11.3 The Kidney & Osmoregulation

Mark Schemes

Course	DP IB Biology
Section	11. Animal Physiology (HL Only)
Topic	11.3 The Kidney & Osmoregulation
Difficulty	Medium

To be used by all students preparing for DP IB Biology HL
Students of other boards may also find this useful

1

The correct answer is **B**.

Remember that osmolarity is a measure of the **number of solute particles** present in a **solution**, so a cell with higher osmolarity than its surroundings has a **higher solute concentration** and will therefore **take on water**.

2

The correct answer is **B**.

The nitrogenous waste of insects is excreted in the form of **uric acid**, unlike many other animals which excrete it in the form of **urea**. Nitrogenous waste is actively transported into the malpighian tubules, which drain into the insect's digestive tract; here it is converted into uric acid.

3

The correct answer is **D**.

The diameter difference between the afferent and efferent arterioles means that blood **flows into** the glomerulus **faster** than it can **flow out**; this generates **high blood pressure inside the glomerulus**, forcing small molecules into the Bowman's capsule. Large molecules are unable to pass through the basement membrane, so are kept out of the filtrate. The other statements are biologically accurate, but do not describe features that **aid** ultrafiltration.

4

The correct answer is **C**.

D is very similar to the correct answer, but structure 4 labels the lumen, or the inside, of the Bowman's capsule, and not the inside of the proximal convoluted tubule.

5

The correct answer is **B**.

Small molecules **pass through** the capillary endothelium, basement membrane, and podocyte layer during **ultrafiltration** to form the **glomerular filtrate**, so we would expect the concentrations of urea, sodium ions, and glucose to remain the **same**, or similar to that of the blood plasma. Large molecules do not fit through the barriers, so protein concentration should be zero, or close to zero, in a healthy individual.

6

The correct answer is **A**.

The **high** osmolarity in the medulla, generated by the ions pumped out of the **ascending** limb, leads to water **leaving the descending limb** by **osmosis**.

The descending limb has few transport proteins, so is relatively **impermeable to ions**.

While it is correct that water is reabsorbed into the vasa recta, this statement does not explain why water leaves the loop of Henle by osmosis.

7

The correct answer is **C**.

Animals that live in **dry environments** often have a very **long** loop of Henlé as this allows them to generate **very concentrated urine** and therefore conserve water. A long loop of Henlé enables the generation of a very **steep concentration gradient** across the medulla and therefore the **reabsorption** of **almost all water** by osmosis. Note that whilst some of the other statements may be true, only statement **C** specifically explains the concentrating ability of the kidney.

8

The correct answer is **A**.

ADH is released into the blood in response to low **blood water content**. It **increases** the number of **aquaporins** in the cells lining the collecting duct, increasing the permeability of the collecting duct to water and leading to increased water reabsorption.

Note that while **C** and **D** would also both lead to increased water reabsorption, we would not expect these features to vary significantly between two humans, and neither would these features explain the differences shown in the image.

9

The correct answer is **D**.

Nucleic acids and **proteins** both contain nitrogen, so nitrogenous waste results from the breakdown of **excess** dietary nucleic acids and proteins. Note that amino acids are the monomers of proteins, so it would also be correct to say that nitrogenous waste comes from the breakdown of excess amino acids.

10

The correct answer is **D**.

During dialysis, substances cross the dialysis membrane by diffusion **down their concentration gradients**. The concentration of HCO_3^- ions is higher in the dialysis fluid, so they diffuse **into the blood**, while urea concentration is higher in the blood, so urea diffuses **into the dialysis fluid**. Na^+ ions and glucose are at **equilibrium**, so there is **no overall movement**.