytose foreign material once it has entered the body.
10. The cilia on the surface are part of which immune system?
- (A) The innate immune system.
 - (B) The acquired immune system.
 - (C) The adaptive immune system.
 - (D) The active immune system.

11. Which of the following biotechnologies would lead to an INCREASE in genetic diversity?

- (A) Artificially inseminating a number of female heifers (cows) from one desirable bull.
- (B) Grafting two or more fruit trees together.
- (C) Artificially pollinating an endangered plant species to increase seed production.
- (D) Producing a transgenic organism.

12. The production of chemicals by cells or tissues of animals is often in response to a pathogen. One of those chemicals is histamine.

What is the purpose of producing histamine in response to invasion by a pathogen?

- (A) Vasoconstriction and triggering an itching response.
- (B) Vasoconstriction and regulating production and function of lymphocytes.
- (C) Vasodilation and preventing blood from clotting.
- (D) Vasodilation and increasing the number of white blood cells.

13. Colour blindness is inherited as an X-linked recessive condition.

It is reasonable to claim that a

- (A) colour-blind female must have a colour-blind father.
- (B) colour-blind male must have a colour-blind mother.
- (C) colour-blind male must have a colour-blind grandfather.
- (D) colour-blind female must have a colour-blind grandmother.

14. Which of the following best describes a single nucleotide polymorphism (SNP)?

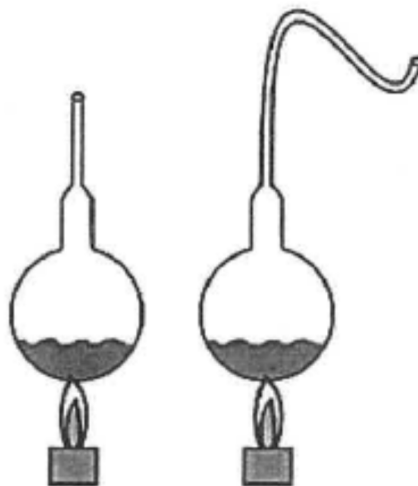
- (A) One characteristic being changed due to multiple mutations.
- (B) One nucleotide being changed in a section of DNA.
- (C) Many proteins within a section of DNA being changed.
- (D) Many changed characteristics from mutations in a section of DNA.

15. The diagram represents a process which may occur during meiosis.



The process is:

- (A) sex-linkage and involves the segregation of non-homologous chromosomes to different poles.
 - (B) crossing over and involves the segregation of homologous chromosomes to different poles.
 - (C) sex-linkage and involves the exchange of alleles between non-homologous chromosomes.
 - (D) crossing over and involves the exchange of alleles between homologous chromosomes.
16. The diagram shows Louis Pasteur's famous swan neck flask experiment.



Which of the following was used as a control in his method?

- (A) Boiling of the broth.
- (B) The swan shape of the flask.
- (C) The measure of cloudiness.
- (D) Particles in the air outside the flask.

17. In 1856, the Austrian monk, Gregor Mendel began his now famous research using pea plants, which led to a proposed model for inheritance. His success was based on precise experimentation and careful observations.

Which of the following techniques ensured that the data he obtained was reliable?

- (A) Bred pea plants hundreds of times and recorded each outcome.
- (B) Ensured pure-breeding lines.
- (C) Kept plants isolated in a greenhouse, to prevent accidental cross pollination.
- (D) Ensured all plants self-pollinated by covering them with bags.

18. Read the information below about Ebola virus disease.

Ebola virus disease was first described from the Sudan and the Congo in 1976.

Since then it has occurred regularly in Central and Western Africa. The most recent outbreak is in Guinea.

The mortality rate is 90%.

The virus is transmitted in human body fluids, particularly blood, vomit and faeces, placing health workers who care for sufferers, or the people who dispose of the bodies, at particular risk.

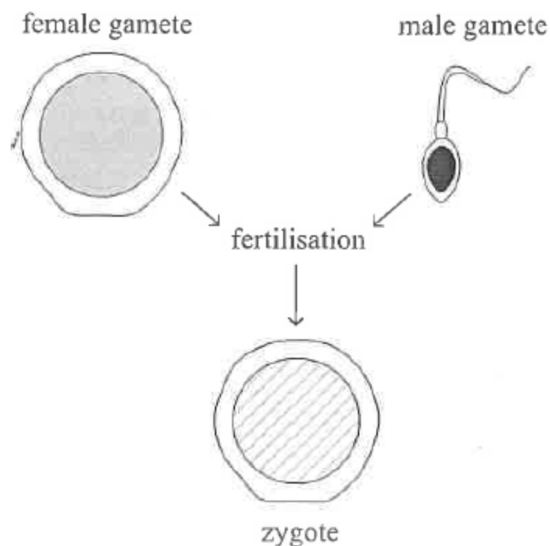
Infection rates of health workers in remote, poorly equipped locations are much higher than those in well equipped, modern hospitals.

From the World Health Organisation website.

From this information, which one of the following measures would be the most effective way of reducing transmission of the disease to health workers?

- (A) Avoid contact with body fluids through use of gloves and sterile procedures.
- (B) Prescribe antibiotics to all health workers in the area.
- (C) Forbid health workers from handling the dead bodies.
- (D) Restrict travel from infected areas.

19. When seeking to establish a cause of a particular non-infectious disease, which of the following must epidemiologists first consider?
- (A) Mortality rates.
 - (B) The preventative and control measures to be implemented as part of the intervention.
 - (C) Evidence that exposure to a pathogen, virus or prion has not occurred before the disease appeared.
 - (D) The correlation between exposure to the suspected cause and the prevalence of the disease.
20. Consider the diagram.



Which statement about these cells is correct?

- (A) No genetic information is passed to the zygote from either gamete.
- (B) The genetic information carried in the nuclei of both gametes is the same.
- (C) The zygote contains all the genetic information from both gametes.
- (D) The gametes lose some of their genetic information when they combine to form the zygote.

2019 Biology Trial Examination

Part B – 80 marks

Attempt all questions.

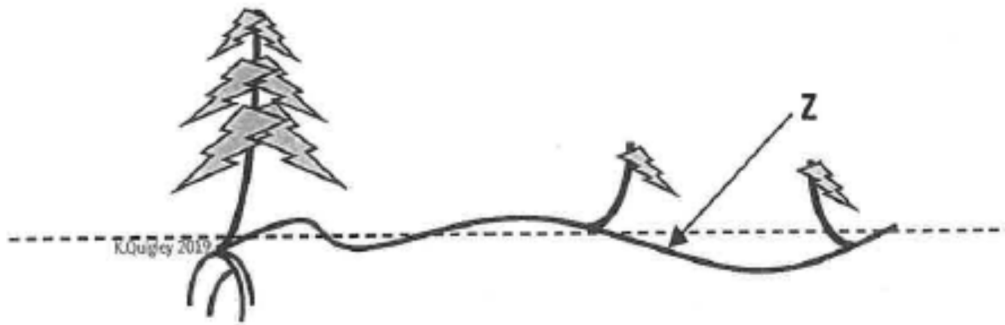
Allow about 2 hours and 20 minutes for this part.

Answer the questions in the spaces provided. These spaces provide guidance for the expected length of response.

Show all relevant working in questions involving calculations.

Marks**Question 21** (3 marks)

The diagram below shows a method of reproduction used by many native species of Australian ferns. The parent plant on the left, grows a specialised horizontal stem called a runner (Z) along the ground and new plants emerge from the stem.



- (a) Identify whether this method of reproduction is sexual or asexual.

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- (b) Outline an advantage and limitation of the type of reproduction identified in (a).

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Marks**Question 22** (4 marks)

‘Golden Rice’ is the name given to a number of varieties of rice that have been genetically modified to produce beta-carotene.

- (a) Explain why Golden Rice is considered to be a biotechnology. **2**

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- (b) Outline ONE social implication of Golden Rice becoming widely used. **1**

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- (c) Outline ONE ethical consideration of Golden Rice becoming widely used. **1**

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Question 23 (4 marks)

A group of university researchers are responsible for five families of pandas in different zoos. Each family has been isolated from other families for generations. As the cubs reach sexual maturity, a mating program aims to improve the genetic diversity of the worldwide panda population.

- (a) Explain how the mating program may affect gene flow. **2**

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- (b) Explain how the isolation of the other families for generations impacts genetic drift. **2**

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Marks**Question 24** (3 marks)

A student designed the following first-hand investigation to determine how one factor in the environment can effect phenotypic expression. The plants used were grown from seed.

Feature	Group A	Group B
Type of seedling	Bean	Bean
Number of seedlings	100	100
Temperature (°C)	10	30
Light (hours/day)	12	12
Water (mL/day)	20	20
Soil	Potting medium	Potting medium

- (a) Identify the independent variable in this investigation.

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- (b) Discuss the validity of this investigation.

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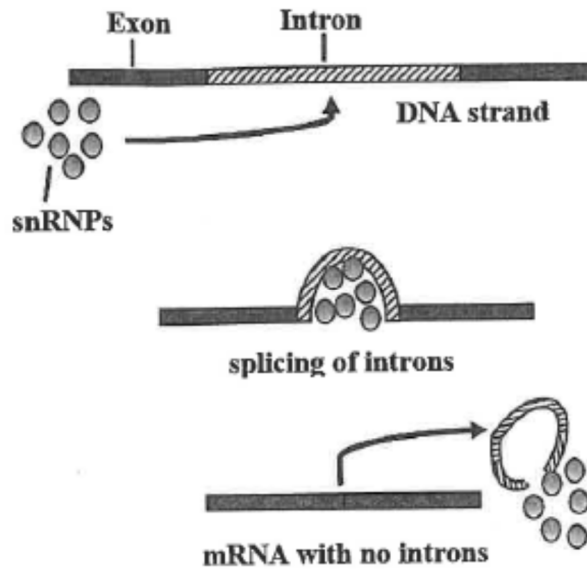
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Marks**Question 25** (3 marks)

The diagram below shows the process of how an intron is removed from a section of DNA to form a strand of mature messenger RNA (mRNA).



- (a) Explain the difference between an exon and an intron.

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- (b) Identify a specific type of electromagnetic radiation that is known to cause mutations and describe how this mutagen causes the mutation.

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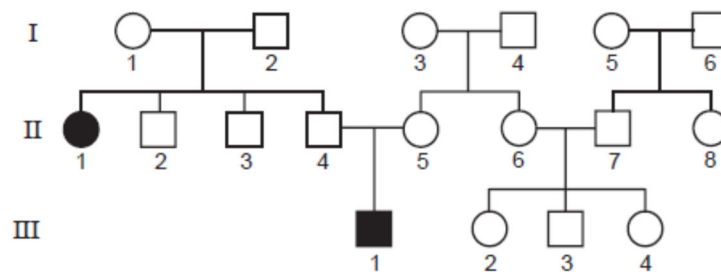
Marks**Question 26** (6 marks)

The quarter horse, as a breed, originated by selective breeding. The first Australian quarter horses were imported from North America in the 1950s. A genetic condition called Hereditary Equine Regional Dermal Asthenia (HERDA) affects certain individuals. HERDA horses have a reduced life expectancy. Affected horses have a pedigree that is linked to an American stallion, Polo Bueno, which lived in the 1940s.

- (a) Which cells in the body of Polo Bueno were affected by the mutation allowing HERDA to be inherited? 1

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Examine the following pedigree.



- (b) Identify the mode of inheritance of HERDA. Justify your answer. 2

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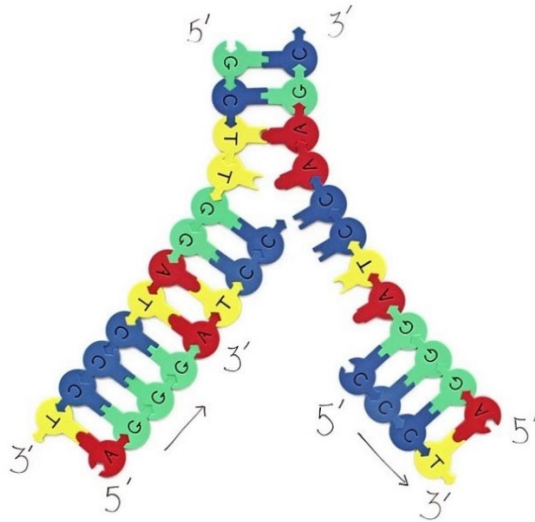
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- (c) After the horses arrived in Australia, mare II5 is mated to a normal stallion from a different family with no family history of HERDA. Using appropriate symbols for genotypes, show all possible outcomes of this mating. Include the genotypes and phenotypes of parents and foals. 3

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Question 27 (2 marks)	
Outline the differences between gene cloning and whole organism cloning.	2
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Marks**Question 28** (6 marks)

The diagram is of a model illustrating the process of DNA replication.



- (a) Explain the importance of exact DNA replication.

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- (b) Describe the function of the enzymes DNA polymerase and DNA helicase in this process.

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- (c) Explain ONE way the model makes the process of DNA replication easier to understand.

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Marks**Question 29** (4 marks)

Tay-Sachs Disease is a rare genetic disorder that destroys the nerve cells in the brain and spinal cord in humans. It is caused by a mutation on the HEXA gene, found on Chromosome 15.

A section of a normal HEXA gene is shown below:

CGTATATCCTATGCCCCTGAC

The same section of the HEXA gene, with the Tay-Sachs mutation is shown below:

CGTATATCTCTATGCCCCTGAC

- (a) Name the type of mutation causing Tay-Sachs Disease.

1

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- (b) The table provided shows the base triplets in mRNA for amino acids.

		Second Base of mRNA Codon					
		U	C	A	G		
First Base of mRNA Codon	U	UUU Phe	UCU Ser	UAU Tyr	UGU Cys	Third Base of mRNA Codon	U
		UUC Phe	UCC Ser	UAC Tyr	UGC Cys		C
		UUA Leu	UCA Ser	UAA STOP	UGA STOP		A
		UUG Leu	UCG Ser	UAG STOP	UGG Trp		G
	C	CUU Leu	CCU Pro	CAU His	CGU Arg		U
		CUC Leu	CCC Pro	CAC His	CGC Arg		C
		CUA Leu	CCA Pro	CAA Gln	CGA Arg		A
		CUG Leu	CCG Pro	CAG Gln	CGG Arg		G
	A	AUU Ile	ACU Thr	AAU Asn	AGU Ser		U
		AUC Ile	ACC Thr	AAC Asn	AGC Ser		C
		AUA Ile	ACA Thr	AAA Lys	AGA Arg		A
		AUG Met	ACG Thr	AAG Lys	AGG Arg		G
	G	GUU Val	GCU Ala	GAU Asp	GGU Gly		U
		GUC Val	GCC Ala	GAC Asp	GGC Gly		C
		GUA Val	GCA Ala	GAA Glu	GGA Gly		A
		GUG Val	GCG Ala	GAG Glu	GGG Gly		G

Using the codon table attached, explain the effect this mutation has on the production of a polypeptide from the HEXA sequence.

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Question 30 (8 marks)

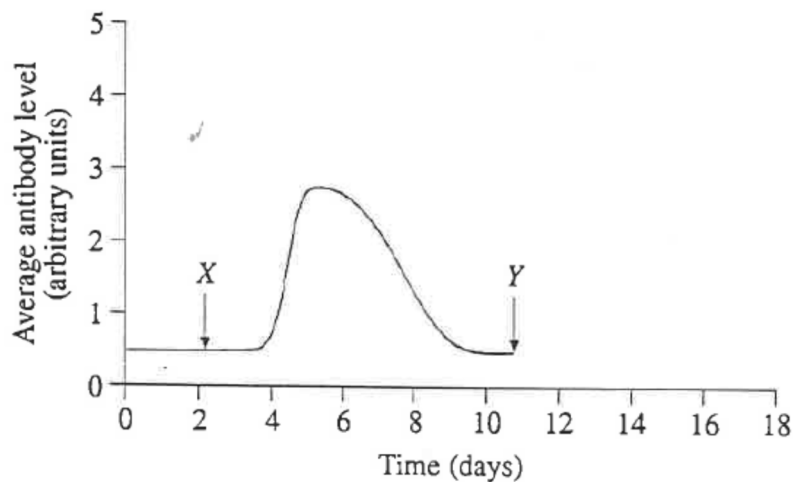
In your answer, include an outline of the process used to create the organism and a discussion of its impacts.

This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

Marks**Question 31** (6 marks)

A group of people were used in a study to determine the effectiveness of an experimental vaccine for a strain of bacteria.

A small sample of the vaccine was injected into members of the group and blood samples were drawn from the group at regular time intervals for analysis of antibody levels. The results of these measurements are shown in the graph below.



- (a) Identify the type of immune cell that produces antibodies.

1

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- (b) Account for the shape of the graph between days 2 and 4.

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- (c) Describe TWO changes you would observe in the antibody levels if a second vaccination were given at Y.

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Question 30 continues over the page.

Marks

Question 30 Continued.

- (d) Explain whether the antibodies produced to the bacterial vaccine could be used to combat a different bacteria.

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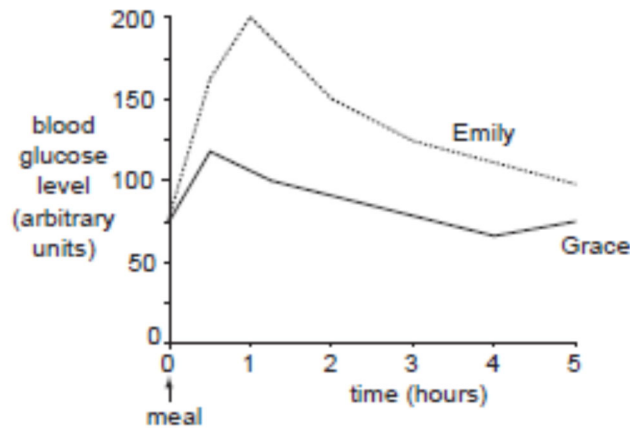
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Marks**Question 32** (3 marks)

Blood glucose levels are controlled by a homeostatic mechanism.

Two females of the same age and similar body structure were each given an identical meal. The following graph shows the level of blood glucose in each female for the five-hour period after eating the meal.



- (a) Explain whether Emily or Grace had a defect in the blood-glucose homeostatic mechanism. Refer to at least two parts of the graph to support your answer. **2**

Name of female:

Explanation:

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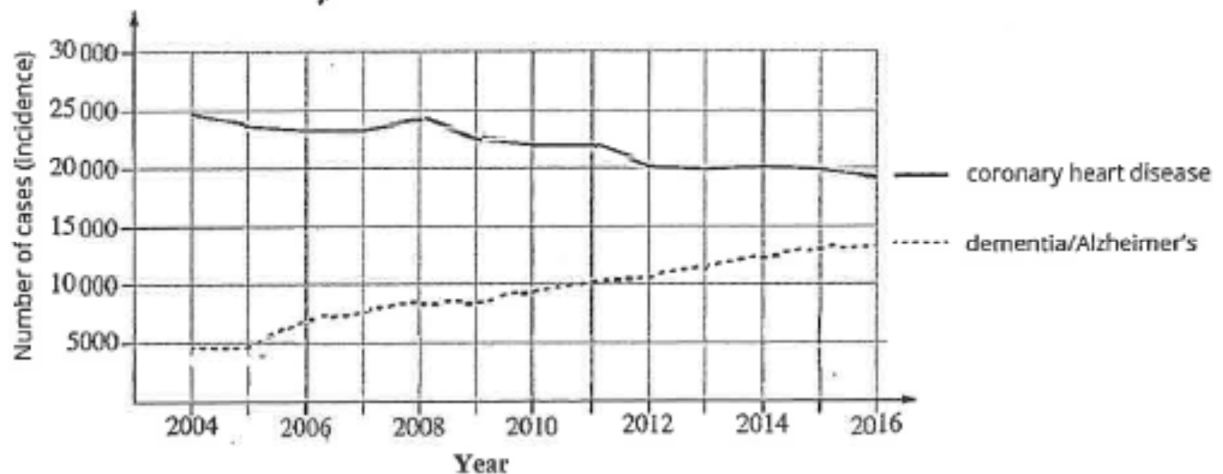
- (b) Consider Grace.
Explain the small rise in her level of glucose between four and five hours after the meal. **1**

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Marks**Question 33** (3 marks)

The graph below shows the incidence of coronary heart disease and dementia in the Australian population from 2004 to 2016.



(a) In 2011 what was the approximate incidence of :

1

(i) Coronary heart disease?

(ii) Dementia/Alzheimer's?

(b) Suggest likely explanations to account for the decrease in the incidence of coronary heart disease from 2006 to 2016.

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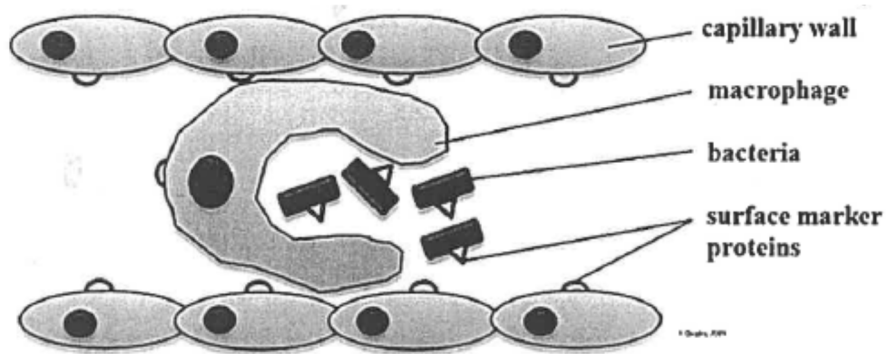
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Marks**Question 34** (3 marks)

The diagram below models how phagocytes recognise potential foreign pathogens in the body.



Describe the process presented by this model.

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Question 35 (4 marks)

Explain the acquired immune response after primary exposure to a pathogen.

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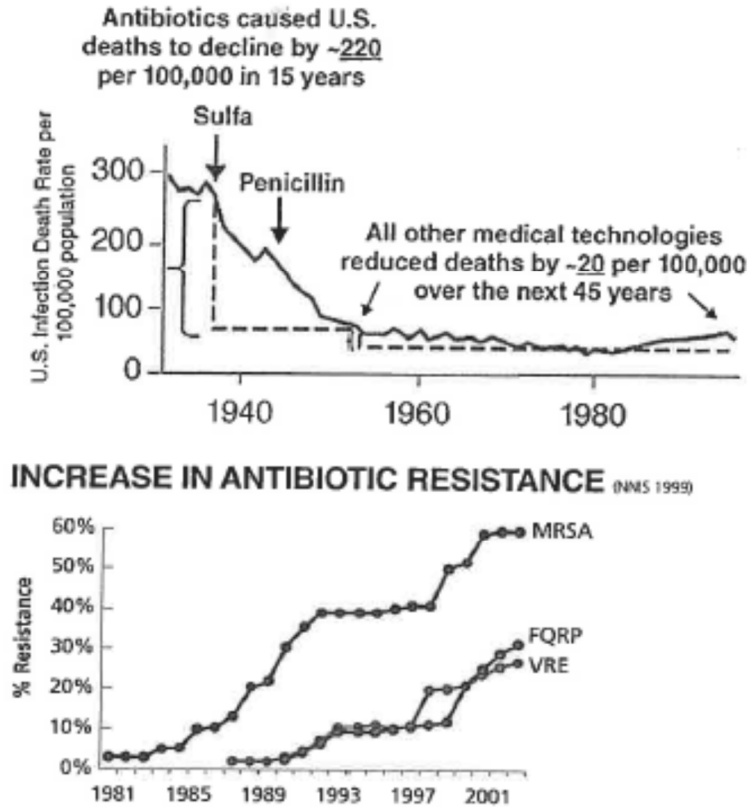
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Marks**Question 36** (5 marks)

The graphs below show different information about the effectiveness of antibiotics as a treatment strategy for infectious disease.



Using the information provided in the graphs and your own knowledge, discuss the effectiveness of antibiotics as a treatment strategy for infectious diseases.

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Marks**Question 37 (5 marks)**

The beet caterpillar is an insect pest of the tomato plant. When a beet caterpillar starts to eat a tomato plant, the plant responds by producing a chemical known as jasmonic acid. Jasmonic acid and its derivatives have a variety of odours. Some scientists have suggested that these odours attract predator wasps to the caterpillar-affected plants.

- (a) (i) Outline an experiment you would carry out to test this hypothesis. **3**

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- (ii) Describe the results that would support the hypothesis. **1**

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- (b) Explain why it would be an advantage to the plant to produce jasmonic acid when its leaves are being eaten by caterpillars. **1**

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Marks

Question 38 (4 marks)

Non-infectious diseases account for all of the top five leading causes of death for Australians over 45 years of age (*Australian institute of Health and Welfare 2018*).

- (a) Describe the cause and effects of a NAMED disease related to environmental exposure or nutrition.

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- (b) Explain the treatment/management options available for the disease you identified in part (a).

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Marks

Question 39 (6 marks)

Evaluate the benefits of engaging in an epidemiological study.

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2019 SHORE BIOLOGY TRIAL ANSWERS

Part A

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
D	D	A	B	B	C	B	C	C	A	D	D	A	B	D	B	A	A	D	C

Part B

Question 21 (a)

Criteria	Mark
Correctly identifies method of reproduction.	1

Sample answer: Asexual reproduction

Question 21 (b)

Criteria	Mark
Correctly outlines an advantage and limitation of the reproduction identified in (a)	2
Correctly outlines an advantage OR limitation of the reproduction identified in (a)	1

Samples answer: The advantage of asexual could include it requires only one parent so numbers are increased quickly as no other plant is required OR maintain genetics in an already suitable environment. The disadvantage could be that being genetically identical if there is an unsuitable change in the environment the population may die.

Comments: Some students confused genetic diversity in species or population with genetic diversity in the offspring.

Exemplars:

(b) Outline an advantage and limitation of the type of reproduction identified in (a). 2

Asexual reproduction is advantageous when the environmental conditions are desirable; thus allowing for their offspring to thrive in the same desirable conditions as the parent. However due to the identical genes shared between both organisms, if a pathogen affects one of the offspring, it will affect all of them (this allows for mass die-off).

Question 22 (a)

Criteria	Mark
- Provides a definition for biotechnology and - Links a description of Golden Rice to the definition.	2
Provides some relevant information.	1

Sample answer: Biotechnology is the manipulation of biological materials or processes for the benefit of humans. Golden rice has been manipulated by humans and had genes from other organisms inserted so that it produces Beta carotene to improve human health in those who cannot get this naturally in their diet.

Comments: The best responses included a definition.

Exemplar:

Biotechnology is anything where understanding of biological processes has allowed for the manipulation of that process to supplement human demand

Question 22 (4 marks)

'Golden Rice' is the name given to a number of varieties of rice that have been genetically modified to produce beta-carotene.

(a) Explain why Golden Rice is considered to be a biotechnology. 2

Golden Rice has been genetically edited to be a transgenic organism which means they have used technology to insert DNA from other organisms into the plant. - Therefore it is defined as a biotechnology. The beta-carotene producing gene is beneficial for humans as it is an important nutrient for normal human function. Hence, Golden rice is a biotechnology.

Question 22 (b)

Criteria	Mark
Describes ONE social implication of Golden Rice either positive or negative	1

Sample answer: Can improve the health of people with vitamin A deficiency.

Exemplar:

Golden Rice may enhance the ability of subsistence farmers to survive due to the reliance on rice and consequent lack of Vitamin A which Golden rice will overcome.

Question 22 (c)

Criteria	Mark
Describes ONE ethical consideration of Golden Rice becoming widely used	1

Sample answer: Numerous possibilities – eg loss of biodiversity if it becomes a monoculture.

Exemplar:

- Potential unseen effects of growing it over other rice such as a smaller production of rice per plant, meaning less available food.

Comments: Some students chose cultural or religious ethics which is a grey area and hard to justify – there are much better areas to choose.

Question 23 (a)

Criteria	Mark
Clear definition of gene flow correctly linked to the impact of the mating programme.	2
Clear definition or some correct information relating to the mating programme and its impact on gene flow in a population.	1

Sample answer: Gene flow is the introduction of new alleles into populations from the movement of individuals. Since the groups have been isolated for many generations there is the likelihood that certain alleles will be present in some population and not in others. Therefore there will be an increase in gene flow as a result of the mating programme.

Exemplar:

- Gene flow is the introduction of new alleles to a population.
 - The mating program will add new alleles from different zoos to a population, increasing gene flow.

Question 23 (b)

Criteria	Mark
Clear definition with the impact of isolation of the populations clearly linked.	2
- Clear definition	1

Sample answer: Genetic drift is the change in allele frequency in a population. If the individuals are all in isolated populations with stable environments (zoo) you would expect little change to allele frequency and therefore there should be little genetic drift.

Exemplar:

Genetic drift is the alteration of gene/allele frequencies due to sudden changes within the population. ^{Previous generations + humans} However, in this population, which is isolated, this causes genetic drift as certain dominant alleles may be present for one time, however not another, therefore leading to an eventual ^{any} differentiation between the ~~populations~~ ^{populations} gene frequencies. A each population/ family, due to isolation, therefore increasing genetic drift.

Comments: The best responses in a) and b) included a definition. Many students seemed to have a lack of understanding on genetic drift.

Question 24 (a)

Criteria	Mark
Correct response given.	1

Sample answer: Temperature.

Question 24 (b)

Criteria	Mark
Two correct points given for and or against validity given.	2
One correct point on validity given.	1

Sample answer: The experiment as shown has some points that ensure validity such as keeping a large number of variables the same while only changing the independent variable. However some points that would need to be considered that could improve the validity include keeping other factors controlled including the type of soil and more variations in the independent variable may give a clearer conclusion to the aim (ie 15, 20 and 25 degrees Celcius).

Exemplar:

Validity refers to how well ^{variables} ~~factors~~ outside of the independent variable, were controlled between the experimental groups. Maintaining consistency in the type of seedling, ~~temperature~~ light exposure, water availability, and soil type all contribute to improving validity. However, factors such as the amounts of soil, or type of water (i.e hard/soft water, higher alkalinity etc), additionally intensity of light, as opposed to just exposure time, all need to be considered to better improve validity.

Comments: The best responses included points for and against. Some students are still confusing validity, reliability and accuracy.

Question 25 (a)

Criteria	Mark
Clear and correct distinction between exons and introns.	1

Sample answer: Exons are coding sections of DNA (ie they code for amino acids and polypeptides). Introns are non-coding parts of the DNA (ie they don't form amino acids but may have a regulatory function)

Exemplar:

An Exon codes for proteins (used in polypeptide synthesis), introns regulate gene expression and can be 'junk' (not needed) DNA (eg, short tandem repeats). An exon is coding DNA & introns are non-coding DNA. Therefore, exons play a role in protein production & introns don't. Exon contains DNA that code for amino acids and thus polypeptides. Introns contain DNA but does not code for amino acids. Its purpose is containing tRNA and gene switches. ^{the ENCODE Project believes it may code for}

Question 25 (b)

Criteria	Mark
Identifies an electromagnetic mutagen and provides detail on how it operates to change DNA.	2
Identifies an electromagnetic mutagen and provides some information on how it causes mutation.	1

Sample answer: UVB radiation has enough energy to penetrate the skin and cell and nuclear membranes. The UV is absorbed by the DNA and causes DIMERS between adjacent thymine molecules which can cause a mutation in the tumour suppressor gene.

Exemplars:

A mutagen is anything that causes a mutation. $UVB + UVc$ ^{absorbed by atmosphere} are ionising radiation that have enough energy to penetrate the nuclear membrane & cause cross-linked nucleotides, known as dimers. $\begin{matrix} T & T \\ | & | \\ A & G \\ | & | \\ T & C \end{matrix}$ These dimers can cause frameshift mutations, which affect the expression of a gene, or phenotype. A known example is melanoma, where dimers in pigment cause mutation which lead to melanoma. *Excellent*

Comments: The best responses had clear detail on the specific changes to the DNA molecule.

Question 26 (a)

Criteria	Mark
Correct cell type identified.	1

Sample answer: Germ-line cells

Question 26 (b)

Criteria	Mark
Correctly identifies inheritance as autosomal recessive with clear reasons using an identified part of the pedigree.	2
Correctly identifies inheritance as autosomal recessive with some correct reasoning given.	1

Sample answer: Individuals 1 and 2 in Generation I are free of the condition yet have a foal with the condition. If the condition was dominant then one of the parents would have to have the condition. This is not the case therefore it is recessive. Individual 1 in Gen II is female with the condition (homozygous recessive). If this was sex linked the father would have passed on his X-chromosome with the recessive allele yet he **does not** have the condition. Therefore it cannot be sex-linked.

Exemplar:

- Recessive: I1 and I2 are not affected yet II 1 their daughter is. The parents must be carriers and this is only possible if recessive. *2*

- Autosomal: Father I2 does not ^{HERDA} have the condition yet his daughter II 1 does. ~~If the condition was sex linked this would not be possible~~

Comments: Some students used the term 'skip a generation' which does shown a full understanding of the genetics to the examiner.

Question 26 (c)

Criteria	Mark
• Correct punnet square with correct genotypic and phenotypic outcomes.	3
• Incorrect parental genotypes but correct genotypic and phenotypic outcomes based on punnet square.	2
• Some aspect of the punnet squares correct.	1

Sample answer:

	H	h	Genotype 2HH : 2Hh
H	HH	Hh	
H	HH	Hh	Phenotype all normal

Exemplar:

$\frac{1}{2} \times \frac{1}{2} = \frac{1}{4}$ let HERDA be n and normal, N

	N	n
Stallion N	NN	Nn
N	NN	Nn

$NN : Nn$
 $2 : 2$
 $\therefore 50\% : 50\%$

genotypic ratios
 50% NN (normal) Homozygous dominant
 50% Nn (carrier) Heterozygous

phenotypic ratios
 100% unaffected / Normal

3

Question 27 (a)

Criteria	Mark
• Two clear differences outlined.	2
• One clear difference outlined.	1

Sample answer: Gene cloning involves cloning many copies of a small section of DNA. Uses recombinant DNA technology or PCR. Usually many copies – millions.

Whole organism cloning involves making an exact genetic copy of an organisms. Usually only one or a few copies using technologies such as somatic cell nuclear transfer for large animals and processes such as grafting or cuttings with plants.

Exemplar:

Gene cloning	Whole organism cloning
- Cloning of a single gene with recombinant DNA techniques - Easier to accomplish, can be mass produced	- Cloning of an entire organism with nuclear somatic cell transfer techniques. - Hard to accomplish, cannot be conducted often, regulations prevent certain woc.

2

Question 28 (a)

Criteria	Mark
Identifies what exact DNA replication is or isn't.	2
Links to a possible consequence if not exact.	1

Sample answer: If DNA replication is not exact for example if an incorrect base is substituted then this can lead to a change in the polypeptide and protein produced.

(a) Explain the importance of exact DNA replication. 2

Excellent

Exact DNA replication with ~~no~~ no mistakes is crucial for ensuring cells and gametes that are created through mitosis and meiosis contain the correct DNA without mutations that can occur if DNA replication is faulty. This ensures the continuation of the species through creating body cells and gametes that are free from negative mutations.

(b) Describe the function of the enzymes DNA polymerase and DNA helicase in this process. 2

Question 28 (b)

Criteria	Mark
Correctly describes the function of both enzymes.	2
Describes the function of one enzyme.	1

Sample answer: Helicase unwinds the DNA strand and polymerase matches the nucleotide bases to the separated strand.

(b) Describe the function of the enzymes DNA polymerase and DNA helicase in this process. 2

In the process of DNA replication, Helicase serves to split the double-helix of DNA through breaking the hydrogen bonds between nucleotides. This enables complementary strands of DNA to be sequenced. DNA Polymerase is used to sequence and add complementary nucleotides (Polymerase 3) whilst it is also used to scan for and correct any mistakes in the sequencing (Polymerase 1).

(c) Explain ONE way the model is different to the real structure or process.

Question 28 (c)

Criteria	Mark
One way the model is different to the real structure or process.	2
Link to a specific part of the model for better understanding.	1

Sample answer: The model is much larger than real DNA therefore the bases can be easily visualised and the pairing process better understood.

- (c) Explain ONE way the model makes the process of DNA replication easier to understand.

This model makes the process of DNA replication easier to understand through increasing the size and proportions of the strands of DNA. This enables individuals to identify the splitting and pairing of individual and fragments of nucleotides along with their respective nucleic acids.

Question 29 (a)

Criteria	Mark
• Identifies mutation	1

Sample answer: insertion or frameshift.

Question 29 (b)

Criteria	Mark
• Provides a detailed response which includes the following:	4
• Correct mRNA sequence from each DNA sequence	
• Correct amino acid sequence from each mRNA sequence	
• Describes the difference between the two amino acid sequence	
• Suggests a possible outcome because of the difference	
• Provides a detailed response with at least THREE of the above	3
• Provides a response with at least TWO of the above	2
• Provides some relevant information	1

Sample answer:

Normal DNA sequence C G T A T A T C C T A T G C C C C T G A C

Normal mRNA sequence G C A U A U A G G A U A C G G G A C U G

Normal amino acid sequence ALA-TYR-ARG-ILE-ARG-GLY-LEU

Tay-Sachs DNA sequence C G T A T A T C T C T A T G C C C C T G A C

Tay-Sachs mRNA sequence G C A U A U A G A G A U A C G G G A C U G

Tay-Sachs amino acid sequence ALA-TYR-ARG-ASP-THR-GLY-THR

The mutation in the Tay-Sachs DNA sequence changes the amino acid sequence after the ARG. Because it is a different amino acid sequence, it is likely to be a dysfunctional polypeptide.

The Tay-Sachs mutation causes a frameshift. The mutation is the mutation of a thymine and changes the polypeptide sequence that the 'HEXA' gene is for. On the HEXA gene normally is Arg Ile Arg Gly Leu but this is changed to become: Arg Asp Thr Gly Thr. This changes the polypeptide to be non-functional. Tay-Sachs DNA code is a sequence of triplet and a mutation changes that code.

Question 29 (b)

Criteria	Mark
- Shows thorough understanding of recombinant DNA technologies used to manufacture a NAMED genetically modifies organism. - Shows a thorough understanding of a NAMED GM organism and its medical or agricultural application. - Provides a detailed discussion for the impact of the named GM organism	8
- Shows sound understanding of recombinant DNA technologies used to manufacture a NAMED genetically modifies organism. - Shows a sound understanding of a NAMED GM organism and its medical or agricultural application. - Provides a discussion for the impact of the named GM organism.	6-7
- Outlines some features of recombinant DNA technologies in the manufacture of GM organisms - Outlines some features of GM organisms and their medical and agricultural application and impact	4-5
Identifies some features of the manufacture of GM organisms AND/OR their medical or agricultural application or impact	2-3
Provides some relevant information	1

Sample answer:

BT Cotton is created by inserting a gene from a soil bacterium into a cell from a cotton plant.

First the bacterial gene is inserted into a plasmid, then the plasmid is injected into the cotton plant cell.

This genetically modified (GM) cotton cell is then grown using tissue culture to produce the GM Bt Cotton plant.

When it was first introduced, BT Cotton was a successful agricultural application to improve cotton yields. The cotton, once modified, could produce its own pesticide. This reduced the need for farmers to spray these crops, thus saving money and improving the yield and farmer profits.

After some time, BT Cotton faced problems with insect resistance and the need for some straying to recommence and the development of new strains.

Question 30 (8 marks)

Describe how recombinant DNA technology has been used in a medical or agricultural application.

In your answer, include an outline of the process used to create the organism and a discussion of its impacts.

6

Recombinant DNA is the use of transgenes to create products ~~are~~ that have ~~specific uses~~.
It has a range of uses, such as insulin in the medical world. The process involves:

1. Using the EcoRI enzyme, the human gene for insulin, or antibiotic resistance gene, and sections of a plasmid is cut.

2. As EcoRI leaves sticky ends, the insulin gene and antibiotic resistance gene ~~is~~ is ~~added~~ to the plasmid, ~~and~~ creating a transgenic plasmid.

3. This ~~insulin transgenic~~ ^{transgenic} plasmid is then ~~used~~ introduced to E. coli bacteria using an electric shock to open up pores in the membrane.

4. A culture of transgenic E. coli bacteria is grown, and then exposed to antibiotics to ensure all E. coli bacteria are transgenic and contain the insulin coding exon.

5. Thus the E. coli bacteria then act as factories to produce human insulin as they have the relevant factors, capabilities and genetic information to do so. Insulin is extracted and used for diabetic patients.

Positive impacts	Negative impacts
Medical: Creates insulin more insulin for diabetic that previously need pig insulin.	Medical: Some NOT 100% responsive to all patients, possible unknown unknown side effects.
Social: Reduction of wasteful killing of pigs.	Social: Relatively high cost, inaccessibility for low SES.
Economic: Reduced costs of insulin production from pigs.	Economic: Still has relatively high cost to diabetics.
Environmental: Reduced unnecessary killing of pigs for insulin.	Environmental: Possible unknown consequences / side effects.

Excellent. 😊

Whilst having a range of negative impacts medically, socially, economically and environmentally, recombinant DNA's benefits outweigh the negatives in this criteria.

Question 30 (a)

Criteria	Mark
Identifies the correct cell	1

Sample answer: B lymphocyte or plasma cell

Question 30 (b)

Criteria	Mark
Accounts for the shape of the graph	1

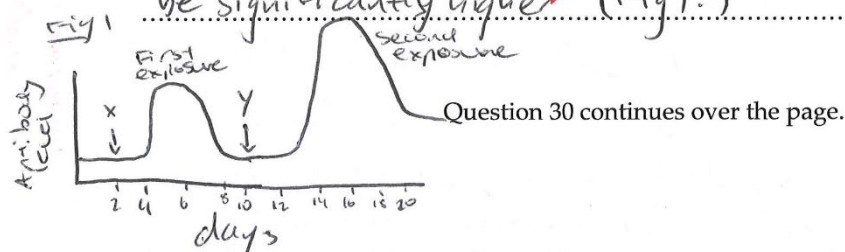
Sample answer: After the introduction of the antigen it takes time for B cell reproduction to take place and produce the antibodies – therefore the 2 day lag.

(b) Account for the shape of the graph between days 2 and 4. 1

The body used the second line defense (nonspecific) to attach the ~~2nd~~ pathogens with neutrophils & macrophages. (it is not producing specific antibodies yet). Once the macrophages displayed the pathogens antigen, it triggered the active immune response via a ~~the~~ ^{the} ~~pathogen~~ ^{antigen}, resulting in the slight increase at day 4.

(c) Describe TWO changes you would observe in the antibody levels if a second vaccination were given at Y.

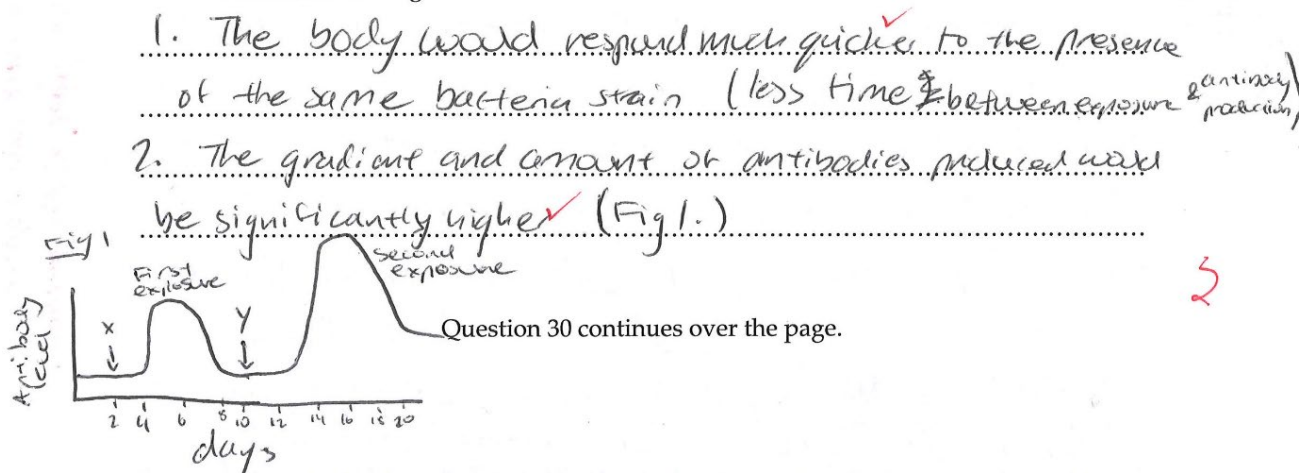
- The body would respond much quicker to the presence of the same bacteria strain (less time ~~between~~ ^{antigen} exposure ^{reaction}).
- The gradient and amount of antibodies produced would be significantly higher (Fig 1.)



Question 30 (c)

Criteria	Mark
• Describes clearly TWO changes in the shape of the curve.	2
• Describes ONE change in the graph.	1

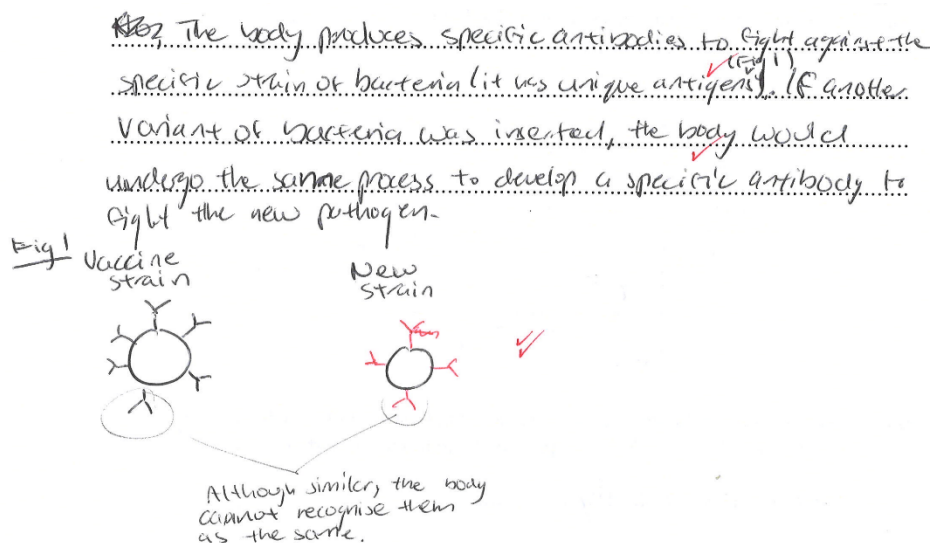
Sample answer: The antibody levels will increase immediately (no lag) the peak of the graph will be higher and the period of time for the drop off of antibodies will be slower.



Question 30 (d)

Criteria	Mark
• Identifies that each antibody is specific to a particular antigen	2
• Links this to new strain having a different antigen therefore ineffective.	1
• As above but fails to show clear link.	1

Sample answer: Each antibody is antigen specific therefore a new strain will contain a new antigen and therefore the antibody will be ineffective.



Question 31 (a)

- (a) Explain whether Emily or Grace had a defect in the blood-glucose homeostatic mechanism. Refer to at least two parts of the graph to support your answer. 2

Name of female: Emily

Explanation:

The average set point for both individuals appears to be around 100. ~~80~~ Emily's larger spike after one hour indicates her cells are slightly resistant to the amount of insulin her pancreas produces, thus causing a higher blood glucose level. Additionally, the amount of time taken for Emily's blood glucose to return to 100 is significantly longer than Grace's, further indicating she is resistant to insulin.

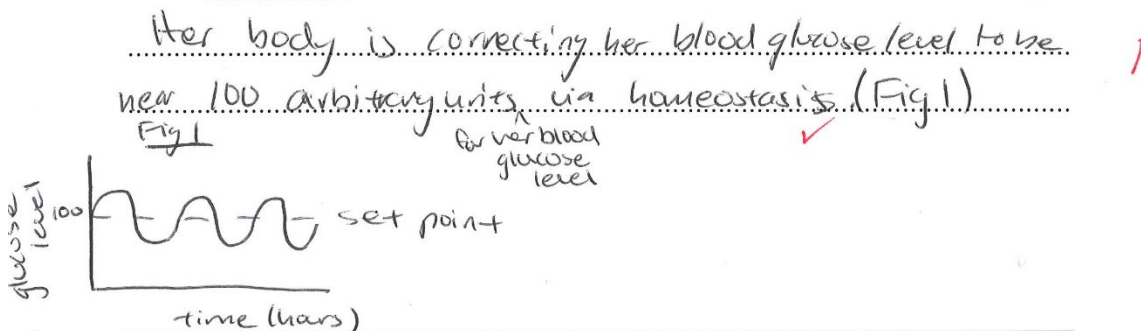
Criteria	Mark
• Correct female named with TWO parts of graph linked	2
• Correct female with ONE part of graph	1

Sample answer: Emily had a defect evidenced by the higher rate of increase, the higher spike, longer delay for decrease compared to Grace and level still not down to set level after 5 hours.

Question 31 (b)

Criteria	Mark
• Small rise explained	1

Sample answer: When the level dropped below the norm hormones kicked in to cause the increase.



Question 32 (a)

Criteria	Mark
• Correct answer stated.	1

Sample answer: Approximately 22 000.

Question 32 (b)

Criteria	Mark
• Correct answer stated.	1

Sample answer: Approximately 10 000.

Question 32 (c)

Criteria	Mark
• Provides TWO logical explanations to account for the decrease.	2
• Provides ONE explanation.	1

Sample answer: Logical responses such as education programs and public advertising campaigns to increase awareness of the benefits of good nutrition and a healthy lifestyle. Increased awareness and participation in fitness programs. Decrease in the number of people regularly smoking.