# Biomedical Admissions Test (BMAT)

## Section 2: Biology

### Questions by Topic

### B9 - Nervous System and Homeostasis

# B9: Nervous System and Homeostasis - Questions by Topic

*(Mark Scheme and explanations at the end)*

**1** Which of the following statements are true?

**1** Synapses are the fastest part of the reflex arc.
**2** Some reflexes are voluntary.
**3** All reflexes include only the peripheral nervous system.
**4** Reflexes increase our chances of survival.

**A** 1 only
**B** 2 only
**C** 3 only
**D** 4 only
**E** None of the statements

**2** Which of the following statements are true?

**1** Hormones are fast-acting, compared to neurons.
**2** Hormones are specific to a precise area of the body.
**3** Hormones travel in the blood.
**4** Adrenaline is a hormone that can cause heart rate to increase.

**A** 1 and 2 only
**B** 1 and 3 only
**C** 2 and 3 only
**D** 2 and 4 only
**E** 3 and 4 only

**3** Which of the following is a response that might occur on a hot day?

**A** Hairs stand up on end to trap a layer of air; sweating to remove heat from skin; blood vessels dilate.
**B** Hairs lie flat to skin; sweating to remove heat from skin; blood vessels constrict.
**C** The thermoregulatory centre in the cerebral cortex induces vessel dilation and sweating.
**D** Hairs lie flat to skin; sweating to remove heat from skin; blood vessels dilate.
**E** The thermoregulatory centre in the hypothalamus induces shivering.

**4** Which of the following outlines how glucose in the blood is controlled?

| | **Stimulating [glucose]** | **Hormone released** | **Effect of hormone** |
|---|---|---|---|
| **A** | High | Glucagon | [glucose] decreases |
| **B** | High | Glucagon | No change |
| **C** | High | Insulin | [glucose] decreases |
| **D** | Low | Insulin | [glucose] decreases |
| **E** | Low | Insulin | No change |

**5** Which of the following statements are true of hormones?

**1** Glucagon causes an increase in glucose concentration.
**2** Adrenaline causes bradycardia.
**3** ADH is released into the blood directly by the hypothalamus.

**A** 1 only
**B** 2 only
**C** 3 only
**D** 1 and 2 only
**E** None of the statements

**6** Which of the following accurately describes water homeostasis?

| | **Environment** | **Volume of Urine** | **Urine Composition** |
|---|---|---|---|
| **A** | Hot | Low | Concentrated |
| **B** | Hot | High | Concentrated |
| **C** | Hot | Low | Dilute |
| **D** | Cold | Low | Dilute |
| **E** | Cold | High | Concentrated |

**7** Which of the following statements are true?

**1** High pressure allows water, urea, ions and proteins to be pushed out of the blood and into the Bowman's capsule.
**2** No sugar is reabsorbed in the kidney.
**3** Ions are transported in the kidney via passive diffusion only.
**4** The nephron is the unit of ultrafiltration in the kidney.

**A** 1 only
**B** 1 and 2 only
**C** 3 only
**D** 3 and 4 only
**E** 4 only

**8** Which of the following accurately describes the control of urine concentration?

**A** Receptor in the brain detects water content is too high; pituitary gland releases more ADH; kidneys reabsorb less water.
**B** Receptor in the brain detects water content is too high; pituitary gland releases less ADH; kidneys reabsorb less water.
**C** Receptor in the brain detects water content is too low; pituitary gland releases less ADH; kidneys reabsorb less water.
**D** Receptor in the brain detects water content is too high; pituitary gland releases less ADH; kidneys reabsorb more water.
**E** Receptor in the brain detects water content is too low; pituitary gland releases more ADH; kidneys reabsorb less water.

**9** Which of the following are true of ADH production?

**1** Alcohol causes dehydration
**2** Alcohol causes large amounts of concentrated urine to be produced
**3** Ecstasy causes ADH production to be increased
**4** Ecstasy causes smaller amounts of concentrated urine to be produced

**A** 1 and 2 only
**B** 1 and 3 only
**C** 1, 2 and 3 only
**D** 1, 3 and 4 only
**E** All of the statements

**10** Which of the following accurately describes the removal of urea?

**A** Proteins can't be stored in the body so they are broken down into fats and carbohydrates; urea is produced as a waste product; urea is poisonous so must be filtered by the liver.
**C** Proteins can't be stored in the body so they are broken down into fats and carbohydrates; urea is produced as a waste product; urea is poisonous so must be filtered by the kidneys.
**D** Fats can't be stored in the body so they are broken down into proteins and carbohydrates; urea is produced as a waste product; urea is poisonous so must be filtered by the liver.
**E** Carbohydrates can't be stored in the body so they are broken down into fats and proteins; urea is produced as a waste product; urea is poisonous so must be filtered by the kidneys.

**11** Which of the following gives the correct order for actions at the synapse?

**A** Impulse triggers release of chemicals; impulse travels down axon; transmitter binds to receptors on second neuron; nerve impulse initiated in the second neuron.

**B** Impulse triggers release of chemicals; transmitter binds to receptors on second neuron; impulse travels down axon; nerve impulse initiated in the second neuron.

**C** Impulse travels down axon; transmitter binds to receptors on second neuron; impulse triggers release of chemicals; nerve impulse initiated in the second neuron.

**D** Impulse travels down axon; transmitter binds to receptors on second neuron; nerve impulse initiated in the second neuron; impulse triggers release of chemicals.

**E** Impulse travels down axon; impulse triggers release of chemicals; transmitter binds to receptors on second neuron; nerve impulse initiated in the second neuron.

# Answers and Explanations

**1 The correct answer is D**

**1** is incorrect - synapses are the **slowest** part of a reflex arc. This is because they are limited by the rate of diffusion, and nerve impulses travel much faster than this.

**2** is incorrect - **all reflexes are involuntary**; they are **innate** processes; we do not have to think about them.

**3** is incorrect - reflexes involve the central nervous system; they pass through the **spinal cord** (a component of the CNS).

**4** *is correct - reflexes are unconscious actions, that prevent us from hurting ourselves - therefore, these actions aid survival.*

**2 The correct answer is E**

**1** is incorrect - hormones travel in the blood, meaning they are slower than nervous impulses.

**2** is incorrect - hormones have a more **generalised** effect than neurons. For example, adrenaline is released into the bloodstream and has effects on multiple different tissues/systems; it increases heart rate, causes vessel constriction and causes dilation of the pupils. Nerves, however, act on a more precise location since they synapse at specific points.

***3*** *is correct.*

***4*** *is correct - this is known as the 'fight or flight' response.*

**3 The correct answer is D**

**A** is incorrect - hairs don't trap a layer of air in the heat, this is a mechanism of homeostasis in cold weather, where a layer of **warm** air is trapped to minimise heat loss.

**B** is incorrect - in the heat, blood vessels dilate and carry blood closer to the surface to maximise heat loss from the blood.

**C** is incorrect - the thermoregulatory centre is in the hypothalamus - the thermoregulatory centre is the area of the brain which controls our body temperature.

***D*** *is correct.*

**E** is incorrect - shivering is a mechanism of homeostasis in cold weather, as this increases the rate of aerobic respiration in cells, of which heat is a by-product.

***Exam Tip*** - Homeostasis is defined as the process of **maintaining a constant internal environment.**

When you have questions where you need to work out homeostatic responses, you can use logic and **think** about how internal conditions can be brought back to normal.

**4** **The correct answer is C**

**A** is incorrect - when blood glucose is **high**, **insulin** is released in order to bring levels down - not glucagon.

**B** is incorrect - when blood glucose is **high**, **insulin** is released in order to bring levels down - not glucagon.

***C*** *is correct - when blood glucose is high, insulin is released by the pancreas and causes a reduction in blood glucose levels.*

**D** is incorrect - when blood glucose levels are **low**, **glucagon** is released to stimulate the breakdown of starch stores into glucose, **causing glucose levels to increase**.

**E** is incorrect - when glucose levels are **low**, **glucagon** is released to stimulate the breakdown of starch stores into glucose, **causing glucose levels to increase**.

***Exam Tip*** - The insulin and glucagon control system is often examined! Make sure you understand it well, and know how and when each hormone acts.

**5** The correct answer is **A**

***1*** *is correct - when glucose levels are **low**, **glucagon** is released to stimulate the breakdown of starch stores into glucose, **causing glucose levels to increase**.*

**2** is incorrect - adrenaline causes the **'fight or flight' response** (this is your body preparing to either fight or to run away from a predator) to be initiated; this has many effects, one of which is an increase in heart rate.

**3** is incorrect - ADH is released into the blood by the pituitary gland.

**6** **The correct answer is A**

***A*** *is correct.*

**B** is incorrect - in hot weather, a smaller volume of more concentrated urine is produced to conserve water stores.

**C** is incorrect - in hot weather, a smaller volume of more concentrated urine is produced to conserve water stores.

**D** is incorrect - in cold weather, higher volumes of dilute urine are produced.

**E** is incorrect - in cold weather, higher volumes of dilute urine are produced.

**7** **The correct answer is E**

**1** is incorrect - proteins do not pass into the urine of healthy individuals as the molecules are too large to pass through the membrane between blood vessels and the Bowman's Capsule.

**2** is incorrect - in healthy individuals, **all sugar is reabsorbed** into the blood. In individuals with diabetes, sugar in the urine can be a sign of high blood glucose levels. This occurs due to the transporters in the nephron becoming overwhelmed with sugar, so some of it escapes being transported back into the blood and is excreted in the urine.

**3** is incorrect - ions are transported via **active transport**.

***4*** *is correct.*

**8** **The correct answer is B**

> ***Exam Tip*** - For questions where many of the options are similar, you may find the following method useful:
>
> - **Cover** the answers and **write down** what you think the answer is.
> - Then, look for the answer most similar to yours and choose this answer!
>
> This may make it easier to identify the correct answer, without being distracted by similar answers.

**A** is incorrect - less ADH is released when water content is higher, so less water is conserved.

***B*** *is correct.*

**C** is incorrect - when water contents low, more ADH is released so that the kidneys reabsorb more water.

**D** is incorrect - less ADH is released when water content is higher, so less water is conserved by the kidneys.

**E** is incorrect - when water contents low, more ADH is released so that the kidneys reabsorb more water.

***Exam Tip*** - With questions like this, if you can't recall what a specific thing does, try to use logic to **eliminate incorrect options**.

For example, if you can't remember what ADH does, you can think about the other parts of the statement. If the water content is too high, your body will act to lose water. This is done by reducing the resorption of water by the kidney. This allows you to eliminate options C-E.

To choose between A and B, you need to recall the function of ADH. It may help you to know that **ADH** means **'antidiuretic hormone'** and the term **'diuresis'** means **to produce urine**. Therefore, **ADH works to decrease the volume of urine**, by increasing reabsorption of water by the kidney.

**9** **The correct answer is D**

***1*** *is correct - **alcohol suppresses ADH production** so that large volumes of dilute urine are produced.*

**2** is incorrect - **dilute** urine is produced following alcohol consumption, because less water is reabsorbed by the kidneys and more passes into the urine. Since the amount of waste products produced remains the same, the urine produced is less concentrated.

***3*** *is correct.*

***4*** *is correct - because more ADH is produced, more water is reabsorbed by the kidney, meaning that small volumes of very concentrated urine are produced.*

***Exam Tip*** - For the BMAT, you should know the effects of ecstasy and alcohol on ADH production:

| **Alcohol** | **Ecstasy** |
|---|---|
| **Suppresses** ADH production | **Increases** production of ADH |
| Kidneys reabsorb **less** water | Kidneys reabsorb **more** water |
| Large volumes of diluted urine | Small volumes of concentrated urine |

**10** **The correct answer is C**

> ***Exam Tip*** - For the BMAT, you need to remember that fats and carbohydrates can be stored in the body, and proteins cannot. Knowing this will enable you to eliminate answers quickly here!

**A** is incorrect - **urea is filtered by the kidneys**, not the liver.

**B** is incorrect - it is **proteins** that **cannot be stored in the body**, meaning any **amino acids** must be **converted into carbohydrates and fats.**

**C** *is correct.*

**D** is incorrect - it is **proteins** that **cannot be stored in the body**, meaning any **amino acids** must be **converted into carbohydrates and fats**. Also, **urea is filtered by the kidneys.**

**E** is incorrect - it is **proteins** that **cannot be stored in the body**, meaning any **amino acids** must be **converted into carbohydrates and fats.**

> ***Exam Tip*** - It is important to learn how urea is removed from the body:
> - Proteins cannot be stored in the body.
> - Amino acids, the product of protein digestion, are converted into fats and carbohydrates since these can be stored.
> - This process occurs in the liver.
> - Urea is the waste product from this process, and is carried in the blood until it is removed from the body by the kidney.

**11** **The correct answer is E**

The sequence of events at the neuron always occurs in the following order:

**1** Impulse travels down the axon.

**2** Impulse triggers release of chemical transmitters form pre-synaptic bouton.

**3** Transmitter binds to postsynaptic receptors on the second receptor.

**4** Nerve impulse is initiated in the second neuron.

> ***Exam Tip*** - This sequence is very often tested, so it is useful to spend some time learning it!
> It is often easier to visualise and recall this pathway by drawing a diagram to show it. Even if your diagram is very rough, it may help you eliminate answers.