

Unit 4 Surviving in a changing environment

Time permitted: 90 minutes

	Section	Number of questions	Marks available
A	Multiple choice	15	15
B	Short answer	5	50
C	Extended answer	2	20
	Total		85

Section A Multiple choice (30 marks)

- Thermoregulation is an issue for any organism living in a cold environment. Important mechanisms to conserve heat are:
D thick fur and a large body mass.
- Each reaction in a metabolic pathway is:
B controlled by an enzyme.
- A disease that can be transmitted between animals and humans is termed:
D zoonotic.
- Adele contracted influenza during the winter months. The next year in winter, she came in contact with the influenza virus, but this time she did not show any symptoms of the disease. This is due to Adele:
B producing and storing memory B cells specific to the influenza strain of that year.
- Vectors are important in the spread of many diseases. It is reasonable to suggest that:
C diseases associated with a particular vector are usually restricted to the geographical area that supports that vector.
- The nervous and circulatory systems work together during homeostasis. Which of the following correctly describes their main homeostatic functions?

	Nervous system	Circulatory system
A	Coordinates sensory information with the body's responses	Transports materials including chemical messengers around the body

- Vasoconstriction is the term used when blood vessels constrict. It is a mechanism used when:
B body temperature decreases.

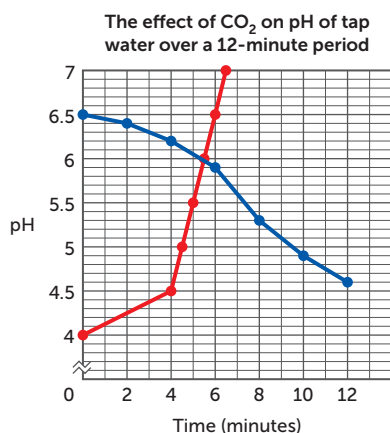
- 8** When the external environmental temperature around a mammal decreases, hair erector muscles perform a function to assist in homeostasis. Which of the following correctly discusses their function?
D Hair erector muscles contract; hair stands up, creating pockets of warm air.
- 9** Osmoregulation is concerned with controlling the water balance in organisms. Water is lost by various methods. Which of the following methods of water loss is *not* also used for thermoregulation?
A Urinating
- 10** An Australian mammal, *Ornithorhynchus anatinus*, the platypus, can survive in cold water by using various mechanisms including a countercurrent heat exchange system. Through the use of this specific mechanism, it can maintain its 32°C body temperature by:
C heat transfer due to the close proximity of the artery and vein.
- 11** The scientist Robert Koch developed a series of postulates (steps) to identify the specific cause of an infectious disease. Which of the following is *not* an essential step?
C Organisms from the pure culture are inoculated into an already infected and recovered host. If the disease develops, this is further evidence for a specific cause.
- 12** Due to globalisation and transportation of goods, some outbreaks have become epidemics and even pandemics. Factors most likely to further increase the chance of spread are:
D multiple direct and indirect modes of transmission.
- 13** A worldwide decline in frog population numbers has caused scientists to investigate the causes. Which of the following factors is *not* contributing to the decline?
A An increase in chytridiomycosis vectors
- 14** *Phytophthora* dieback kills susceptible plants, such as banksias, jarrah and grass trees, by attacking their root systems. Which of the following statements relating to *Phytophthora* is correct?
B The Phylum *Oomycota* containing *Phytophthora* dieback has been removed from the Fungi Kingdom and placed in the Protista Kingdom.
- 15** Which of the following is the main portal of entry for the disease crown gall?
D A wound in the roots of a plant

Section B Short answer (50 marks)

- 1 a** Exit: Droplets of mucus forced out of respiratory system and into air via coughing/sneezing/talking (1 mark); Enter: Inhalation into respiratory system (1 mark)
- b** Influenza (1 mark), tuberculosis (1 mark)
- c** The following four stages (1 mark each):
Entry via deep wound/puncture wound, from dirty object or soil (where spores lay dormant)
Replication in tissue in a deep wound in the absence of oxygen
The neurotoxins travel up neurons/blocking the release of inhibitory neurotransmitters in the CNS
Life cycle stops/tetanus not contagious/possible return to soil via animal faeces/herbivores and omnivores carry the bacilli in their intestines and excrete the spores in their faeces

- d** The neurotoxins travel up neurons, blocking the release of inhibitory neurotransmitters in the CNS (1 mark). This leaves excitatory nerve impulses unopposed, resulting in muscle spasms, and the toxin is taken up via endocytosis by nerve cells (at the neuromuscular junctions) after which it is transported inside the axons (1 mark). The tetanus toxin acts on four areas of the nervous system: 1 – the motor end plates in the skeletal system; 2 – the spinal cord; 3 – the brain; and 4 – the sympathetic nervous system (1 mark).

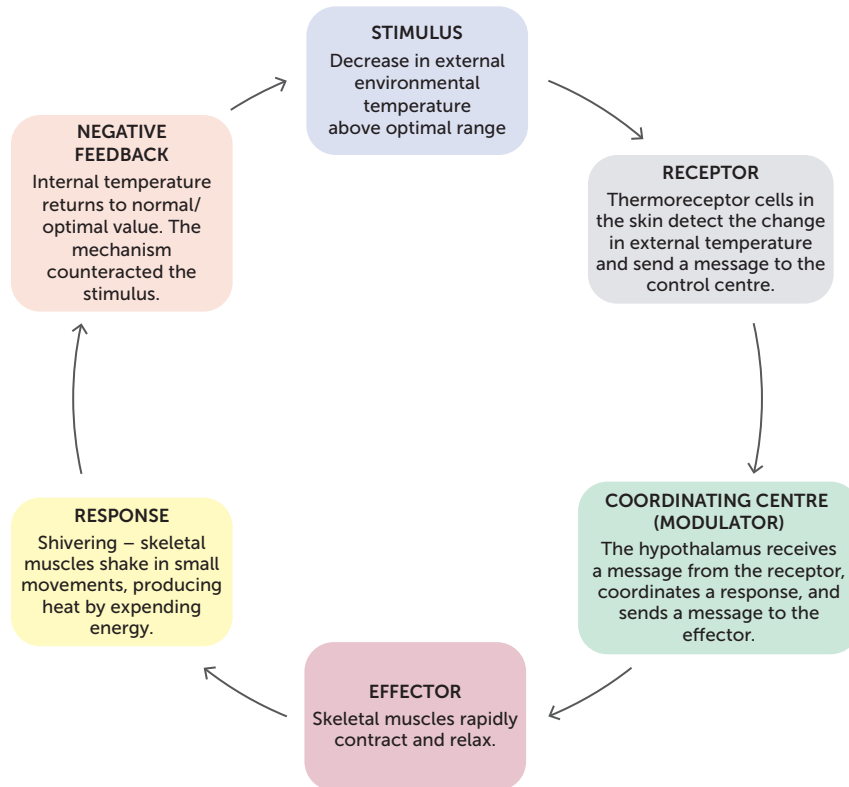
2 a



To achieve full marks, students should:

- include an accurate title that includes both variables (1 mark)*
 - choose an appropriate graph type (line graph) (1 mark)*
 - correctly allocate independent and dependent variables to x- and y-axes respectively (1 mark)*
 - use a scale that shows correct intervals and use appropriate graph/grid size (1 mark)*
 - correctly label both axes, including units (1 mark)*
 - accurately draw data points and accurately join them (1 mark).*
- b** Reliability is the degree to which an assessment instrument or protocol consistently and repeatedly measures an attribute achieving similar results (1 mark) for the same population (1 mark).
- c** The student undertook three repetitions of the investigation and calculated an average/mean.
- d** Replacement

3 a



b Licking forearms: evaporative cooling as saliva absorbs heat energy from body, and changes into water vapour, drawing heat away from the body and into the surroundings (1 mark)

Rapid breathing/panting: evaporative cooling as water at the base of the respiratory system changes into water vapour, drawing heat away from the body and into the surroundings (1 mark)

Sweating: evaporative cooling as sweat is secreted from sweat glands and changes into water vapour, drawing heat away from the body and into the surroundings (1 mark)

Seeking shade: avoiding heat gain by radiation from the Sun (1 mark)

4 a The time lag between the time of infection (1 mark) and the onset of symptoms (1 mark)

b After invading liver cells, sporozoites divide repeatedly by asexual reproduction, and develop to produce thousands of merozoites (1 mark). Merozoites are a relatively mature form of the *Plasmodium* pathogen (1 mark). The merozoites leave the liver and enter the bloodstream, where they infect red blood cells and divide asexually again (1 mark).

c Any of the following information to gain 4 marks:

Mosquitos are a vector. (1 mark)

When the mosquito penetrates the skin with its proboscis, pathogens may enter or exit through this portal. (1 mark)

Through one tube of the proboscis, saliva containing *Plasmodium* sporozoites (a relatively immature form of *Plasmodium*) is injected into the host, and blood is sucked up through a separate tube. (1 mark)

Inside the mosquito gut, the gametocytes mature into male and female gametes and fuse to form zygotes, which is known as sexual reproduction. (1 mark)

The zygotes penetrate and burrow through the wall of the mosquito stomach and form cysts. Sporozoites form within the cysts and migrate to the salivary glands of the mosquito, ready to infect a new host. (1 mark)

d Any one of the following:

Barrier: bed netting/clothing prevents transmission

Eliminate stagnant (still) water to remove breeding sites of mosquito vectors and reduce vector populations.

Avoid being outdoors when mosquitoes are most active (dawn and dusk) to avoid a mosquito bite.

Use insect repellent.

5 a Interrelated factors are those that depend on one another. They need to occur together to have an effect.

b i A susceptible host is someone who has not been immunised against rabies/ABL. No host means no spread. (1 mark) High density can lead to an increase in the number of susceptible hosts coming into contact with infected bats and a higher chance of transmission. If people do not come into contact with a bat, transmission will not occur. (1 mark)

ii If there are small numbers of the pathogen population, the risk of spread is very low (1 mark). The pathogen population residing in bats may never come into contact with a susceptible host (1 mark).

iii If the mode of transmission is not suited to an actual transfer of the pathogen from bat to human, the disease cannot spread. (1 mark) The pathogen requires a bite or scratch from an infected bat to a susceptible human. If humans do not get close enough for this mode of transmission to be effective, spread will stop. / If the bats used a different mode of transmission such as airborne droplets or fomites, the spread would increase. (1 mark)

c Endemic means a disease is always present at low levels in some populations or regions; no sudden increase (1 mark). Epidemic means there is a sudden increase in the prevalence of a particular disease that spreads rapidly through a region or nation after an outbreak (1 mark).

Section C Extended answer (20 marks)

1 Adaptations to low humidity (dry environment):

Thick waxy cuticle: Impermeable to water, preventing evaporation and water loss. Stops uncontrolled evaporation through leaf cells. (2 marks)

Small leaf surface area: Fewer stomata, leading to reduced water loss. Less surface area for evaporation. Smaller surface area of leaf is exposed to the drying effects of the wind, reducing evaporation and reducing water loss. (2 marks)

Sunken stomata/Hairy stomata: Stomata in sunken pits or containing hairs prevent water loss by increasing the relative humidity in the vicinity of each stoma, decreasing the concentration gradient and reducing evaporation and diffusion. Creates a microclimate. (2 marks)

Stomata opening at night/reverse stomatal rhythm: The stomata are closed during the hottest part of the day, reducing water loss by transpiration/evaporation. CO₂ uptake occurs at night and is then stored for use in photosynthesis during the day. (2 marks)

Adaptation for saline soil:

Accumulates salts in leaves: Salt is directed to older leaves, where it accumulates. The leaves eventually die and drop off, removing the salt from the plant. (2 marks)

2

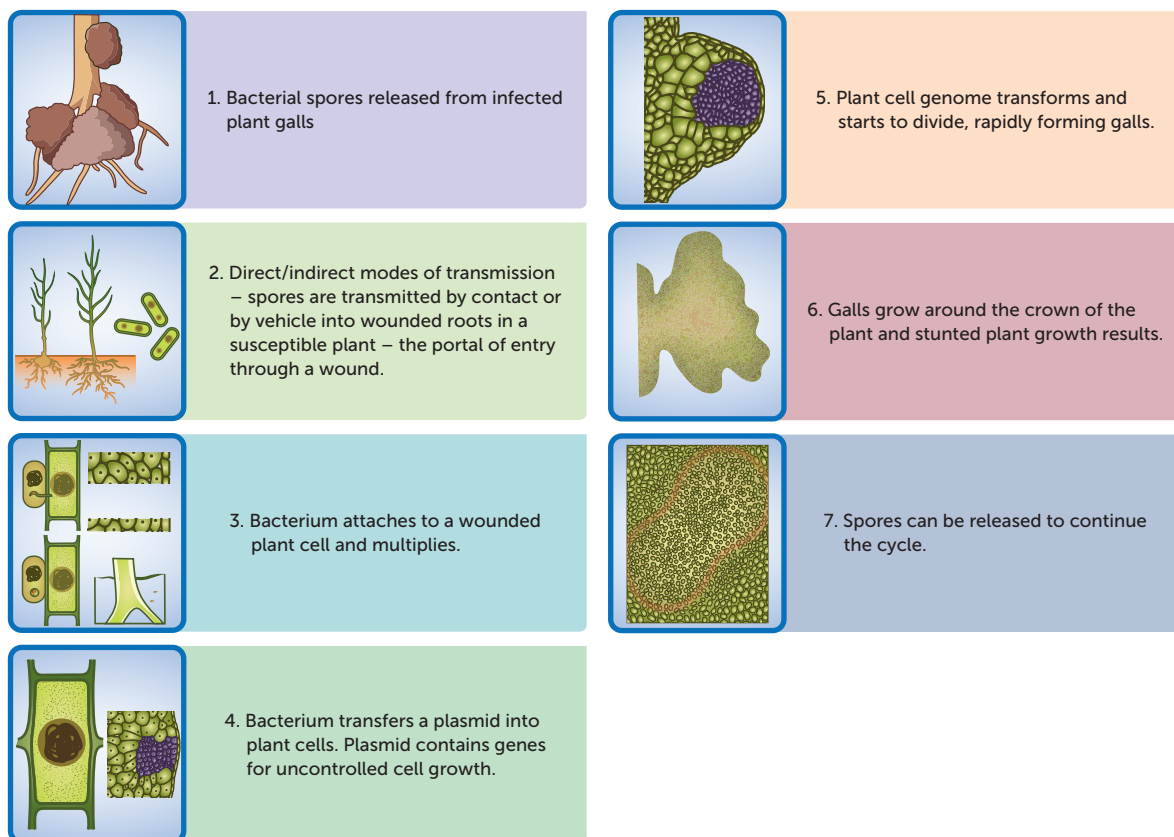


Diagram is worth 5 marks and must show that:

- *spores in soil enter roots via injury*
- *bacterium replicates binary fission/asexual reproduction*
- *bacteria plasmid DNA gene is injected into host plant genome*
- *galls grow by uncontrolled cell division*
- *some replicated bacteria move back into soil ready to infect another susceptible plant, carried by water.*

Description (any of the following to achieve 5 marks):

The bacterium that causes crown gall lives in the soil that surrounds the roots of plants. (1 mark)

This bacterium can live in the soil as a decomposer for years without infecting a living host. (1 mark)

When a plant is injured (either by mechanical transmission, insect feeding, or naturally) the damaged cells release compounds into the soil, attracting the bacterium to the wound site. (1 mark)

Once inside the plant root, the bacterium replicates rapidly via binary fission, forming a tumour-like gall (a large cluster of undifferentiated cells that looks like a brown sphere) (1 mark) by integrating some of its DNA (deoxyribonucleic acid), which is contained in a circular plasmid, into the host's DNA/genome (1 mark).

A plasmid is a small DNA molecule that is isolated from the chromosomal DNA and can replicate on its own. *(1 mark)*

Once the bacterial genomic material is incorporated into the host's genome, the normal plant cells are altered and genes for uncontrolled cell division are expressed. *(1 mark)*

They multiply and form the gall structure. *(1 mark)*

The bacteria cells outside of galls may enter soil, ready to be transported by water or a vehicle to another susceptible host. *(1 mark)*