SCIENCE TEACHERS ASSOCIATION VICTORIA 2023

TRIAL EXAMINATION

QUESTION AND ANSWER BOOK

Total writing time:
1 hour 30 minutes

BIOLOGY
UNIT 2

Student name	

Student ID									**Letter**	

Structure of book

Section	Number of questions	Number of marks
A	25	25
B	6	50
	Total	**75**

- Students are permitted to bring into the examination room: pens, pencils, highlighters, erasers, sharpeners and rulers.
- Students are NOT permitted to bring into the examination room: blank sheets of paper and/or white out liquid/tape.
- No calculators are allowed in this examination.

Materials supplied

- Question and answer book of 19 pages, with a detachable answer sheet for multiple-choice questions inside the front cover.

Instructions

- Detach the answer sheet for multiple-choice questions during reading time.
- Write your name and student ID in the space provided above on this page and on the answer sheet for multiple-choice questions.
- All written responses should be in English.

At the end of the examination

- Place the answer sheet for multiple-choice questions inside the front cover of this book.

STAV PUBLISHING

Published by STAV

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Coburg VIC 3058 Australia
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ABN: 59 004 145 329

stav.org.au/stav-publishing

STAV Founded 1943

STAV
2023

BIOLOGY
Unit 2 Trial Examination
MULTIPLE CHOICE ANSWER SHEET

STUDENT NAME:	

INSTRUCTIONS: **USE PENCIL ONLY**

- Write your name in the space provided above.
- Use a **PENCIL** for **ALL** entries.
- If you make a mistake, **ERASE** it – **DO NOT** cross it out.
- Marks will **NOT** be deducted for incorrect answers.
- **NO MARK** will be given if more than **ONE** answer is completed for any question.
- Mark your answer by **SHADING** the letter of your choice.

	ONE ANSWER PER LINE					ONE ANSWER PER LINE				
1	A	B	C	D	14	A	B	C	D
2	A	B	C	D	15	A	B	C	D
3	A	B	C	D	16	A	B	C	D
4	A	B	C	D	17	A	B	C	D
5	A	B	C	D	18	A	B	C	D
6	A	B	C	D	19	A	B	C	D
7	A	B	C	D	20	A	B	C	D
8	A	B	C	D	21	A	B	C	D
9	A	B	C	D	22	A	B	C	D
10	A	B	C	D	23	A	B	C	D
11	A	B	C	D	24	A	B	C	D
12	A	B	C	D	25	A	B	C	D
13	A	B	C	D					

SECTION A – Multiple-choice questions

Instructions for Section A

Answer **all** questions on the answer sheet provided for multiple-choice questions.
Choose the response that is **correct** or that **best answers** the question.
A correct answer scores 1; an incorrect answer scores 0.
Marks will **not** be deducted for incorrect answers.
No marks will be given if more than one answer is completed for any question.
Unless otherwise indicated, the diagrams in this book are **not** drawn to scale.

Question 1

When considering the relationship between genes and alleles

A. genes are a sequence of nucleotides whereas alleles are a sequence of proteins.

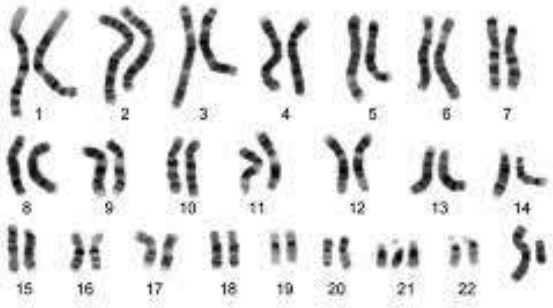
B. all organisms of the same species have variation in their genes but their alleles are identical.

C. genes are found in eukaryotes whereas alleles are found in prokaryotes.

D. variation in the sequence of nucleotides in a gene produces alleles.

Use the following information to answer Questions 2 and 3.

The image below shows a human karyotype.



Question 2

The individual shown above

A. is male with no chromosomal abnormalities.

B. is a male with a trisomy.

C. is a female polyploid.

D. is a female aneuploid.

Question 3

During meiosis, the chromosomes shown above may have been taken from cells in

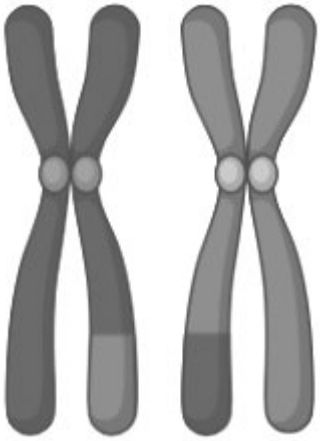
A. cytokinesis.

B. prophase 2.

C. anaphase 1.

D. telophase 2.

Question 4



Source https://app.biorender.com/illustrations/63d1afff3efd616bf1730efa

The diagram above shows

A. a non-homologous pair of chromosomes that have undergone crossing over during metaphase 1 of meiosis.

B. a homologous pair of chromosomes that duplicated during telophase 2 of meiosis.

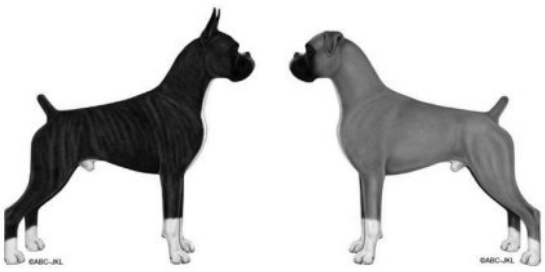
C. a homologous pair of chromosomes that have undergone crossing over during prophase 1 of meiosis.

D. a pair of male sex chromosomes that have undergone crossing over during cytokinesis.

Question 5

Dog breeds such as the Boxer have fur coat colour that can vary, with two coat colours being fawn and brindle. A gene called the K locus controls the production of black pigment in the coat. If a dog inherits one K allele the coat colour will be brindle, whereas if they inherit two k alleles, they will have a fawn coat.

brindle fawn



Source https://americanboxerclub.org/akc-color-markings.html

A breeder bred two brindle coloured Boxers together and the resultant litter had 6 brindle coloured puppies and 1 fawn coloured puppy. The genotypes of the parents must be

A. Kk and Kk

B. KK and kk

C. kk and kk

D. KK and Kk

Question 6

Sex-linked traits are controlled by genes located on the sex chromosomes, specifically the X and Y chromosomes in humans. In most cases, sex-linked traits are primarily associated with the X chromosome since it carries a larger number of genes compared to the Y chromosome. Common examples of X-linked traits in humans include colour blindness, haemophilia, and Duchenne muscular dystrophy (DMD).

X-linked traits more frequently affect males as

A. the X chromosome is dormant in males, as the genes for male sex characteristics are only found on the Y chromosome.

B. males have an additional X chromosome; therefore, they express twice as much of whichever allele they inherit.

C. males only have one X chromosome; therefore, they express whatever allele they have inherited from their father.

D. males only have one X chromosome; therefore, they express whatever allele they have inherited from their mother.

Question 7

The Chernobyl disaster, which occurred in 1986, was a catastrophic nuclear accident at the Chernobyl Nuclear Power Plant in Ukraine. The accident resulted in a release of a significant amount of radioactive material into the environment, causing widespread contamination and long-term health effects on the affected population.

A study conducted on children from Belarus, a neighbouring country very close to Chernobyl, who were exposed to radiation in utero or during early childhood, found differences in DNA methylation patterns in their blood samples compared to unexposed individuals. These changes were observed in genes involved in immune system regulation and cancer development.

This is an example of

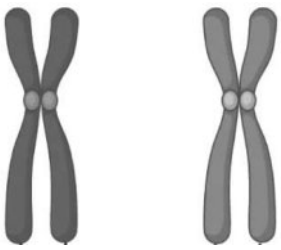
A. genotype being affected by the phenotype

B. epigenetics

C. linked genes

D. dominant and recessive mode of inheritance

Question 8



Source https://thebiologynotes.com

The diagram above shows

A. two homologous chromosomes with sister chromatids.

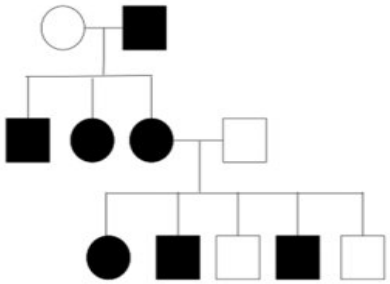
B. two sister chromosomes with homologous chromatids.

C. two heterozygous chromosomes with sister chromatids.

D. two homologous chromosomes with identical alleles at each locus.

Question 9

The following pedigree shows the inheritance between 3 generations of Marfan syndrome.
Marfan syndrome is caused by mutations in the FBN1 gene, which encodes the fibrillin-1 protein. Fibrillin-1 is a crucial component of connective tissue. These mutations lead to the production of abnormal or insufficient fibrillin-1, resulting in weakened connective tissue.



The mode of inheritance shown in the pedigree above is most likely

A. autosomal dominant

B. autosomal recessive

C. X-linked dominant

D. X-linked recessive

Question 10

Linked genes refer to genes that tend to be inherited together more frequently than expected when inheritance follows the of law of independent assortment.

A way to show if two genes were linked would be to complete a heterozygous

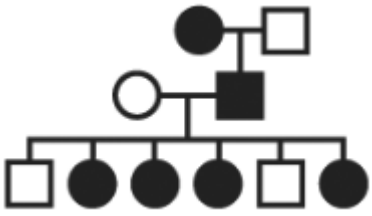
A. monohybrid cross with a 3 : 1 ratio.

B. dihybrid cross with a 9 : 3 : 3 : 1 ratio.

C. dihybrid cross with a 1 : 1 : 0.1 : 0.1 ratio.

D. monohybrid cross with a 1 : 2 : 1 ratio.

Question 11



Source https://www.geeksforgeeks.org/pedigree-analysis/

How many affected females are shown in the pedigree above?

A. 1

B. 3

C. 4

D. 5

Question 12

Hereford cattle are a breed of beef cattle that originated in Herefordshire, England. They are known for their distinctive appearance, with a white face, red body, and white markings on their brisket, underline, and lower legs. Herefords are one of the most popular beef cattle breeds globally and are renowned for their adaptability, docile temperament, and high-quality meat production as they are larger than standard beef cattle.

Source https://www.thecattlesite.com/breeds/beef/14/hereford

Hereford cattle can be either horned or hornless. The image above shows a bull (male cow) expressing the autosomal dominant horned trait.

If the cow is heterozygous for the horned trait, it would be expected

A. if crossed with another cow heterozygous for horns, they would have 1 horned offspring and 3 hornless offspring.

B. if crossed with another cow heterozygous for horns, they would have 3 horned offspring and 1 hornless offspring.

C. if crossed with another cow homozygous for horns, they would have 1 horned offspring and 3 hornless offspring.

D. if crossed with another cow homozygous for horns, they would have 3 horned offspring and 1 hornless offspring.

Question 13

The image below shows budding in hydra (*Hydra vulgaris*).

Source Subramoniam, T. (2018) Mode of Reproduction: Invertebrate Animals

Budding differs to binary fission as

A. budding produces genetically identical offspring whereas binary fission does not.

B. budding produces offspring smaller than the parent whereas binary fission does not.

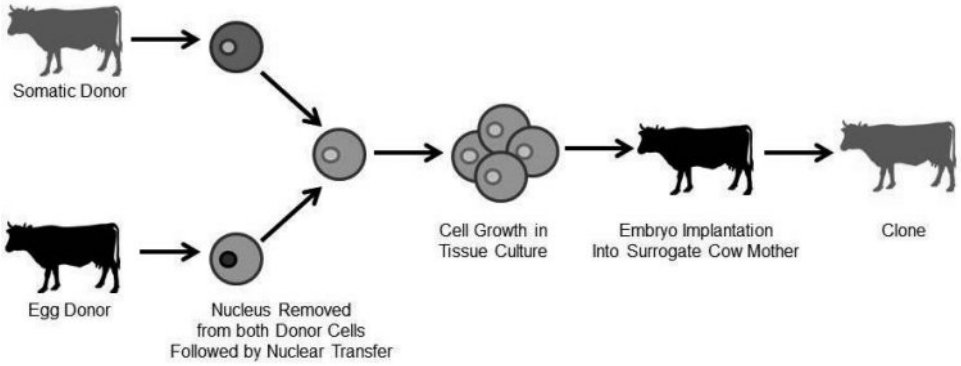
C. budding undergoes meiosis whereas binary fission undergoes mitosis.

D. budding only occurs in aquatic species whereas binary fission only occurs in terrestrial species.

Question 14

Somatic cell nuclear transfer (SCNT) is a method used to create clones of larger organisms. 'Dolly' the sheep was the first mammal to be cloned from an adult somatic cell.

The diagram below shows a simplified overview of how SCNT works.



Source https://wildlifesnpits.files.wordpress.com/2016/01/scnt1.jpg

The purpose of the egg donor is

A. to allow the formation of a blastocyst.

B. to increase genetic variation.

C. to ensure that both male and female genes contribute to the resultant offspring.

D. to produce female offspring.

Question 15

Dolly the sheep lived at the Roslin Institute, Scotland. She gave birth to several lambs through natural breeding methods, proving that cloned animals can reproduce. Unfortunately, Dolly's health began to decline at the age of six due to a progressive lung disease called Jaagsiekte. It is believed that Dolly's short life was due to her being a clone. To prevent further suffering, she was euthanised on February 14, 2003.

The ethical concept breached when considering Dolly's longevity was

A. integrity

B. justice

C. non-maleficence

D. beneficence

Question 16

During the coldest parts of the Antarctic winter, Emperor penguins huddle on the ice. Through sharing warmth they conserve energy and protect the species as a whole.

Huddling is an example of a

A. structural adaptation.

B. physiological adaptation.

C. behavioural adaptation.

D. co-adaption.

Question 17

Which of the following is a consequence of sexual reproduction?

A. less genetic variation in familial population

B. offspring are more susceptible to disease

C. energy is required to find a mate

D. it is generally faster to repopulate

Question 18

African Elephants are known for their ability to modify their environment. They feed on a wide variety of vegetation, including grasses, leaves, bark, and branches. In the process of feeding, they can uproot trees, break branches, and trample vegetation, creating clearings, which can benefit other plant species and provide opportunities for different types of vegetation to grow.

African Elephants consume a large quantity of plant matter daily. As they move across the landscape, they disperse seeds as they defecate. Some seeds pass through their digestive system unchanged, allowing for long-distance dispersal. This seed dispersal maintains plant biodiversity and contributes to the regeneration of different plant species in the ecosystem.

African elephants are an example of

A. a keystone species.

B. an apex predator.

C. a second order consumer.

D. a producer.

Question 19

Indigenous Australians have used cool burning or cultural burning for over 60,000 years. Cool burning is a traditional land management practice where controlled fires are deliberately ignited during cooler weather conditions to manage and maintain ecosystems.

Which of the following would **not** be considered a benefit of this practice?

A. a reduced fuel load in the warmer months

B. germination of some seeds

C. it aids in the recycling of nutrients

D. excessive nutrients in nearby streams

Question 20

Sexual reproduction increases genetic diversity as

A. chromosomes independently assort during mitosis.

B. crossing over occurs during prophase 1 of meiosis.

C. mutations occur more frequently than in asexual reproduction as no checkpoints are present in the cell cycle.

D. only those with the phenotype best suited to the environment are able to reproduce.

Question 21

The echidna is a monotreme native to Australia. They lay eggs, which are incubated in a pouch-like structure and hatch after about 10 days. The baby stays in the pouch for several months, feeding on milk secreted by mammary glands until it develops spines and is ready to venture out.

Source https://sdzwildlifeexplorers.org/animals/echidna

The spines of the echidna are a structural adaptation that provides the echidna with

A. protection from predators.

B. warmth.

C. camouflage in tropical environments.

D. the ability to create burrows.

Question 22

Aboriginal Australians have a deep connection with the natural world and have developed an extensive knowledge of their environment over thousands of years. The 'gunyah' or 'humpy' is a traditional type of Aboriginal shelter that is often built using branches, bark, and leaves. The design of the gunyah is influenced by the structures found in nature, such as animal nests and burrows. The gunyah's rounded shape and use of materials like bark and foliage help provide insulation and ventilation, allowing for temperature regulation inside the shelter.

The gunyah is an example of

A. biopiracy.

B. biomimicry.

C. assisted reproductive technologies.

D. the interdependence between humans and the environment.

Use the following information to answer Questions 23 to 25.

A student conducted an experiment to obtain numerical data which they recorded in their logbook. The lesson ended and they did not have time to repeat their experiment to ascertain the validity of their data. To overcome this, they sourced data from 3 other groups within the same class who completed the same experiment.

Question 23

The data collected is

A. primary data only.

B. both primary and secondary data.

C. secondary data only.

D. tertiary data only.

Question 24

All four sets of data obtained results that showed the same trend. This shows that the experiment was

A. accurate.

B. repeatable.

C. reproducible.

D. biased.

Question 25

Another group of students in the class decided to collect qualitative data rather than quantitative data.

As such, the additional data set could be considered

A. concordant.

B. unbiased.

C. numerical.

D. subjective.

END OF SECTION A

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SECTION B

Instructions for Section B

Answer **all** questions in the spaces provided.

Unless otherwise indicated, the diagrams in this book are **not** drawn to scale.

Question 1

Reeves's muntjac are a mammal native to East Asia and can be found in countries including China, Taiwan, Myanmar, Vietnam, and Laos. Reeves's muntjac exists in a range of habitats, including forests, woodlands, grasslands, and agricultural areas. They prefer areas with dense vegetation and access to water sources.

Source https://commons.wikimedia.org/w/index.php?curid=43040129

Muntjacs are known for their distinctive 'barking' vocalisations, which they use to communicate with one another. They are primarily nocturnal, being more active at dawn and dusk. Muntjacs are excellent jumpers and can navigate through dense vegetation with ease. When startled or threatened, they will often freeze or retreat to cover rather than running away.

a. Muntjacs have 46 chromosomes. What technique is used to provide a visual representation, **and** what chromosomal characteristic determines the order of chromosomes?

_____

_____

_____

(3 marks)

b. Humans, like muntjacs, also have 46 chromosomes. Explain, with reference to genes, alleles and chromosome number why despite this similarity, we are distinctly different species.

_____

_____

_____

_____

_____

_____

_____

(4 marks)

c. Reeves's muntjacs replicate via sexual reproduction. As such, their gametes are produced via meiosis. Name and describe **two** events that occur during meiosis that increase variation in offspring.

_____

_____

_____

_____

(4 marks)

d. Muntjacs are excellent jumpers. Identify this type of adaptation **and** describe the survival advantage.

_____

_____

_____

(2 marks)

Total 13 marks

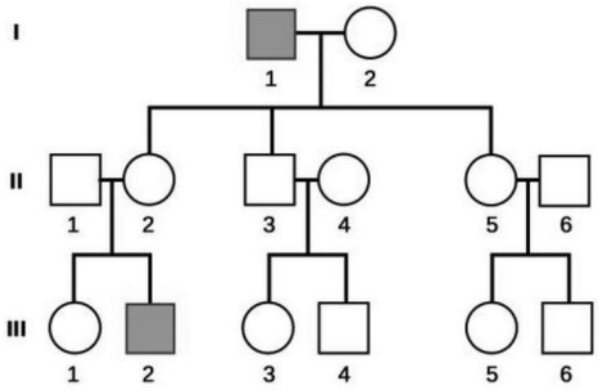
Question 2

Hunter syndrome, also known as mucopolysaccharidosis type II (MPS II), is a rare genetic disorder that belongs to a group of conditions called lysosomal storage disorders.

Hunter syndrome is caused by a deficiency or malfunctioning of the enzyme iduronate-2-sulfatase (IDS). IDS is responsible for breaking down certain molecules called glycosaminoglycans (GAGs) in the body. In individuals with Hunter syndrome, the deficiency of IDS leads to the accumulation of GAGs in the cells and tissues, which can cause a wide range of symptoms, including progressive developmental delay and cognitive impairment, skeletal abnormalities such as short stature, joint stiffness, and a thickened, claw-like appearance of the hands or organ enlargement, particularly of the liver and spleen.

The prognosis for individuals with Hunter syndrome varies depending on the severity of the condition and the age of onset. In severe cases, the lifespan may be significantly shortened, often into the teenage or early adulthood years. In milder forms, individuals may have a better prognosis and longer life expectancy, although they still face significant health challenges.

The pedigree below shows the inheritance of Hunter Syndrome across 3 generations.



Source https://theory.labster.com/Pedigree/

a. Using evidence from the pedigree, identify and explain the mode of inheritance for Hunter syndrome.

_____

_____

_____

_____

_____

_____

(3 marks)

b. Assign an appropriate symbol for Hunter syndrome.

_____

(1 mark)

c. Individual III2 decides to have a child with an unaffected homozygous individual. With the aid of a punnet square, determine the chance that their child will be affected by Hunter syndrome.

_____

(2 marks)

Total 6 marks

Question 3

The New Mexico whiptail lizard is an all-female species that reproduces exclusively through parthenogenesis. The unfertilised eggs undergo normal development and result in genetically identical offspring that are all female. This asexual reproduction strategy, called obligate parthenogenesis, allows the New Mexico whiptail lizard to persist as a single-sex species.

Source https://www.flickr.com/photos/40928097@N07/28140079236/

a. Outline **two** ways in which parthenogenesis differs from other forms of asexual reproduction.

_____

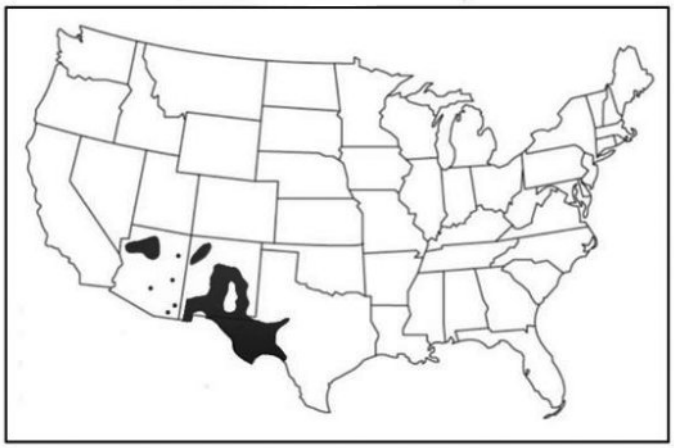
_____

_____

_____

(2 marks)

The New Mexico whiptail lizard is primarily found in the states of New Mexico and Arizona in the United States (shown shaded on the map below), as well as in parts of northern Mexico. Their habitat is primarily arid and semi-arid with dry conditions and sparse vegetation. These habitats include desert scrublands, grasslands, rocky areas, and canyon bottoms. They are well adapted to the dry environment and can tolerate high temperatures.



Source https://birdwatchinghq.com/whiptail-lizards-in-new-mexico/

The New Mexico whiptail lizard has a slender and elongated body, which allows it to move quickly and efficiently through its environment. They have well-developed limbs, with each limb ending in five toes equipped with claws. These limbs allow the lizard to navigate its surroundings, climb, and dig burrows. The limbs are relatively short in comparison to the body length, contributing to the lizard's streamlined shape. The New Mexico whiptail lizard is covered in small, overlapping scales. These scales provide protection and reduce water loss in the arid habitats they inhabit.

Although they inhabit arid regions, New Mexico whiptail lizards are found in areas with some vegetation cover. This includes grasses, low shrubs, cacti, and other desert-adapted plants that provide hiding places, shelter, and foraging opportunities. They rely on external heat sources to regulate their body temperature and often bask in the sun to warm up and become active.

New Mexico whiptail lizards utilise burrows or other crevices as shelters and hiding places. They dig burrows in the soil or utilize existing burrows made by other animals to seek refuge from extreme temperatures or to escape from predators.

b. With reference to the information above, complete the following table for **two** adaptations of the New Mexico whiptail lizard.

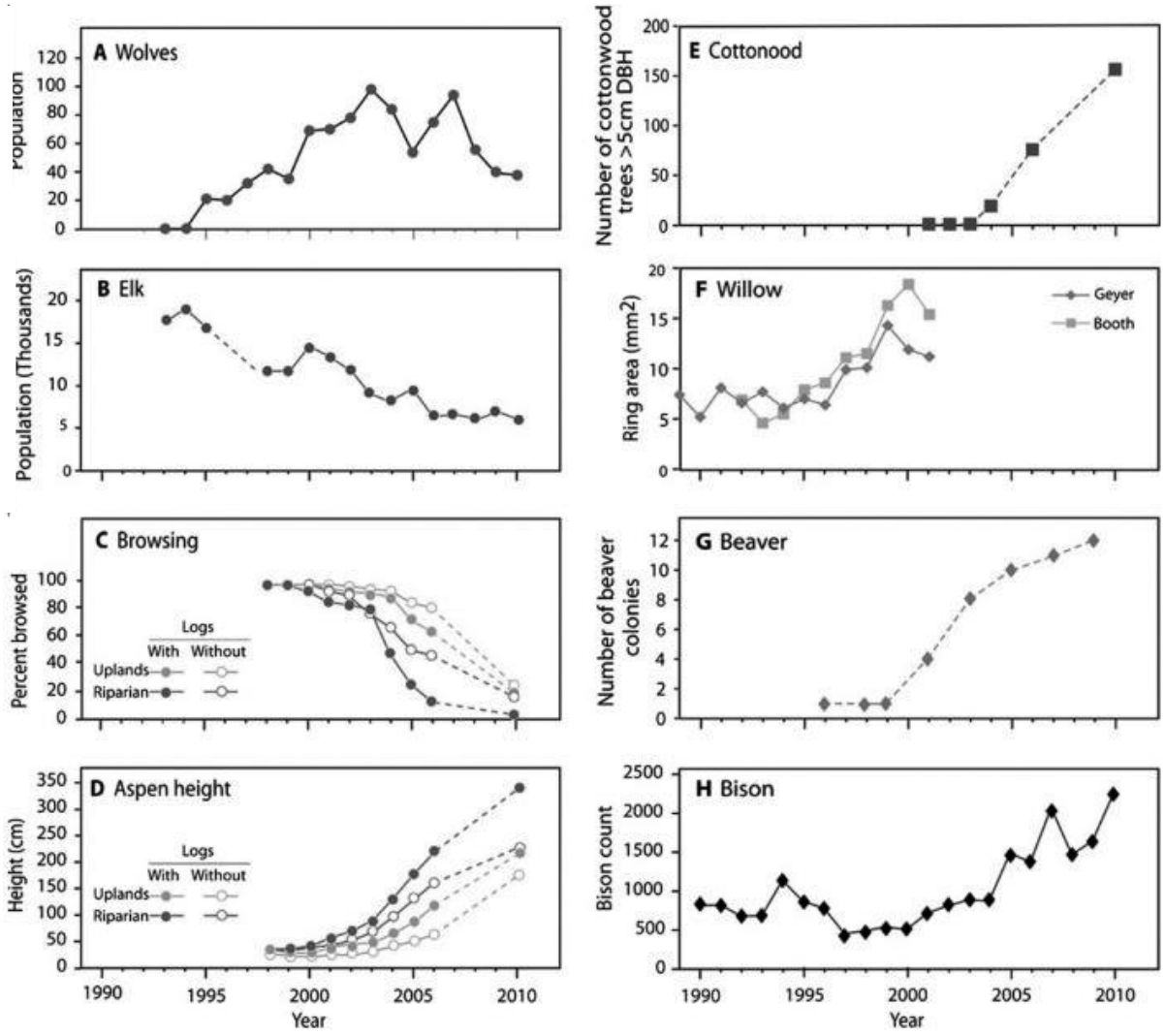
description of adaptation	type of adaptation	survival advantage

(6 marks)

Total 8 marks

Question 4

Wolves were historically native to the Yellowstone National Park ecosystem but were eradicated by the mid-1900s due to hunting and predator control efforts. In 1995 and 1996, Gray wolves from Canada were reintroduced to Yellowstone National Park, in the North Western states of the USA as part of a program to restore the park's natural balance. The data below shows the change in various components within the ecosystem following the reintroduction of the wolves.



Source Ripple, W. J., & Beschta, R. L. (2012). Trophic cascades in Yellowstone: the first 15 years after wolf reintroduction. *Biological Conservation*, *145*(1), 205-213.

a. **(i)** Graph D shows the number of aspen (a type of tree) grazed on by elk. Describe the relationship between elk numbers (Graph B) and aspen height (Graph D).

_____

(1 mark)

(ii) Suggest what caused the relationship outlined in part **(i)**.

_____

_____

(1 mark)

b. Aspen, cottonwood and willow are all types of plant. Describe the role of a plant in an ecosystem.

(3 marks)

c. Identify the term used to describe the role of the wolves within the ecosystem. Use data to justify your response.

(4 marks)

d. If wolves had not been re-introduced into Yellowstone National Park, predict what may have occurred in the ecosystem.

(2 marks)

Total 11 marks

Question 5

The neem tree (*Azadirachta indica*) is native to the Indian subcontinent and has been widely used by local communities for its medicinal, agricultural, and pest control properties for centuries.

Source https://www.medicalnewstoday.com/articles/325048

In the 1990s, the United States-based multinational corporation, W.R. Grace & Co., obtained a patent for the extraction process of neem tree compounds that have pesticidal properties. The patent covered the broad use of neem as an insecticide and method of extraction, essentially claiming ownership over traditional knowledge that had been practiced by indigenous communities in India for generations. This is an example of biopiracy.

This patenting of neem extracts raised concerns about the misappropriation of traditional knowledge. Indigenous communities and organisations argued that the patent represented an unjust exploitation of their traditional practices and threatened their rights to access and control the resources associated with the neem tree.

After a long legal battle and widespread public outcry, the European Patent Office eventually revoked the patent in 2005, citing prior knowledge and usage of the neem tree in India.

State **two** ethical concepts that biopiracy of the neem tree breached **and** explain how these principles were breached.

_____

_____

_____

_____

_____

_____

_____

_____

_____

(4 marks)

Total 4 marks

Question 6

Huntington's disease (HD) is a progressive and inherited neurodegenerative disorder that affects the brain. It is caused by a mutation in the HTT gene, which leads to the production of a toxic protein called huntingtin.

Huntington's disease is caused by an autosomal dominant mutation in the HTT gene, which is responsible for producing the huntingtin protein. The mutation involves the expansion of a CAG trinucleotide repeat in the gene. The greater the number of repeats, the earlier the onset and more severe the symptoms of the disease. Huntington's disease typically presents in mid-adulthood, between 35 and 45 years of age. The disease affects both motor and cognitive functions.

a. Huntington's disease is autosomal dominant. Identify the number of copies of the allele that are needed to express the trait in the phenotype.

_____ (1 mark)

b. Explain a potential consequence of symptoms not presenting until mid-adulthood.

_____

_____

_____

_____

(2 marks)

The mother of a 25-year-old male had just been diagnosed with the early onset of Huntington's disease. The 25-year-old had recently decided that he was ready to start a family, however he now had the knowledge that he may carry the gene for Huntington's.

c. What advice may a genetic counsellor give to the man?

_____

_____

_____

_____

(2 marks)

d. How can assisted reproductive technologies, such as IVF, reduce the prevalence of Huntington's in future generations?

_____

_____

_____

_____

(2 marks)

e. Provide an ethical argument against using assisted reproductive technologies to reduce the prevalence of Huntington's disease.

_____

_____

_____

(1 mark)
Total 8 marks

END OF TRIAL EXAMINATION