CLASS 11 BIOLOGY NCERT SOLUTIONS

NCERT Solutions for Class 11 Biology Chapter 16: Excretory Products and their Elimination – Free PDF Download

Chapter 16, Excretory Products and their Elimination, explains how animals remove nitrogenous wastes such as ammonia, urea and uric acid from their bodies, and takes a detailed look at the human excretory system - the kidneys, ureters, urinary bladder and urethra. It covers nephron structure, the three steps of urin...

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Chapter 16, **Excretory Products and their Elimination**, explains how animals remove nitrogenous wastes such as ammonia, urea and uric acid from their bodies, and takes a detailed look at the human excretory system – the kidneys, ureters, urinary bladder and urethra. It covers nephron structure, the three steps of urine formation (filtration, reabsorption and secretion), the counter-current mechanism that concentrates urine, hormonal regulation of kidney function through **renin-angiotensin-aldosterone (RAAS)** and **ADH**, micturition, and common excretory disorders such as kidney stones, uraemia and dialysis. These Class 11 Biology Chapter 16 solutions are also useful as quick revision notes before exams.

Exercises

Q1. Define Glomerular Filtration Rate (GFR).

The **Glomerular Filtration Rate (GFR)** is the total amount of filtrate formed by both kidneys together in one minute. In a healthy adult, the GFR is approximately **125 mL per minute**, which works out to nearly **180 litres of filtrate per day**. This filtrate is essentially protein-free plasma pushed out of the **glomerular capillaries** into the **Bowman's capsule** under pressure, and it contains water, glucose, amino acids, urea, uric acid, salts and other small solutes.

Q2. Explain the autoregulatory mechanism of GFR.

The kidney can keep GFR fairly constant through an intrinsic feedback system involving the **juxtaglomerular apparatus (JGA)**, a specialised patch of cells located where the **distal convoluted tubule (DCT)** touches the afferent arteriole of the same nephron. When the glomerular blood flow (and hence GFR) falls – for example due to a fall in blood pressure – the macula densa cells of the JGA sense the change and stimulate the juxtaglomerular cells of the afferent arteriole to release the enzyme **renin**. Renin converts angiotensinogen (a plasma protein made by the liver) into **angiotensin I**, which is then converted to **angiotensin II**. Angiotensin II is a powerful vasoconstrictor that raises glomerular blood pressure, and it also stimulates the adrenal cortex to release **aldosterone**, which promotes reabsorption of Na+ and water. Together these actions restore blood pressure and glomerular filtration back to normal, forming a self-correcting (autoregulatory) loop.

Q3. Indicate whether the following statements are true or false:
(a) Micturition is carried out by a reflex.
(b) ADH helps in water elimination, making the urine hypotonic.
(c) Protein-free fluid is filtered from blood plasma into the Bowman's capsule.
(d) Henle's loop plays an important role in concentrating the urine.
(e) Glucose is actively reabsorbed in the proximal convoluted tubule.

Statement	True / False	Correction (if false)
(a) Micturition is carried out by a reflex.	True	The stretch receptors in the bladder wall trigger the micturition reflex.
(b) ADH helps in water elimination, making the urine hypotonic.	False	ADH (vasopressin) promotes **water reabsorption** from the distal tubule and collecting duct, which makes the urine **hypertonic** (concentrated), not hypotonic.
(c) Protein-free fluid is filtered from blood plasma into the Bowman's capsule.	True	Because plasma proteins are too large to cross the filtration membrane, only a protein-free

		filtrate enters the capsule.
(d) Henle's loop plays an important role in concentrating the urine.	True	The loop of Henle, along with the vasa recta, operates the counter-current mechanism that builds up the medullary osmotic gradient needed to concentrate urine.
(e) Glucose is actively reabsorbed in the proximal convoluted tubule.	True	Glucose, amino acids and most electrolytes are reabsorbed almost completely (by active transport) in the PCT.

Q4. Give a brief account of the counter-current mechanism.

The **counter-current mechanism** is the arrangement by which the kidney concentrates urine and conserves water. It operates through two U-shaped structures lying parallel to each other and running in opposite directions: the **loop of Henle** (part of the nephron) and the **vasa recta** (a capillary network that runs alongside the loop, supplying blood to the juxtamedullary nephrons). In the loop of Henle, filtrate flows down the descending limb and up the ascending limb; the descending limb is permeable to water but not to salts, while the thick ascending limb is impermeable to water but actively pumps out NaCl. This differential permeability, aided by the flow of blood in the opposite direction along the vasa recta, progressively increases the osmolarity of the interstitial fluid of the medulla from about **300 mOsmol/L** near the cortex to about **1200 mOsmol/L** deep in the inner medulla. As the collecting duct passes through this increasingly concentrated medullary interstitium, water is drawn out of it (especially under the influence of ADH), so the final urine that leaves the kidney is much more concentrated than the initial filtrate. This is the chief mechanism by which the mammalian kidney produces hypertonic urine and prevents excessive loss of water.

Q5. Describe the role of the liver, lungs and skin in excretion.

Liver: The liver is a major excretory organ. It deaminates excess amino acids and converts toxic ammonia into less toxic **urea** via the ornithine cycle. It also breaks down haemoglobin from dead red blood cells into bile pigments (**bilirubin** and **biliverdin**), and excretes cholesterol, steroid hormone breakdown products, vitamins and certain drugs through bile, which is eventually eliminated with the faeces.

Lungs: The lungs excrete large quantities of **CO_2** (roughly 200 mL per minute) produced during cellular respiration, along with water vapour and small amounts of other volatile substances during expiration.

Skin: Sweat glands in the skin secrete sweat, which contains water, NaCl, and small amounts of nitrogenous wastes such as urea and lactic acid; this also plays a role in thermoregulation. Sebaceous glands secrete sebum, which removes some sterols, hydrocarbons and waxes and also protects the skin surface.

Q6. Explain micturition.

Micturition is the process of voluntary passing out (voiding) of urine from the urinary bladder. Urine formed continuously by the kidneys is stored temporarily in the urinary bladder. As urine accumulates, the bladder walls stretch, and this stretching activates **stretch receptors** present in the bladder wall. These receptors send afferent signals to the spinal cord, initiating the **micturition reflex**, which causes contraction of the smooth muscles of the bladder and relaxation of the urethral sphincter, leading to expulsion of urine. Although micturition is a spinal reflex, it is normally under conscious cerebral control in adults, allowing voluntary initiation or postponement of urination.

Q7. Match the items of Column I with those of Column II:

Column I	Column II
(a) Ammonotelism	(iii) Bony fish
(b) Bowman's capsule	(v) Renal tubule
(c) Micturition	(iv) Urinary bladder
(d) Uricotelism	(i) Birds
(e) ADH	(ii) Water reabsorption

Q8. What is meant by the term osmoregulation?

Osmoregulation is the physiological process by which an organism maintains a relatively constant osmotic concentration (the balance of water and dissolved solutes such as salts) in its body fluids, regardless of changes in the external environment. In humans, the kidneys – through regulated filtration, reabsorption and secretion, along with hormones such as ADH and aldosterone – are the principal osmoregulatory organs, ensuring the body neither loses too much water nor accumulates excess salts.

Q9. Terrestrial animals are generally either ureotelic or uricotelic, not ammonotelic. Why?

Ammonia is highly toxic and needs to be dissolved in large volumes of water for safe elimination, which is why **ammonotelism** (direct excretion of ammonia) is mainly seen in aquatic animals like bony fish, where the surrounding water is freely available to dilute and wash away the ammonia. Terrestrial animals, however, do not have unlimited access to water and must conserve it. Excreting ammonia directly would require far too much water and would risk toxic accumulation. To overcome this problem, terrestrial animals convert ammonia into less toxic compounds that need far less water for excretion: mammals and many amphibians convert it into **urea** (ureotelism), while reptiles, birds and insects convert it into semi-solid, virtually non-toxic **uric acid** (uricotelism), which can be excreted with minimal water loss. This adaptation allows terrestrial animals to conserve body water while safely disposing of nitrogenous waste.

Q10. What is the significance of the juxtaglomerular apparatus (JGA) in kidney function?

The **juxtaglomerular apparatus (JGA)** is a specialised sensory and regulatory structure formed at the point of contact between the afferent arteriole and the distal convoluted tubule of the same nephron. It plays a central role in regulating **glomerular filtration rate (GFR)** and overall kidney function through the **renin-angiotensin-aldosterone system (RAAS)**. Whenever GFR falls (for instance, due to low blood pressure or reduced blood volume), the JGA is activated and releases the enzyme **renin**. Renin converts angiotensinogen into angiotensin I, which is then converted to **angiotensin II**, a potent vasoconstrictor. Angiotensin II raises glomerular blood pressure directly by constricting blood vessels, and also stimulates the adrenal cortex to secrete **aldosterone**, which causes the kidney tubules to reabsorb more Na+ and water. These combined actions increase blood volume and blood pressure, which in turn restores GFR to its normal level – making the JGA a vital component of the kidney's homeostatic feedback control.

Q11. Name the following:
(a) A chordate animal having flame cells as excretory structures.
(b) Cortical portions projecting between the medullary pyramids in the human kidney.
(c) A loop of capillary running parallel to Henle's loop.

Description	Answer
(a) Chordate with flame cells as excretory structures	*Amphioxus* (Branchiostoma) – flame cells/protonephridia are its excretory units
(b) Cortical tissue projecting between the medullary pyramids	Columns of Bertini (renal columns)
(c) Capillary loop running parallel to the loop of Henle	Vasa recta

Q12. Fill in the gaps:
(a) Ascending limb of Henle's loop is ______ to water, whereas the descending limb is ______ to it.
(b) Reabsorption of water from the distal parts of the tubules is facilitated by the hormone ______.
(c) Dialysis fluid contains all the constituents as in plasma except ______.
(d) A healthy adult human excretes (on an average) ______ gm of urea per day.

Blank	Answer
(a) Ascending limb / descending limb	impermeable to water / permeable to water
(b) Hormone facilitating water reabsorption	Vasopressin (Antidiuretic Hormone, ADH)
(c) Dialysis fluid lacks	Nitrogenous wastes (such as urea)
(d) Average daily urea excretion	25-30 gm

Class 11 Biology Chapter 16 – Notes and Extra Questions

Chapter 16 has a compact but concept-dense exercise set of **12 questions** that blend short definitional answers (GFR, osmoregulation), diagram-based or descriptive answers (counter-current mechanism, micturition, JGA), and objective-style items (true/false, matching, fill-in-the-blanks, and naming structures). Students should focus on being able to label and explain a nephron diagram, trace the exact path of urine formation from glomerular filtration through reabsorption and secretion to micturition, and clearly distinguish ammonotelism, ureotelism and uricotelism with suitable examples. The RAAS pathway and the role of ADH are frequently tested as short-answer and assertion-reason questions in exams, so understanding the sequence renin -> angiotensin I -> angiotensin II -> aldosterone is essential. It is also worth remembering key numerical facts such as GFR (125 mL/min), daily filtrate volume (~180 L), and average daily urea excretion (25-30 gm), as these often appear directly in fill-in-the-blank and one-mark questions.

What is the difference between ureotelism and uricotelism?

Ureotelism is the excretion of nitrogenous waste mainly as **urea**, seen in mammals, many adult amphibians, and marine fish. Urea is less toxic than ammonia and requires comparatively less water for its removal. **Uricotelism** is the excretion of nitrogenous waste mainly as **uric acid**, seen in reptiles, birds, land snails and insects. Uric acid is nearly non-toxic and can be excreted as a semi-solid paste with minimal water loss, making it especially suited to organisms that need to conserve water (such as birds, which also need to keep body weight low for flight).

What are the three main steps involved in urine formation?

Urine formation involves three sequential processes in the nephron: (1) **Glomerular filtration**, where blood pressure forces water and small solutes from the glomerular capillaries into the Bowman's capsule to form the glomerular filtrate; (2) **Tubular reabsorption**, where useful substances such as glucose, amino acids, water and salts are reabsorbed back into the blood mainly from the proximal convoluted tubule, loop of Henle and distal convoluted tubule; and (3) **Tubular secretion**, where the tubular cells actively secrete substances like H+, K+, and certain drugs from the blood into the filtrate, which helps maintain the ionic and acid-base balance of the blood. The final fluid that reaches the collecting duct is the urine.

Why is dialysis needed, and how does it work?

When the kidneys fail to remove nitrogenous wastes efficiently (a condition called uraemia), these wastes accumulate in the blood and can be life-threatening. **Haemodialysis** is used in such cases to artificially perform the function of the kidney. The patient’s blood is passed through a dialysing unit containing a selectively permeable membrane, which is surrounded by a dialysing fluid that has the same composition as normal plasma but lacks nitrogenous wastes. Because of the concentration gradient, urea and other wastes diffuse out of the blood into the dialysing fluid, and the purified blood is returned to the patient’s body.

What is the role of the loop of Henle in concentrating urine?

The loop of Henle enables the kidney to produce concentrated (hypertonic) urine through the **counter-current mechanism**. Its descending limb is permeable to water but not to salts, while the thick ascending limb is impermeable to water but actively transports NaCl out into the medullary interstitium. This creates and maintains a strong osmotic gradient in the renal medulla (increasing from the cortex toward the inner medulla), which draws water out of the collecting duct as urine passes through it, especially in the presence of ADH. Without this mechanism, the kidney would only be able to produce urine that is as dilute as the original filtrate, leading to excessive water loss from the body.