



NSW Education Standards Authority

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Centre Number

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Student Number

2024 HIGHER SCHOOL CERTIFICATE EXAMINATION

Biology

General Instructions

- Reading time – 5 minutes
- Working time – 3 hours
- Write using black pen
- Draw diagrams using pencil
- Calculators approved by NESA may be used
- Write your Centre Number and Student Number at the top of this page

Total marks: 100

Section I – 20 marks (pages 2–14)

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

Section II – 80 marks (pages 17–40)

- Attempt Questions 21–35
- Allow about 2 hours and 25 minutes for this section

Section I

20 marks

Attempt Questions 1–20

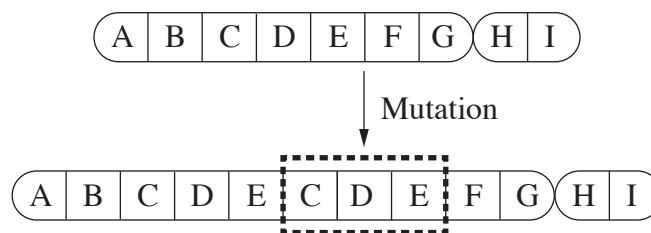
Allow about 35 minutes for this section

Use the multiple-choice answer sheet for Questions 1–20.

- 1** Which of the following are non-cellular pathogens?
- A. Bacteria
 - B. Fungi
 - C. Prions
 - D. Protozoa
- 2** Resin produced by spinifex grass has long been used by Aboriginal Peoples. Spinifex resin is currently used to produce medicinal creams.

What is this an example of?

- A. Biotechnology
 - B. Selective breeding
 - C. Artificial insemination
 - D. Genetically modified organisms
- 3** The image shows a chromosome that has undergone mutation. Each letter represents a gene.



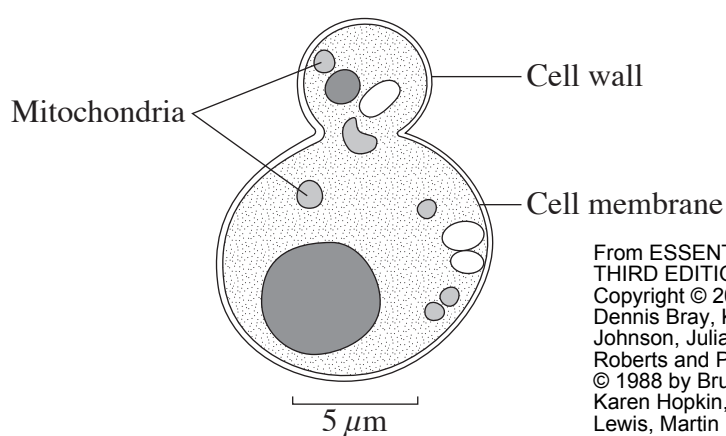
What type of mutation has occurred?

- A. Deletion
- B. Duplication
- C. Inversion
- D. Substitution

4 Which row of the table correctly identifies components of DNA?

	<i>Phosphate</i>	<i>Ribose</i>	<i>Deoxyribose</i>	<i>Uracil</i>	<i>Thymine</i>
A.	✓		✓	✓	
B.		✓		✓	✓
C.		✓	✓		✓
D.	✓		✓		✓

5 The diagram shows a cell reproducing.

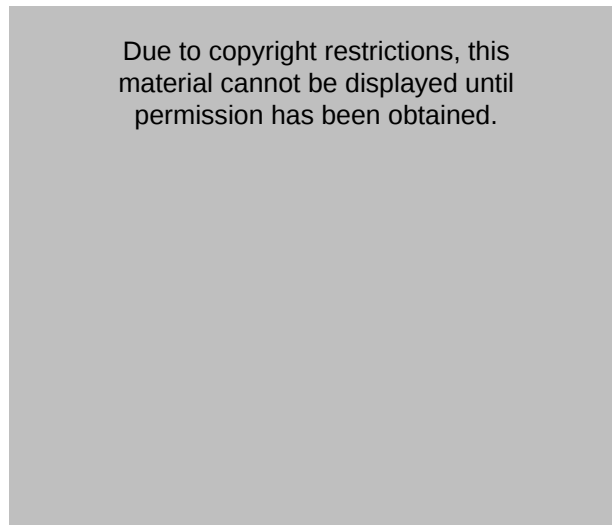


From ESSENTIAL CELL BIOLOGY,
THIRD EDITION by Bruce Alberts, et al.
Copyright © 2010, 2004 Bruce Alberts,
Dennis Bray, Karen Hopkin, Alexander
Johnson, Julian Lewis, Martin Raff, Keith
Roberts and Peter Walker.
© 1988 by Bruce Alberts, Dennis Bray,
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Lewis, Martin Raff, Keith Roberts and Peter
Walker. Used by permission
of W. H. Norton & Company, Inc.

Which row of the table correctly identifies the method of reproduction and the type of organism shown in the diagram?

	<i>Method of reproduction</i>	<i>Type of organism</i>
A.	Budding	Fungi
B.	Binary fission	Bacteria
C.	Production of spores	Plant
D.	Gamete production	Protist

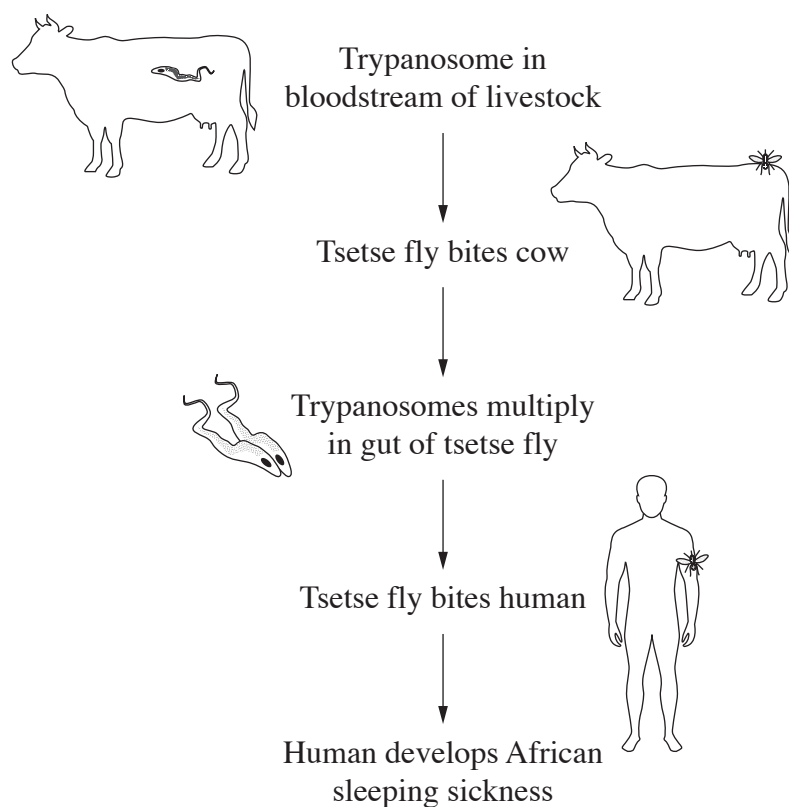
- 6 The diagram shows the karyotypes of a body cell for a male and a female fruit fly.



How many chromosomes will the egg of a female fruit fly have?

- A. 2
 - B. 4
 - C. 6
 - D. 8
- 7 How do stomata maintain water balance in plants?
- A. They close in hot weather to decrease transpiration.
 - B. They open in cold weather to decrease transpiration.
 - C. They open in hot weather to decrease evaporative cooling.
 - D. They close in cold weather to decrease evaporative cooling.

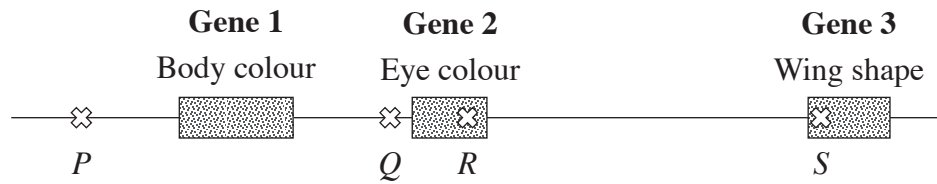
- 8 Trypanosomes (*Trypanosoma brucei*) are protozoans that cause African sleeping sickness in humans. The diagram shows the way that the disease is transmitted to humans.



Which row of the table identifies the pathogen, vector and method of disease transmission to humans?

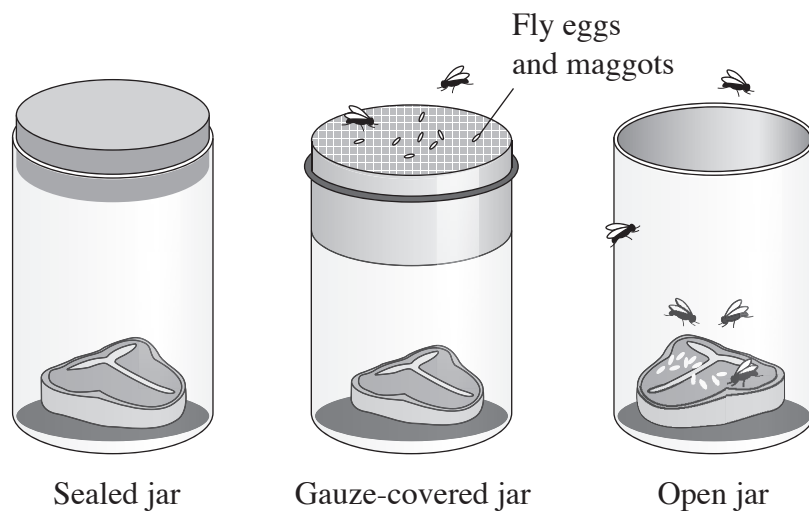
	<i>Pathogen</i>	<i>Vector</i>	<i>Method of disease transmission</i>
A.	Trypanosomes	Tsetse fly	Direct
B.	Tsetse fly	Cow	Direct
C.	Trypanosomes	Tsetse fly	Indirect
D.	Tsetse fly	Cow	Indirect

- 9 The diagram shows a section of a chromosome in an insect. It represents three genes amongst non-coding DNA. The crosses mark locations of four separate mutations.



Which location could produce a new allele for eye colour?

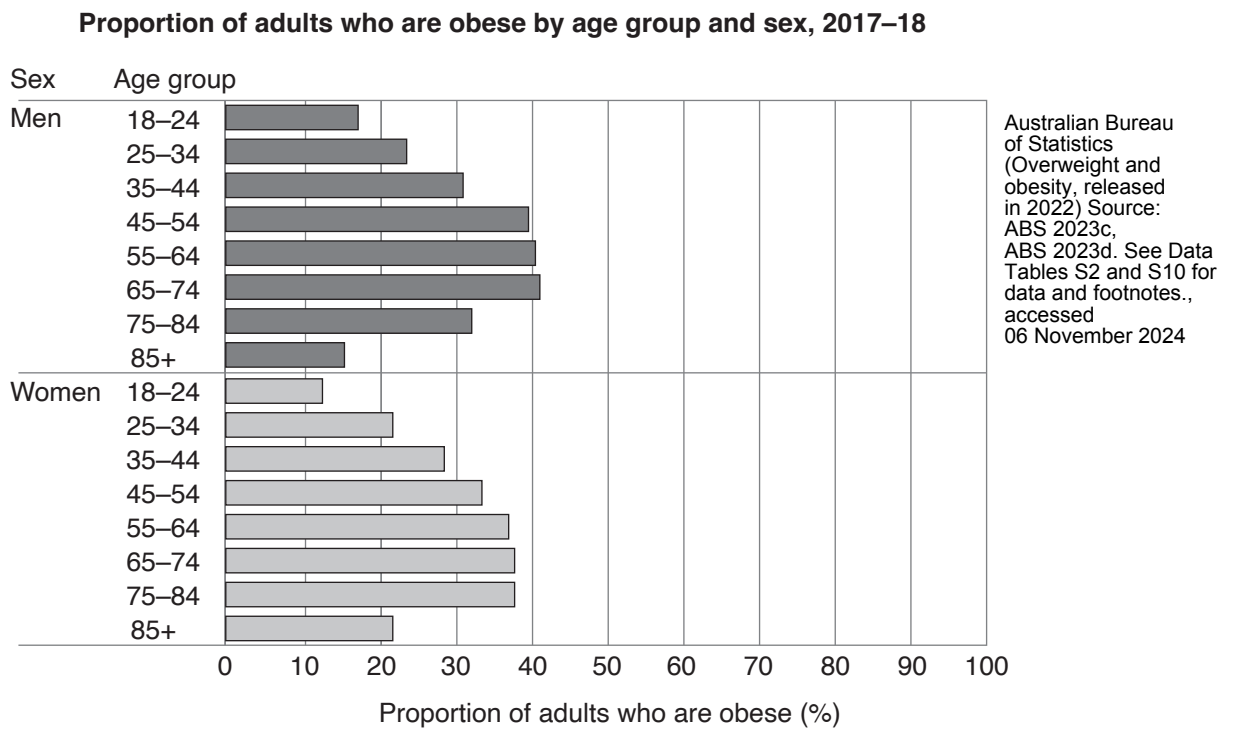
- A. *P*
 - B. *Q*
 - C. *R*
 - D. *S*
- 10 Francesco Redi challenged the idea that maggots arose spontaneously from rotting meat. A modern version of his experiment was set up as shown.



Which of the following is correct for this experimental set up?

- A. The sealed jar improves the validity of the experiment.
- B. The independent variable is whether the meat spoils or not.
- C. The use of three jars improves the reliability of the experiment.
- D. The dependent variable is the use of different covers for the jars.

- 11 The data shows the proportion of adults living in Australia who are obese.



Which of the following can be observed from the data?

- A. The proportion of obese adults always increases with age.
- B. There is a greater percentage of men who are obese than women in all age groups.
- C. The proportion of women who are obese increases from 13% at 18–24 to 38% at 65–74.
- D. The proportion of men who are obese increases from 18% at 18–24 to 35% at 45–54, then decreases to 23% at age 85 and over.

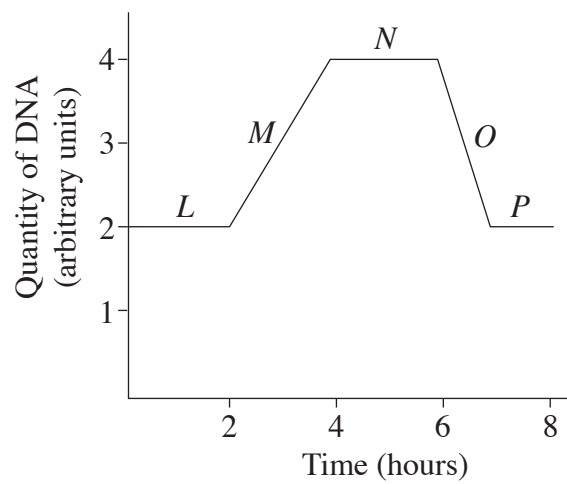
- 12** Robert Koch produced a set of criteria to establish whether a particular organism is the cause of a disease in an animal. The criteria are listed below but not in the correct order.

1. The microorganism must cause disease when introduced to a healthy experimental animal.
2. The microorganism must be extracted and isolated from the diseased animal and subsequently grown in culture.
3. The microorganism must be extracted from the diseased experimental animal and demonstrated to be the same microorganism that was isolated from the first diseased animal.
4. The microorganism must be found in the diseased animal, and not found in healthy animals.

Which of the following correctly shows the order of steps required to determine the cause of a particular disease in an animal?

- A. 2, 3, 1, 4
 - B. 2, 4, 1, 3
 - C. 4, 2, 1, 3
 - D. 4, 3, 2, 1
- 13** Which of the following identifies plant responses to pathogens?
- A. Increased phagocytosis and programmed cell death
 - B. Increased number of stomata and programmed cell death
 - C. Production of antihistamines and increased thickness of cell walls
 - D. Production of antimicrobial substances and increased thickness of cell walls

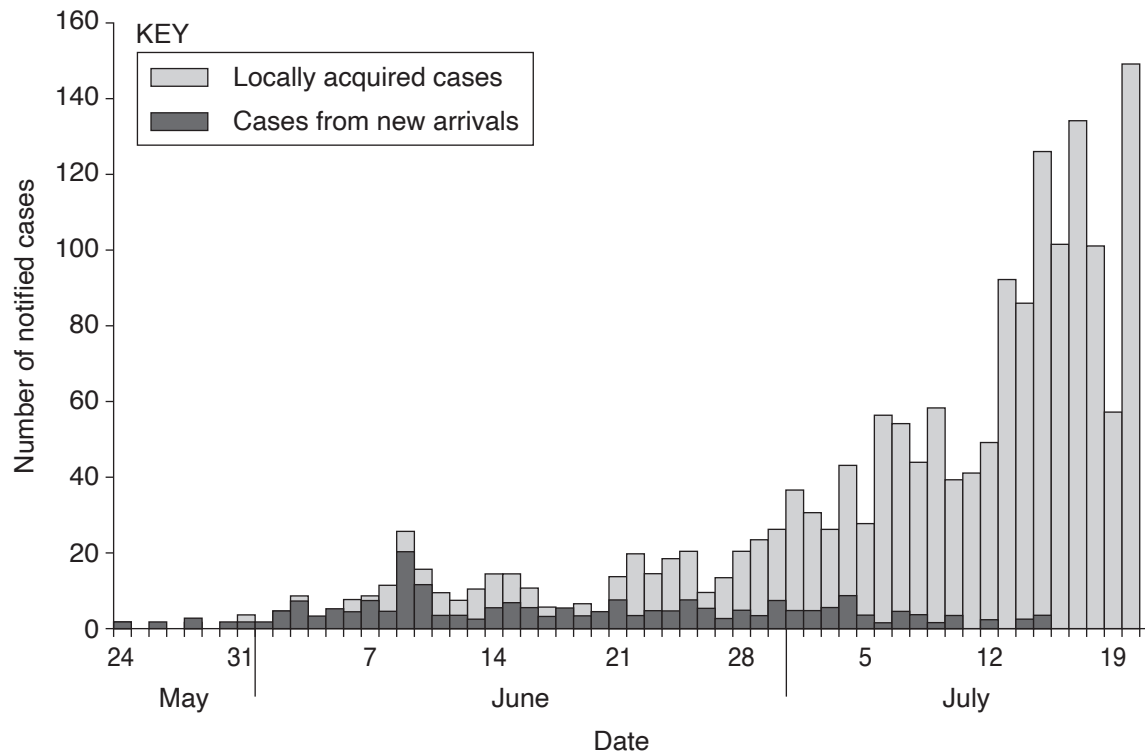
- 14 The graph shows the quantity of DNA in one mammalian cell over time.



Which of the statements about the cell's activity is correct?

- A. The cell is dividing during section *O*.
- B. The cell is inactive for the first two hours.
- C. The cell takes one hour to replicate its DNA.
- D. The cell becomes diploid only during section *N*.

- 15 The graph shows the number of cases of Swine Flu (a viral respiratory illness) from May to July 2009 in Australia.

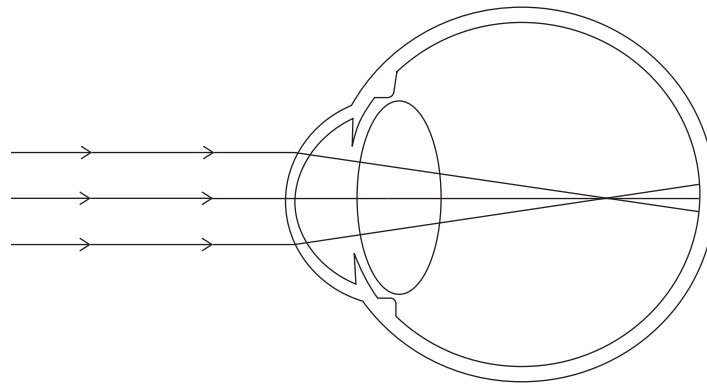


PLOS ONE (Pandemic (H1N1) 2009 Influenza Community Transmission Was Established in One Australian State When the Virus Was First Identified in North America)

What effective control measures could have been introduced between May and July to limit the spread of the disease in Australia?

	<i>May–June</i>	<i>July</i>
A.	Quarantine all people arriving in Australia	Encourage people to wear masks and wash hands regularly
B.	Issue antibiotics to overseas visitors	Isolate people with symptoms
C.	Encourage people to wear masks and wash hands regularly	Quarantine all people arriving in Australia
D.	Isolate people with symptoms	Vaccinate all people arriving in Australia

- 16** In a person with a particular visual disorder, light from a distant object focuses in front of the retina.



Biology in Focus Year 12',
2nd Ed, Chidrawi et al, 2018,
ISBN: 9780170408851.
Reproduced with permission
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Australia.

How can this disorder be corrected?

- A. Laser surgery to reshape the retina
 - B. Use of a diverging lens in front of the eye
 - C. Use of a converging lens in front of the eye
 - D. Laser surgery to make the cornea more curved
- 17** Over 12 months, the prevalence of a non-infectious disease will increase in a population if
- A. the total population increases.
 - B. disease recovery time decreases.
 - C. the incidence rate of the disease decreases.
 - D. the survival time of individuals with the disease increases.

- 18 The following diagram models a population of glowworms in an isolated cave. The letters B and b represent the alleles for a gene in an individual.

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Which row of the table correctly identifies the process and reason for the change in the gene pool?

	<i>Process</i>	<i>Reason</i>
A.	Gene flow	Change in frequency of the b allele due to a mutation
B.	Genetic drift	Change in frequency of the b allele due to random events
C.	Gene flow	Introduction of more b alleles due to new members moving into the population
D.	Genetic drift	Introduction of more b alleles due to this allele being more advantageous

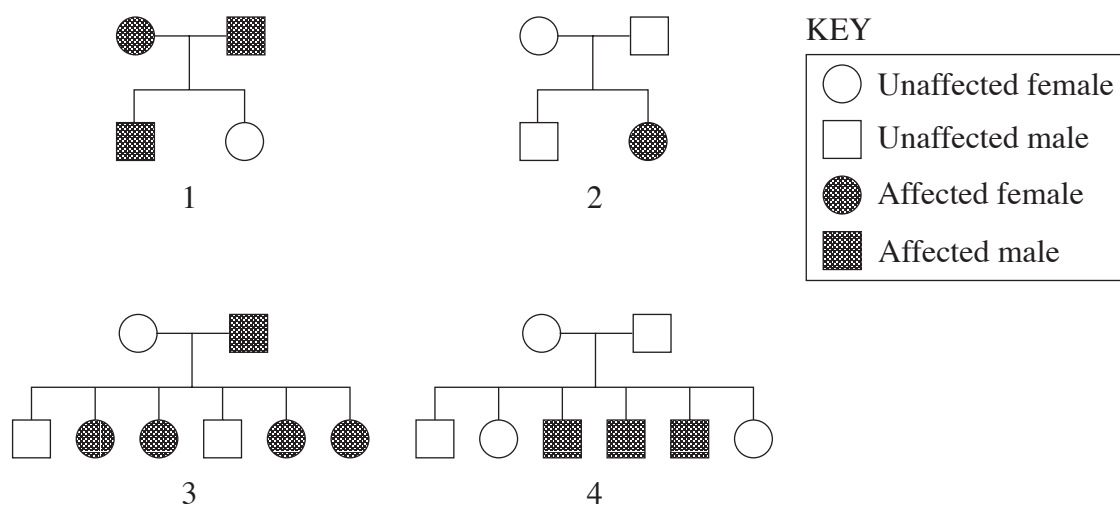
- 19** The diagram represents some experimental steps used in the production of large amounts of human growth hormone.

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What makes this technology successful?

- A. DNA ligase can cut human growth hormone genes from human cells.
- B. Human growth hormone can cause *E. coli* to grow and mature rapidly.
- C. Human plasmids containing the gene of interest can be inserted into bacteria.
- D. Restriction enzymes can produce sticky ends on both bacterial and human DNA.

20 Analyse the following four pedigrees.



© Epomedicine.com

Which row in the table correctly identifies the pedigree with the type of inheritance?

	<i>Autosomal dominant</i>	<i>Sex-linked dominant</i>	<i>Autosomal recessive</i>	<i>Sex-linked recessive</i>
A.	2	1	3	4
B.	1	4	2	3
C.	1	3	2	4
D.	2	4	1	3

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Centre Number

Biology

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Student Number

Section II Answer Booklet

80 marks

Attempt Questions 21–35

Allow about 2 hours and 25 minutes for this section

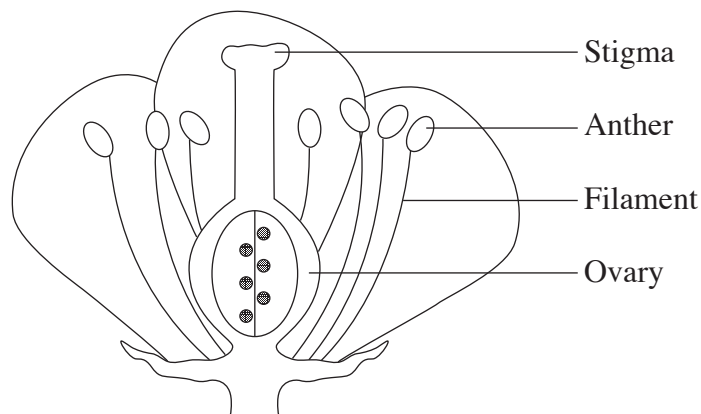
Instructions

- Write your Centre Number and Student Number at the top of this page.
- 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.
- Extra writing space is provided at the back of this booklet. If you use this space, clearly indicate which question you are answering.

Please turn over

Question 21 (5 marks)

A diagram of the different parts of a flower is shown.



Courtesy of Physics Catalyst

- (a) Identify the structures where pollen and ovules are located.

2

Pollen

Ovules

- (b) Complete the table to compare features of sexual and asexual reproduction.

3

<i>Feature</i>	<i>Sexual</i>	<i>Asexual</i>
Genetic variability (yes/no)		
Number of parents required		
Example of an organism which uses this type of reproduction		

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Question 22 (4 marks)

A student designed and conducted a practical investigation to test for the presence of microbes in water and food samples.

- (a) Justify a safety precaution required to prevent infection when conducting the investigation. **2**

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- (b) Explain how the student could ensure the reliability of the investigation. **2**

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Please turn over

Question 23 (2 marks)

Outline how ONE type of electromagnetic radiation can cause a germline mutation.

2

Name of electromagnetic radiation:

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Do NOT write in this area.

Question 24 (5 marks)

- (a) Outline the cause of a disease due to environmental exposure.

2

Name of disease:

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- (b) Explain how an educational program or campaign can be used to decrease the incidence of a disease caused by environmental exposure.

3

Name of disease:

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Please turn over

Question 25 (6 marks)

- (a) One-Eyed Jack was a rescue dog that had been injured and lost an eye before his owner adopted him. One-Eyed Jack was cloned and the clone was born with two eyes.

2

Explain why the cloned dog was born with two eyes.

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- (b) Describe how animals like dogs can be cloned.

4

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Question 26 (4 marks)

Describe a plant disease and its effect on agricultural production.

4

Name of plant disease:

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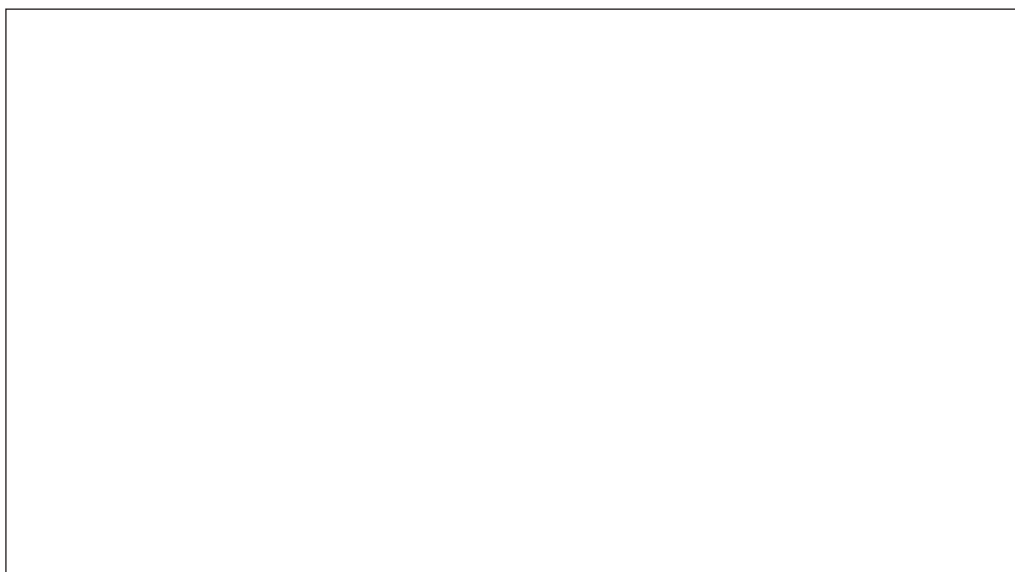
Question 28 (7 marks)

Cystic fibrosis is an inherited disorder that causes damage to the lungs, digestive system and other organs in the body. A person with cystic fibrosis will have two faulty recessive alleles for the cystic fibrosis gene (CFTR) on chromosome 7.

- (a) Two healthy parents, heterozygous for cystic fibrosis, have a child that does not have cystic fibrosis. They are planning to have a second child.

3

Using a Punnett square, determine the probability of their second child being born with the condition. Use ' R ' for the normal CFTR allele, and ' r ' for the faulty CFTR allele.



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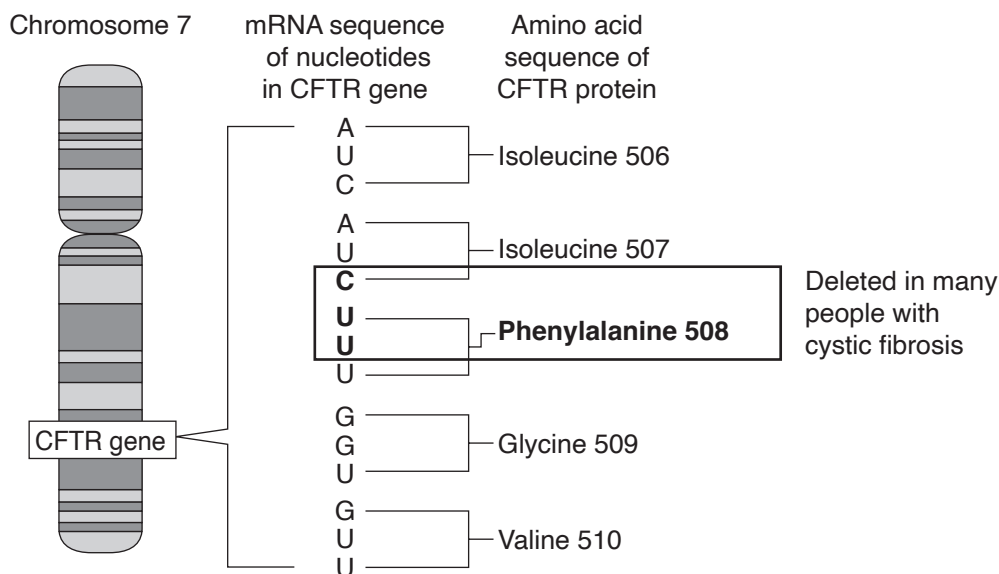
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Question 28 continues on page 26

Question 28 (continued)

The defect that creates the faulty CFTR allele is often caused by the deletion of three nucleotides. The following diagram illustrates a small section of the CFTR gene and the corresponding amino acid sequence of the CFTR protein.



The following codon chart displays all the codons and the corresponding amino acids. The chart translates mRNA sequences into amino acids.

		Second base					
		U	C	A	G		
First base	U	UUU } Phenylalanine	UCU } Serine	UAU } Tyrosine	UGU } Cysteine	U	Third base
		UUC } Phenylalanine	UCC } Serine	UAC } Tyrosine	UGC } Cysteine	C	
		UUA } Leucine	UCA } Serine	UAA - STOP	UGA - STOP	A	
		UUG } Leucine	UCG } Serine	UAG - STOP	UGG - Tryptophan	G	
	C	CUU } Leucine	CCU } Proline	CAU } Histidine	CGU } Arginine	U	
		CUC } Leucine	CCC } Proline	CAC } Histidine	CGC } Arginine	C	
		CUA } Leucine	CCA } Proline	CAA } Glutamine	CGA } Arginine	A	
		CUG } Leucine	CCG } Proline	CAG } Glutamine	CGG } Arginine	G	
	A	AUU } Isoleucine	ACU } Threonine	AAU } Asparagine	AGU } Serine	U	
		AUC } Isoleucine	ACC } Threonine	AAC } Asparagine	AGC } Serine	C	
		AUA } Isoleucine	ACA } Threonine	AAA } Lysine	AGA } Arginine	A	
		AUG - Methionine	ACG } Threonine	AAG } Lysine	AGG } Arginine	G	
	G	GUU } Valine	GCU } Alanine	GAU } Aspartic acid	GGU } Glycine	U	
		GUC } Valine	GCC } Alanine	GAC } Aspartic acid	GGC } Glycine	C	
		GUA } Valine	GCA } Alanine	GAA } Glutamic acid	GGA } Glycine	A	
		GUG } Valine	GCG } Alanine	GAG } Glutamic acid	GGG } Glycine	G	

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Question 28 continues on page 27

Question 28 (continued)

- (b) Explain how the deletion of nucleotides in the CFTR gene removes only one amino acid. Include reference to the nucleotides that code for isoleucine and phenylalanine amino acids.

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End of Question 28

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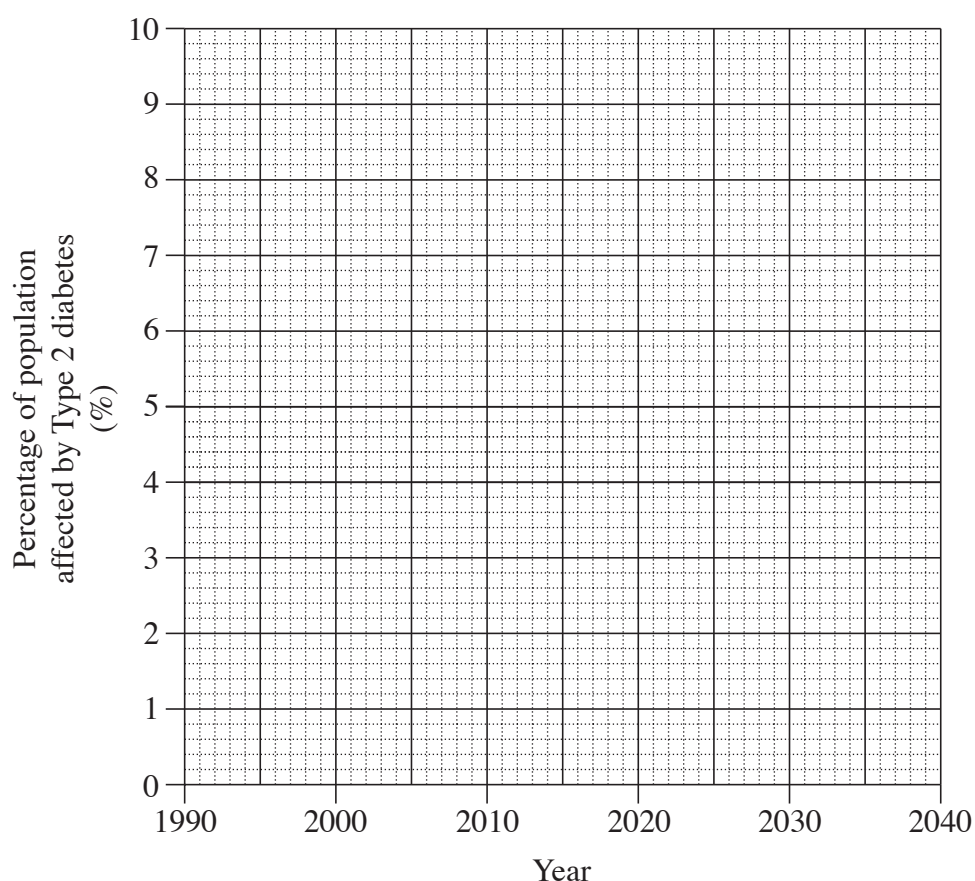
Question 29 (5 marks)

An epidemiological study was conducted to help model how many people will be affected by Type 2 diabetes globally in the future. Continuous data were collected from 1990 to 2020. From that data, the following data points were chosen to demonstrate the trend.

<i>Year</i>	<i>Percentage of population affected by Type 2 diabetes (%)</i>
1990	3.1
2000	3.7
2010	4.3
2020	5.6

- (a) Plot the data on the grid provided and include the line of best fit.

2



Question 29 continues on page 29

Question 29 (continued)

- (b) A prediction of the global population numbers suggests there will be about 9 billion (9 000 000 000) people on the planet by 2040. 3

Predict the number of people that will be affected by diabetes in 2040. Show working on your graph on the previous page and your calculations.

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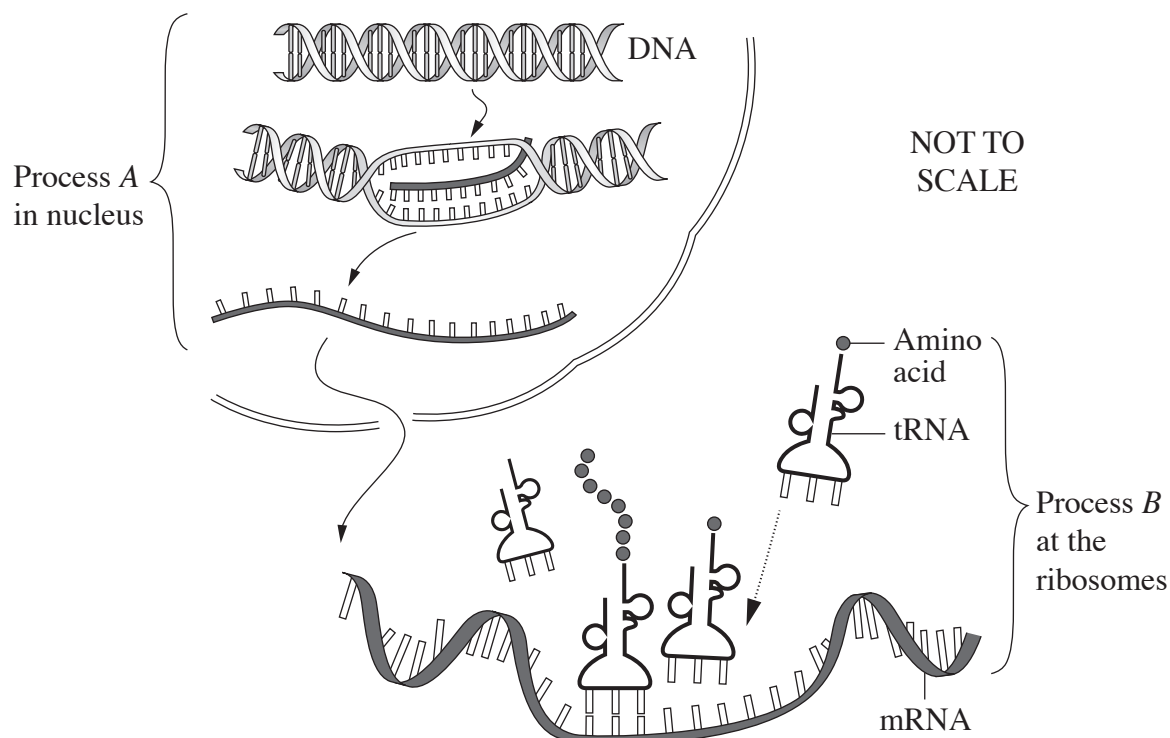
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End of Question 29

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Question 30 (8 marks)

The diagram shows a simplified version of the process of polypeptide synthesis.



This file is licensed under the Creative Commons Attribution-Share Alike 3.0 Unported license – <http://commons.wikimedia.org/wiki/File:MRNA-interaction.png>

- (a) Compare Process A with DNA replication.

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Question 30 continues on page 31

Question 30 (continued)

- (b) Explain the importance of mRNA and tRNA in polypeptide synthesis.

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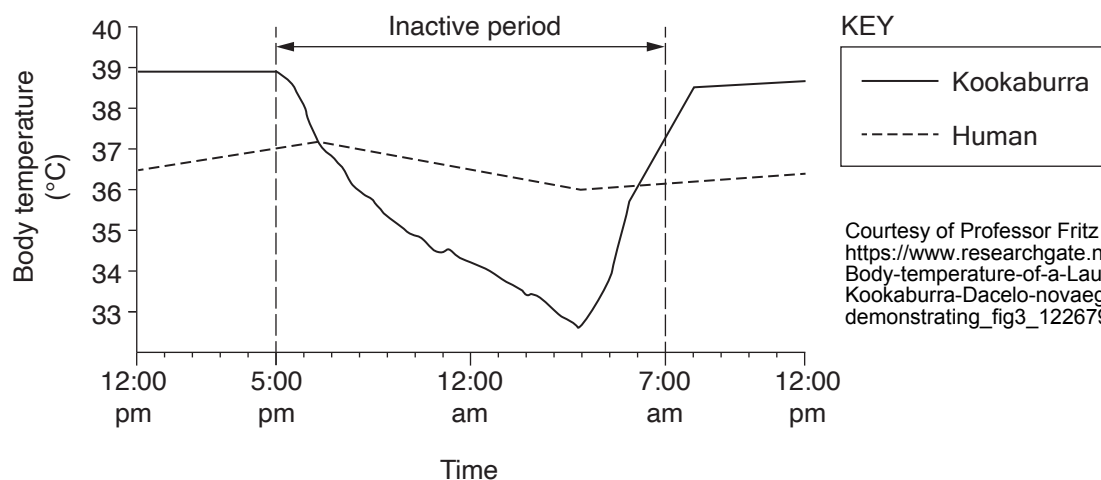
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End of Question 30

Question 31 (6 marks)

A study monitored the changes in the body temperature of a kookaburra (an Australian bird) and a human over a 24-hour period. The results of the study are shown in the graph.



- (a) At what time was the kookaburra's body temperature the lowest? 1

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- (b) Some endothermic organisms can display torpor (a significant decrease in physiological activity). 3

With reference to the graph, explain whether the human or the kookaburra was displaying torpor and if so, state the time this occurred.

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- (c) Outline an adaptation that may lead to an increase in the kookaburra's body temperature during the inactive period. 2

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Question 32 (7 marks)

Helicobacter pylori is a bacterium that invades the gut lining and can cause damage to the stomach as shown in the diagram.

7

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With reference to innate and adaptive immunity, explain how the body responds after exposure to *Helicobacter pylori*.

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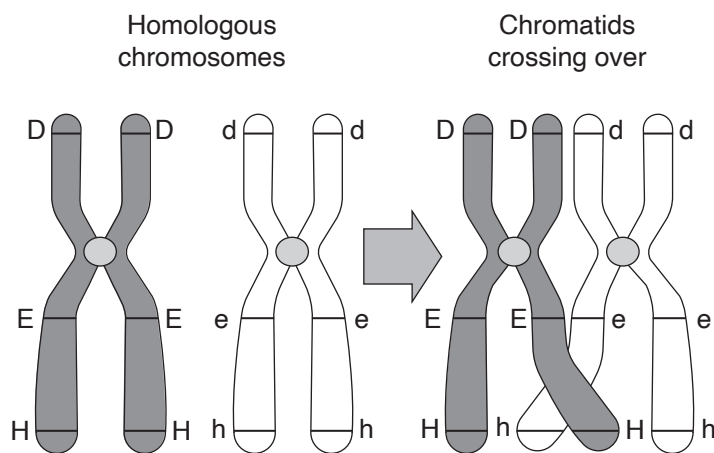
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Question 33 (4 marks)

Female Jack Jumper ants (*Myrmecia pilosula*) have a single pair of chromosomes. During meiosis, crossing over occurs. The diagram shows the crossing over and the position of three genes on the chromosomes.



- (a) Outline the significance of crossing over for the Jack Jumper ants.

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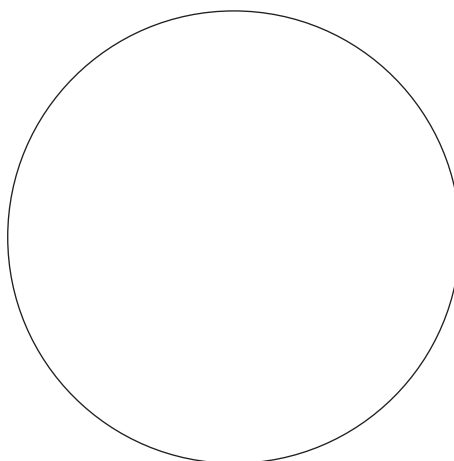
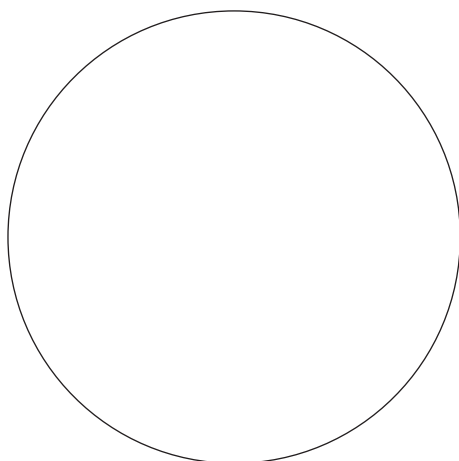
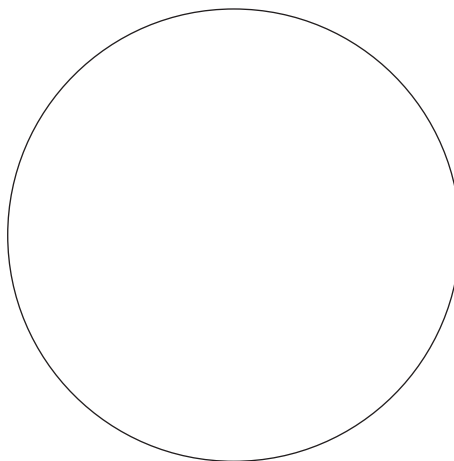
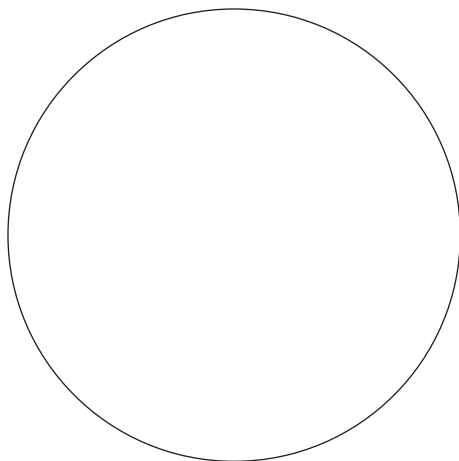
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Question 33 continues on page 35

Question 33 (continued)

- (b) Draw the chromosomes of the four possible gametes after crossing over for the Jack Jumper ants occurs. Include the alleles for each gene.

2



End of Question 33

Discuss the ethical implications and impacts on society of the use of TWO biotechnologies.

This image shows a full page of white paper with horizontal ruling lines. The lines are evenly spaced and extend across the width of the page, providing a template for handwriting practice or general writing. There are no margins, text, or other markings on the page.

Do NOT write in this area.

Question 35 (5 marks)

The graph shows the results of a survey conducted to determine if children changed their method of communication after cochlear implantation.

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With reference to the data, describe how cochlear implants work, and how they affect communication in children.

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Section II extra writing space

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Section II extra writing space

If you use this space, clearly indicate which question you are answering.

Handwriting practice lines for Section II extra writing space.

Section II extra writing space

If you use this space, clearly indicate which question you are answering.

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2024 HSC Biology Marking Guidelines

Section I

Multiple-choice Answer Key

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

Section II

Question 21 (a)

Criteria	Marks
• Identifies BOTH structures correctly	2
• Provides some relevant information	1

Sample answer:

Pollen – anther

Ovule – ovary

Question 21 (b)

Criteria	Marks
• Correctly compares all features of sexual and asexual reproduction	3
• Compares most features of sexual and asexual reproduction correctly	2
• Provides some relevant information	1

Sample answer:

Feature	Sexual	Asexual
Genetic variability	Yes	No
Number of parents required	2	1
Example of an organism which uses this type of reproduction	Humans	Bacteria

Question 22 (a)

Criteria	Marks
• Justifies a safety precaution used to prevent infection	2
• Provides some relevant information	1

Sample answer:

The wearing of gloves to prevent contact with skin and the subsequent entry of pathogens into skin/mouth

Answers could include:

Keeping the petri dish closed and wiping down the benchtop with an antiseptic after viewing the microbes – this will kill any pathogens that may have escaped the petri dish and could be transferred to the student.

Question 22 (b)

Criteria	Marks
• Explains how to ensure the investigation is reliable	2
• Provides some relevant information	1

Sample answer:

The student could repeat the experiment by using five plates to culture the same sample of food or water. This would mean the student could check that the results are similar in each test.

Question 23

Criteria	Marks
• Outlines how a named type of electromagnetic radiation can cause a DNA mutation	2
• Provides some relevant information	1

Sample answer:

X-rays are a type of electromagnetic radiation that damages the structure of DNA. If this damage occurs to the DNA in gametes (sex cells) then it is a germline mutation.

Question 24 (a)

Criteria	Marks
• Outlines a cause of a disease relating to environmental exposure	2
• Provides some relevant information	1

Sample answer:

Lung cancer can be caused by exposure to inhalation of smoke from cigarettes.

Question 24 (b)

Criteria	Marks
• Explains how a program/campaign will help to decrease the incidence of the disease	3
• Outlines features of a relevant program/campaign	2
• Provides some relevant information	1

Sample answer:

An educational program in schools could teach students that UV exposure causes skin cancer, and that to protect from this, they should wear hats and sunscreen when outside. This will help to increase student's understanding of the risk and therefore increase compliance, and help to prevent the cause of skin cancer (UV rays damaging DNA in cells).

Question 25 (a)

Criteria	Marks
• Explains the relationship between the cloning of the dog and being born with both eyes	2
• Provides some relevant information	1

Sample answer:

The rescue dog had been injured and lost an eye but it still had the genetic code for two eyes which the clone inherited.

Question 25 (b)

Criteria	Marks
• Describes how animals can be cloned	4
• Outlines how animals can be cloned	3
• Demonstrates some understanding of the cloning of animals	2
• Provides some relevant information	1

Sample answer:

The egg of a host animal is enucleated (nucleus removed). The nucleus of a body cell of the animal to be cloned is removed. The nucleus of the animal to be cloned is inserted into the enucleated host animal's egg to produce a zygote. The zygote is stimulated to divide via electric charge. The zygote is then transplanted into the surrogate mother's uterus. After a period of time, a cloned animal is born.

Question 26

Criteria	Marks
• Describes a named plant disease and its effects on agriculture	4
• Outlines a plant disease and its effect on agriculture	3
• Demonstrates some understanding of a plant disease or its effects on agriculture	2
• Provides some relevant information	1

Sample answer:

Stone fruit scab

This is a fungal disease that affects stone fruit such as plums, peaches and nectarines. It starts as small dark spots on the fruit which later become scabby and may cause the fruit to crack, shrivel and fall off the plant.

It causes downgrading of fruit quality and decreased fruit yield, leading to economic losses.

Question 27

Criteria	Marks
• Demonstrates a thorough understanding of the trends observed in the graph and the role of Pasteur's work	5
• Demonstrates a sound understanding of the trends observed in the graph and the role of Pasteur's work	4
• Demonstrates some understanding of Pasteur's work with reference to trend(s) in the graph	3
• Demonstrates some understanding of Pasteur's work or a trend in the graph	2
• Provides some relevant information	1

Sample answer:

Pasteur's work involved disproving spontaneous generation. This understanding of microbes explains that organisms in the milk could be causing the disease outbreaks.

Pasteur's work also showed that heating substances to high temperatures causes microbes to be killed. Similarly, increasing the temperature of the milk to 70°C kills many bacteria in milk.

The knowledge that there are microbes in milk and that heating the milk would kill the microbes explains why pasteurised milk would reduce the likelihood of disease outbreaks. This is seen with the number of outbreaks due to pasteurised milk generally being much lower compared to raw milk – it can be seen that after 1945 the number of raw milk disease outbreaks decreased significantly.

The low number of outbreaks after 1945 may also be due to fewer people drinking raw milk. There were some outbreaks due to pasteurised milk – this could be due to problems during the pasteurisation, storage or transport of the pasteurised milk.

Question 28 (a)

Criteria	Marks
- Provides the correct parental genotypes and suitable working with a Punnett square - Provides the correct probability of the second child having cystic fibrosis	3
- Provides the correct probability with some correct working OR - Provides the correct parental genotypes with suitable working	2
Provides some relevant information	1

Sample answer:

	<i>R</i>	<i>r</i>
<i>R</i>	<i>RR</i>	<i>Rr</i>
<i>r</i>	<i>Rr</i>	<i>rr</i>

There is a 25% chance of the second child having cystic fibrosis.

Question 28 (b)

Criteria	Marks
- Provides a thorough explanation of how the deletion removes only one amino acid - Refers to isoleucine, phenylalanine and the final amino acid sequence	4
- Provides a sound explanation of the deletion of one amino acid - Refers to appropriate amino acids or the effects of deletions	3
Demonstrates some understanding of how mRNA codes for amino acids or of the effects of deletions	2
Provides some relevant information	1

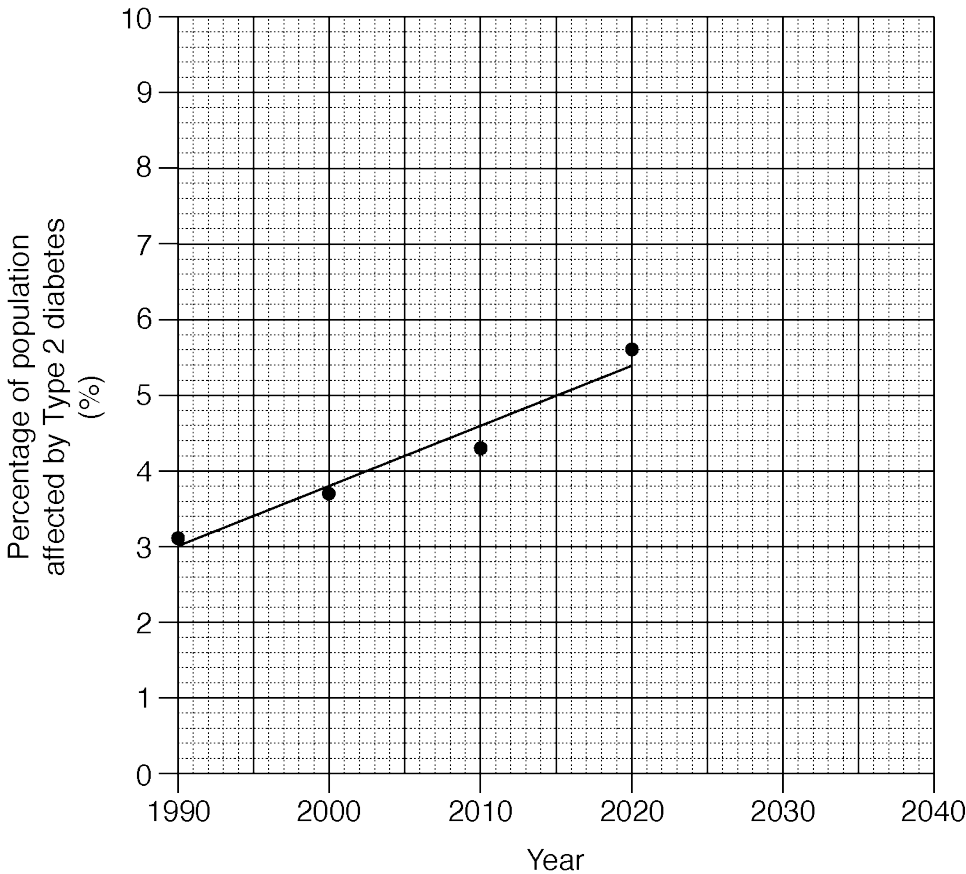
Sample answer:

A triplet of mRNA nucleotides codes for one amino acid, however, the three nucleotides that are removed span across two triplet codons – the codon for isoleucine and the codon for phenylalanine. Therefore, it would be expected that both amino acids are affected. However, isoleucine can be coded for by a number of different triplet nucleotide combinations. The correct coding is AUC, but after the deletion of the three nucleotides, the code left is AUU, which also codes for isoleucine. Thus, only the phenylalanine amino acid is removed.

Question 29 (a)

Criteria	Marks
- All points plotted correctly - Appropriate line of best fit drawn	2
- Some points plotted correctly OR - Line of best fit attempted	1

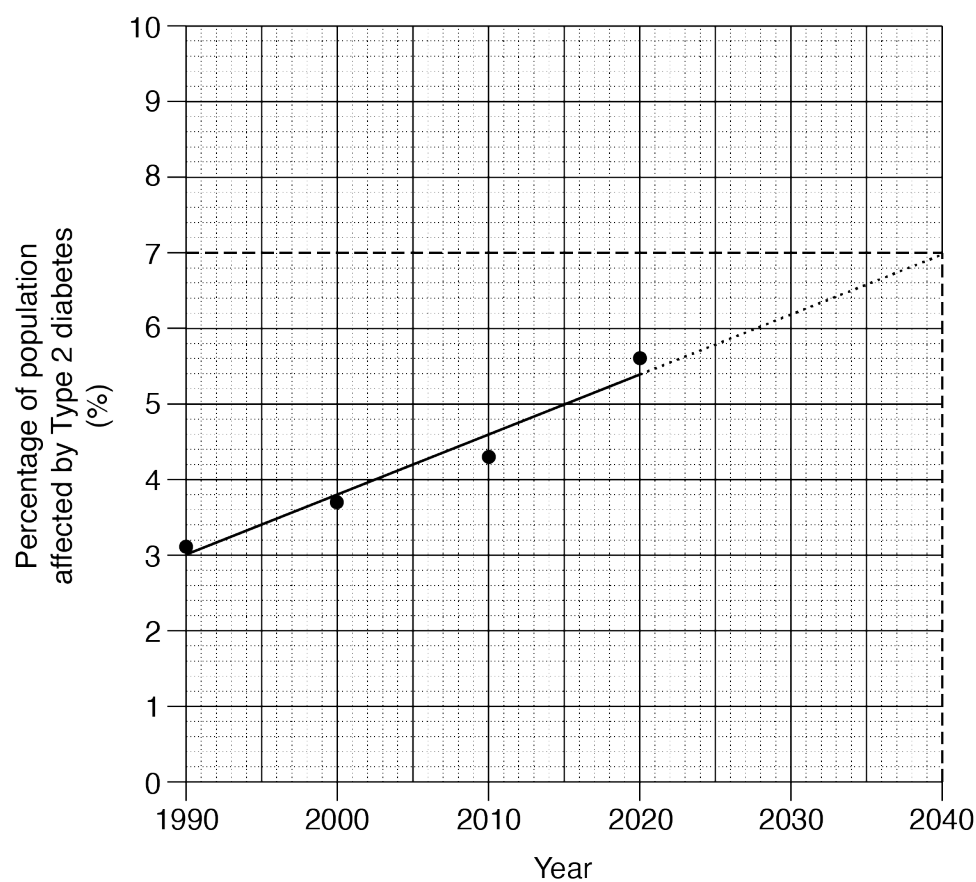
Sample answer:



Question 29 (b)

Criteria	Marks
- Extrapolates the line of best fit - States the percentage value from y-axis - Calculates the number of people with type 2 diabetes in 2040 based on 9 billion people	3
Demonstrates some understanding of how to determine the number of people with type 2 diabetes in 2040	2
Provides some relevant detail	1

Sample answer:



7% of the population

$$\frac{7}{100} \times 9 \text{ billion} = 0.63 \text{ billion or } 630 \text{ million}$$

Question 30 (a)

Criteria	Marks
• Provides a sound comparison of the processes of transcription and DNA replication	3
• Demonstrates some understanding of the process of transcription and DNA replication	2
• Provides some relevant information	1

Sample answer:

Both process A (transcription) and DNA replication involve unwinding of DNA double strand to produce complementary strand. In replication, DNA is copied to produce two identical strands of DNA whereas in transcription, DNA is copied to produce single strand mRNA.

Question 30 (b)

Criteria	Marks
• Provides a thorough explanation of the importance of mRNA and tRNA in polypeptide synthesis	5
• Provides a sound explanation of the importance of mRNA and tRNA in polypeptide synthesis	4
• Demonstrates some understanding of the importance of mRNA and tRNA in polypeptide synthesis	3
• Demonstrates an understanding of mRNA or tRNA	2
• Provides some relevant information	1

Sample answer:

mRNA is synthesised from the DNA template in the nucleus during transcription. This mRNA carries the genetic instructions (codon) from the DNA in the nucleus to the ribosomes in the cytoplasm. Once the mRNA reaches the ribosome, the process of translation begins. Each tRNA molecule has an anticodon that pairs with a complementary codon on the mRNA strand. The mRNA codons are read in sequence, and as each tRNA brings its specific amino acid to the ribosome, the polypeptide is assembled.

Question 31 (a)

Criteria	Marks
Identifies the correct time	1

Sample answer:

4 am

Question 31 (b)

Criteria	Marks
Provides a sound explanation of whether torpor is present in the human and kookaburra with reference to the graph	3
Provides a sound explanation of whether torpor is present in the kookaburra with reference to the graph	2
Provides some relevant information	1

Sample answer:

The human did not display torpor, since their body temperature remained fairly constant throughout the time period. This did not indicate a decrease in physiological functioning.

The kookaburra did display torpor, since they had a decrease in body temperature between 5 pm and 4 am, which indicates a decrease in physiological functioning.

Question 31 (c)

Criteria	Marks
Outlines an adaptation leading to heat generation or retention	2
Provides some relevant information	1

Sample answer:

The kookaburra can raise its temperature by fluffing up feathers which traps a layer of warm air between the feathers and the body. This retains heat.

Question 32

Criteria	Marks
• Demonstrates an extensive understanding of the innate and adaptive immune response including phagocytosis, inflammatory response, stimulation and role of B and T cells • Relates body's responses to innate and adaptive immunity against <i>H.pylori</i>	7
• Demonstrates a thorough understanding of the innate and adaptive immune response including phagocytosis, inflammatory response, stimulation and role of B and T cells	5–6
• Demonstrates a sound understanding of the innate and adaptive immune response	3–4
• Demonstrates some understanding of the immune response	2
• Provides some relevant information	1

Sample answer:

Damaged cells cause chemicals to be released, causing inflammation. Dilation of blood vessels as a part of inflammatory response increases blood flow which facilitates movement of phagocytes including macrophages and neutrophils into the infected area. Phagocytes process bacterial antigens and present them to the helper T-cells which triggers the adaptive immune response through release of cytokines. This results in activation of T and B cells. Cytotoxic T-cells specific to *H.pylori* directly attack the bacteria while the memory T-cells stay in the system to induce a rapid secondary immune response. Suppressor T-cells help with the regulation of the immune response. Plasma B-cells produce antibodies specific to *H.pylori* while memory B-cells remain in the system for secondary immune response. The antibodies can neutralise the antigens directly or tag it for destruction by phagocytes.

Both innate and adaptive immune responses work together to eliminate *H.pylori*. Innate response is rapid and provides immediate defence against *H.pylori* whereas adaptive response is slow but provides lifelong immunity through specific memory cells.

Question 33 (a)

Criteria	Marks
• Outlines clearly the significance of crossing over in meiosis	2
• Provides some relevant information	1

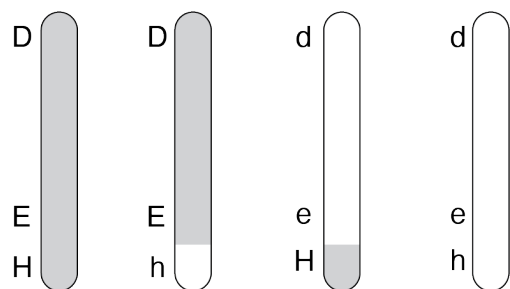
Sample answer:

Increasing genetic variation, which gives the Jack Jumper ant a better chance to survive environmental change.

Question 33 (b)

Criteria	Marks
• Draws all four possible chromosomes correctly for the gametes	2
• Provides some relevant information	1

Sample answer:



Question 34

Criteria	Marks
Provides an extensive discussion of the ethical implications and impacts for society of the use of two biotechnologies	7
Provides a thorough discussion of the ethical implications and impacts for society of the use of two biotechnologies	5–6
Provides a sound discussion of the ethical implication(s) and/or impact(s) for society of the use of biotechnology/biotechnologies	3–4
Demonstrates some understanding of the ethical implication or benefit of the use of a biotechnology	2
Provides some relevant information	1

Sample answer:

A plant biotechnology that is of benefit to society is recombinant DNA technology eg when used to produce Bt corn or Bt cotton.

Recombinant DNA technology has many ethical implications. For example, Bt corn seeds cost money to purchase each season, while farmers using normal corn seeds can regrow their crops each year from their own seeds. This leads to inequalities in who has access to these GM seeds, and thus access to markets to sell their products.

The use of selective breeding/hybridisation is a type of biotechnology used in animals eg hybridisation of dairy cows to produce greater milk yielding cows. This has ethical implications for example, the side-effect of continuously selecting for greater milk yield has been a decrease in fertility amongst these cows, and may affect quality of life for cows. However, there are also many benefits to society of the use of recombinant DNA technology or selective breeding/hybridisation. For example:

- the production of more food like Bt corn which can allow the human population to continue to grow, or greater milk availability for consumers in society
- greater yields for farmers, leading to increased profits and quality of life for farmers.

Question 35

Criteria	Marks
Demonstrates an extensive understanding of how cochlear implants work and how they affect communication in children with reference to the data	5
Demonstrates a thorough understanding of how cochlear implants work and how they affect communication in children with reference to the data	4
- Demonstrates a sound understanding of how cochlear implants work and how they affect communications in children with some reference to the data OR - Demonstrates a thorough understanding of how cochlear implants affect communication in children with reference to the data	3
Demonstrates some understanding of how cochlear implants work or how they affect communication in children	2
Provides some relevant information	1

Sample answer:

Cochlear implants are electronic devices that are surgically inserted into the cochlear to improve hearing when the cochlear is damaged. They directly stimulate the auditory nerve and help carry the sound signals directly to the brain.

If a child is implanted at a young age they reduce their use of sign language as a mode of communication over the following five years so that approximately 10% of children are using sign language five years after implantation. If children are implanted when they are older (> 5 years old) they continue to use sign language and don't change their mode of communication. If children are implanted when they are between three and five years of age they decrease their use of sign language, but not as much as when they are implanted younger. The data suggest that cochlear implants change communication when implanted at a younger age.

2024 HSC Biology Mapping Grid

Section I

Question	Marks	Content	Syllabus outcomes
1	1	Mod 7 Causes of Infectious Disease	12-14
2	1	Mod 6 Biotechnology	12-13
3	1	Mod 6 Mutation	12-4, 12-13
4	1	Mod 5 DNA and Polypeptide Synthesis	12-12
5	1	Mod 5 Reproduction	12-4, 12-12
6	1	Mod 5 Inheritance Patterns in a Population	12-6, 12-12
7	1	Mod 8 Homeostasis	12-15
8	1	Mod 7 Causes of Infectious Disease	12-5, 12-14
9	1	Mod 6 Mutation	12-6, 12-13
10	1	Mod 7 Causes of Infectious Disease	12-5, 12-14
11	1	Mod 8 Epidemiology	12-5, 12-15
12	1	Mod 7 Causes of Infectious Disease	12-14
13	1	Mod 7 Responses to Pathogens	12-14
14	1	Mod 5 Cell Replication	12-6, 12-12
15	1	Mod 7 Prevention, Treatment and Control	12-5, 12-14
16	1	Mod 8 Technologies and Disorders	12-4, 12-15
17	1	Mod 8 Epidemiology	12-15
18	1	Mod 6 Mutation	12-4, 12-13
19	1	Mod 6 Genetic Technologies	12-4, 12-13
20	1	Mod 5 Genetic Variation	12-6, 12-12

Section II

Question	Marks	Content	Syllabus outcomes
21 (a)	2	Mod 5 Reproduction	12-4, 12-12
21 (b)	3	Mod 5 Genetic Variation	12-12
22 (a)	2	Mod 7 Prevention, Treatment and Control	12-2, 12-14
22 (b)	2	Mod 7 Prevention, Treatment and Control	12-2, 12-14
23	2	Mod 6 Mutation	12-13
24 (a)	2	Mod 8 Causes and Effects	12-15
24 (b)	3	Mod 8 Prevention	12-7, 12-15
25 (a)	2	Mod 6 Genetic Technologies	12-13
25 (b)	4	Mod 6 Biotechnology	12-13
26	4	Mod 7 Causes of Infectious Disease	12-14
27	5	Mod 7 Prevention, Treatment and Control	12-5, 12-14
28 (a)	3	Mod 5 Inheritance Patterns in a Population	12-6, 12-7, 12-12
28 (b)	4	Mod 6 Mutation	12-4, 12-6, 12-13

Question	Marks	Content	Syllabus outcomes
29 (a)	2	Mod 8 Causes and Effects	12-4, 12-7, 12-15
29 (b)	3	Mod 8 Epidemiology	12-5, 12-6, 12-15
30 (a)	3	Mod 5 DNA and Polypeptide Synthesis	12-4, 12-12
30 (b)	5	Mod 5 DNA and Polypeptide Synthesis	12-12
31 (a)	1	Mod 8 Homeostasis	12-5, 12-15
31 (b)	3	Mod 8 Homeostasis	12-5, 12-6, 12-15
31 (c)	2	Mod 8 Homeostasis	12-15
32	7	Mod 7 Immunity	12-4, 12-14
33 (a)	2	Mod 5 Genetic Variation	12-4, 12-12
33 (b)	2	Mod 5 Genetic Variation	12-4, 12-6, 12-12
34	7	Mod 6 Biotechnology	12-13
35	5	Mod 8 Technologies and Disorders	12-5, 12-6, 12-15