

Excretory Products and Their Elimination — NEET MCQs with Solutions

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Q1. Urea is synthesized from ammonia in the liver by which cycle?

- (A) Krebs cycle
- (B) Calvin cycle
- (C) Ornithine cycle
- (D) Glycolytic cycle

Q2. Animals living in arid or desert environments are predominantly:

- (A) Ammonotelic, to conserve nitrogen
- (B) Ureotelic, to use water efficiently
- (C) Ammonotelic and ureotelic equally
- (D) Uricotelic, to conserve maximum water

Q3. Which of the following correctly explains why ureotelic animals can survive moderate water scarcity better than ammonotelic animals?

- (A) Urea is actively pumped out by nephrons without water loss
- (B) Ureotelic animals store urea in muscles for later excretion
- (C) Urea is less toxic than ammonia and can be concentrated in urine, requiring less water for safe excretion
- (D) Ureotelic animals convert urea back to ammonia when water is scarce

Q4. Approximately what percentage of nephrons in the human kidney are juxtamedullary?

- (A) 85 percent
- (B) 15 percent
- (C) 50 percent
- (D) 5 percent

Q5. Under resting conditions, kidneys receive approximately what fraction of resting cardiac output?

- (A) One tenth
- (B) One third
- (C) One fifth
- (D) Three fourths

Q6. Glomeruli are exclusively located in which region of the kidney?

- (A) Inner medulla
- (B) Outer medulla
- (C) Renal sinus
- (D) Renal cortex

Q7. When blood glucose concentration exceeds the renal threshold and tubular maximum, which condition results?

- (A) Complete tubular reabsorption of glucose
- (B) Proteinuria due to filtration failure
- (C) Glycosuria — glucose appears in urine
- (D) Reduced GFR due to tubular back-pressure

Q8. Urea recycling from the collecting duct back into the medullary interstitium contributes to which process?

- (A) Glomerular filtration pressure
- (B) Tubular secretion of H^+
- (C) Maintenance of medullary hyperosmolarity
- (D) Obligatory water reabsorption in PCT

Q9. The juxtaglomerular apparatus (JGA) regulates GFR primarily by sensing which two parameters?

- (A) Blood glucose and urine pH
- (B) Plasma protein levels and urine volume
- (C) Afferent arteriole blood pressure and tubular NaCl concentration
- (D) Aldosterone levels and ADH levels

Q10. The descending limb of the loop of Henle allows passive movement of:

- (A) Na^+ into the tubular lumen
- (B) Glucose into the interstitium
- (C) K^+ out of tubular cells
- (D) Water into the medullary interstitium

Q11. Which of the following organic nutrients is significantly reabsorbed in the proximal convoluted tubule?

- (A) Creatinine
- (B) Urea (majority)
- (C) Inulin
- (D) Amino acids

Q12. Which of the following correctly explains why bicarbonate reabsorption in the proximal tubule is essential for acid-base balance?

- (A) HCO_3^- reabsorption restores plasma buffer capacity; its loss would cause metabolic acidosis
- (B) HCO_3^- reabsorption raises urinary pH above 8.0
- (C) Bicarbonate reabsorption is regulated by ADH
- (D) HCO_3^- is actively pumped into the tubular lumen to neutralise H^+ secreted there

Q13. The ability to produce concentrated urine is directly proportional to:

- (A) Total number of glomeruli in both kidneys
- (B) Thickness of the renal cortex
- (C) Length of the loop of Henle
- (D) Size of the renal pelvis

Q14. Desert mammals can produce highly concentrated urine mainly because they have:

- (A) A greater number of glomeruli per nephron
- (B) Reduced ADH secretion to conserve water
- (C) Longer loops of Henle extending deep into the medulla
- (D) Lower baseline medullary osmolarity

Q15. Which of the following best explains the mechanism by which ADH increases water reabsorption in the collecting duct?

- (A) ADH binds basolateral receptors and opens sodium channels
- (B) ADH triggers insertion of aquaporin-2 channels into the apical membrane
- (C) ADH directly inhibits urea recycling in the inner medulla
- (D) ADH increases GFR to reduce tubular fluid volume

Q16. The macula densa is a specialised region of the:

- (A) Loop of Henle
- (B) Distal convoluted tubule
- (C) Collecting duct
- (D) Proximal convoluted tubule

Q17. Which of the following correctly explains the RAAS effect on blood volume?

- (A) RAAS decreases blood volume by promoting natriuresis
- (B) RAAS is activated by high blood pressure to reduce volume
- (C) RAAS increases blood volume by promoting Na^+ reabsorption and osmotic water retention
- (D) RAAS promotes K^+ retention to increase osmolarity

Q18. Activation of sympathetic nervous system increases renin release primarily by:

- (A) Stimulating β_1 adrenergic receptors on JG cells directly
- (B) Constricting the efferent arteriole via α receptors
- (C) Stimulating macula densa to release NaCl
- (D) Activating aldosterone receptors on DCT

Q19. Which organ temporarily stores urine before elimination?

- (A) Ureter
- (B) Renal pelvis
- (C) Urinary bladder
- (D) Collecting duct

Q20. Effective micturition requires simultaneous detrusor contraction and:

- (A) Constriction of the ureters
- (B) Increased glomerular filtration rate
- (C) Closure of the internal urethral sphincter
- (D) Relaxation of both urethral sphincters

Q21. Which of the following correctly explains how higher brain centres influence micturition?

- (A) They stimulate detrusor contraction directly via sympathetic nerves
- (B) They permanently suppress the spinal micturition reflex arc
- (C) The cerebral cortex can voluntarily inhibit or permit the spinal micturition reflex
- (D) Hypothalamus triggers micturition by activating bladder stretch receptors

Q22. Dialysis is the treatment of choice primarily in cases of:

- (A) Hypertension alone
- (B) Recurrent urinary tract infections
- (C) Kidney failure with waste accumulation
- (D) Renal calculi causing obstruction

Q23. Urinary tract infection most characteristically results in:

- (A) Reduced urine output (oliguria)
- (B) Frequent and painful urination (dysuria)
- (C) Elevated plasma protein levels
- (D) Increased GFR

Q24. Which of the following correctly explains why proteinuria occurs in glomerular damage?

- (A) Reduced tubular secretion expels proteins into urine
- (B) Loop of Henle fails to reabsorb filtered proteins
- (C) Damaged glomerular barrier loses size and charge selectivity
- (D) Collecting duct becomes permeable to plasma proteins

Answer key and explanations

Q1. Answer: (C) Ornithine cycle

Urea synthesis occurs exclusively via the ornithine cycle (urea cycle) in the liver — ammonia is combined with CO_2 to ultimately produce urea. The Krebs cycle (Option A) is the top distractor as it also occurs in the liver, but it functions in energy production, not urea synthesis.

Q2. Answer: (D) Uricotelic, to conserve maximum water

Uricotelic animals excrete uric acid as a nearly dry semi-solid paste, losing minimal water — the maximum water conservation strategy. Ureotelic animals still need water to dilute urine; ammonotelic animals need the most water. Desert reptiles, birds, and insects are uricotelic.

Q3. Answer: (C) Urea is less toxic than ammonia and can be concentrated in urine, requiring less water for safe excretion

Urea's lower toxicity allows it to accumulate temporarily and be excreted in concentrated urine — far less water is needed than for toxic ammonia. Option D describes a reverse process that does not occur physiologically. Option B is incorrect: urea is stored transiently in blood, not muscles.

Q4. Answer: (B) 15 percent

About 15% of nephrons are juxtamedullary (with long loops of Henle); the remaining ~85% are cortical nephrons with short loops. This ratio is frequently tested in NEET.

Q5. Answer: (C) One fifth

Kidneys receive ~1200 mL/min of blood, which is approximately one-fifth (20%) of the resting cardiac output of ~5000 mL/min. One-tenth (10%) and one-third are both incorrect values.

Q6. Answer: (D) Renal cortex

Glomeruli, along with Bowman's capsules forming renal corpuscles, are exclusively cortical structures. Their presence in medulla would suggest a pathological condition; this is a common HARD-level NEET trap.

Q7. Answer: (C) Glycosuria — glucose appears in urine

When plasma glucose exceeds ~180 mg/dL (renal threshold), carriers saturate at T_m (~320 mg/min) and excess glucose cannot be reabsorbed, appearing in urine as glycosuria — hallmark of uncontrolled diabetes mellitus.

Q8. Answer: (C) Maintenance of medullary hyperosmolarity

Urea diffuses from the inner collecting duct into the medullary interstitium, contributing significantly to the high osmolarity of the medulla. This gradient is essential for water reabsorption from the descending limb and collecting duct.

Q9. Answer: (C) Afferent arteriole blood pressure and tubular NaCl concentration

JG cells in the afferent arteriole sense stretch (blood pressure), while macula densa cells sense NaCl concentration in tubular fluid. Together they trigger renin release and autoregulate GFR. Aldosterone/ADH act downstream of JGA signals.

Q10. Answer: (D) Water into the medullary interstitium

The descending limb is freely permeable to water (via aquaporin-1) but impermeable to Na^+ and other electrolytes. As tubular fluid descends into the hypertonic medulla, water moves out osmotically, concentrating the tubular fluid. Na^+ , glucose, and K^+ are not passively transported across the descending limb.

Q11. Answer: (D) Amino acids

Amino acids are completely reabsorbed in the PCT via Na^+ -linked cotransporters (secondary active transport). Creatinine is not significantly reabsorbed and serves as a GFR marker. Inulin is neither reabsorbed nor secreted (used to measure GFR). Urea is partially reabsorbed but is a waste product, not an organic nutrient.

Q12. Answer: (A) HCO_3^- reabsorption restores plasma buffer capacity; its loss would cause metabolic acidosis

~85% of filtered HCO_3^- is reabsorbed in the PCT via carbonic anhydrase-mediated reactions. This restores plasma bicarbonate, the primary extracellular buffer. Loss of HCO_3^- in urine would deplete plasma buffering capacity, causing metabolic acidosis. HCO_3^- is reabsorbed from — not secreted into — the lumen.

Q13. Answer: (C) Length of the loop of Henle

A longer loop of Henle allows the counter-current multiplier to create a steeper and deeper corticopapillary osmotic gradient. This gradient is what drives water reabsorption in the collecting duct. Glomerular number, cortical thickness, and pelvis size do not determine concentrating ability.

Q14. Answer: (C) Longer loops of Henle extending deep into the medulla

Long loops of Henle allow the counter-current multiplier to establish a steeper and deeper osmotic gradient in the medulla, enabling greater water reabsorption. Desert mammals have evolved proportionally longer juxtamedullary nephron loops as an adaptation. Reduced ADH would have the opposite effect.

Q15. Answer: (B) ADH triggers insertion of aquaporin-2 channels into the apical membrane

ADH binds V2 receptors on collecting duct cells, activating adenylyl cyclase → cAMP → PKA pathway, which inserts pre-formed aquaporin-2 vesicles into the apical membrane. This increases water permeability dramatically. Sodium channels and GFR are not the mechanism of ADH action here.

Q16. Answer: (B) Distal convoluted tubule

Macula densa cells are tall, closely packed, modified epithelial cells of the DCT located at the point where the DCT contacts the afferent arteriole of the same nephron. They are the chemosensory component of the JGA. This is a high-frequency anatomical fact tested directly in NEET.

Q17. Answer: (C) RAAS increases blood volume by promoting Na⁺ reabsorption and osmotic water retention

Aldosterone (final RAAS effector) upregulates ENaC and Na⁺/K⁺-ATPase in DCT/collecting duct principal cells, increasing Na⁺ reabsorption. Retained Na⁺ raises plasma osmolarity, stimulating ADH release and osmotic water retention — net effect: increased blood volume and pressure. RAAS is activated by low BP, not high.

Q18. Answer: (A) Stimulating β₁ adrenergic receptors on JG cells directly

Sympathetic nerve terminals directly innervate JG cells of the afferent arteriole. β₁ adrenergic receptor activation on JG cells triggers renin granule release — independent of the baroreceptor and macula densa pathways. This is why haemorrhage (sympathetic surge) rapidly activates RAAS. Aldosterone acts on DCT; it has no receptors on JG cells.

Q19. Answer: (C) Urinary bladder

The urinary bladder is the storage organ for urine. The renal pelvis and ureter are conduits, while the collecting duct is part of the nephron involved in concentration, not storage.

Q20. Answer: (D) Relaxation of both urethral sphincters

Voiding requires coordinated detrusor contraction combined with relaxation of both the internal (involuntary) and external (voluntary) sphincters. Sphincter closure would obstruct outflow and prevent micturition.

Q21. Answer: (C) The cerebral cortex can voluntarily inhibit or permit the spinal micturition reflex

The cerebral cortex modulates the spinal reflex by exerting inhibitory or facilitatory control, enabling voluntary postponement or initiation of urination. This cortical override, not permanent suppression, is what allows social control of voiding.

Q22. Answer: (C) Kidney failure with waste accumulation

Dialysis is indicated when kidneys fail to filter blood adequately, leading to dangerous accumulation of nitrogenous wastes. Renal calculi and UTI are managed by other interventions; hypertension alone does not require dialysis.

Q23. Answer: (B) Frequent and painful urination (dysuria)

UTI (typically bacterial) causes inflammation of the urinary tract lining, producing dysuria (painful urination) and increased frequency. It does not primarily affect GFR or plasma proteins — those point to glomerular disorders.

Q24. Answer: (C) Damaged glomerular barrier loses size and charge selectivity

The glomerular filtration barrier (endothelium + basement membrane + podocytes) normally excludes large, negatively charged plasma proteins. Damage disrupts both size and charge selectivity, allowing proteins to enter the filtrate and appear in urine.

Excretion facts to remember

Topic	Key fact
Ammonotelic	Bony fishes, aquatic amphibians, aquatic insects
Ureotelic	Mammals, many terrestrial amphibians, marine fishes
Uricotelic	Reptiles, birds, land snails, insects
Excretory structures	Flame cells/protonephridia (Platyhelminthes, rotifers, some annelids, Amphioxus); nephridia (earthworm); Malpighian tubules (insects); green glands (prawn)
Nephrons	About 1 million per kidney; about 15% are juxtamedullary with long loops of Henle
Filtration	GFR about 125 mL/min (180 L/day); nearly 99% is reabsorbed; about 1.5 L urine per day
PCT	Reabsorbs 70-80% of electrolytes and water, all glucose and amino acids; secretes H^+ , NH_3 and K^+
Loop of Henle	Descending limb permeable to water; ascending limb impermeable to water but lets electrolytes out
Counter-current mechanism	Loop of Henle and vasa recta keep the medulla concentrated (up to about 1200 mOsm/L) using NaCl and urea
ADH (vasopressin)	Increases water reabsorption from DCT and collecting duct
JGA and RAAS	Low GFR $\rightarrow$ renin $\rightarrow$ angiotensin II $\rightarrow$ aldosterone $\rightarrow$ more Na^+ and water reabsorption; ANF from the heart opposes it
Urine	About 1-1.5 L per day, pH about 6; 25-30 g urea excreted daily
Other excretory organs	Lungs remove CO_2 ; liver excretes bilirubin and other substances in bile; skin through sweat and sebum
Disorders	Uremia (treated by haemodialysis), renal calculi, glomerulonephritis; glycosuria and ketonuria indicate diabetes mellitus