Excretory Products and Their Elimination — CBSE Pattern Test 2

Class 11 Biology · 90 minutes · 40 marks · Sections A–D with answer key · Narayan Gurukul Academy

Test 2 — CBSE Pattern (90 minutes, 40 marks)

Class 11 Biology · Excretory Products and Their Elimination · Narayan Gurukul Academy (ClassApna)

General Instructions: (1) This paper has four sections — Section A (1 × 10), Section B (2 × 4), Section C (3 × 4) and Section D (5 × 2) — total 40 marks. Time allowed: 90 minutes.
(2) All questions are compulsory. For MCQ questions choose the single correct option; for VSA questions write a single line.
(3) Quotation of NCERT values (GFR, osmolarity, urine output, etc.) is expected wherever relevant. Use of a calculator is not permitted.

Section A — MCQ & VSA (10 × 1 = 10 marks)

1. The amount of filtrate formed by the kidneys per day in a healthy adult is approximately —
   (A) 180 L
   (B) 1.5 L
   (C) 18 L
   (D) 12 L
2. Which of the following lowers blood pressure and acts as a check on the renin–angiotensin mechanism?
   (A) Atrial natriuretic factor (ANF)
   (B) ADH
   (C) aldosterone
   (D) renin
3. The Columns of Bertini are the —
   (A) cortical portions projecting between the medullary pyramids
   (B) projections of the renal pelvis called calyces
   (C) loops of peritubular capillaries in the medulla
   (D) double-walled cups enclosing the glomerulus
4. The double-walled cup that encloses the glomerulus is the —
   (A) Bowman's capsule
   (B) collecting duct
   (C) calyx
   (D) renal pelvis
5. The dialysing fluid used in hemodialysis is similar to blood plasma except that it lacks —
   (A) nitrogenous wastes
   (B) water
   (C) glucose
   (D) sodium ions
6. Define osmoregulation.
7. What is renal calculi?
8. Give the osmolarity value of the kidney cortex in $mOsmolL^{-1}$.
9. What are filtration slits?
10. Which organ secretes bile containing bilirubin and biliverdin?

Section B — Short Answer I (4 × 2 = 8 marks)

11. Why is the ascending limb of the loop of Henle impermeable to water, and how does this help build the medullary gradient?

12. Distinguish between ammonotelism, ureotelism and uricotelism, giving one example of each.

13. Explain how tubular secretion helps the nephron maintain the pH of body fluids.

14. Mention the characteristics of normal urine and state what the analysis of urine reveals.

Section C — Short Answer II (4 × 3 = 12 marks)

15. Explain the autoregulatory mechanism of GFR by the juxta glomerular apparatus.

16. Describe the role of the lungs and the skin in the elimination of excretory wastes.

17. Explain how the loops of Henle and the vasa recta together constitute a counter current mechanism, and why this arrangement can concentrate urine to about 1200 $mOsmolL^{-1}$.

18. Explain how ADH produces a concentrated urine, and how ANF acts as a check on the renin–angiotensin mechanism.

Section D — Long Answers (2 × 5 = 10 marks)

19. (a) Describe the three layers involved in ultrafiltration at the glomerulus. (b) Explain how ADH and aldosterone regulate the water and ionic balance of the body.

20. (a) Describe the hormonal feedback regulation of kidney function involving the hypothalamus, the JGA and the heart. (b) Why are reptiles and birds uricotelic while mammals are ureotelic?

Answer Key (Marking Scheme)

Q1 — (A) 180 L. Q2 — (A) Atrial natriuretic factor (ANF). Q3 — (A) cortical portions projecting between the medullary pyramids. Q4 — (A) Bowman's capsule. Q5 — (A) nitrogenous wastes.

Q6 — Osmoregulation is the maintenance of the ionic balance and fluid volume (osmotic concentration) of body fluids by excretory structures such as the flame cells of protonephridia and the nephridia.

Q7 — Renal calculi are stone-like deposits of calcium oxalate, uric acid, etc., formed in the kidney.

Q8 — About 300 $mOsmolL^{-1}$.

Q9 — Filtration slits are the fine spaces between the pedicels (foot processes) of podocytes in the visceral layer of Bowman's capsule, through which the glomerular filtrate passes during ultrafiltration.

Q10 — The liver (bile contains bilirubin and biliverdin).

Q11 — If the ascending limb were water-permeable, water would diffuse out into the interstitium along with the NaCl, diluting the gradient. Because it actively transports NaCl out while remaining impermeable to water, a rich gradient of salt accumulates in the medullary interstitium, which drives water out of the descending limb and collecting duct.

Q12 — Ammonotelism: chief waste is ammonia (highly toxic, needs large water volumes), e.g. bony fishes. Ureotelism: chief waste is urea formed in the liver (moderately toxic, less water needed), e.g. mammals. Uricotelism: chief waste is uric acid (almost insoluble, least water), e.g. birds, reptiles and insects.

Q13 — The renal tubules selectively secrete H^+ and K^+ ions and reabsorb bicarbonate, so that the pH of blood plasma is maintained; the DCT and collecting duct are the main sites of this H^+/K^+ secretion, and ammonia secretion helps buffer the acid load.

Q14 — Normal urine: yellow, ~1.5 L/day, slightly acidic (pH ~6), with urea (~25–30 g/day), water, uric acid, creatinine, Na^+, K^+, etc.; it is protein-free and glucose-free. Analysis reveals disorders — glucose (glycosuria, diabetes mellitus),

proteins (kidney-filter damage), ketone bodies (ketonuria, starvation/diabetes), and its composition reflects the state of osmoregulation.

Q15 — A fall in GFR activates the JG cells of the JGA, which act as chemoreceptors (macula densa as osmoreceptors); renin is released and converts angiotensinogen to angiotensin, which raises glomerular blood flow (and pressure) so that the GFR is restored to normal — the JGA autoregulates GFR.

Q16 — Lungs: remove CO_2 (≈ 200 mL/min) and water as vapour in expired air. Skin: sweat glands excrete NaCl, urea and lactic acid in sweat (along with water), serving the kidney in excretion and thermal regulation.

Q17 — The descending limb concentrates the filtrate (water leaves), the ascending limb actively transports NaCl into the medullary interstitium while being water-impermeable; the vasa recta, running counter to the loop with slow flow, acts as a counter current exchanger that removes reabsorbed water and solutes without washing out the gradient. NaCl and the urea returned by the collecting duct build the osmolarity gradient from ~300 $mOsmolL^{-1}$ (cortex) to ~1200 $mOsmolL^{-1}$ (inner medulla), so the collecting duct can concentrate urine to this tonicity.

Q18 — On a rise in blood osmolarity, ADH released from the posterior pituitary increases the water permeability of the DCT and collecting duct → large water reabsorption → concentrated urine (antidiuresis). ANF, released by the atrial wall of the heart when stretched (fluid overload), vasodilates the renal vessels, inhibits renin release and acts as a check on the renin–angiotensin mechanism, thereby lowering blood pressure and fluid volume.

Q19 — (a) Three layers: endothelium of the glomerular capillaries (fenestrated), the basement membrane, and the visceral layer of Bowman's capsule made of podocytes (with filtration slits). Together they act as the glomerular filtration membrane through which protein-free fluid is ultrafiltered. (b) ADH: increases water permeability of DCT/collecting duct → water conservation, concentrated urine. Aldosterone (released under renin–angiotensin when GFR/volume falls): increases Na^+ reabsorption in the DCT, water follows salt → restores ionic balance and blood volume. Both restore the water/ionic balance by feedback.

Q20 — (a) Hypothalamus: osmoreceptors detect fluid loss → posterior pituitary releases ADH → DCT/collecting duct reabsorb more water (concentrated urine). JGA: fall in GFR → renin → angiotensin → aldosterone → Na^+ (and water) reabsorption, raising blood pressure. Heart: atrial distension on fluid overload → ANF → vasodilation and inhibition of renin → blood pressure and volume fall. (b) Reptiles/birds excrete uric acid (almost insoluble, eliminated as a paste) to conserve water on land; mammals convert ammonia to urea — less toxic than ammonia and still excretable in a concentrated solution, balancing detoxification with the moderate water loss available to a well-hydrated terrestrial animal.