



**HERITAGE COLLEGE**  
A CHRISTADELPHIAN SCHOOL  
ADELAIDE, AUSTRALIA

STAGE 2 BIOLOGY  
FORMATIVE SACE TEST

**TOPIC: HOMEOSTASIS**

**Section A: Multiple-Choice Questions – Select the most correct answer.**

1. The saltwater crocodile (*Crocodylus porosus*) is the largest of all living reptiles. The photo below shows a saltwater crocodile basking in the sun on the bank of the Daintree River in Queensland, Australia.



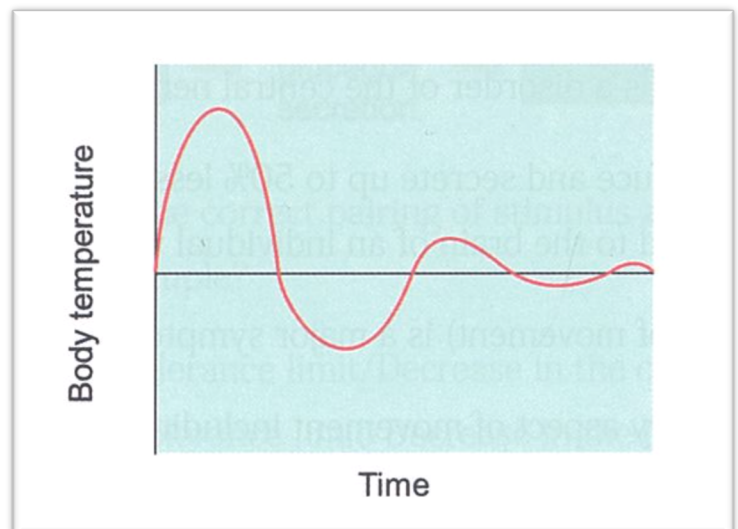
Saltwater crocodiles can be seen basking in the sun for several hours every morning.

Which one of the following statements accurately describes the method of thermoregulation in saltwater crocodiles and the reason for the basking?

- J Endothermy, increase body temperature to increase the rate of metabolic reactions in cells.
  - K Ectothermy, decrease body temperature to increase rate of metabolic reactions in cells.
  - L Endothermy, decrease body temperature to increase rate of metabolic reactions in cells.
  - M Ectothermy, increase body temperature to increase rate of metabolic reactions in cells.
2. The graph (below, right) shows changes in the body temperature of an endotherm with time.

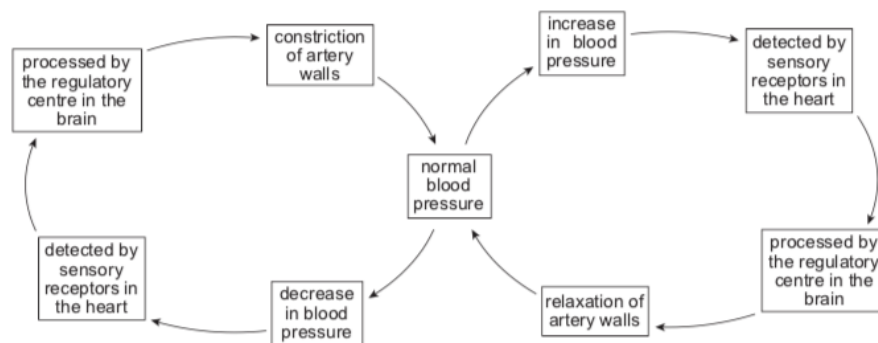
Which one of the following accurately describes the regulatory mechanism shown in the graph?

- J Negative feedback
- K Positive feedback
- L Thermoregulation
- M Both J and L



3. Which one of the following statements is **not** correct?
- J Neurotransmitters are released by neurons.
  - K Neurotransmitters carry a message from one neuron to an adjacent neuron.
  - L Neurotransmitters detect a stimulus.
  - M Neurotransmitters bind to specific receptors.
4. The response to an increase in the level of antidiuretic hormone in the blood of a healthy human being would include
- J increased urine output
  - K decreased production of insulin
  - L decreased blood pressure
  - M increased water reabsorption
5. Which one of the following statements about the regulation of secretion of the hormones insulin and glucagon from the pancreas is **false**?
- J some cells in the pancreas respond to changes in the blood glucose level.
  - K In glucose homeostasis, the blood hormone levels are regulated by negative feedback loops.
  - L Sensory receptors and effectors in the glucose control pathway are located in the pancreas.
  - M After a meal, the increase in the blood glucose level stimulates the release of glucagon.

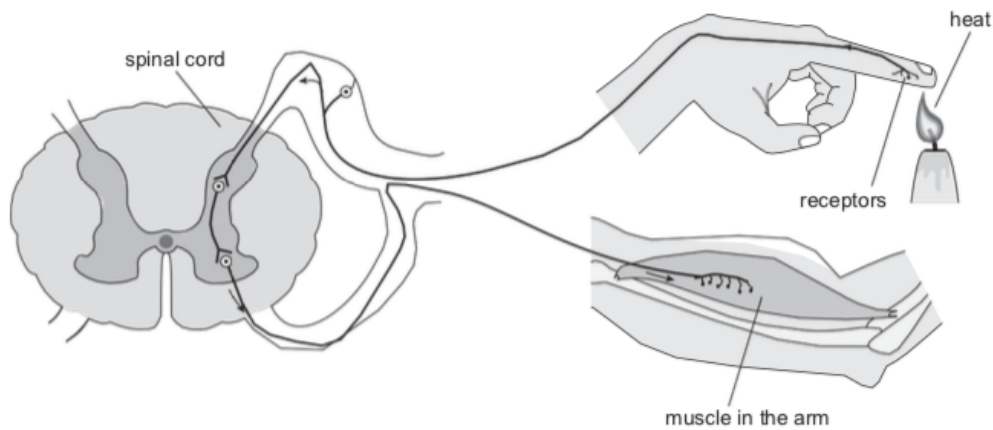
6. Refer to the following pathway, which shows the response of the human body to changes in blood pressure:



Which one of the following statements is **not** consistent with the information in the pathway?

- J The body responds to a decrease in blood pressure.
- K This pathway is an example of a reflex response.
- L In this pathway, the effectors are the artery walls.
- M This pathway involves negative feedback.

7. Refer to the following diagram, which shows a nerve pathway:



Source: Adapted from danielscienceblogg.blogspot.com

If the motor neuron is cut, the most likely outcome is

- J** the heat from the flame is still felt.
  - K** a hormonal message is transmitted instead of an electrical message.
  - L** the speed of transmission is reduced, increasing the reaction time of the response.
  - M** the message is transmitted directly from the sensory neuron to the muscle in the arm.
8. Parkinson's disease (PD) is a disorder of the central nervous system.

Individuals with PD produce and secrete up to 50% less of the neurotransmitter dopamine in the brain when compared to the brain of an individual without PD.

Bradykinesia (slowness of movement) is a major symptom in every case of PD. Bradykinesia affects every aspect of movement including planning, initiation, and execution of movement.

Given this information, it is likely that:

- J** Bradykinesia is caused by lack of dopamine in the part of the brain responsible for movement.
- K** All symptoms of PD are caused by lack of dopamine in the central nervous system.
- L** PD is caused by lack of dopamine in the part of the brain responsible for movement.
- M** Persons with PD produce fewer dopamine receptors than persons without PD.

9. Vasopressin is a hormone found in animals.

Vasopressin binds with its receptor on the surface (membrane) of target cells.

Binding of vasopressin to its receptor activates a series of intracellular (relay) molecules which change the activity of the target cell.

Given this information, vasopressin is most likely classed as:

**J** A steroid hormone.

**K** A lipid soluble hormone.

**L** A peptide hormone.

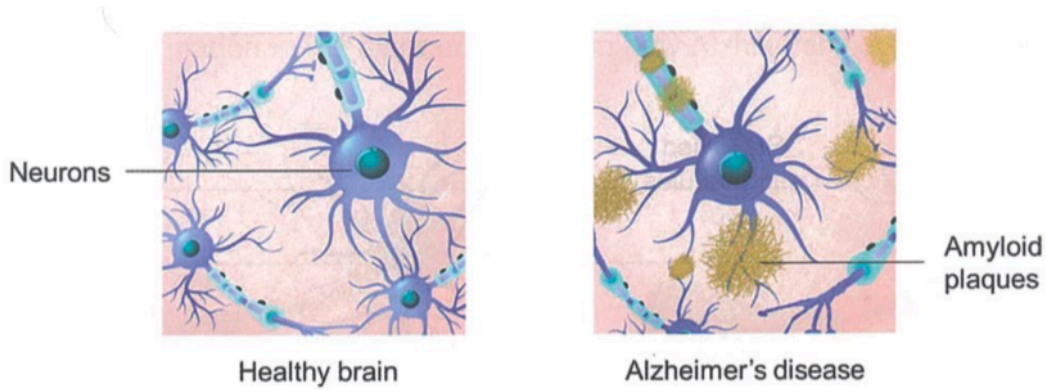
**M** None of the above.

**Section B: Short Answer**

1. Dementia is a category of progressive diseases that affect brain function over time.

Alzheimer's disease is the most common form of dementia.

Alzheimer's disease involves the formation of amyloid plaques in the brain.



Amyloid plaques are sticky masses composed of a protein called amyloid-beta.

Amyloid beta proteins clump together and accumulate between neurons.

(a) Explain how amyloid plaques reduce brain function in persons with Alzheimer's disease.

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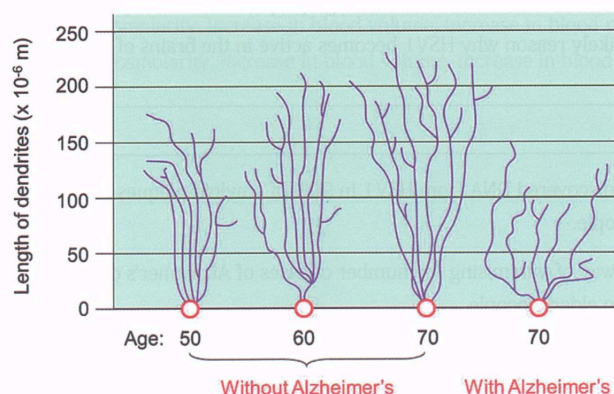
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(2 marks)

(b) The hippocampus is a part of the human brain that is associated with memory.

Dendrites are structures that extend from the cell body and are involved in the transmission of nerve impulses between neurons in the hippocampus and all other areas of the brain.

The graph below shows the length and appearance of the dendrites of neurons in the hippocampus of healthy individuals and those from a person with Alzheimer's disease.



(i) State how the length of dendrites varies with age in healthy individuals.

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(1 marks)

(ii) State the effect of Alzheimer's disease on the length of dendrites in the hippocampus.

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(1 marks)

(iii) Use the information in the diagram to explain how Alzheimer's disease causes memory loss.

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(2 marks)

(c) Acetylcholine (ACh) is a neurotransmitter that is essential for processing memory in the hippocampus.

ACh is synthesized by an enzyme named choline acetyltransferase (ChAT).

The concentration of ChAT is reduced in the hippocampus of persons with Alzheimer's disease. Explain how a decrease in ChAT causes progressive memory loss in persons with Alzheimer's disease.

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(2 marks)

2. 'Fever' is a medical term for a body temperature higher than about 37.5°C. Fever can occur when prostaglandin E2 (PGE2) is released by the body. PGE2 causes the temperature regulation centre of the brain to reset the body's 'normal' temperature to above 37.5°C. When this happens, the body will respond as if it was feeling colder than normal, even if the body temperature is already 37.5°C.

(a) State the change in body temperature that occurs in response to the release of PGE2.

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(1 marks)

(b) Resetting the body's normal temperature to above 37.5°C triggers a hormonal response. Describe this response and its effect on the body.

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(3 marks)

(c) Ibuprofen is a drug used to treat fever. This drug causes vasodilation. Explain what vasodilation is and how it can reduce body temperature.

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(3 marks)

3. The thyroid gland in the neck of humans responds to high levels of calcium in the blood by secreting calcitonin. Calcitonin stimulates the uptake and storage of calcium ions from the blood into the bones.

(a) In the process described above, name the following:

i. Receptor:

\_\_\_\_\_ (1 marks)

ii. Effector:

\_\_\_\_\_ (1 marks)

ii. Type of transmission:

\_\_\_\_\_ (1 marks)

(b) Using this example, explain the process of negative feedback.

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\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_ (2 marks)

(c) Homeostasis mechanisms often involve both hormones and nerves. Describe **two** differences between how hormones and nerves work to assist homeostasis.

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\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_ (2 marks)



4. After vigorous exercise an individual often hyperventilates. Hyperventilation causes an increase in the pH of blood.

(a) State one reason why it is important to maintain the pH of blood.

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(1 marks)

(b) Explain how hyperventilation causes an increase in the pH of blood.

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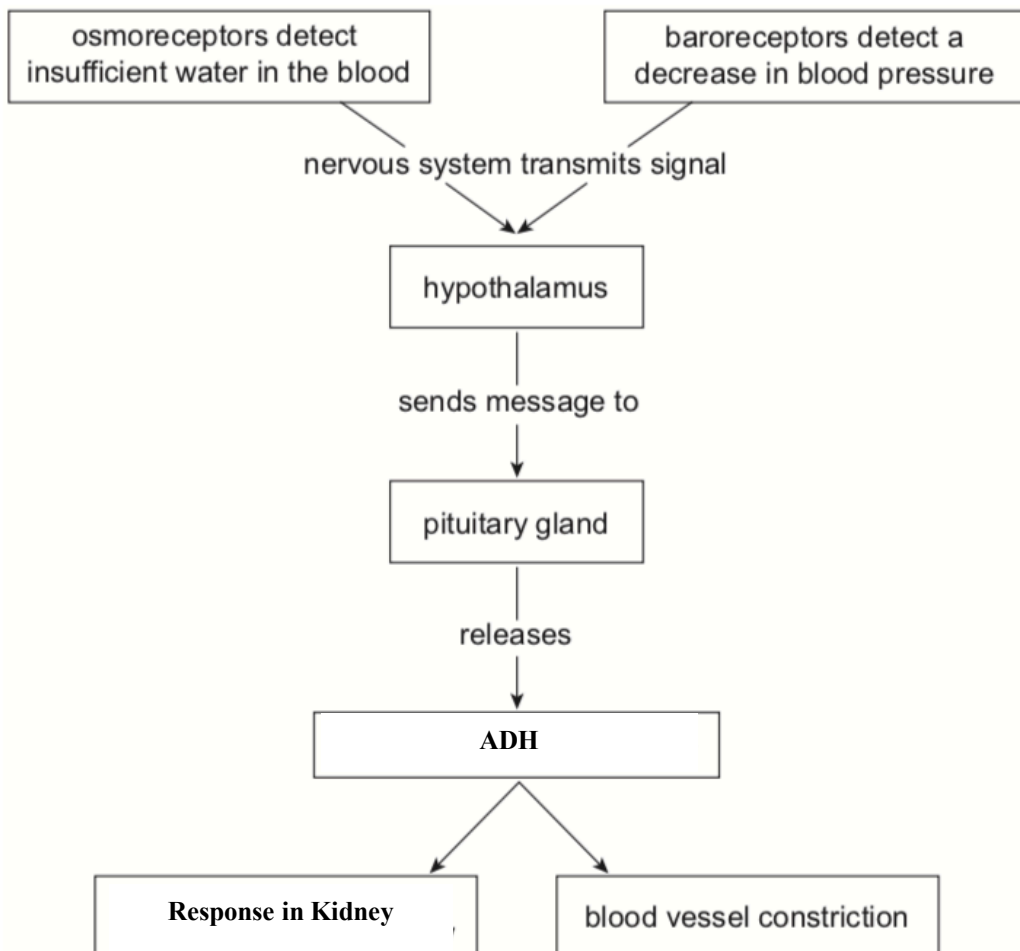
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(2 marks)

5. Refer to the following flow chart, which shows part of a human being's response to a change in water in the blood and a change in blood pressure.

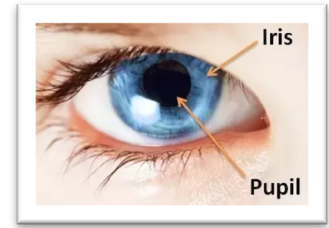




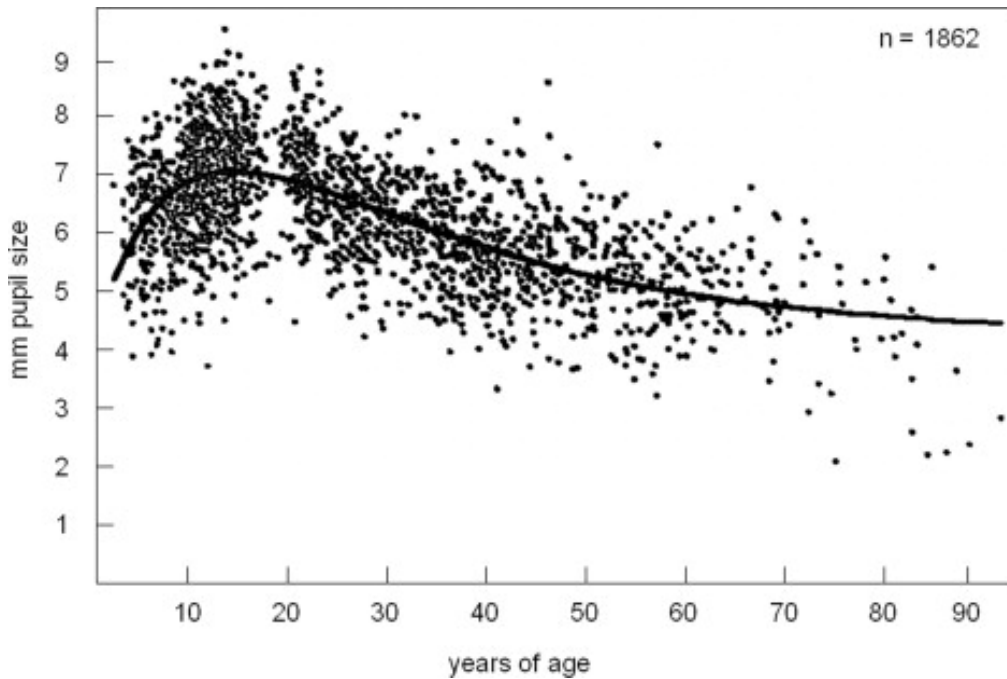
6. The pupillary light reflex (PLR) is a reflex that controls the diameter of the pupil of your eyes. PLR is a response to the intensity of light detected by the eye, and as a result can help adjust your vision to changes in light levels.

In total darkness a person's pupil is at its maximum diameter.

Irene Loewenfield, a well-known pupil scientist, conducted an experiment in 1950 that studied the relationship of a person's age to their pupil size in darkness.



The results of her investigation are plotted below. The solid line represents the mean. The study size, n, involved 1862 individual participants.



Source: *Medical Pharmacology and Therapeutics*, 2018.  
<https://www.sciencedirect.com/topics/neuroscience/pupillary-reflex>

- (a) Explain the **trend** in the data.

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(2 marks)

- (b) Draw a relevant **conclusion** from data.

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(1 marks)



### Section C: Extended Response

*Answer on the 'Extended Response Answer Sheet'. An 'A' level performance will show a clear, well-expressed answer that is well organised, relevant to the question, and demonstrates a deep and broad level of understanding.*

#### Question:

People suffering from Type 1 Diabetes are in danger of possibly life-threatening symptoms. **Discuss** the cause and resulting effects of Type 1 diabetes on an individual and **explain** why they will need to be careful to take medication for the rest of their life control the disease.

**Describe** how glucose regulation in a normal human is controlled by the balance and interaction of two key hormones.

(8 marks)

