

**BIO · BIOLOGY**

10. Homeostasis

Official PMDC Solved Past Paper Topical Booklet · High-Yield Examination Series

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2022 Archive

Boards: PMDC

Weightage: 34% of MDCAT (68 MCQs)

Curated by Ibrahim for fellow bees. Every question in this chapter has been verified against official UHS, NUMS, SZABMU, DUHS, and KMU answer keys. Propolis cognitive autopsies are provided at the end of this booklet to explain core concepts and break down common distractor traps.

OFFICIAL SOLVED EDITION**Q1.**

PMDC 2022

Chemically, **vasopressin (antidiuretic hormone)** is classified as a:

- (A) Steroid hormone
- (B) Catecholamine
- (C) Peptide hormone
- (D) Glycoprotein hormone

Q2.

PMDC

The definitive, long-term therapeutic intervention for end-stage renal failure is:

- (A) Hemodialysis
- (B) Peritoneal dialysis
- (C) Kidney transplantation
- (D) Lithotripsy

Q3.

PMDC

The catabolic deamination of amino acids in the human liver initially generates which toxic nitrogenous compound?

- (A) Ammonia
- (B) Arginine
- (C) Ornithine
- (D) Urea

Q4.

PMDC

Malpighian tubules serve as the primary excretory structures in which of the following organisms?

- (A) Planaria
- (B) Cockroach
- (C) Earthworm
- (D) Human

Q5.

PMDC

An inherited metabolic disorder characterized by urine that rapidly turns **black** upon exposure to atmospheric oxygen is:

- (A) Phenylketonuria
- (B) Sickle cell anemia
- (C) Hemophilia
- (D) Alkaptonuria

Q6.

PMDC

The systemic concentration of Na^+ ions in human extracellular fluid is regulated by which steroid hormone?

- (A) Aldosterone
- (B) Parathormone
- (C) Antidiuretic hormone (ADH)
- (D) Estrogen

Q7.

PMDC

In the human nephron, filtered **glucose** is completely reabsorbed back into the peritubular capillaries at which site and via which mechanism?

- (A) Glomerulus by ultrafiltration
- (B) Collecting duct by active secretion
- (C) Proximal convoluted tubule by active reabsorption
- (D) Distal convoluted tubule by passive diffusion

Q8.

PMDC

Which row in the table below correctly describes the physiological responses involved in human thermoregulation during exposure to hot temperatures?

Option	Blood vessels in the surface of skin	Sweat production
A	constrict	decreases
B	constrict	increases
C	dilate	decreases
D	dilate	increases

- (A) Vasodilation of cutaneous arterioles and increased sweating
- (B) Vasoconstriction of skin vessels and decreased sweating
- (C) Vasodilation with shivering thermogenesis
- (D) Vasoconstriction with erection of hair follicles

Q9.

PMDC

The production of **hypertonic urine** in the human kidney is primarily dependent on the osmotic gradient established by the:

- (A) Glomerular capsule
- (B) Loop of Henle
- (C) Proximal convoluted tubule
- (D) Distal convoluted tubule

Q10.

PMDC

Active reabsorption of Na^+ ions in the thick ascending limb and distal nephron segments is promoted by:

- (A) Thyroxine
- (B) Antidiuretic hormone (ADH)
- (C) Cortisone
- (D) Aldosterone

Q11.

PMDC

When the surrounding environmental temperature rises above core body temperature, the human body responds by:

- (A) Involuntary shivering
- (B) Cutaneous vasoconstriction
- (C) Cutaneous vasodilation
- (D) Piloerection

Q12.

PMDC

Antidiuretic hormone (ADH) regulates blood water potential by directly increasing water permeability in the:

- (A) Collecting duct
- (B) Ascending limb of the Loop of Henle
- (C) Descending limb of the Loop of Henle
- (D) Proximal convoluted tubule

Q13.

PMDC

Urine formation in human nephrons is the cumulative result of which three processes?

- (A) Ultrafiltration only
- (B) Ultrafiltration, tubular reabsorption, and tubular secretion
- (C) Tubular secretion and active transport only
- (D) Passive diffusion and osmosis only

Q14.

PMDC

The active maintenance of a stable internal physiological state despite external environmental changes is termed:

- (A) Coordination
- (B) Integration
- (C) Organization
- (D) Homeostasis

Q15.

PMDC

Which of the following taxonomic animal groups consists entirely of **homeothermic** species?

- (A) Birds
- (B) Reptiles
- (C) Amphibians
- (D) Fishes

Q16.

PMDC

Sunken stomata located inside deep epidermal pits are characteristic adaptations of which group of plants?

- (A) Mesophytes
- (B) Hydrophytes
- (C) Xerophytes
- (D) Halophytes

Q17.

PMDC

When an amphibian such as a frog is submerged in water, it periodically sheds an outer epidermal layer composed of:

- (A) Cuboidal epithelium
- (B) Squamous epithelium
- (C) Columnar epithelium
- (D) Ciliated epithelium

Q18.

PMDC

Urine exits the renal pelvis of the kidney and travels to the urinary bladder through the:

- (A) Urethra
- (B) Nephron
- (C) Collecting duct
- (D) Ureter

Q19.

PMDC

Almost all freshwater animals and the vast majority of marine vertebrates maintain internal osmolarity distinct from their surroundings, classifying them as:

- (A) Osmoregulators
- (B) Osmoconformers
- (C) Isotonic conformers
- (D) Thermal conformers

Q20.

PMDC

In marine teleost fishes, excess divalent inorganic ions such as Mg^{2+} and SO_4^{2-} ingested with seawater are excreted primarily by the:

- (A) Gills
- (B) Operculum
- (C) Kidneys
- (D) Skin

Q21.

PMDC

Freshwater protozoans eliminate excess water entering continuously by osmosis using specialized organelles called:

- (A) Flame cells
- (B) Contractile vacuoles
- (C) Malpighian tubules
- (D) Nephridia

Q22.

PMDC

Plants characterized by thick cuticles, needle-like reduced leaves, and stomata located in deep pits belong to which group?

- (A) Hydrophytes
- (B) Mesophytes
- (C) Halophytes
- (D) Xerophytes

Q23.

PMDC

The process by which an organism maintains its internal environment within narrow physiological limits despite external environmental changes is called:

- (A) Homeostasis
- (B) Acclimatization
- (C) Thermoregulation
- (D) Osmoconformity

Q24.

PMDC

The involuntary internal sphincter muscle that controls urine release is located at the anatomical junction between the:

- (A) Renal pelvis and ureter
- (B) Ureter and urinary bladder
- (C) Urinary bladder and urethra
- (D) Urethra and ureter

Q25.

PMDC

Which xerophytic adaptation directly functions to reduce the rate of cuticular transpiration?

- (A) Large surface area of leaves
- (B) Thick waxy cuticle
- (C) Increased density of stomata
- (D) Presence of stomata on both leaf surfaces

Q26.

PMDC

Humans maintain a constant internal core body temperature through metabolic heat production because they are:

- (A) Ectothermic
- (B) Poikilothermic
- (C) Heterothermic
- (D) Endothermic

Q27.

PMDC

Under healthy physiological conditions, human tissue cells maintain an internal fluid concentration that is ____ relative to the surrounding interstitial fluid.

- (A) Hypotonic
- (B) Isotonic
- (C) Hypertonic
- (D) Hyperosmotic

Q28.

PMDC

In humans, the vast majority of synthesized urea, $(\text{NH}_2)_2\text{CO}$, is eliminated from the body via:

- (A) Sweat
- (B) Saliva
- (C) Urine
- (D) Feces

Q29.

PMDC

The active transport process by which specific waste solutes are transferred directly from peritubular capillaries into the renal tubular lumen is called:

- (A) Tubular secretion
- (B) Glomerular filtration
- (C) Tubular reabsorption
- (D) Ultrafiltration

Q30.

PMDC

Which of the following organic compounds is **NOT** a nitrogenous waste product?

- (A) Hypoxanthine
- (B) Allantoin
- (C) Citrulline
- (D) Xanthophyll

Q31.

PMDC

In human abdominal anatomy, the right kidney is located slightly lower than the left kidney due to the space occupied by the:

- (A) Heart
- (B) Liver
- (C) Pancreas
- (D) Stomach

Q32.

PMDC

The specialized, straight capillary loops that run parallel to the loop of Henle in juxtamedullary nephrons are the:

- (A) Peritubular capillaries
- (B) Glomerular capillaries
- (C) Vasa recta
- (D) Lacteals

Q33.

PMDC

The ureters open into and discharge urine into the posterior floor of the urinary bladder through the:

- (A) Ureteral orifices
- (B) Renal hilum
- (C) External urethral meatus
- (D) Renal pelvis

Q34.

PMDC

Among nitrogenous metabolic wastes, which compound requires the **least amount of water** per gram of nitrogen for safe excretion?

- (A) Ammonia
- (B) Urea
- (C) Creatinine
- (D) Uric Acid

Q35.

PMDC

Antidiuretic hormone (ADH), which increases water retention in renal collecting ducts, is released into the bloodstream from the:

- (A) Adrenal cortex
- (B) Posterior pituitary gland
- (C) Thyroid gland
- (D) Renal cortex

Q36.

PMDC

The physiological mechanism regulating water volume and solute concentration in body fluids is specifically termed:

- (A) Thermoregulation
- (B) Deamination
- (C) Osmoregulation
- (D) Hemodialysis

Q37.

PMDC

Plants such as *Brassica* (mustard) and *Rosa* (rose) that grow in regions with moderate water availability belong to which group?

- (A) Mesophytes
- (B) Hydrophytes
- (C) Xerophytes
- (D) Halophytes

Q38.

PMDC

Organisms that do not actively regulate internal salt and water balance, allowing internal fluid osmolarity to match the external environment, are called:

- (A) Osmoregulators
- (B) Thermoregulators
- (C) Anhydrobiotic organisms
- (D) Osmoconformers

Q39.

PMDC

Which desert-dwelling mammal can survive indefinitely without drinking liquid water, obtaining all required hydration from metabolic water and dry seeds?

- (A) Desert pig
- (B) Kangaroo rat
- (C) Camel
- (D) Kangaroo

Q40.

PMDC

Nitrogenous wastes like ammonia and urea are generated as by-products of which metabolic catabolic pathway?

- (A) Assimilation
- (B) Decarboxylation
- (C) Deamination
- (D) Ingestion

Q41.

PMDC

Which of the following nitrogenous waste compounds exhibits the **highest solubility** in water?

- (A) Urea
- (B) Ammonia
- (C) Uric Acid
- (D) Creatine

Q42.

PMDC

Ingesting a high-salt meal causes a temporary surge in blood sodium levels. Which regulatory mechanism is activated to restore blood sodium concentration to normal limits?

- (A) Positive feedback
- (B) Feedforward control
- (C) Negative feedback
- (D) Passive osmotic drift

Q43.

PMDC

The reabsorption of water from renal collecting ducts into the hypertonic medullary interstitium is directly increased by:

- (A) Magnesium ions
- (B) High urine pH
- (C) Aldosterone
- (D) Antidiuretic hormone (ADH)

Q44.

PMDC

Thick waxy cuticles, leathery leaves, and sunken stomata are typical morphological features of:

- (A) Xerophytes
- (B) Hydrophytes
- (C) Mesophytes
- (D) Halophytes

Q45.

PMDC

The principal nitrogenous excretory product eliminated in human urine is:

- (A) Ammonia
- (B) Uric acid
- (C) Urea
- (D) Creatinine

Q46.

PMDC

The hepatic **urea cycle** functions primarily to convert which highly toxic nitrogenous product into a less harmful form?

- (A) Creatine
- (B) Carbon dioxide
- (C) Amino acids
- (D) Ammonia

Q47.

PMDC

Maintaining the balance of water volume and electrolyte concentration in body fluids is defined as:

- (A) Osmoregulation
- (B) Thermoregulation
- (C) Selective reabsorption
- (D) Ultrafiltration

Q48.

PMDC

After processing through the distal convoluted tubule, the tubular filtrate empties directly into the:

- (A) Efferent arteriole
- (B) Collecting duct
- (C) Peritubular capillaries
- (D) Bowman's space

Q49.

PMDC

The solute potential, total volume, and osmolarity of human blood plasma are regulated by which peptide hormone?

- (A) Estrogen
- (B) Epinephrine
- (C) Thyroxine
- (D) Vasopressin (ADH)

Q50.

PMDC

Under which core physiological framework are the biochemical processes of **metabolism** (anabolism and catabolism) categorized?

- (A) Neural coordination
- (B) Structural organogenesis
- (C) Homeostasis
- (D) Behavioral adaptation

Q51.

PMDC

During active daytime photosynthesis, autotrophic green plants release which gaseous by-product into the atmosphere?

- (A) O₂
- (B) CO₂
- (C) H₂O vapor
- (D) N₂

Q52.

PMDC

Which hormone directly controls urine formation by altering the water permeability of renal distal convoluted tubules and collecting ducts?

- (A) ACTH
- (B) ADH (Vasopressin)
- (C) Oxytocin
- (D) Somatotropin

Q53.

PMDC

The primary neural control centers responsible for integrating **thermoregulation** and **osmoregulation** are located in the:

- (A) Thalamus
- (B) Amygdala
- (C) Hypothalamus
- (D) Cerebellum

Q54.

PMDC

Pigeons (birds), platypuses (monotremes), and pandas (placental mammals) maintain stable internal body temperatures and are classified as:

- (A) Homeothermic
- (B) Poikilothermic
- (C) Ectothermic
- (D) Heterothermic

Q55.

PMDC

A high turgor pressure in plant cells is maintained primarily by which of the following vacuolar conditions?

- (A) Low vacuolar solute concentration
- (B) Higher osmotic pressure of the vacuolar sap and elevated ionic concentration inside the vacuole
- (C) Reduced cell wall mechanical elasticity
- (D) Active efflux of water out of the vacuole

Q56.

PMDC

Nephrons whose renal corpuscles lie adjacent to the corticomedullary junction and possess long loops of Henle extending deep into the inner medulla are called:

- (A) Cortical nephrons
- (B) Juxtamedullary nephrons
- (C) Outer cortical nephrons
- (D) Subcapsular nephrons

Q57.

PMDC

During conditions of severe dehydration, maximum renal water reabsorption and urine concentration depend primarily on the function of:

- (A) Juxtamedullary nephrons
- (B) Cortical nephrons
- (C) Glomerular capsules
- (D) Cortical interstitial tissue

Q58.

PMDC

In the human nephron, the **counter-current multiplier system** operates specifically within the:

- (A) Bowman's capsule
- (B) Glomerulus
- (C) Loop of Henle
- (D) Collecting duct

Q59.

PMDC

The **thick ascending limb** of the loop of Henle actively transports Na^+ and Cl^- , but is completely impermeable to:

- (A) Water
- (B) Na^+ ions
- (C) K^+ ions
- (D) Cl^- ions

Q60.

PMDC

Diabetes insipidus is a clinical disorder characterized by polyuria (excessive excretion of dilute urine) caused by a deficiency of:

- (A) Antidiuretic hormone (ADH)
- (B) Aldosterone
- (C) Insulin
- (D) Thyroxine

Q61.

PMDC

Under normal physiological conditions, the vast majority of filtered water and sodium ions are reabsorbed in the:

- (A) Urinary bladder and urethra
- (B) Ureter and renal pelvis
- (C) Adrenal cortex
- (D) Proximal Convoluted Tubule and Collecting Duct

Q62.

PMDC

In the human nephron, approximately 65% to 80% of all filtered water, electrolytes, and organic nutrients are reabsorbed in the:

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

Q63.

PMDC

What are the three core components required for a functional biological **homeostatic feedback mechanism**?

- (A) Receptors, control center, and effectors
- (B) Sensory neurons, motor neurons, and interneurons
- (C) Central nervous system, peripheral nervous system, and autonomic system
- (D) Cerebrum, cerebellum, and pons

Q64.

PMDC

Unfiltered systemic arterial blood enters the glomerular capillary network of a nephron through the:

- (A) Efferent arteriole
- (B) Afferent arteriole
- (C) Renal vein
- (D) Vasa recta

Q65.

PMDC

Which specific nephron tubular segments contain principal cells whose water permeability is regulated by **ADH**?

- (A) Distal convoluted tubule and collecting ducts
- (B) Bowman's capsule and glomerulus
- (C) Ascending limb of Henle
- (D) Descending limb of Henle

Q66.

PMDC

Which nephron population possesses long loops of Henle extending deep into the inner medulla to generate the renal medullary osmotic gradient?

- (A) Juxtamedullary nephrons
- (B) Cortical nephrons
- (C) Superficial nephrons
- (D) Peritubular nephrons

Q67.

PMDC

The majority of essential filtered organic solutes (such as 100% of glucose and amino acids) are reabsorbed in the:

- (A) Proximal tubule
- (B) Distal tubule
- (C) Bowman's capsule
- (D) Glomerulus

Q68.

PMDC

Which specific hair-pin loop structure within the renal medulla functions as a **countercurrent multiplier**?

- (A) Loop of Henle
- (B) Proximal tubule
- (C) Distal tubule
- (D) Renal pelvis

Q69.

PMDC

The initial ultrafiltration of blood plasma in human nephrons occurs specifically across which structural unit?

- (A) Proximal and distal convoluted tubules
- (B) Ascending and descending limbs of Henle
- (C) Glomerulus and Bowman's Capsule
- (D) Collecting duct

Q70.

PMDC

Antidiuretic hormone (ADH) regulates renal physiology by specifically increasing the tubular reabsorption of:

- (A) Water
- (B) Amino acids
- (C) Sodium chloride
- (D) Ammonia

Q71.

PMDC

Active reabsorption of Na^+ ions in the thick ascending limb of Henle and distal nephron is promoted by which adrenal hormone?

- (A) Parathormone
- (B) Aldosterone
- (C) Thyroxine
- (D) Cortisol

Q72.

PMDC

The dynamic process by which an organism maintains its internal environment within narrow physiological limits despite external environmental fluctuations is called:

- (A) Adaptation
- (B) Thermoregulation
- (C) Morphological evolution
- (D) Homeostasis

Q73.

PMDC

The active outward transport of Na^+ ions into the medullary interstitium without accompanying water movement occurs at the:

- (A) Ascending loop of Henle
- (B) Descending loop of Henle
- (C) Proximal tubule
- (D) Collecting duct

Q74.

PMDC

The homeostatic regulation of solute concentration and water balance between an organism's internal body fluids and its environment is defined as:

- (A) Thermoregulation
- (B) Osmoregulation
- (C) Deamination
- (D) Ultrafiltration

Q75.

PMDC

Which of the following vertebrate classes consists of **endothermic homeotherms**?

- (A) Amphibians
- (B) Reptiles
- (C) Birds
- (D) Fishes

Q76.

PMDC

Filtered blood exits the high-pressure capillary bed of the glomerulus through the:

- (A) Efferent arteriole
- (B) Afferent arteriole
- (C) Renal vein
- (D) Peritubular capillary

Q77.

PMDC

The clinical condition marked by elevated systemic blood concentrations of urea and creatinine due to severe end-stage renal failure is:

- (A) Hyperoxaluria
- (B) Hypercalcemia
- (C) Hematuria
- (D) Uremia

Q78.

PMDC

Which human organs weigh less than 1% of total body weight yet receive approximately 20% to 25% of total cardiac output?

- (A) Heart
- (B) Kidneys
- (C) Lungs
- (D) Brain

Q79.

PMDC

The involuntary contraction of cutaneous arrector pili muscles resulting in **goosebumps** is triggered when the human body is:

- (A) Overcooled
- (B) Overheated
- (C) Dehydrated
- (D) In a state of hypercapnia

Q80.

PMDC

In marine teleost fishes, excess divalent inorganic cations such as Mg^{2+} and Ca^{2+} are excreted primarily by the:

- (A) Gills
- (B) Operculum
- (C) Kidneys
- (D) Skin

Q81.

PMDC

Amphibians are ectothermic poikilotherms that cannot regulate body temperature internally; consequently, they undergo **hibernation** during:

- (A) Summer
- (B) Winter
- (C) Autumn
- (D) Spring

Q82.

PMDC

The medial concave surface of the human kidney features a deep longitudinal fissure called the:

- (A) Renal pelvis
- (B) Renal medulla
- (C) Renal pyramid
- (D) Hilum

Q83.

PMDC

Which of the following nitrogenous metabolic wastes exhibits the **lowest toxicity** to biological tissues?

- (A) Uric acid
- (B) Ammonia
- (C) Urea
- (D) Bilirubin

Q84.

PMDC

The aquatic plant *Potamogeton* (pondweed) grows fully submerged or floating in freshwater, classifying it as a:

- (A) Xerophyte
- (B) Hydrophyte
- (C) Mesophyte
- (D) Halophyte

Q85.

PMDC

The medical term describing the excretion of an abnormally large volume of urine is:

- (A) Polydipsia
- (B) Polyphagia
- (C) Polyuria
- (D) Oliguria

Q86.

PMDC

Marine **bony fishes** maintain osmotic balance in hypertonic seawater by drinking large quantities of seawater and producing:

- (A) Scanty, concentrated urine rich in divalent ions
- (B) Copious, dilute urine rich in water
- (C) Isotonic urine with zero salt content
- (D) Large volumes of urea-rich sweat

Q87.

PMDC

During states of dehydration, mammalian kidneys maximize water reabsorption because circulating hormones directly increase the:

- (A) Permeability of ascending limbs to salts
- (B) Solute concentration inside the renal pelvis
- (C) Glomerular filtration rate
- (D) Aquaporin permeability of collecting ducts to water

Q88.

PMDC

The muscular tube that conveys urine from the renal pelvis of the kidney down to the urinary bladder is the:

- (A) Ureter
- (B) Urethra
- (C) Uterus
- (D) Eustachian tube

Q89.

PMDC

Direct excretion of toxic ammonia without prior conversion to urea or uric acid (ammonotelism) is characteristic of:

- (A) Terrestrial reptiles
- (B) Mammals
- (C) Aquatic bony fishes
- (D) Birds

Q90.

PMDC

Structurally, the glomerulus inside Bowman's capsule consists of a:

- (A) Convoluted single epithelial tubule
- (B) Smooth muscle sphincter ring
- (C) Cup-shaped collecting duct
- (D) High-pressure ball of capillaries

Q91.

PMDC

In response to binding the peptide hormone glucagon, target liver cells produce which intracellular second messenger to stimulate glycogenolysis?

- (A) Cyclic AMP (cAMP)
- (B) Insulin
- (C) Inositol trisphosphate (IP3)
- (D) Calmodulin

Q92.

PMDC

Excretion and osmoregulation in flatworms such as *Planaria* are mediated by a tubular network of:

- (A) Malpighian tubules
- (B) Protonephridia equipped with flame cells
- (C) Metanephridia
- (D) Glomerular nephrons

Q93.

PMDC

Osmotic water movement across a semipermeable membrane toward a region of higher solute concentration is driven by a difference in:

- (A) Pressure potential
- (B) Matrix potential
- (C) Solute potential
- (D) Gravitational potential

Q94.

PMDC

The medical term **polydipsia** refers to a physiological condition characterized by:

- (A) Abnormally high urine output
- (B) Excessive food consumption
- (C) Low plasma glucose levels
- (D) Excessive, persistent thirst

Q95.

PMDC

Active uptake of sodium in the thick ascending limb of Henle and collecting duct is promoted by:

- (A) Aldosterone
- (B) Antidiuretic hormone (ADH)
- (C) Parathyroid hormone (PTH)
- (D) Atrial natriuretic peptide (ANP)

Q96.

PMDC

The hydrostatic pressure required to completely prevent the inward osmotic flow of pure water across a semipermeable membrane into a solution is defined as:

- (A) Solute potential
- (B) Osmotic Pressure
- (C) Soil potential
- (D) Turgor deficit

Q97.

PMDC

Severe **frostbite** occurs under extreme cold exposure when peripheral cutaneous blood vessels undergo intense:

- Ⓐ Vasoconstriction
- Ⓑ Vasodilation
- Ⓒ Muscular hypertrophy
- Ⓓ Endothelial sloughing

Q98.

PMDC

Specialized spongy plant tissue containing prominent intercellular air spaces called **aerenchyma** is an anatomical feature of:

- Ⓐ Xerophytes
- Ⓑ Mesophytes
- Ⓒ Sciophytes
- Ⓓ Hydrophytes

Q99.

PMDC

During elevated environmental temperatures, terrestrial plants maintain thermal balance by losing water vapor from their leaves via:

- Ⓐ Guttation
- Ⓑ Transpiration
- Ⓒ Photosynthesis
- Ⓓ Osmosis

RAPID 5-COLUMN ANSWER KEY

Official PMDC verified answer keys for 10. Homeostasis.

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Q#	KEY	BOARD	Q#	KEY	BOARD	Q#	KEY	BOARD	Q#	KEY	BOARD	Q#	KEY	BOARD
1	C	PMDC 2022	21	B	PMDC	41	B	PMDC	61	D	PMDC	81	B	PMDC
2	C	PMDC	22	D	PMDC	42	C	PMDC	62	A	PMDC	82	D	PMDC
3	A	PMDC	23	A	PMDC	43	D	PMDC	63	A	PMDC	83	A	PMDC
4	B	PMDC	24	C	PMDC	44	A	PMDC	64	B	PMDC	84	B	PMDC
5	D	PMDC	25	B	PMDC	45	C	PMDC	65	A	PMDC	85	C	PMDC
6	A	PMDC	26	D	PMDC	46	D	PMDC	66	A	PMDC	86	A	PMDC
7	C	PMDC	27	B	PMDC	47	A	PMDC	67	A	PMDC	87	D	PMDC
8	A	PMDC	28	C	PMDC	48	B	PMDC	68	A	PMDC	88	A	PMDC
9	B	PMDC	29	A	PMDC	49	D	PMDC	69	C	PMDC	89	C	PMDC
10	D	PMDC	30	D	PMDC	50	C	PMDC	70	A	PMDC	90	D	PMDC
11	C	PMDC	31	B	PMDC	51	A	PMDC	71	B	PMDC	91	A	PMDC
12	A	PMDC	32	C	PMDC	52	B	PMDC	72	D	PMDC	92	B	PMDC
13	B	PMDC	33	A	PMDC	53	C	PMDC	73	A	PMDC	93	C	PMDC
14	D	PMDC	34	D	PMDC	54	A	PMDC	74	B	PMDC	94	D	PMDC
15	A	PMDC	35	B	PMDC	55	B	PMDC	75	C	PMDC	95	A	PMDC
16	C	PMDC	36	C	PMDC	56	B	PMDC	76	A	PMDC	96	B	PMDC
17	B	PMDC	37	A	PMDC	57	A	PMDC	77	D	PMDC	97	A	PMDC
18	D	PMDC	38	D	PMDC	58	C	PMDC	78	B	PMDC	98	D	PMDC
19	A	PMDC	39	B	PMDC	59	A	PMDC	79	A	PMDC	99	B	PMDC
20	C	PMDC	40	C	PMDC	60	A	PMDC	80	C	PMDC			

TOTAL
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Question #1 Key: (C)

PMDC 2022

Chemically, vasopressin (antidiuretic hormone) is classified as a:

CORE CONCEPT AND DERIVATION

Chemical structure of hormones.

Solution: Vasopressin is a nonapeptide (a **peptide hormone** consisting of a 9-amino-acid chain) synthesized in the hypothalamus.

Why other options are incorrect:

- **Option A (Steroid):** Lipid-soluble cholesterol derivatives (e.g., aldosterone, cortisol, estrogen).
- **Option B (Catecholamine):** Amino acid derivatives (e.g., epinephrine, norepinephrine).
- **Option D (Glycoprotein):** Complex protein hormones with carbohydrate side chains (e.g., TSH, FSH, LH).

Question #2 Key: (C)

PMDC

The definitive, long-term therapeutic intervention for end-stage renal failure is:

CORE CONCEPT AND DERIVATION

Management of end-stage renal failure.

Solution: While hemodialysis and peritoneal dialysis act as temporary maintenance therapies, surgical **kidney transplantation** is the only definitive cure that fully restores renal endocrine, excretory, and metabolic functions long-term.

Why other options are incorrect:

- **Option A (Hemodialysis):** A temporary mechanical blood filtration process requiring frequent hospital visits.
- **Option B (Peritoneal dialysis):** A temporary dialysis method using the peritoneal membrane inside the abdomen.
- **Option D (Lithotripsy):** A non-invasive procedure used to break down kidney stones, not treat renal failure.

Question #3 Key: (A)

PMDC

The catabolic deamination of amino acids in the human liver initially generates which toxic nitrogenous compou...

CORE CONCEPT AND DERIVATION

Hepatic amino acid catabolism.

Solution: Deamination involves the enzymatic removal of the amino group ($-\text{NH}_2$) from an amino acid. This group immediately accepts a hydrogen ion to produce highly toxic **ammonia** (NH_3), which is subsequently converted into urea via the urea cycle.

Why other options are incorrect:

- **Option B & Option C (Arginine & Ornithine):** Intermediate amino acids formed during the hepatic urea cycle.
- **Option D (Urea):** The end-product synthesized from ammonia and carbon dioxide in the liver.

Question #4 Key: (B)

PMDC

Malpighian tubules serve as the primary excretory structures in which of the following organisms?

CORE CONCEPT AND DERIVATION

Comparative excretory organs in invertebrates.

Solution: Insects such as the **cockroach** utilize Malpighian tubules attached to their digestive tract to collect nitrogenous wastes and precipitates them as uric acid.

Why other options are incorrect:

- **Option A (Planaria):** Employs protonephridia equipped with flame cells.
- **Option C (Earthworm):** Uses metanephridia located in each body segment.
- **Option D (Human):** Excretes waste using metanephric kidneys containing nephrons.

Question #5 Key: (D)

PMDC

An inherited metabolic disorder characterized by urine that rapidly turns black upon exposure to atmospheric O_2 ...

CORE CONCEPT AND DERIVATION

Inborn errors of amino acid metabolism.

Solution: **Alkaptonuria** is caused by a deficiency in homogentisate 1,2-dioxygenase, leading to the accumulation of homogentisic acid in urine. Upon oxidation in air, homogentisic acid polymerizes into a dark, black pigment.

Why other options are incorrect:

- **Option A (Phenylketonuria):** Caused by phenylalanine hydroxylase deficiency; urine does not turn black.
- **Option B & Option C (Sickle cell anemia & Hemophilia):** Genetic hematological disorders affecting hemoglobin structure and blood clotting, respectively.

Question #6 Key: (A)

PMDC

The systemic concentration of [Formula] ions in human extracellular fluid is regulated by which steroid hormone...

CORE CONCEPT AND DERIVATION

Endocrine control of renal electrolyte balance.

Solution: **Aldosterone**, secreted by the adrenal cortex, acts on the distal convoluted tubules and collecting ducts to promote active reabsorption of Na^+ into the blood.

Why other options are incorrect:

- **Option B (Parathormone):** Regulates calcium (Ca^{2+}) and phosphate levels.
- **Option C (ADH):** Regulates free water reabsorption by altering aquaporin channels.
- **Option D (Estrogen):** Female sex hormone involved in reproductive cycles.

Question #7 Key: (C)

PMDC

In the human nephron, filtered glucose is completely reabsorbed back into the peritubular capillaries at which...

CORE CONCEPT AND DERIVATION

Tubular reabsorption mechanisms in the nephron.

Solution: Under normal conditions, 100% of filtered glucose is reabsorbed in the **proximal convoluted tubule (PCT)** via secondary active transport utilizing sodium-glucose cotransporters (SGLT).

Why other options are incorrect:

- **Option A:** Ultrafiltration occurs in the glomerulus to form filtrate; it does not reabsorb substances back into blood.
- **Option B:** Collecting ducts adjust water and urea balance, not glucose reabsorption.
- **Option D:** Glucose is not reabsorbed in the distal tubule via passive diffusion.

Question #8 Key: (A)

PMDC

Which row in the table below correctly describes the physiological responses involved in human thermoregulation...

CORE CONCEPT AND DERIVATION

Physiological mechanisms of heat dissipation.

Solution: To lower core body temperature during heat exposure, cutaneous blood vessels undergo **vasodilation** to increase blood flow to the skin for radiant heat loss, while sweat glands increase **sweat production** for evaporative cooling.

Why other options are incorrect:

- **Option B & Option D:** Vasoconstriction and piloerection (hair erection) are responses to cold stress designed to conserve heat.
- **Option C:** Shivering generates metabolic heat and occurs during cold exposure, not hot exposure.

Question #9 Key: (B)

PMDC

The production of hypertonic urine in the human kidney is primarily dependent on the osmotic gradient established...

CORE CONCEPT AND DERIVATION

Countercurrent multiplier mechanism.

Solution: The countercurrent multiplier system operating in the **Loop of Henle** generates a hyperosmotic medullary interstitial gradient, enabling water reabsorption from collecting ducts to produce concentrated (hypertonic) urine.

Why other options are incorrect:

- **Option A:** The glomerular capsule generates isotonic filtrate via passive pressure filtration.
- **Option C & Option D:** While PCT and DCT reabsorb solutes and water, the deep medullary gradient required for hypertonic urine relies specifically on the Loop of Henle.

Question #11 Key: (C)

PMDC

When the surrounding environmental temperature rises above core body temperature, the human body responds by:

CORE CONCEPT AND DERIVATION

Autonomic homeostatic responses to elevated temperature.

Solution: Smooth muscles in superficial arterioles relax, causing **cutaneous vasodilation**. This directs warm blood to the skin surface to facilitate heat loss via radiation and convection.

Why other options are incorrect:

- **Option A:** Shivering generates muscle heat during cold stress.
- **Option B:** Vasoconstriction reduces surface blood flow to conserve heat in cold conditions.
- **Option D:** Piloerection traps an insulating layer of air during cold exposure.

Question #10 Key: (D)

PMDC

Active reabsorption of [Formula] ions in the thick ascending limb and distal nephron segments is promoted by:

CORE CONCEPT AND DERIVATION

Hormonal regulation of renal sodium transport.

Solution: **Aldosterone** upregulates Na^+/K^+ -ATPase pumps and sodium channels, enhancing active sodium reabsorption across the thick ascending limb, distal tubule, and collecting duct.

Why other options are incorrect:

- **Option A:** Thyroxine regulates overall basal metabolic rate.
- **Option B:** ADH increases water permeability by inserting aquaporin channels.
- **Option C:** Cortisone is a glucocorticoid involved in glucose metabolism and inflammation control.

Question #12 Key: (A)

PMDC

Antidiuretic hormone (ADH) regulates blood water potential by directly increasing water permeability in the:

CORE CONCEPT AND DERIVATION

Target site and action of ADH.

Solution: ADH binds to V2 receptors on principal cells of the **collecting duct** (and late DCT), triggering insertion of aquaporin-2 channels into the luminal membrane to facilitate water reabsorption.

Why other options are incorrect:

- **Option B:** The ascending limb is impermeable to water under all conditions.
- **Option C:** The descending limb is passively permeable to water independent of ADH.
- **Option D:** The PCT reabsorbs water obligatorily independent of ADH levels.

Question #13 Key: (B)

PMDC

Urine formation in human nephrons is the cumulative result of which three processes?

CORE CONCEPT AND DERIVATION

Steps in urine formation.

Solution: Renal urine production requires **ultrafiltration** at the glomerulus, selective **tubular reabsorption** along the nephron tubules, and active **tubular secretion** of wastes into the lumen.

Why other options are incorrect:

- **Option A, Option C & Option D:** These options list single or incomplete isolated processes involved in nephron function.

Question #14 Key: (D)

PMDC

The active maintenance of a stable internal physiological state despite external environmental changes is term...

CORE CONCEPT AND DERIVATION

Fundamental definition of homeostasis.

Solution: Homeostasis is the capacity of an organism to regulate its internal chemical, physical, and thermal parameters within narrow survival limits.

Why other options are incorrect:

- **Option A:** Coordination refers to organ systems working together via nervous or endocrine signals.
- **Option B & Option C:** Integration and organization describe structural hierarchy and processing of information.

Question #15 Key: (A)

PMDC

Which of the following taxonomic animal groups consists entirely of homeothermic species?

CORE CONCEPT AND DERIVATION

Endothermy and homeothermy in Kingdom Animalia.

Solution: Birds (Aves) and mammals are homeotherms; they maintain a constant internal core body temperature through metabolic heat production regardless of ambient conditions.

Why other options are incorrect:

- **Option B, Option C & Option D:** Reptiles, amphibians, and fishes are poikilotherms (ectotherms) whose body temperatures fluctuate with the environment.

Question #16 Key: (C)

PMDC

Sunken stomata located inside deep epidermal pits are characteristic adaptations of which group of plants?

CORE CONCEPT AND DERIVATION

Plant xeromorphic structural adaptations.

Solution: Xerophytes live in arid conditions. Sunken stomata trap moist air within epidermal depressions, reducing the water vapor concentration gradient and minimizing transpiration.

Why other options are incorrect:

- **Option A:** Mesophytes live in moderate water environments and have surface stomata.
- **Option B:** Hydrophytes live in water and often have stomata on upper leaf surfaces or lack them.
- **Option D:** Halophytes are adapted to saline soils.

Question #17 Key: (B)

PMDC

When an amphibian such as a frog is submerged in water, it periodically sheds an outer epidermal layer compose...

CORE CONCEPT AND DERIVATION

Epithelial tissue structure in skin.

Solution: The outermost stratum corneum of amphibian skin consists of flattened, scale-like cells forming a **squamous epithelium**, which is periodically sloughed off in water.

Why other options are incorrect:

- **Option A:** Cuboidal epithelium lines secretory glands and renal tubules.
- **Option C:** Columnar epithelium lines the gastrointestinal tract.
- **Option D:** Ciliated epithelium lines the respiratory tract and oviducts.

Question #18 Key: (D)

PMDC

Urine exits the renal pelvis of the kidney and travels to the urinary bladder through the:

CORE CONCEPT AND DERIVATION

Gross anatomy of the human urinary tract.

Solution: The **ureter** is a muscular tube that conveys urine from the renal pelvis of each kidney down to the urinary bladder via peristaltic waves.

Why other options are incorrect:

- **Option A:** The urethra conveys urine from the urinary bladder to the external environment.
- **Option B:** The nephron is the microscopic functional unit within the kidney parenchyma.
- **Option C:** Collecting ducts drain urine into minor calyces within the kidney.

Question #19 Key: (A)

PMDC

Almost all freshwater animals and the vast majority of marine vertebrates maintain internal osmolarity distinct...

CORE CONCEPT AND DERIVATION

Physiological osmoregulation vs. osmoconformity.

Solution: **Osmoregulators** actively expend energy to maintain an internal blood osmotic concentration that differs from the osmolarity of their external environment.

Why other options are incorrect:

- **Option B & Option C:** Osmoconformers maintain internal fluids iso-osmotic with their environment (e.g., marine invertebrates).
- **Option D:** Thermal conformers allow internal temperature to mirror ambient temperature.

Question #20 Key: (C)

PMDC

In marine teleost fishes, excess divalent inorganic ions such as [Formula] and [Formula] ingested with seawater...

CORE CONCEPT AND DERIVATION

Osmoregulation in marine bony fishes.

Solution: While monovalent ions (Na^+ , Cl^-) are actively pumped out across the gills, excess divalent ions (like Mg^{2+} and Ca^{2+}) are secreted into the urine by the **kidneys**.

Why other options are incorrect:

- **Option A:** Gills primarily eliminate monovalent ions (Na^+ , Cl^-) and nitrogenous waste (ammonia).
- **Option B & Option D:** The operculum is a bony flap covering the gills; skin in bony fishes is largely impermeable to ions.

Question #21 Key: (B)

PMDC

Freshwater protozoans eliminate excess water entering continuously by osmosis using specialized organelles called...

CORE CONCEPT AND DERIVATION

Subcellular osmoregulation in unicellular protists.

Solution: Freshwater unicellular organisms (e.g., *Amoeba*, *Paramecium*) collect cytosolic water into a **contractile vacuole**, which periodically fuses with the plasma membrane to pump water out.

Why other options are incorrect:

- **Option A:** Flame cells are multicellular excretory structures in flatworms (*Planaria*).
- **Option C:** Malpighian tubules are excretory organs in insects.
- **Option D:** Nephridia are excretory organs in annelids.

Question #22 Key: (D)

PMDC

Plants characterized by thick cuticles, needle-like reduced leaves, and stomata located in deep pits belong to...

CORE CONCEPT AND DERIVATION

Structural adaptations to drought.

Solution: **Xerophytes** exhibit drought-resistant adaptations including reduced leaf surface area (needles), sunken stomata, and thick waxy cuticles to conserve water.

Why other options are incorrect:

- **Option A:** Hydrophytes are adapted to aquatic habitats.
- **Option B:** Mesophytes are adapted to moderate moisture.
- **Option C:** Halophytes are adapted to high-salt environments.

Question #23 Key: (A)

PMDC

The process by which an organism maintains its internal environment within narrow physiological limits despite...

CORE CONCEPT AND DERIVATION

Broad scope of homeostasis.

Solution: **Homeostasis** encompasses all dynamic regulatory mechanisms that maintain internal equilibrium across temperature, pH, water, and solute balances.

Why other options are incorrect:

- **Option B:** Acclimatization is a long-term physiological adjustment to environmental change over time.
- **Option C:** Thermoregulation is a specific sub-category of homeostasis dealing only with temperature.
- **Option D:** Osmoconformity is the passive matching of internal osmolarity to the environment.

Question #24 Key: (C)

PMDC

The involuntary internal sphincter muscle that controls urine release is located at the anatomical junction between the urinary bladder and the urethra.

CORE CONCEPT AND DERIVATION

Urinary bladder sphincters.

Solution: The internal urethral sphincter consists of smooth muscle located at the **junction of the urinary bladder and the urethra**, preventing urine flow under autonomic nervous control.

Why other options are incorrect:

- **Option A & Option B:** Ureters connect the renal pelvis to the bladder; muscle folds act as passive valves here, not true sphincters.
- **Option D:** Urethra and ureter do not directly join each other.

Question #25 Key: (B)

PMDC

Which xerophytic adaptation directly functions to reduce the rate of cuticular transpiration?

CORE CONCEPT AND DERIVATION

Adaptations limiting transpiration.

Solution: A **thick waxy cuticle** composed of hydrophobic cutin coats the leaf epidermis, creating an impermeable barrier to water evaporation.

Why other options are incorrect:

- **Option A, Option C & Option D:** Increased surface area, higher stomatal density, and amphistomatous leaves all increase transpiration rates.

Question #26 Key: (D)

PMDC

Humans maintain a constant internal core body temperature through metabolic heat production because they are:

CORE CONCEPT AND DERIVATION

Thermal classification of organisms.

Solution: **Endothermic** organisms generate thermal energy internally via cellular respiration and metabolic processes to stabilize internal body temperature.

Why other options are incorrect:

- **Option A & Option B:** Ectothermic and poikilothermic organisms rely on external environmental heat sources.
- **Option C:** Heterotherms fluctuate between self-regulation and poikilothermy (e.g., hibernating species).

Question #27 Key: (B)

PMDC

Under healthy physiological conditions, human tissue cells maintain an internal fluid concentration that is ____.

CORE CONCEPT AND DERIVATION

Fluid balance and cell volume maintenance.

Solution: Plasma and interstitial fluids are kept **isotonic** (iso-osmotic) relative to intracellular fluid to prevent net movement of water that would cause cell lysis or crenation.

Why other options are incorrect:

- **Option A:** A hypotonic surrounding fluid causes cells to swell and burst.
- **Option C & Option D:** A hypertonic surrounding fluid causes cells to shrink (crenate).

Question #28 Key: (C)

PMDC

In humans, the vast majority of synthesized urea, [Formula], is eliminated from the body via:

CORE CONCEPT AND DERIVATION

Primary nitrogenous excretion pathways.

Solution: Urea is filtered at the renal glomeruli and concentrated in **urine**, which accounts for over 90% of total nitrogenous waste clearance.

Why other options are incorrect:

- **Option A & Option B:** Sweat and saliva contain trace concentrations of urea, but account for a negligible percentage of total excretion.
- **Option D:** Feces eliminate unabsorbed digestive wastes, not metabolic urea.

Question #29 Key: (A)

PMDC

The active transport process by which specific waste solutes are transferred directly from peritubular capillaries into the tubular lumen is:

CORE CONCEPT AND DERIVATION

Renal tubular secretion mechanisms.

Solution: **Tubular secretion** involves active transport of substances (e.g., H^+ , K^+ , penicillin) from peritubular blood directly into the tubular filtrate.

Why other options are incorrect:

- **Option B & Option D:** Glomerular filtration/ultrafiltration is non-specific bulk movement of fluid from glomerulus into Bowman's capsule.
- **Option C:** Tubular reabsorption moves valuable solutes from filtrate back into peritubular blood.

Question #30 **Key: (D)**

PMDC

Which of the following organic compounds is NOT a nitrogenous waste product?

CORE CONCEPT AND DERIVATION

Biochemistry of metabolic waste vs. plant pigments.

Solution: Xanthophyll is an oxygenated carotenoid plant pigment. It contains no nitrogen and is not a metabolic waste product.

Why other options are incorrect:

- **Option A:** Hypoxanthine is a nitrogenous purine catabolite.
- **Option B:** Allantoin is a purine breakdown product excreted by non-primate mammals.
- **Option C:** Citrulline is a nitrogenous amino acid intermediate in the urea cycle.

Question #31 **Key: (B)**

PMDC

In human abdominal anatomy, the right kidney is located slightly lower than the left kidney due to the space o...

CORE CONCEPT AND DERIVATION

Gross anatomical orientation of kidneys.

Solution: The large right lobe of the liver sits superior to the right kidney, displacing the right kidney downward relative to the left kidney.

Why other options are incorrect:

- **Option A:** The heart is located superiorly in the thoracic cavity above the diaphragm.
- **Option C & Option D:** The pancreas and stomach are situated in the left upper quadrant of the abdomen.

Question #32 **Key: (C)**

PMDC

The specialized, straight capillary loops that run parallel to the loop of Henle in juxtamedullary nephrons ar...

CORE CONCEPT AND DERIVATION

Renal countercurrent exchanger system.

Solution: The vasa recta are specialized hair-pin blood vessels descending deep into the renal medulla alongside juxtamedullary loops of Henle to preserve the hyperosmotic medullary gradient.

Why other options are incorrect:

- **Option A:** Peritubular capillaries surround convoluted tubules in the renal cortex.
- **Option B:** Glomerular capillaries perform ultrafiltration in Bowman's capsule.
- **Option D:** Lacteals are lymphatic capillaries in intestinal villi.

Question #33 **Key: (A)**

PMDC

The ureters open into and discharge urine into the posterior floor of the urinary bladder through the:

CORE CONCEPT AND DERIVATION

Anatomy of the bladder trigone.

Solution: The two ureteral orifices are slit-like openings forming the superior angles of the bladder trigone through which urine enters from the ureters.

Why other options are incorrect:

- **Option B:** The renal hilum is the entry/exit fissure on the medial side of the kidney.
- **Option C:** The external urethral meatus is the distal exit point of the urethra.
- **Option D:** The renal pelvis is the funnel-like origin of the ureter inside the kidney.

Question #34 Key: (D)

PMDC

Among nitrogenous metabolic wastes, which compound requires the least amount of water per gram of nitrogen for...

CORE CONCEPT AND DERIVATION

Comparative water requirements for nitrogenous excretion.

Solution: Uric acid is relatively insoluble and non-toxic, requiring only ~1 mL of water per gram of nitrogen for excretion as a semi-solid paste.

Why other options are incorrect:

- **Option A (Ammonia):** Highly toxic; requires ~500 mL of water per gram of nitrogen.
- **Option B (Urea):** Moderately toxic; requires ~50 mL of water per gram of nitrogen.
- **Option C (Creatinine):** Soluble waste excreted in aqueous urine solution.

Question #35 Key: (B)

PMDC

Antidiuretic hormone (ADH), which increases water retention in renal collecting ducts, is released into the b...

CORE CONCEPT AND DERIVATION

Endocrine origin and release of ADH.

Solution: ADH (vasopressin) is synthesized by neurosecretory cells in the hypothalamus and stored/released from the posterior pituitary gland (neurohypophysis).

Why other options are incorrect:

- **Option A:** The adrenal cortex secretes mineralocorticoids like aldosterone.
- **Option C:** The thyroid gland secretes thyroxine and calcitonin.
- **Option D:** The renal cortex synthesizes hormones like erythropoietin and renin.

Question #36 Key: (C)

PMDC

The physiological mechanism regulating water volume and solute concentration in body fluids is specifically te...

CORE CONCEPT AND DERIVATION

Definition of osmoregulation.

Solution: Osmoregulation is the process of maintaining solute concentrations and water balance across fluid compartments.

Why other options are incorrect:

- **Option A:** Thermoregulation refers strictly to thermal body heat balance.
- **Option B:** Deamination is the enzymatic removal of amino groups from amino acids.
- **Option D:** Hemodialysis is an artificial medical procedure for clearing blood wastes.

Question #37 Key: (A)

PMDC

Plants such as Brassica (mustard) and Rosa (rose) that grow in regions with moderate water availability belong...

CORE CONCEPT AND DERIVATION

Ecological classification of terrestrial plants.

Solution: Mesophytes are terrestrial plants adapted to environments with average, moderate water supply.

Why other options are incorrect:

- **Option B:** Hydrophytes are aquatic plants growing in water.
- **Option C:** Xerophytes are adapted to arid, desert habitats.
- **Option D:** Halophytes are adapted to saline soil conditions.

Question #38 Key: (D)

PMDC

Organisms that do not actively regulate internal salt and water balance, allowing internal fluid osmolarity to...

CORE CONCEPT AND DERIVATION

Physiology of osmoconformity.

Solution: **Osmoconformers** maintain internal fluids iso-osmotic to their marine environment, avoiding net osmotic gradient stresses without active ion pumping.

Why other options are incorrect:

- **Option A:** Osmoregulators actively expend energy to maintain an internal osmolarity different from the surrounding medium.
- **Option B:** Thermoregulators regulate body temperature.
- **Option C:** Anhydrobiotic organisms tolerate near-complete desiccation.

Question #39 Key: (B)

PMDC

Which desert-dwelling mammal can survive indefinitely without drinking liquid water, obtaining all required hy...

CORE CONCEPT AND DERIVATION

Specialized mammalian desert adaptations.

Solution: The **kangaroo rat** (*Dipodomys*) survives without drinking water by producing hyper-concentrated urine, dry feces, and deriving 90% of its water from metabolic oxidation of carbohydrate-rich seeds.

Why other options are incorrect:

- **Option A, Option C & Option D:** Camels and kangaroos possess desert adaptations, but still require periodic water ingestion.

Question #40 Key: (C)

PMDC

Nitrogenous wastes like ammonia and urea are generated as by-products of which metabolic catabolic pathway?

CORE CONCEPT AND DERIVATION

Catabolism of amino acids.

Solution: When excess proteins are consumed, amino acids undergo **deamination** in the liver. The removed amino group is converted into toxic ammonia and subsequently into urea.

Why other options are incorrect:

- **Option A:** Assimilation is the anabolic incorporation of absorbed nutrients into body tissues.
- **Option B:** Decarboxylation is the removal of a carboxyl group (releasing CO_2).
- **Option D:** Ingestion is the intake of food into the digestive tract.

Question #41 Key: (B)

PMDC

Which of the following nitrogenous waste compounds exhibits the highest solubility in water?

CORE CONCEPT AND DERIVATION

Comparative solubility and toxicity of nitrogenous wastes.

Solution: **Ammonia** is extremely soluble in water (requiring ~500 mL of water per gram of nitrogen to dilute to non-toxic levels). This makes it the ideal excretory product for aquatic organisms.

Why other options are incorrect:

- **Option A (Urea):** Moderately soluble in water; requires ~50 mL of water per gram of nitrogen.
- **Option C (Uric Acid):** Almost insoluble in water; excreted as a semi-solid paste to conserve water.
- **Option D (Creatine):** A nitrogenous organic acid involved in muscle energy storage, not a primary excretory waste product.

Question #42 Key: (C)

PMDC

Ingesting a high-salt meal causes a temporary surge in blood sodium levels. Which regulatory mechanism is acti...

CORE CONCEPT AND DERIVATION

Principles of homeostatic feedback loops.

Solution: **Negative feedback** loops detect deviations from a physiological set-point and trigger counter-regulatory responses (e.g., inhibiting aldosterone, releasing ANP, increasing thirst/water retention) to reverse the initial disruption and restore baseline levels.

Why other options are incorrect:

- **Option A (Positive feedback):** Amplifies the initial stimulus, driving physiological parameters further away from set points (e.g., blood clotting cascade, childbirth labor).
- **Option B:** Anticipates changes before they occur rather than responding to detected blood surges.
- **Option D:** Unregulated passive movement that does not represent an active homeostatic loop.

Question #43 Key: (D)

PMDC

The reabsorption of water from renal collecting ducts into the hypertonic medullary interstitium is directly i...

CORE CONCEPT AND DERIVATION

Endocrine regulation of collecting duct permeability.

Solution: ADH (vasopressin) triggers the insertion of aquaporin-2 water channels into the luminal membranes of collecting duct principal cells, promoting water reabsorption.

Why other options are incorrect:

- **Option A & Option B:** Magnesium concentration and pH do not act as primary hormonal signals for aquaporin insertion.
- **Option C (Aldosterone):** Primarily stimulates active sodium reabsorption and potassium secretion.

Question #44 Key: (A)

PMDC

Thick waxy cuticles, leathery leaves, and sunken stomata are typical morphological features of:

CORE CONCEPT AND DERIVATION

Xerophytic plant anatomy.

Solution: Xerophytes exhibit thick waxy cuticles and leathery leaves to minimize cuticular evaporation and restrict transpiration in arid environments.

Why other options are incorrect:

- **Option B (Hydrophytes):** Lack thick cuticles because water conservation is unnecessary in aquatic habitats.
- **Option C (Mesophytes):** Possess thin, flexible cuticles suited for moderate water supply.
- **Option D (Halophytes):** Adapted specifically for high-salt environments, often displaying succulence.

Question #45 Key: (C)

PMDC

The principal nitrogenous excretory product eliminated in human urine is:

CORE CONCEPT AND DERIVATION

Ureotelism in humans.

Solution: Humans are ureotelic organisms. Ammonia produced by hepatic deamination is converted via the urea cycle into urea, which constitutes over 80–90% of total excreted nitrogenous waste.

Why other options are incorrect:

- **Option A (Ammonia):** Too toxic to circulate in high amounts; converted rapidly to urea.
- **Option B (Uric acid):** Represents a minor waste product derived from purine catabolism in humans.
- **Option D (Creatinine):** A minor waste product derived from skeletal muscle creatine breakdown.

Question #46 Key: (D)

PMDC

The hepatic urea cycle functions primarily to convert which highly toxic nitrogenous product into a less harmful...

CORE CONCEPT AND DERIVATION

Detoxification of ammonia in the liver.

Solution: Free ammonia is highly neurotoxic. The liver utilizes the metabolic urea cycle to combine two molecules of ammonia with carbon dioxide to synthesize non-toxic, water-soluble urea.

Why other options are incorrect:

- **Option A & Option C:** Creatine and intact amino acids are metabolic metabolites, not toxic waste molecules requiring conversion to urea.
- **Option B (Carbon dioxide):** CO₂ is utilized as a substrate in the urea cycle, but the primary toxic entity being detoxified is ammonia.

Question #47 Key: (A)

PMDC

Maintaining the balance of water volume and electrolyte concentration in body fluids is defined as:

CORE CONCEPT AND DERIVATION

Definition of osmoregulation.

Solution: Osmoregulation is the active homeostatic control of water potential, total fluid volume, and solute/salt concentrations across body compartments.

Why other options are incorrect:

- **Option B:** Thermoregulation manages thermal heat balance.
- **Option C & Option D:** Selective reabsorption and ultrafiltration are specific transport mechanisms within nephrons that contribute to overall osmoregulation.

Question #48 Key: (B)

PMDC

After processing through the distal convoluted tubule, the tubular filtrate empties directly into the:

CORE CONCEPT AND DERIVATION

Nephron tubular flow path.

Solution: Multiple distal convoluted tubules drain their final filtrate into a single shared **collecting duct**, which carries urine down through the renal medulla to the renal pelvis.

Why other options are incorrect:

- **Option A & Option C:** Efferent arterioles and peritubular capillaries belong to the renal vascular network, not the urine-conducting tubular lumen.
- **Option D:** Bowman's space is located at the start of the nephron.

Question #49 Key: (D)

PMDC

The solute potential, total volume, and osmolarity of human blood plasma are regulated by which peptide hormone...

CORE CONCEPT AND DERIVATION

Hormonal regulation of plasma osmolarity.

Solution: Vasopressin (antidiuretic hormone) is released in response to high blood osmolarity, stimulating renal aquaporin channels to retain free water, lowering blood solute potential back to normal.

Why other options are incorrect:

- **Option A:** Estrogen regulates reproductive cycles.
- **Option B:** Epinephrine mediates sympathoadrenal fight-or-flight responses.
- **Option C:** Thyroxine controls general metabolic rate.

Question #50 Key: (C)

PMDC

Under which core physiological framework are the biochemical processes of metabolism (anabolism and catabolism...

CORE CONCEPT AND DERIVATION

Metabolic homeostasis.

Solution: Cellular **metabolism** requires precise homeostatic regulation of substrates, enzymes, pH, and energy levels to maintain internal cellular equilibrium.

Why other options are incorrect:

- **Option A:** Neural coordination provides rapid electrical signal transmission.
- **Option B:** Organogenesis refers to embryonic development of tissue structures.
- **Option D:** Behavioral adaptation involves organismal activity changes.

Question #51 Key: (A)

PMDC

During active daytime photosynthesis, autotrophic green plants release which gaseous by-product into the atmos...

CORE CONCEPT AND DERIVATION

Plant photosynthetic gas exchange.

Solution: During light-dependent reactions of photosynthesis, photolysis of water splits H_2O , releasing molecular **oxygen** (O_2) as a metabolic by-product.

Why other options are incorrect:

- **Option B (CO_2):** Carbon dioxide is consumed during the Calvin cycle, not produced as a photosynthetic waste.
- **Option C (H_2O):** Transpired water vapor is a physical evaporative loss rather than a photosynthetic chemical waste product.
- **Option D (N_2):** Atmospheric nitrogen is inert and not produced by photosynthesis.

Question #52 Key: (B)

PMDC

Which hormone directly controls urine formation by altering the water permeability of renal distal convoluted ...

CORE CONCEPT AND DERIVATION

Endocrine regulation of diuresis.

Solution: ADH (antidiuretic hormone) acts on the distal convoluted tubule and collecting ducts to increase water reabsorption, concentrating urine and reducing total urine volume.

Why other options are incorrect:

- **Option A (ACTH):** Stimulates the adrenal cortex to secrete cortisol.
- **Option C (Oxytocin):** Stimulates uterine contractions and milk ejection.
- **Option D (Somatotropin):** Growth hormone promoting protein synthesis and tissue growth.

Question #53 Key: (C)

PMDC

The primary neural control centers responsible for integrating thermoregulation and osmoregulation are located...

CORE CONCEPT AND DERIVATION

Hypothalamic homeostatic centers.

Solution: The **hypothalamus** contains central thermoreceptors and osmoreceptors that monitor core temperature and blood osmolarity, initiating autonomic, endocrine, and behavioral corrections.

Why other options are incorrect:

- **Option A:** The thalamus acts as a sensory relay center for cortical inputs.
- **Option B:** The amygdala processes emotional responses and fear conditioning.
- **Option D:** The cerebellum coordinates motor movement and balance.

Question #54 Key: (A)

PMDC

Pigeons (birds), platypuses (monotremes), and pandas (placental mammals) maintain stable internal body tempera...

CORE CONCEPT AND DERIVATION

Endothermic homeothermy in Aves and Mammalia.

Solution: Birds and mammals are **homeothermic endotherms**; they utilize metabolic energy to maintain a constant internal core body temperature.

Why other options are incorrect:

- **Option B & Option C:** Poikilothermic and ectothermic animals (reptiles, amphibians, fish) allow body temperatures to fluctuate with external environmental temperature.
- **Option D:** Heterotherms switch between poikilothermy and homeothermy depending on environmental conditions (e.g., torpor).

Question #55 Key: (B)

PMDC

A high turgor pressure in plant cells is maintained primarily by which of the following vacuolar conditions?

CORE CONCEPT AND DERIVATION

Mechanism of plant turgor pressure.

Solution: Plant cells actively accumulate inorganic ions and organic solutes inside the central vacuole. This generates a **high vacuolar osmotic pressure** (hypertonic sap), driving inward osmotically generated water movement that presses the plasma membrane firmly against the rigid cell wall.

Why other options are incorrect:

- **Option A & Option D:** Low solute concentration or water efflux would decrease turgor pressure, leading to cell plasmolysis.
- **Option C:** Rigid cell walls allow high turgor pressure to build without bursting, but cell wall elasticity itself does not drive inward osmotic water uptake.

Question #56 Key: (B)

PMDC

Nephrons whose renal corpuscles lie adjacent to the corticomedullary junction and possess long loops of Henle ...

CORE CONCEPT AND DERIVATION

Structural types of nephrons.

Solution: **Juxtamedullary nephrons** make up ~15% of human nephrons. Their corpuscles lie near the medulla, and their long loops of Henle extend deep into the renal pyramids to establish the hyperosmotic medullary gradient.

Why other options are incorrect:

- **Option A, Option C & Option D:** Cortical/subcapsular nephrons make up ~85% of nephrons; their corpuscles lie in the outer cortex and their short loops of Henle barely penetrate the outer medulla.

Question #57 Key: (A)

PMDC

During conditions of severe dehydration, maximum renal water reabsorption and urine concentration depend prima...

CORE CONCEPT AND DERIVATION

Specialized role of juxtamedullary nephrons.

Solution: Juxtamedullary nephrons generate and maintain the deep medullary osmotic gradient via their long loops of Henle, enabling maximum osmotic water extraction from collecting ducts during dehydration.

Why other options are incorrect:

- **Option B:** Cortical nephrons have short loops that cannot generate the deep hyperosmotic gradient required for maximum urine concentration.
- **Option C & Option D:** Glomerular capsules perform filtration; cortical interstitium is isotonic to normal plasma (~300 mOsm/L).

Question #58 Key: (C)

PMDC

In the human nephron, the counter-current multiplier system operates specifically within the:

CORE CONCEPT AND DERIVATION

Countercurrent multiplication mechanism.

Solution: Countercurrent multiplication occurs in the **Loop of Henle**, where opposing fluid flow in descending and ascending limbs coupled with active salt pumping in the thick ascending limb creates a medullary concentration gradient.

Why other options are incorrect:

- **Option A & Option B:** Perform ultrafiltration of plasma.
- **Option D:** Collecting ducts serve as osmotic exchangers that utilize the medullary gradient generated by the Loop of Henle.

Question #59 Key: (A)

PMDC

The thick ascending limb of the loop of Henle actively transports [Formula] and [Formula], but is completely ...

CORE CONCEPT AND DERIVATION

Segmental tubular permeability.

Solution: The thick ascending limb lacks aquaporin channels, making it **impermeable to water**. Active reabsorption of salts without water dilution creates hypotonic tubular fluid.

Why other options are incorrect:

- **Option B, Option C & Option D:** The ascending limb actively transports Na^+ , K^+ , and Cl^- ions across luminal membranes via NKCC2 cotransporters.

Question #60 Key: (A)

PMDC

Diabetes insipidus is a clinical disorder characterized by polyuria (excessive excretion of dilute urine) caus...

CORE CONCEPT AND DERIVATION

Etiology of diabetes insipidus.

Solution: Neurogenic **diabetes insipidus** results from an **ADH deficiency** (or renal insensitivity in nephrogenic DI), preventing water reabsorption in collecting ducts and resulting in copious, dilute urine excretion.

Why other options are incorrect:

- **Option B (Aldosterone):** Deficiency causes hypoaldosteronism, leading to sodium loss and hyperkalemia.
- **Option C (Insulin):** Deficiency causes diabetes mellitus, characterized by glucosuria and osmotic diuresis.
- **Option D (Thyroxine):** Deficiency causes hypothyroidism.

Question #61 Key: (D)

PMDC

Under normal physiological conditions, the vast majority of filtered water and sodium ions are reabsorbed in t...

CORE CONCEPT AND DERIVATION

Sites of renal sodium and water reabsorption.

Solution: Over 65% of water and sodium is reabsorbed obligatorily in the **proximal convoluted tubule (PCT)**, while fine-tuning of remaining water reabsorption occurs in the **collecting duct** under hormonal control.

Why other options are incorrect:

- **Option A & Option B:** Storage and urinary conducting structures that exhibit no active reabsorption capacity.
- **Option C:** The adrenal cortex is an endocrine gland secreting steroid hormones; it is not a nephron segment.

Question #62 Key: (A)

PMDC

In the human nephron, approximately 65% to 80% of all filtered water, electrolytes, and organic nutrients are ...

CORE CONCEPT AND DERIVATION

Bulk reabsorption in the PCT.

Solution: The **proximal convoluted tubule (PCT)** possesses microvilli (brush border) and dense mitochondria, reabsorbing ~65–80% of filtered water/solutes and 100% of glucose and amino acids.

Why other options are incorrect:

- **Option B & Option D:** Reabsorb smaller, highly regulated percentages of remaining water and ions.
- **Option C:** Reabsorbs ~25% of filtered salts, but no water.

Question #63 Key: (A)

PMDC

What are the three core components required for a functional biological homeostatic feedback mechanism?

CORE CONCEPT AND DERIVATION

Architecture of homeostatic control loops.

Solution: Homeostatic feedback mechanisms require a **receptor** (detects stimulus changes), a **control center** (processes input and determines set point response), and an **effector** (carries out the response).

Why other options are incorrect:

- **Option B, Option C & Option D:** These describe specific neural cell types or anatomical divisions of the brain/nervous system, not the general functional components of a control loop.

Question #64 Key: (B)

PMDC

Unfiltered systemic arterial blood enters the glomerular capillary network of a nephron through the:

CORE CONCEPT AND DERIVATION

Renal microvascular architecture.

Solution: The **afferent arteriole** delivers blood into the high-pressure glomerular capillary bed for ultrafiltration.

Why other options are incorrect:

- **Option A:** The efferent arteriole carries filtered blood away from the glomerulus.
- **Option C:** The renal vein drains deoxygenated, filtered blood from the kidney back to the inferior vena cava.
- **Option D:** Vasa recta are specialized capillary loops branching from efferent arterioles in the medulla.

Question #65 Key: (A)

PMDC

Which specific nephron tubular segments contain principal cells whose water permeability is regulated by ADH?

CORE CONCEPT AND DERIVATION

ADH sensitive nephron segments.

Solution: ADH acts specifically on principal cells of the **late distal convoluted tubule and collecting ducts** to insert aquaporin-2 channels.

Why other options are incorrect:

- **Option B:** Glomerular filtration is driven by Starling capillary forces, independent of ADH.
- **Option C:** The ascending limb is permanently water-impermeable.
- **Option D:** The descending limb is constitutively water-permeable via aquaporin-1.

Question #66 Key: (A)

PMDC

Which nephron population possesses long loops of Henle extending deep into the inner medulla to generate the r...

CORE CONCEPT AND DERIVATION

Juxtamedullary nephron functional anatomy.

Solution: **Juxtamedullary nephrons** have long loops of Henle that extend into the inner medullary zone, generating the steep osmotic gradient required for water reabsorption.

Why other options are incorrect:

- **Option B & Option C:** Cortical/superficial nephrons have short loops confined mainly to the cortex and outer medulla.
- **Option D:** "Peritubular" refers to capillary networks surrounding tubules, not a nephron type.

Question #67 Key: (A)

PMDC

The majority of essential filtered organic solutes (such as 100% of glucose and amino acids) are reabsorbed in...

CORE CONCEPT AND DERIVATION

Proximal tubule nutrient reabsorption.

Solution: The **proximal tubule** contains specialized secondary active cotransporters that reabsorb virtually all filtered glucose, amino acids, and water-soluble vitamins.

Why other options are incorrect:

- **Option B:** The distal tubule regulates electrolytes (Na^+ , K^+ , Ca^{2+}) and acid-base balance, not primary nutrient reabsorption.
- **Option C & Option D:** Perform filtration rather than reabsorption.

Question #68 Key: (A)

PMDC

Which specific hair-pin loop structure within the renal medulla functions as a countercurrent multiplier?

CORE CONCEPT AND DERIVATION

Renal countercurrent multiplier.

Solution: The **Loop of Henle** acts as a countercurrent multiplier; opposing fluid flow and active salt pumping in the ascending limb create a longitudinal medullary hyperosmotic gradient.

Why other options are incorrect:

- **Option B & Option C:** Convoluted tubules in the cortex do not establish the longitudinal medullary osmotic gradient.
- **Option D:** The renal pelvis collects urine for excretion into the ureter.

Question #69 Key: (C)

PMDC

The initial ultrafiltration of blood plasma in human nephrons occurs specifically across which structural unit...

CORE CONCEPT AND DERIVATION

Anatomy of the renal corpuscle.

Solution: Ultrafiltration occurs across the renal corpuscle, which consists of the **glomerulus** (a high-pressure capillary network) and **Bowman's Capsule** (the surrounding epithelial cup that receives the filtrate).

Why other options are incorrect:

- **Option A & Option B:** Convoluted tubules and loops of Henle perform selective reabsorption and secretion, not primary ultrafiltration.
- **Option D:** Collecting ducts modify final urine concentration via water reabsorption.

Question #70 Key: (A)

PMDC

Antidiuretic hormone (ADH) regulates renal physiology by specifically increasing the tubular reabsorption of:

CORE CONCEPT AND DERIVATION

Selective action of ADH.

Solution: ADH acts selectively on principal cells of late distal tubules and collecting ducts to insert aquaporin-2 water channels, driving free **water** reabsorption into the hypertonic medullary interstitium.

Why other options are incorrect:

- **Option B:** Amino acids are 100% reabsorbed in the PCT via sodium cotransporters, independent of ADH.
- **Option C (Sodium chloride):** Sodium reabsorption is regulated primarily by aldosterone, not ADH.
- **Option D:** Ammonia is secreted into the lumen to regulate acid-base balance.

Question #71 Key: (B)

PMDC

Active reabsorption of [Formula] ions in the thick ascending limb of Henle and distal nephron is promoted by w...

CORE CONCEPT AND DERIVATION

Endocrine regulation of sodium transport.

Solution: **Aldosterone** is a mineralocorticoid secreted by the adrenal cortex that upregulates Na^+/K^+ -ATPase pumps to drive active sodium reabsorption.

Why other options are incorrect:

- **Option A:** Parathormone regulates calcium and phosphate levels.
- **Option C & Option D:** Thyroxine and cortisol regulate metabolic rate and glucocorticoid pathways, respectively.

Question #72 Key: (D)

PMDC

The dynamic process by which an organism maintains its internal environment within narrow physiological limits...

CORE CONCEPT AND DERIVATION

Definition of homeostasis.

Solution: **Homeostasis** is the physiological maintenance of a stable internal environment (including pH, temperature, water, and glucose balance).

Why other options are incorrect:

- **Option A & Option C:** Adaptation and evolution refer to long-term genetic changes in populations over generations.
- **Option B:** Thermoregulation is a specific sub-category of homeostasis restricted to temperature regulation.

Question #73 Key: (A)

PMDC

The active outward transport of [Formula] ions into the medullary interstitium without accompanying water move...

CORE CONCEPT AND DERIVATION

Function of the thick ascending limb.

Solution: The **thick ascending loop of Henle** actively pumps sodium and chloride out of the lumen while remaining impermeable to water, creating a hypertonic medullary interstitium.

Why other options are incorrect:

- **Option B (Descending loop):** Highly permeable to water, but lacks active ion transport mechanisms.
- **Option C (Proximal tubule):** Reabsorbs solutes and water together isothermally.
- **Option D (Collecting duct):** Reabsorbs water in the presence of ADH, but does not create the initial medullary salt gradient.

Question #74 Key: (B)

PMDC

The homeostatic regulation of solute concentration and water balance between an organism's internal body fluid...

CORE CONCEPT AND DERIVATION

Definition of osmoregulation.

Solution: **Osmoregulation** is the active physiological control of osmotic pressure, fluid volume, and solute concentrations within an organism.

Why other options are incorrect:

- **Option A:** Thermoregulation refers strictly to thermal heat balance.
- **Option C:** Deamination is the enzymatic removal of an amino group from an amino acid.
- **Option D:** Ultrafiltration is a mechanical process of pressure-driven fluid movement across membranes.

Question #75 Key: (C)

PMDC

Which of the following vertebrate classes consists of endothermic homeotherms?

CORE CONCEPT AND DERIVATION

Endothermy across vertebrate classes.

Solution: **Birds (Aves)** and mammals generate metabolic heat internally to maintain a constant high body temperature, making them endothermic homeotherms.

Why other options are incorrect:

- **Option A, Option B & Option D:** Amphibians, reptiles, and fishes are ectothermic poikilotherms that depend on external environmental heat.

Question #76 Key: (A)

PMDC

Filtered blood exits the high-pressure capillary bed of the glomerulus through the:

CORE CONCEPT AND DERIVATION

Renal microvascular arrangement.

Solution: Blood enters the glomerulus via the afferent arteriole and exits via the narrower **efferent arteriole**, which maintains high hydrostatic pressure within the glomerular capillaries.

Why other options are incorrect:

- **Option B:** The afferent arteriole supplies unfiltered blood into the glomerulus.
- **Option C:** The renal vein drains fully processed venous blood from the kidney back to the vena cava.
- **Option D:** Peritubular capillaries branch from the efferent arteriole to surround the cortical tubules.

Question #77 Key: (D)

PMDC

The clinical condition marked by elevated systemic blood concentrations of urea and creatinine due to severe e...

CORE CONCEPT AND DERIVATION

Pathophysiology of renal failure.

Solution: **Uremia** (literally "urea in the blood") is the toxic clinical syndrome resulting from severe decline in renal clearance, causing systemic accumulation of nitrogenous waste products.

Why other options are incorrect:

- **Option A (Hyperoxaluria):** Excessive urinary oxalate excretion, predisposing to kidney stone formation.
- **Option B (Hypercalcemia):** Abnormally high calcium levels in the blood.
- **Option C (Hematuria):** Presence of intact red blood cells in the urine.

Question #78 Key: (B)

PMDC

Which human organs weigh less than 1% of total body weight yet receive approximately 20% to 25% of total cardi...

CORE CONCEPT AND DERIVATION

Renal blood flow kinetics.

Solution: The two **kidneys** weigh roughly 300 grams combined (<1% of body weight) but receive ~1.2 L/min of blood (~20–25% of resting cardiac output) to maintain high rates of glomerular filtration.

Why other options are incorrect:

- **Option A:** The heart receives ~5% of cardiac output via coronary arteries.
- **Option C:** The lungs receive the entire right ventricular output via pulmonary circulation, but their metabolic tissue supply via bronchial arteries is small.
- **Option D:** The brain receives ~15% of cardiac output and weighs ~2% of total body mass.

Question #79 Key: (A)

PMDC

The involuntary contraction of cutaneous arrector pili muscles resulting in goosebumps is triggered when the h...

CORE CONCEPT AND DERIVATION

Thermoregulatory piloerection.

Solution: When the body is **overcooled**, sympathetic nerves trigger arrector pili muscles to contract, erecting hair follicles (piloerection / goosebumps) to trap an insulating layer of still air next to the skin.

Why other options are incorrect:

- **Option B:** When overheated, arrector pili muscles relax so hair lies flat to allow heat dissipation.
- **Option C & Option D:** Dehydration and hypercapnia trigger osmotic and respiratory compensations, not piloerection.

Question #80 Key: (C)

PMDC

In marine teleost fishes, excess divalent inorganic cations such as [Formula] and [Formula] are excreted prima...

CORE CONCEPT AND DERIVATION

Marine teleost ionic excretion.

Solution: Marine bony fishes drink seawater to replace lost water. Divalent ions (Mg^{2+} , SO_4^{2-} , Ca^{2+}) are actively secreted into urine by the **kidneys**.

Why other options are incorrect:

- **Option A (Gills):** Excrete monovalent ions (Na^+ , Cl^-) and nitrogenous waste (ammonia).
- **Option B & Option D:** Operculum and skin do not possess active divalent ion transport glands.

Question #81 Key: (B)

PMDC

Amphibians are ectothermic poikilotherms that cannot regulate body temperature internally; consequently, they ...

CORE CONCEPT AND DERIVATION

Seasonal dormancy in poikilotherms.

Solution: During **winter**, low environmental temperatures cause amphibian metabolic rates to plummet. They undergo winter dormancy (hibernation) in mud or underwater to survive freezing conditions.

Why other options are incorrect:

- **Option A (Summer):** Dormancy during hot/dry summer conditions is termed estivation, not hibernation.
- **Option C & Option D:** Autumn and spring are transitional active seasons.

Question #82 Key: (D)

PMDC

The medial concave surface of the human kidney features a deep longitudinal fissure called the:

CORE CONCEPT AND DERIVATION

Gross anatomy of the kidney.

Solution: The **hilum** is the medial vertical notch through which the renal artery enters, and the renal vein and ureter exit the kidney.

Why other options are incorrect:

- **Option A:** The renal pelvis is the funnel-shaped expansion of the ureter inside the renal sinus.
- **Option B:** The renal medulla is the inner tissue layer containing renal pyramids.
- **Option C:** Renal pyramids are cone-shaped medullary tissue masses.

Question #83 Key: (A)

PMDC

Which of the following nitrogenous metabolic wastes exhibits the lowest toxicity to biological tissues?

CORE CONCEPT AND DERIVATION

Comparative toxicity of nitrogenous wastes.

Solution: **Uric acid** is non-toxic and insoluble in water, allowing it to be safely stored in tissues or excreted as a paste without causing osmotic or chemical damage.

Why other options are incorrect:

- **Option B (Ammonia):** Extremely toxic; disrupts cellular pH and membrane potentials.
- **Option C (Urea):** Moderately toxic; requires dilution in water for safe transport and excretion.
- **Option D:** Bilirubin is a bile pigment from hemoglobin breakdown, not a primary nitrogenous waste.

Question #84 Key: (B)

PMDC

The aquatic plant *Potamogeton* (pondweed) grows fully submerged or floating in freshwater, classifying it as a:

CORE CONCEPT AND DERIVATION

Ecological classification of plants.

Solution: **Hydrophytes** are plants adapted to live fully or partially submerged in water or water-saturated soils.

Why other options are incorrect:

- **Option A:** Xerophytes are adapted to arid, desert habitats.
- **Option C:** Mesophytes are adapted to average land moisture.
- **Option D:** Halophytes are adapted to high-salinity soils.

Question #85 Key: (C)

PMDC

The medical term describing the excretion of an abnormally large volume of urine is:

CORE CONCEPT AND DERIVATION

Clinical urinary symptoms.

Solution: **Polyuria** is defined as urine output exceeding 3 liters per day in adults, commonly caused by diabetes mellitus or diabetes insipidus.

Why other options are incorrect:

- **Option A (Polydipsia):** Excessive fluid consumption/thirst.
- **Option B (Polyphagia):** Excessive hunger/food intake.
- **Option D (Oliguria):** Abnormally low urine output (<400 mL/day).

Question #86 Key: (A)

PMDC

Marine bony fishes maintain osmotic balance in hypertonic seawater by drinking large quantities of seawater and...

CORE CONCEPT AND DERIVATION

Osmoregulation in marine teleosts.

Solution: Marine bony fishes lose water by osmosis across their gills. To compensate, they drink seawater and conserve water by excreting a **small volume of concentrated urine** containing excess divalent ions (Mg^{2+} , SO_4^{2-}).

Why other options are incorrect:

- **Option B:** Producing copious dilute urine is the osmoregulatory strategy of *freshwater* teleosts.
- **Option C & Option D:** Marine bony fishes cannot produce zero-salt urine, nor do they possess sweat glands.

Question #87 Key: (D)

PMDC

During states of dehydration, mammalian kidneys maximize water reabsorption because circulating hormones direct...

CORE CONCEPT AND DERIVATION

Endocrine compensation during dehydration.

Solution: High plasma osmolarity during dehydration triggers ADH release, which **inserts aquaporin-2 channels into collecting duct membranes**, enabling maximal water reabsorption into the hypertonic medulla.

Why other options are incorrect:

- **Option A:** Ascending limb salt transport is driven by NKCC2 cotransporters, not acute hormonal water-channel changes.
- **Option B & Option C:** Elevating GFR or pelvis solute concentration would increase water loss rather than conserve it.

Question #88 Key: (A)

PMDC

The muscular tube that conveys urine from the renal pelvis of the kidney down to the urinary bladder is the:

CORE CONCEPT AND DERIVATION

Anatomy of the urinary tract.

Solution: The **ureter** is the smooth-muscle tube that uses peristalsis to move urine from the renal pelvis to the urinary bladder.

Why other options are incorrect:

- **Option B (Urethra):** Conveys urine from the urinary bladder to the outside of the body.
- **Option C (Uterus):** Female reproductive organ.
- **Option D (Eustachian tube):** Connects the middle ear to the nasopharynx.

Question #89 **Key: (C)**

PMDC

Direct excretion of toxic ammonia without prior conversion to urea or uric acid (ammonotelism) is characterist...

CORE CONCEPT AND DERIVATION

Ammonotelism in aquatic organisms.

Solution: Aquatic bony fishes are ammonotelic. Because water is abundant, they easily flush out highly soluble, toxic ammonia across their gill membranes.

Why other options are incorrect:

- **Option A & Option D:** Terrestrial reptiles and birds are uricotelic (excrete uric acid to conserve water).
- **Option B:** Mammals are ureotelic (excrete urea).

Question #90 **Key: (D)**

PMDC

Structurally, the glomerulus inside Bowman's capsule consists of a:

CORE CONCEPT AND DERIVATION

Glomerular microanatomy.

Solution: The **glomerulus** is a tuft or **ball of fenestrated capillaries** positioned between the afferent and efferent arterioles.

Why other options are incorrect:

- **Option A:** Refers to the nephron tubules (PCT/DCT).
- **Option B:** Refers to vascular or urethral sphincters.
- **Option C:** Refers to Bowman's capsule combined with collecting structures.

Question #91 **Key: (A)**

PMDC

In response to binding the peptide hormone glucagon, target liver cells produce which intracellular second me...

CORE CONCEPT AND DERIVATION

Glucagon signaling cascade.

Solution: Glucagon binds to G-protein coupled receptors on hepatocytes, activating adenylyl cyclase to produce **cyclic AMP (cAMP)**, which activates protein kinase A to trigger glycogen breakdown.

Why other options are incorrect:

- **Option B (Insulin):** A pancreatic hormone that opposes glucagon action.
- **Option C & Option D:** Secondary messengers involved in calcium signaling pathways.

Question #92 **Key: (B)**

PMDC

Excretion and osmoregulation in flatworms such as *Planaria* are mediated by a tubular network of:

CORE CONCEPT AND DERIVATION

Protonephridial excretory system.

Solution: Flatworms (*Planaria*) possess **protonephridia**—a network of dead-end tubules driven by ciliated **flame cells** that propel fluid out through excretory pores.

Why other options are incorrect:

- **Option A:** Malpighian tubules are found in insects.
- **Option C:** Metanephridia open into coelomic cavities in annelids.
- **Option D:** Nephrons are functional units of vertebrate kidneys.

Question #93 **Key: (C)**

PMDC

Osmotic water movement across a semipermeable membrane toward a region of higher solute concentration is drive...

CORE CONCEPT AND DERIVATION

Water potential components.

Solution: Solutes lower the water potential of a solution. This component is defined as **solute potential (Ψ_s)**. Water moves passively from higher (less negative) to lower (more negative) solute potential.

Why other options are incorrect:

- **Option A (Pressure potential):** Represents physical hydrostatic pressure exerted on water (e.g., turgor).
- **Option B (Matrix potential):** Represents water adhesion to insoluble surfaces (e.g., soil/cell walls).
- **Option D:** Represents the effect of gravity on water.

Question #94 **Key: (D)**

PMDC

The medical term polydipsia refers to a physiological condition characterized by:

CORE CONCEPT AND DERIVATION

Clinical terminology.

Solution: **Polydipsia** is the medical term for excessive, abnormal thirst, often accompanying diabetes mellitus or diabetes insipidus.

Why other options are incorrect:

- **Option A:** High urine output is termed *polyuria*.
- **Option B:** Excessive food consumption is termed *polyphagia*.
- **Option C:** Low plasma glucose is termed *hypoglycemia*.

Question #95 Key: (A)

PMDC

Active uptake of sodium in the thick ascending limb of Henle and collecting duct is promoted by:

CORE CONCEPT AND DERIVATION

Endocrine regulation of renal sodium handling.

Solution: **Aldosterone** increases sodium reabsorption in renal tubules. (Conversely, ANP *inhibits* sodium reabsorption).

Why other options are incorrect:

- **Option B (ADH):** Regulates water reabsorption via aquaporins.
- **Option C (PTH):** Regulates calcium reabsorption and phosphate excretion.
- **Option D (ANP):** Promotes sodium excretion (natriuresis) to reduce blood pressure.

Question #96 Key: (B)

PMDC

The hydrostatic pressure required to completely prevent the inward osmotic flow of pure water across a semiper...

CORE CONCEPT AND DERIVATION

Definition of osmotic pressure.

Solution: **Osmotic pressure** is the exact hydrostatic pressure needed to oppose and stop inward osmotic water movement across a selective membrane.

Why other options are incorrect:

- **Option A (Solute potential):** The negative contribution of dissolved solutes to total water potential.
- **Option C & Option D:** Specific ecological or plant physiological terms describing soil moisture or turgor loss.

Question #97 Key: (A)

PMDC

Severe frostbite occurs under extreme cold exposure when peripheral cutaneous blood vessels undergo intense:

CORE CONCEPT AND DERIVATION

Pathophysiology of frostbite.

Solution: Extreme cold triggers massive sympathetic **vasoconstriction** of skin arterioles to conserve core body heat. Severe, prolonged reduction in local peripheral blood flow leads to tissue ischemia, freezing, and frostbite.

Why other options are incorrect:

- **Option B (Vasodilation):** Increases warm blood flow to the skin, preventing cold injury.
- **Option C & Option D:** Structural cellular changes that do not trigger acute vascular cold injury.

Question #98 Key: (D)

PMDC

Specialized spongy plant tissue containing prominent intercellular air spaces called **aerenchyma** is an anatomic...

CORE CONCEPT AND DERIVATION

Anatomy of hydrophytic plants.

Solution: **Hydrophytes** possess **aerenchyma** tissue with large lacunae (air channels), enabling internal gas exchange (oxygen transport to submerged roots) and providing buoyancy.

Why other options are incorrect:

- **Option A:** Xerophytes contain dense palisade parenchyma and water-storing succulents.
- **Option B:** Mesophytes contain standard spongy and palisade mesophyll.
- **Option C:** Sciophytes are shade-adapted plants with high chlorophyll density.

Question #99 Key: (B)

PMDC

During elevated environmental temperatures, terrestrial plants maintain thermal balance by losing water vapor ...

CORE CONCEPT AND DERIVATION

Evaporative cooling in plants.

Solution: **Transpiration** is the evaporation of water from stomata and leaf surfaces, absorbing latent heat of vaporization to cool the plant body.

Why other options are incorrect:

- **Option A (Guttation):** Exudation of liquid water droplets from hydathodes under high root pressure, which does not provide evaporative cooling.
- **Option C:** Photosynthesis is a biochemical carbon-fixation pathway.
- **Option D:** Osmosis is passive water movement across membranes.