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Nephron Structure & Basic Renal Physiology

Exam — Renal Physiology

High-school/pre-med-level questions on nephron anatomy, transport mechanisms, SGLT, glucose handling, medullary gradients and urine concentration.

35 items — Printable Exam

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1 **The nephron is best defined as:**

A The whole kidney including its blood vessels

B The microscopic functional unit of the kidney that forms urine

C Only the glomerulus without tubules

D The blood supply of the kidney

E The capsule surrounding the kidney

2 **Which sequence correctly lists the parts of a nephron in the order that filtrate/urine flows through them?**

A Bowman's capsule → distal convoluted tubule → loop of Henle → proximal convoluted tubule → collecting duct

B Glomerulus → Bowman's capsule → proximal convoluted tubule → loop of Henle → distal convoluted tubule → collecting duct

C Afferent arteriole → collecting duct → glomerulus → proximal tubule → loop of Henle

D Collecting duct → loop of Henle → proximal tubule → glomerulus → Bowman's capsule

E Glomerulus → loop of Henle → proximal tubule → distal tubule → Bowman's capsule

3 **The main process occurring at the glomerulus/Bowman's capsule is:**

A Selective secretion of waste into the tubule

B Bulk filtration of plasma to form an ultrafiltrate

C Fine-tuning of water reabsorption under ADH

D Active transport of glucose into the blood

E Production of erythropoietin

4 **Which substance is normally present in blood plasma but almost completely ABSENT from the initial glomerular filtrate in a healthy person?**

A Na^+ ions

B Glucose

C Large plasma proteins such as albumin

D Urea

E Cl^- ions

5 **Which combination best describes the normal composition of fluid in Bowman's capsule COMPARED with plasma?**

A Same as plasma including cells and proteins

B Similar to plasma but lacking cells and most large proteins

C Only water with no solutes

D Contains only waste products like urea, no useful substances

E Contains only proteins and no ions

6 **Which vessels bring blood TO and FROM the glomerulus respectively?**

A Efferent arteriole → afferent arteriole

B Renal vein → renal artery

C Afferent arteriole → efferent arteriole

D Peritubular capillary → vasa recta

E Bowman's capsule → collecting duct

7 Which region of the nephron reabsorbs the LARGEST fraction of the filtered water, Na^+, and glucose under normal conditions?

A Bowman's capsule

B Proximal convoluted tubule (PCT)

C Loop of Henle

D Distal convoluted tubule (DCT)

E Collecting duct

8 Which statement about fluid leaving the proximal convoluted tubule (PCT) is MOST accurate?

A It is usually more concentrated (hypertonic) than plasma

B It is usually more dilute (hypotonic) than plasma

C Its osmolarity is similar to plasma, because water and solutes are reabsorbed together (iso-osmotic reabsorption)

D It contains no Na^+ at all

E It no longer contains any urea

9 Glucose reabsorption from the filtrate in the proximal tubule primarily occurs by:

A Simple diffusion directly through the lipid bilayer

B Primary active transport directly using ATP on the luminal membrane

C Secondary active cotransport with Na^+ via SGLT (sodium–glucose transporters)

D Endocytosis of whole glucose molecules

E Filtration only, with no reabsorption

10 After glucose enters the proximal tubule cell via SGLT, how does it usually exit the cell into the peritubular capillary blood?

A Via a Na^+/glucose symporter on the basolateral membrane

B Via facilitated diffusion through GLUT transporters on the basolateral membrane

C Via simple diffusion across the lipid bilayer

D By exocytosis in vesicles

E It is not transported; it accumulates in the tubular cell

11 In a healthy person, why is there normally NO glucose in the urine?

A Glucose is not filtered at the glomerulus

B Glucose is filtered but completely reabsorbed in the proximal tubule below its transport maximum (Tm)

C Glucose is destroyed in the kidney

D Glucose is secreted back into the blood in the collecting duct

E Glucose is too large to pass through any membrane transporters

12 **In uncontrolled diabetes mellitus, glucose appears in the urine mainly because:**

A The glomerular filter becomes leaky to glucose

B Plasma glucose is so high that filtered load exceeds the transport maximum (Tm) of SGLT transporters

C The kidneys stop filtering glucose

D The collecting duct secretes glucose into the urine

E Glucose channels open only in the presence of insulin

13 **Which best describes the DIFFERENCE between tubular reabsorption and tubular secretion?**

A Reabsorption moves substances from blood into filtrate; secretion moves substances from filtrate into blood

B Reabsorption moves substances from filtrate into blood; secretion moves substances from blood into filtrate

C Reabsorption occurs only in the PCT; secretion only in the glomerulus

D They are identical processes with different names

E Reabsorption applies only to water; secretion only to ions

14 **Which relationship between filtration (F), reabsorption (R), secretion (S), and excretion (E) of a substance is correct?**

A $E = F + R - S$

B $E = F - R + S$

C $E = R - F + S$

D $E = F - S - R$

E $E = F + R + S$

15 **A substance is freely filtered and not reabsorbed or secreted anywhere in the nephron. How does its amount excreted in urine compare with the amount filtered?**

A Excreted amount is zero

B Excreted amount is less than filtered

C Excreted amount equals the filtered amount

D Excreted amount is greater than filtered

E Excreted amount depends only on secretion

16 **Which segment of the nephron descends into the medulla, is highly permeable to water, but has low permeability to NaCl?**

A Proximal convoluted tubule

B Descending limb of the loop of Henle

C Thick ascending limb of the loop of Henle

D Distal convoluted tubule

E Collecting duct

17 **Which segment is often called the 'diluting segment' because it reabsorbs NaCl but is essentially impermeable to water?**

A Proximal convoluted tubule

B Descending limb of the loop of Henle

C Thick ascending limb of the loop of Henle

D Early distal convoluted tubule

E Collecting duct

18 **The medullary osmotic gradient (increasing osmolarity from cortex to inner medulla) is mainly generated by:**

A Active water pumping in the collecting duct

B NaCl reabsorption in the ascending limb of the loop of Henle and urea recycling

C Glucose secretion in the proximal tubule

D Protein filtration in Bowman's capsule

E Bulk flow of blood through afferent arterioles

19 **The ability of the kidney to produce CONCENTRATED urine (small volume, high osmolarity) depends most directly on:**

A The presence of long juxtamedullary nephrons and a medullary osmotic gradient

B The absence of any gradient in the medulla

C Complete impermeability of collecting ducts to water

D The lack of ADH (antidiuretic hormone)

E Only cortical nephrons with very short loops of Henle

20 **Antidiuretic hormone (ADH) mainly increases water reabsorption by:**

A Making the proximal tubule more permeable to water

B Increasing water permeability of the late distal tubule and collecting duct via insertion of aquaporins

C Blocking Na^+ reabsorption in the thick ascending limb

D Raising glomerular filtration rate

E Reducing medullary osmolarity

21 In the ABSENCE of ADH, which of the following is TRUE?

A Collecting ducts are highly permeable to water and urine is concentrated

B Collecting ducts are relatively impermeable to water and a large volume of dilute urine is produced

C Glomerular filtration stops

D No Na^+ is reabsorbed in the nephron

E The medullary osmotic gradient disappears immediately

22 Most students assume 'most water is reabsorbed in the collecting duct because ADH acts there'. Which correction is MOST accurate?

A Most water is actually reabsorbed in the proximal tubule, regardless of ADH

B No water is reabsorbed in the proximal tubule

C ADH acts mainly on the glomerulus

D All water reabsorption is optional and ADH-dependent

E Water is reabsorbed only in the loop of Henle

23 **Which nephron segment is MOST responsible for fine-tuning Na^+ and K^+ balance under the influence of aldosterone?**

A Proximal convoluted tubule

B Descending limb of loop of Henle

C Thick ascending limb

D Late distal convoluted tubule and collecting duct (principal cells)

E Bowman's capsule

24 **Which of the following is a common example of a substance that is SECRETED into the nephron rather than primarily filtered and reabsorbed?**

A Glucose

B Na^+

C Urea

D Many drugs and H^+ ions

E Water

25 **Which part of the nephron lies mainly in the cortex?**

A Glomerulus, Bowman's capsule, proximal and distal convoluted tubules

B Descending and ascending limbs of juxtamedullary loops only

C Collecting ducts only

D Vasa recta only

E Entire loop of Henle and papillary ducts

26 **The vasa recta (capillaries running alongside the loops of Henle of juxtamedullary nephrons) mainly function to:**

A Generate the medullary osmotic gradient by active Na^+ pumping

B Carry away reabsorbed water and solutes while preserving the medullary gradient (countercurrent exchange)

C Filter plasma into Bowman's capsule

D Act as the main site of glucose reabsorption

E Secrete ADH into the nephron

27 **The macula densa is a specialised region of cells located in the:**

A Proximal convoluted tubule near the glomerulus

B Thick ascending limb/distal tubule where it contacts its own glomerulus

C Collecting duct opening into the renal pelvis

D Bowman's capsule wall facing the ureter

E Vasa recta in the medulla

28 **Which statement best describes the osmolarity of tubular fluid at the END of the thick ascending limb (entering the distal tubule) in normal conditions?**

A More concentrated (hypertonic) than plasma

B Similar to plasma (isotonic)

C More dilute (hypotonic) than plasma

D Contains no solutes at all

E Is always an exact copy of plasma

29 In which situation would the kidney most likely produce a LARGE volume of DILUTE urine?

A High levels of ADH and a strong medullary gradient

B Low or absent ADH (e.g. central diabetes insipidus)

C Very high plasma oncotic pressure

D Severe dehydration with high ADH

E Reduced NaCl reabsorption in the ascending limb

30 Which of the following best explains why plasma proteins (like albumin) normally stay in the blood and do NOT appear in the filtrate?

A They are too small to pass through the filtration barrier

B The filtration barrier is both size- and charge-selective, restricting large and negatively charged proteins

C They are actively secreted back into the blood in Bowman's capsule

D They are trapped by SGLT transporters

E They are bound to red blood cells and follow them into the filtrate

31 Which of the following combinations is correct regarding LOCATION and MAIN ROLE?

A Proximal tubule – fine-tuning of Na^+ under aldosterone

B Loop of Henle – creating the medullary osmotic gradient

C Collecting duct – main site of glucose reabsorption

D Bowman's capsule – secretion of drugs

E Distal tubule – bulk reabsorption of water and Na^+

32 Which statement about SGLT (sodium–glucose cotransporters) is TRUE and often misunderstood?

A SGLT uses ATP directly to move glucose

B SGLT uses the Na^+ gradient created by the Na^+/K^+ pump, so it is a form of secondary active transport

C SGLT is found on the basolateral membrane facing the blood

D SGLT moves glucose out of the blood into the filtrate

E SGLT only works when urine volume is very high

33 Which of the following would MOST likely lead to an INCREASE in water reabsorption from the collecting ducts?

A Decreased ADH secretion

B Increased ADH secretion and an intact medullary gradient

C Destruction of the medullary gradient

D Blockade of all aquaporin channels

E Infusion of a large volume of hypotonic fluid

34 **Which statement about cortical vs juxtamedullary nephrons is correct?**

A Cortical nephrons have very long loops of Henle deep into the medulla; juxtamedullary nephrons have very short loops

B Juxtamedullary nephrons with long loops are more important for concentrating urine

C Only cortical nephrons produce filtrate

D Juxtamedullary nephrons have no glomeruli

E Both types are functionally identical with identical loop lengths

35 **Which change would most likely IMPAIR the kidney's ability to concentrate urine?**

A Loss of glomerular fenestrations

B Loss of thick ascending limb NaCl reabsorption (no salt pumping)

C Increased glucose reabsorption in the PCT

D Mild reduction in GFR only

E Slight increase in aldosterone

#	Ans	Answer Text
	B	
2	B	Glomerulus → Bowman's capsule → proximal convoluted tubule → loop of Hen…
	B	
4	C	Large plasma proteins such as albumin
	B	
6	C	Afferent arteriole → efferent arteriole
	B	
8	C	Its osmolarity is similar to plasma, because water and solutes are reabs…
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10	B	Via facilitated diffusion through GLUT transporters on the basolateral m…
	B	
12	B	Plasma glucose is so high that filtered load exceeds the transport maxim…
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14	B	$E = F - R + S$
	C	
16	B	Descending limb of the loop of Henle
	C	
18	B	NaCl reabsorption in the ascending limb of the loop of Henle and urea re…
	A	
20	B	Increasing water permeability of the late distal tubule and collecting d…
	B	
22	A	Most water is actually reabsorbed in the proximal tubule, regardless of …
	D	
24	D	Many drugs and H^+ ions
	A	
26	B	Carry away reabsorbed water and solutes while preserving the medullary g…
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28	C	More dilute (hypotonic) than plasma
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30	B	The filtration barrier is both size- and charge-selective, restricting l…
	B	
32	B	SGLT uses the Na^+ gradient created by the Na^+/K^+ pump, so it is a form o…
	B	
34	B	Juxtamedullary nephrons with long loops are more important for concentra…
	B	