NCERT Exemplar Solutions of Class 11 Biology – Chapter 19: Excretory Products and their Elimination

VERY SHORT ANSWER TYPE QUESTIONS

1. Where does the selective reabsorption of Glomerular filtrate take place?

Solution: Selective reabsorption of glomerular filtrate takes place primarily in the **Distal Convoluted Tubule (DCT)**.

Enhanced Explanation:

- **DCT** performs fine-tuning of electrolyte balance
- **Hormone-regulated**: ADH, aldosterone, ANF control reabsorption
- **Selective process**: Reabsorbs Na^+, K^+, Ca^{2+} based on body requirements
- **Also occurs in**: Collecting duct under hormonal control

2. What is the excretory product from kidneys of reptiles?

Solution: The excretory product from kidneys of reptiles is **uric acid**.

Enhanced Explanation:

- **Reptiles are uricotelic animals**
- **Advantage**: Conserves water in terrestrial environment
- **Form**: Semi-solid paste requiring minimal water
- **Energy cost**: Higher metabolic cost but water conservation benefit
- **Other uricotelic animals**: Birds, insects, land snails

3. What is the composition of sweat produced by sweat glands?

Solution: The composition of sweat includes **water, lactic acid, salt (NaCl), minerals, and urea**.

Enhanced Explanation: Major components of sweat:

- **Water** (99%): Primary component for thermoregulation
- **Sodium chloride (NaCl)**: 0.5-0.8%
- **Urea**: Small amounts of nitrogenous waste
- **Lactic acid**: Metabolic byproduct
- **Minerals**: Potassium, calcium, magnesium
- **Trace amounts**: Amino acids, glucose, vitamins

4. Identify the glands that perform the excretory function in prawns.

Solution: The excretory glands in prawns are **antennal glands** or **green glands**.

Enhanced Explanation: Antennal glands characteristics:

- **Location**: Near the base of antennae
- **Structure**: Paired glands with coiled tubules
- **Function**: Remove nitrogenous wastes and regulate water balance
- **Also called**: Green glands due to their greenish color
- **Excretory product**: Primarily ammonia (ammonotelic)

5. What is the excretory structure in amoeba?

Solution: The excretory structure in amoeba is the **contractile vacuole**.

Enhanced Explanation: Contractile vacuole functions:

- **Osmoregulation**: Maintains water balance
- **Waste removal**: Eliminates metabolic wastes
- **Mechanism**: Collects excess water and wastes, then contracts to expel them
- **Formation**: Formed by fusion of smaller vacuoles
- **Cycle**: Fill → contract → empty → reform

6. The following abbreviations are used in the context of excretory functions, what do they stand for?

a. ANF b. ADH c. GFR d. DCT

Solution: a) **ANF**: Atrial Natriuretic Factor

b) **ADH**: Anti-Diuretic Hormone

c) **GFR**: Glomerular Filtration Rate

d) **DCT**: Distal Convoluted Tubule

Enhanced Explanation:

- **ANF**: Hormone from heart atria that promotes sodium excretion and vasodilation
- **ADH**: Hormone that increases water reabsorption in collecting duct
- **GFR**: Volume of filtrate formed per minute (normal: 125 mL/min)
- **DCT**: Nephron segment responsible for fine-tuning electrolyte balance

7. Differentiate Glycosuria from Ketonuria.

Solution:

- **Glycosuria**: Presence of glucose in urine
- **Ketonuria**: Presence of high amounts of ketone bodies in urine

Enhanced Explanation:

Parameter	Glycosuria	Ketonuria
Definition	Glucose in urine	Ketone bodies in urine
Normal level	Absent	Trace amounts
Causes	Diabetes mellitus, renal threshold exceeded	Diabetes, starvation, high-fat diet
Indication	Blood glucose >180 mg/dL	Fat metabolism, insulin deficiency
Detection	Benedict's test, glucose strips	Ketone strips, nitroprusside test

8. What is the role of sebaceous glands?

Solution: Sebaceous glands eliminate substances like **sterols, hydrocarbons, and waxes** through sebum.

Enhanced Explanation: Functions of sebaceous glands:

- **Excretion**: Remove lipophilic wastes (sterols, hydrocarbons, waxes)
- **Protection**: Sebum waterproofs and protects skin
- **Antimicrobial**: Sebum has antimicrobial properties
- **Temperature regulation**: Helps maintain skin temperature

- **Location**: Associated with hair follicles throughout body

9. Name two actively transported substances in Glomerular filtrate.

Solution: Two actively transported substances in glomerular filtrate are **amino acids** and **glucose**.

Enhanced Explanation: Active transport in nephron:

- **Glucose**: 100% reabsorbed in PCT via sodium-glucose co-transporters
- **Amino acids**: Essential for protein synthesis, actively reabsorbed
- **Mechanism**: Uses ATP and carrier proteins
- **Location**: Primarily in PCT
- **Other actively transported substances**: Na^+, K^+, Ca^{2+}, phosphate

10. Mention any two metabolic disorders which can be diagnosed by analysis of urine.

Solution: Two metabolic disorders: a) **Ketonuria**

b) **Glycosuria**

Enhanced Explanation: Urinalysis for metabolic disorders:

- **Ketonuria**: Indicates diabetes mellitus, starvation, or ketogenic diet
- **Glycosuria**: Primary indicator of diabetes mellitus
- **Other detectable disorders**: Proteinuria (kidney disease), phenylketonuria, alkaptonuria
- **Advantages**: Non-invasive, cost-effective screening method

11. What are the main processes of urine formation?

Solution: The main processes are:

1. **Glomerular Filtration**
2. **Reabsorption**
3. **Tubular Secretion**

Enhanced Explanation: Detailed process:

1. **Glomerular Filtration** (Malpighian body):
    - Blood pressure forces filtrate formation
    - Rate: ~125 mL/min (180 L/day)
2. **Reabsorption** (PCT, Henle's loop, DCT):
    - 99% of filtrate reabsorbed
    - Selective recovery of useful substances
3. **Tubular Secretion** (PCT, DCT):
    - Active removal of wastes from blood
    - K^+, H^+, NH_3, drugs secreted

12. Sort the following into actively or passively transported substances during reabsorption of GFR: glucose, amino acids, nitrogenous wastes, Na^+, water

Solution: Actively transported: Glucose, amino acids, Na^+

Passively transported: Nitrogenous wastes, water

Enhanced Explanation:

Transport Type	Substances	Mechanism	Energy
Active	Glucose, amino acids, Na^+	Carrier proteins, pumps	ATP required
Passive	Water, nitrogenous wastes	Osmosis, diffusion	No ATP

Note: Water transport is often secondary active transport (follows sodium gradient)

13. Complete the following:

a. urinary excretion = tubular reabsorption + tubular secretion –

b. Dialysis fluid = Plasma –

Solution: a. urinary excretion = tubular reabsorption + tubular secretion – **Glomerular filtration**

b. Dialysis fluid = Plasma – **nitrogenous wastes**

Enhanced Explanation: Formula a: Shows relationship between urine formation processes

- **Correct formula**: Urinary excretion = Glomerular filtration - Tubular reabsorption + Tubular secretion

Formula b: Dialysis fluid composition mimics normal plasma without toxic wastes

14. Mention the substances that exit from the tubules to maintain a concentration gradient in the medullary interstitium.

Solution: The substances are **urea** and **sodium chloride (NaCl)**.

Enhanced Explanation: Gradient maintenance mechanism:

- **NaCl**: Actively transported from ascending limb of Henle's loop
- **Urea**: Reabsorbed from collecting duct into medullary interstitium
- **Purpose**: Creates osmotic gradient (300-1200 mOsm/L)
- **Result**: Enables concentration of urine up to 4-5 times plasma concentration

15. Fill in the blanks appropriately:

Solution: a) **Kidneys**: Urea, uric acid, ammonia (varies by organism, typically urea in humans)

b) **Lungs**: CO_2 and H_2O

c) **Liver**: Bilirubin, biliverdin, cholesterol, vitamins, and other drugs

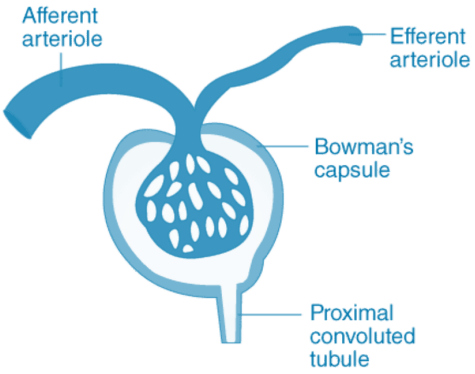
d) **Skin**: Water, sweat (salt, urea, lactic acid), sebum (sterols, hydrocarbons)

Enhanced Explanation: Organ-specific excretion:

- **Kidneys**: Primary excretory organs for nitrogenous wastes
- **Lungs**: Gaseous waste removal and water vapor
- **Liver**: Bile pigments, cholesterol, drug metabolism products
- **Skin**: Thermoregulation and minor waste removal

SHORT ANSWER QUESTIONS

1. Show the structure of a renal corpuscle with the help of a diagram.



Solution: [The diagram showing the renal corpuscle structure with labeled parts including afferent arteriole, efferent arteriole, Bowman's capsule, glomerulus, and proximal convoluted tubule]

Enhanced Explanation: Components of renal corpuscle:

- **Glomerulus**: Cluster of capillaries for filtration
- **Bowman's capsule**: Cup-shaped structure surrounding glomerulus
- **Afferent arteriole**: Brings blood to glomerulus
- **Efferent arteriole**: Carries filtered blood away
- **Podocytes**: Specialized cells forming filtration slits
- **Mesangial cells**: Support cells within glomerulus

Function: Blood filtration occurs due to high hydrostatic pressure and selective permeability

2. What is the role played by Renin-Angiotensin in the regulation of kidney function?

Solution: The Renin-Angiotensin system regulates kidney function through the following mechanism:

Enhanced Explanation: Step-by-step process:

1. **Trigger**: Fall in GFR or blood pressure detected by JG cells
2. **Renin release**: JG cells secrete renin enzyme
3. **Angiotensin I formation**: Renin converts angiotensinogen → Angiotensin I
4. **Angiotensin II formation**: ACE converts Angiotensin I → Angiotensin II
5. **Effects of Angiotensin II**:
    - Vasoconstriction → Increases blood pressure and GFR
    - Stimulates aldosterone release from adrenal cortex
    - Increases ADH release
    - Promotes thirst and salt appetite

Result: Restoration of normal blood pressure and GFR through increased sodium/water retention

3. Aquatic animals generally are ammonotelic in nature whereas terrestrial forms are not. Comment.

Solution: Enhanced Explanation: Aquatic animals (Ammonotelic):

- **Excrete ammonia directly**: Most toxic but highly soluble
- **Water availability**: Abundant water for dilution
- **Energy efficient**: Direct excretion without conversion
- **Examples**: Fish, aquatic invertebrates, tadpoles

Terrestrial animals (Non-ammonotelic):

- **Water conservation critical**: Limited water availability
- **Ureotelic mammals**: Convert ammonia → urea (less toxic, moderate water needed)
- **Uricotelic reptiles/birds**: Convert ammonia → uric acid (least toxic, minimal water needed)
- **Energy cost**: Higher metabolic cost but water conservation benefit

Evolutionary adaptation: Excretory products evolved based on water availability in environment

4. The composition of glomerular filtrate and urine is not the same. Comment.

Solution: The glomerular filtrate and urine have different compositions due to processing along the nephron.

Enhanced Explanation: Glomerular Filtrate (at Bowman's capsule):

- Contains: Water, glucose, amino acids, urea, creatinine, ions
- **Similar to plasma** but lacks proteins and blood cells
- Volume: ~180 L/day

Final Urine (at collecting duct):

- **99% water reabsorbed**: Volume reduced to ~1.5 L/day
- **No glucose/amino acids**: Completely reabsorbed (if healthy)
- **Concentrated wastes**: Higher concentration of urea, creatinine
- **Modified ion composition**: Adjusted for homeostasis

Processing changes:

- **PCT**: 65% water, glucose, amino acids reabsorbed
- **Henle's loop**: Water and salt handling for concentration
- **DCT/Collecting duct**: Final adjustments under hormonal control

5. What is the procedure advised for the correction of extreme renal failure? Give a brief account of it.

Solution: The procedure for extreme renal failure correction is **kidney transplantation**.

Enhanced Explanation: Kidney Transplantation Process:

Pre-transplant evaluation:

- **Compatibility testing**: ABO blood typing, HLA matching
- **Cross-matching**: Ensure no pre-existing antibodies
- **Medical evaluation**: Overall health assessment

Surgical procedure:

- **Donor kidney placement**: Usually in right iliac fossa
- **Vascular connections**: Renal artery to iliac artery, renal vein to iliac vein
- **Ureter connection**: To bladder (ureteroneocystostomy)
- **Original kidneys**: Usually left in place

Post-transplant care:

- **Immunosuppressive drugs**: Prevent rejection
- **Regular monitoring**: Kidney function, drug levels
- **Infection prevention**: Due to immunosuppression

Success rates: 90-95% one-year survival, 85-90% five-year survival

6. How have the terrestrial organisms adapted themselves for the conservation of water?

Solution: Enhanced Explanation: Water conservation adaptations in terrestrial organisms:

Excretory adaptations:

- **Mammals**: Ureotelic (urea excretion) - 50% less water than ammonia
- **Birds/Reptiles**: Uricotelic (uric acid) - 95% less water than ammonia
- **Concentrated urine**: Counter-current mechanism in kidneys

Anatomical adaptations:

- **Longer Henle's loops**: Desert animals have exceptionally long loops
- **Specialized kidneys**: Kangaroo rat can concentrate urine 25× plasma
- **Reduced glomeruli**: Some desert animals have fewer functional glomeruli

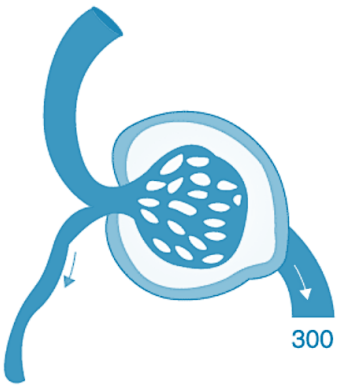
Physiological adaptations:

- **ADH regulation**: Enhanced water reabsorption
- **Aldosterone response**: Increased sodium retention
- **Behavioral adaptations**: Seeking shade, nocturnal activity

Metabolic adaptations:

- **Dry feces**: Efficient water reabsorption in large intestine
- **Minimal sweating**: Some animals rely on panting instead

7. Label the parts in the following diagram.



Solution: [The diagram of the renal corpuscle with labels for:]

- Afferent arteriole
- Efferent arteriole
- Bowman's capsule
- Glomerulus

Enhanced Explanation: Additional structures that might be included:

- **Podocytes**: Specialized epithelial cells with filtration slits
- **Mesangial cells**: Support and contractile cells
- **Basement membrane**: Filtration barrier between capillaries and Bowman's space
- **Macula densa**: Specialized cells in DCT that detect sodium levels
- **JG cells**: In afferent arteriole wall, secrete renin