

# **Renal**

## **Section 1**

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- 1 Which substance is 60 times more concentrated in urine than in plasma?
  - a) glucose
  - b) creatinine
  - c) sodium
  - d) urea
  
- 2 Regarding the anatomy of the kidney:
  - a) the afferent arteriole is smaller than the efferent
  - b) the kidney contains 1.3 million nephrons
  - c) there are three layers separating the blood in the arteriole from the glomerular filtrate
  - d) podocytes are contractile and regulate GFR
  
- 3 Regarding the glomerulus filtration fx:
  - a) it allows passage of molecules up to 4nm diameter freely, and up to 8nm with some difficulty depending on charge
  - b) positively charged molecules pass more easily than neutral
  - c) endothelial pores have a greater diameter than podocyte filtration slits
  - d) the basal lamina contains interruptions
  
- 4 Which causes an increase in GFR:
  - a) endothelins
  - b) noradrenalin
  - c) PGE<sub>2</sub>
  - d) histamine
  
- 5 The renal tubule:
  - a) all sections are lined with cuboidal epithelial cells with luminal microvilli
  - b) the thick loop of Henle rises to lie adjacent to its glomerulus
  - c) there are a greater number of juxamedullary nephrons than cortical
  - d) the lacis cells of the juxtaglomerular apparatus secrete renin

- 6 Regarding glomerular blood supply:
- a) the efferent arterioles are branches of the interlobular arterioles
  - b) the descending vasa recta vessels contain fenestrated endothelium to assist urea transport
  - c) the efferent arterioles empties into the peritubular network
  - d) the glomerular capillaries drain into the efferent vein
- 7 If  $[urine]_{PAH} = 14\text{mg/ml}$ , urine flow =  $0.9\text{ml/min}$  and  $[plasma]_{PAH} = 0.02\text{mg/ml}$
- i) What is the clearance of PAH?
  - ii) If the extraction ratio of PAH is 0.9, what is the renal blood flow (Hct=45%)?
- a)  $Cl_{PAH} = 630$ , renal blood flow =  $1273\text{ml/min}$
  - b)  $Cl_{PAH} = 630$ , renal blood flow =  $700\text{mb/min}$
  - c)  $Cl_{PAH} = 77$ , renal blood flow =  $155\text{mb/min}$
  - d)  $Cl_{PAH} = 777\text{mb/min}$ , renal blood flow =  $1569\text{mb/min}$
- 8 Renal blood pressure:
- a) the pressure drop across the glomerulus is about  $20\text{mmHg}$
  - b) pressure in the renal vein is about  $15\text{mmHg}$
  - c) the glomerular capillary pressure is about 80% that of arterial
  - d) the greatest drop in pressure (percentage wise) is from the efferent arteriole to the peritubular capillary
- 9 Regarding renal innervation:
- a) transplanted kidneys initially have reduced concentrating ability because of lack of innervation of the juxtaglomerular cells and therefore decreased renin secretion
  - b) norepinephrine acts directly on  $\alpha$  receptors on the juxtaglomerular cells
  - c) renal blood flow increases during exercise
  - d) autoregulation of renal blood flow can be disrupted by angiotensin-II inhibitors when renal perfusion is low
- 10 The glomerular filtration rate:
- a) is usually in the order of  $125\text{mL/min}$  for an average healthy male
  - b) is equal to the clearance of creatinine
  - c) is indirectly related to filtration coefficient
  - d) is determined by  $[urine]_{\text{inulin}}$
- ??????

- 11 Which of the following will cause an increase in GFR?
- dehydration
  - ureteral obstruction
  - afferent arteriole constriction
  - hypoproteinaemia
- 12  $\text{Na}^+$  resorption does not occur in which part of the nephron?
- proximal convoluted tubule
  - thin descending loop of Henle
  - thick ascending loop of Henle
  - distal convoluted tubule
  - collecting duct
- 13 Which is NOT resorbed via cotransport with  $\text{Na}^+$  in the PCT?
- lactate
  - phosphate
  - hydrogen
  - amino acids
- 14 Fanconi's syndrome of decreased levels of ATP in the tubular epithelium of the PCT:
- decreases  $\text{Na}^+$  extrusion from the cell into the interstitium
  - causes increased phosphate absorption
  - causes metabolic alkalosis
  - results in decreased amino acid excretion
- 15 Anti-diuretic hormone controls the concentration of urine,
- and can concentrate urine to up to 2500mosm/kg H???  $\text{H}_2\text{O}$
  - in its absence, the collecting duct is impermeable to water
  - causing the ultimate resorption of up to 99.7% of the filtrate
  - by causing upregulation of aquaporin-1 channels
- 16 Regarding  $\text{H}^+$  renal excretion:
- the distal convoluted tubule brush border contains carbonic anhydrase
  - $\text{H}^+$  secretion occurs in all segments of the nephrons
  - $\text{H}^+ + \text{NH}_3 \rightarrow \text{NH}_4^+$  is the most significant tubular buffering reaction
  - $\text{CO}_2$  is recycled / resorbed in the PCT to allow enhanced acid secretion
- 17 In the nervous control of the bladder which nerves do NOT play a role in micturition?
- sympathetic nerves from L2 in hypogastric nerve
  - somatic motor neurons in pudendal nerve
  - sensory neurons to S2/3 in pelvic nerves
  - parasympathetic supply in pelvic nerves

- 18 Which is the least significant buffering system in the blood?
- a)  $\text{H}^+ + \text{plasma protein} \rightleftharpoons \text{HProt}$
  - b)  $\text{H}^+ + \text{HPO}_4^{2-} \rightleftharpoons \text{H}_2\text{PO}_4^-$
  - c)  $\text{H}^+ + \text{HCO}_3^- \rightleftharpoons \text{H}_2\text{CO}_3$
  - d)  $\text{H}^+ + \text{Hb} \rightleftharpoons \text{HHb}$
- 19 In which body compartment is the bicarb buffering system least important?
- a) intracellular
  - b) interstitial
  - c) CSF
  - d) blood
- 20 In which state is extracellular buffering more important than intracellular?
- a) respiratory acidosis
  - b) respiratory alkalosis
  - c) metabolic acidosis
  - d) metabolic alkalosis
- 21 Renal acid secretion is enhanced by:
- a) respiratory acidosis
  - b) respiratory alkalosis
  - c) hyperkalaemia
  - d) carbonic anhydrase inhibition
- 22 Carbonic anhydrase is not inhibited by:
- a) cyanide
  - b) zinc
  - c) azide
  - d) sulphide
- 23 What increases GFR:
- a) moderate constriction of efferent arterioles
  - b) moderate constriction of afferent arterioles
  - c) increased Bowman's capsule pressure
  - d) increased glomerular capillary osmotic pressure
- 24 What increases the anion gap:
- a) increased concentration of  $\text{Mg}^{2+}$
  - b) decreased concentration of plasma proteins
  - c) decreased concentration of lactate
  - d) increased concentration of ketoacids

- 25 Which is CORRECT?
- a) humans have approximately 1.3 million nephrons
  - b) glomerular membrane excludes substances greater than 4nm in diameter
  - c) total area of glomerular capillary endothelium is  $8\text{m}^2$
  - d) nephrons length is 45-65mm
- 26 Which of the following is TRUE?
- a) U/P ratio for creatinine is 150mg/dl
  - b) U/P ratio for glucose is 10
  - c) Na concentration in the urine usually exceeds over 150mg/dl
  - d) the usual glucose excretion in the urine is 100mg/dl
- 27 Which of the following is FALSE?
- a) proximal convoluted tubular cells have lateral intercellular spaces
  - b) the cells in the descending loop of Henle have large numbers of mitochondria
  - c) the ascending loop of Henle contributes to the formation of juxtaglomerular apparatus
  - d) in humans only 15% of the nephrons have long loops
- 28 Regarding tubular function:
- a) 90% of the water is absorbed by the proximal convoluted tubule
  - b) renal threshold for glucose is 300mg/dl
  - c) the main mechanism of the Na reabsorption from the tubular fluid to proximal convoluted tubule is via Na/K/ATP a pump
  - d) the main mechanism of Na absorption in the ascending loop of Henle is via cotransport of Na/K/2Cl:
- 29 The maximum effect of vasopressin occurs at:
- a) distal convoluted tubule
  - b) proximal convoluted tubule
  - c) cortical part of the collecting duct
  - d) medullary part of collecting duct
  - e) thick ascending limb of loop of Henle
- 30 Regarding the buffer system in the tubular fluid, which one is TRUE?
- a) the main buffer system is  $\text{H}_2\text{PO}_4^-$
  - b) the main mechanism of  $\text{H}^+$  secretion in the proximal tubule is via proton pump
  - c) dibasic phosphate buffer is most effective at proximal convoluted tubule
  - d) the  $\text{H}^+$  secretion at proximal tubule is mediated Na/K/ATPase

- 31 Regarding the renin-angiotensin system, which is CORRECT?
- a) renin has many functions including the formation of angiotensin I from angiotensinogen
  - b) after nephrectomy, circulating levels of prorenin fall
  - c) renin is formed in the juxtaglomerular cells of the kidney
  - d) active renin has a half-life in the circulation of 40 minutes or less
  - e) prorenin is biologically active
- 32 All of the following increase renin secretion EXCEPT:
- a) sodium depletion
  - b) diuretics
  - c) hypertension
  - d) cardiac failure
  - e) cirrhosis
- 33 All of the following factors inhibit renin secretion EXCEPT:
- a) prostaglandins
  - b) angiotensin II
  - c) vasopressin
  - d) increased afferent arteriolar pressure
  - e) increased  $\text{Na}^+$  and  $\text{Cl}^-$  reabsorption across the macula densa
- 34 Which of the following blood gas results is consistent with a three-week residence at 4000m altitude, after previously living at sea-level?
- | pH      | $\text{HCO}_3^-$ (meq/L) | $\text{pCO}_2$ |
|---------|--------------------------|----------------|
| a) 7.40 | 24.1                     | 40             |
| b) 7.50 | 30.1                     | 40             |
| c) 6.96 | 5.0                      | 23             |
| d) 7.34 | 33.5                     | 64             |
| e) 7.48 | 18.7                     | 26             |
- 35 In a resting adult, the kidneys receive how much of the cardiac output?
- a) 15%
  - b) 20%
  - c) 25%
  - d) 30%
  - e) 35%

- 36 Which of the following is INCORRECT regarding regulation of renal blood flow?
- a) noradrenaline constricts the renal vessels
  - b) dopamine causes renal vasodilation and natriuresis
  - c) angiotensin II exerts a constrictor effect on the efferent arterioles
  - d) prostaglandins increase blood flow in the renal cortex and decrease blood flow in the renal medulla
  - e) acetylcholine produces renal vasoconstriction
- 37 Erythropoietin:
- a) is produced in the juxtaglomerular cells of the kidney
  - b) production is stimulated by theophylline
  - c) secretion is facilitated by the acidosis that develops at high altitude
  - d) has a half-life in the circulation of about 5 hours
  - e) is produced predominantly in the spleen in neonates
- 38 Mesengial cell contraction is stimulated by:
- a) ANP
  - b) dopamine
  - c) PGE<sub>2</sub>
  - d) cAMP
  - e) angiotensin II
- 39 Ethanol's action as a diuretic occurs by:
- a) inhibition of vasopressin secretion
  - b) inhibition of the action of vasopressin on the collecting duct
  - c) production of an osmotic diuresis
  - d) decreasing tubular reabsorption of Na and increasing GFR
  - e) inhibition of the Na<sup>+</sup>-K<sup>+</sup>-Cl<sup>-</sup> cotransporter in the medullary thick ascending limb of the loop of Henle
- 40 With regard to diuretics:
- a) frusemide acts on the thick ascending limb of the loop of Henle
  - b) antagonists to V<sub>2</sub> vasopressin receptors act on the early portion of the distal convoluted tubule
  - c) thiazides act primarily on the thick ascending limb of the loop of Henle
  - d) loop diuretics act on the collecting ducts
  - e) aldosterone antagonists act on the early portion of the distal convoluted tubule

## **Section 1**

### **Answers**

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- 1 D
- 2 B
- 3 A
- 4 No answer
- 5 B
- 6 C
- 7 A
- 8 D
- 9 D
- 10 A
- 11 D
- 12 B
- 13 C
- 14 A
- 15 C
- 16 D
- 17 A
- 18 B
- 19 A
- 20 D
- 21 A
- 22 B
- 23 A
- 24 D
- 25 D
- 26 A
- 27 B
- 28 D
- 29 C
- 30 D
- 31 C
- 32 C
- 33 A
- 34 E
- 35 C
- 36 E
- 37 D
- 38 E
- 39 B
- 40 A

## Section 2

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- 1 In the presence of vasopressin, most filtered water is absorbed in the?
  - a) proximal tubule
  - b) loop of Henle
  - c) distal tubule
  - d) cortical collecting system
  - e) medullary collecting system
  
- 2 Which pattern of laboratory findings in the tale below is most consistent with a diagnosis of diabetes insipidus?

	24 Hr Urine Vol	Ketones	Glucose	Protein
a)	4.0	+	0	0
b)	6.2	2+	4+	0
c)	1.6	0	0	4+
d)	6.4	0	0	0
e)	5.0	0	0	3+
  
- 3 On which of the following does aldosterone exert its greatest effect?
  - a) glomerulus
  - b) proximal tubule
  - c) thin portion of loop of Henle
  - d) thick portion of look of Henle
  - e) cortical collecting system
  
- 4 What is the clearance of a substance when its concentration in plasma is 1mg/ml, its concentration in urine is 10mg/ml and the urine flow is 2ml/min?
  - a) 2ml/min
  - b) 10ml/min
  - c) 20ml/min
  - d) 200ml/min
  - e) clearance cannot be determined from the information given
  
- 5 Glucose reabsorption occurs in the:
  - a) proximal tubule
  - b) loop of Henle
  - c) distal tubule
  - d) cortical collecting system
  - e) medullary collecting system

- 6 As urine flow increases during osmotic diuresis:
- the osmolality of urine falls
  - the osmolality of urine increases
  - the osmolality of urine approaches that of plasma
  - the osmolality of urine is unchanged
  - the osmolality of urine depends primarily on other factors
- 7 Which of the following is NOT true regarding the voiding reflex?
- it involves parasympathetic fibres
  - it remains intact in the period of spinal shock following transaction of the spinal cord
  - it occurs when the bladder volume reaches 300-400mls
  - it is integrated in the sacral segments of the spinal cord
  - its threshold is altered by inhibitory fibres from the brainstem
- 8 Which of the following substances is NOT actively secreted in to the tubular lumen by the proximal renal tubule?
- urate
  - para-amino hippuric acid
  - catecholamines
  - sodium
  - creatinine
- 9 Angiotensin II causes:
- greater constriction of efferent than afferent arterioles
  - greater construction of afferent than efferent arterioles
  - constriction of afferent arterioles only
  - constriction of efferent arterioles only
  - has no effect on arteriolar constriction
- 10 With regard to the effect of hormones on renal tubules, which is CORRECT?
- aldosterone increases potassium reabsorption from the distal tubule
  - angiotensin II increases hydrogen ion secretion from the proximal tubules
  - ADH increases water reabsorption in the proximal tubule
  - atrial natriuretic peptide decreases sodium reabsorption from the proximal tubules
  - parathyroid hormone increases phosphate reabsorption
- 11 With regard to tuboglomerular feedback:
- the GFR increases when flow through the distal tubule increases
  - the macula densa on the afferent arteriole is the sensor
  - the afferent arteriole is constricted by thromboxane A<sub>2</sub>
  - it is designed to maintain sodium reabsorption
  - it does not operate in individual nephrons

- 12 The primary reason for the decreased medullary hypertonicity associated with osmotic diuresis is:
- an associated increased urine volume
  - the limiting concentration gradient for sodium reabsorption is reached
  - tubular fluid has an increased sodium concentration
  - the total amount of sodium reaching the loop of Henle is increased
  - the associated maximal vasopressin secretion
- 13 With respect to renal handling of glucose:
- glucose is reabsorbed from within the distal tubule by co-transport
  - glucose is reabsorbed from within the proximal tubule by facilitated diffusion
  - glucose is always completely reabsorbed
  - movement of glucose from tubular epithelial cells is by passive diffusion
  - none of the above
- 14 Creatinine:
- is synthesised in the liver from methionine, glycine and arginine
  - is converted directly to creatine
  - has variable excretion from day to day
  - creatinuria occurs normally in the elderly and in pregnant women
  - all of the above
- 15 The thin ascending loop of Henle is:
- relatively permeable to water
  - relatively impermeable to sodium ion
  - permeable to both water and sodium ion
  - relatively impermeable to water
  - relatively impermeable to both water and sodium ion
- 16 The primary effect of angiotensin II on renal vasculature is:
- constriction of efferent arterioles
  - enhanced prostaglandin mediated increased blood flow to the renal cortex
  - enhanced catecholamine mediated afferent arteriolar vasoconstriction
  - enhanced catecholamine mediated afferent vasodilatation
  - constriction of interlobular arteries
- 17 With respect to the counter current system:
- the loops of Henle act as counter current exchanges
  - solutes diffuse out of vessels conducting blood towards the cortex
  - water diffuses out of ascending vessels
  - water diffuses into the collecting ducts
  - counter current exchange is passive and can operate even if counter current multiplication ceases

- 18 What percentage of filtered sodium is reabsorbed by the kidney?
- a) 1%
  - b) 93%
  - c) 99%
  - d) 50%
  - e) 100%
- 19 Tuboglomerular feedback refers to:
- a) the process of increased sodium reabsorption associated with an increased glomerular filtration
  - b) changes in peri-tubular oncotic pressure associated with changes in glomerular filtration
  - c) decreased glomerular filtration associated with increased flow through the loop of Henle
  - d) increased glomerular filtration associated with decreased peri-tubular oncotic pressure
  - e) thromboxane A2 mediated increased sodium reabsorption associated with increased renal blood flow
- 20 Frusemide acts mainly at:
- a) proximal tubule
  - b) thin limb of loop of Henle
  - c) thick limb of loop of Henle
  - d) distal tubule
  - e) collecting duct
- 21 At which site does tubular fluid osmolality exceed that of plasma by the greatest amount?
- a) proximal tubule
  - b) thin limb of loop of Henle
  - c) thick limb of loop of Henle
  - d) distal tubule
  - e) collecting duct
- 22 At which site is sodium ion NOT actively reabsorbed?
- a) proximal tubule
  - b) thin limb of loop of Henle
  - c) thick limb of loop of Henle
  - d) distal tubule
  - e) collecting duct

- 23 At which site(s) is potassium ion secreted?
- distal tubule and collecting duct
  - proximal tubule and distal tubule
  - thin limb of loop of Henle only
  - thin limb and thick limb of loop of Henle
  - none of the above
- 24 At which site does chlorthiazide act?
- proximal tubule
  - thin limb of loop of Henle
  - thick limb of loop of Henle
  - distal tubule
  - collecting duct
- 25 The cortical portion of the collecting duct has the capacity to reabsorb approximately 10% of the filtered water. Which substance is most important in regulating this effect?
- angiotensin II
  - histamine
  - vasopressin
  - sodium
  - prostaglandins
- 26 With respect to GFR:
- clearance of p-amino hippuric acid is used to determine GFR
  - inulin cannot be used to measure GFR
  - GFR is usually reduced in ureteric obstruction
  - filtration pressure changes with change in blood pressure
  - contraction of mesangial cells increases GFR
- 27 With respect to the loop of Henle:
- the ascending limb is highly permeable to water
  - the descending limb is impermeable to water
  - the thick ascending limb co-transports sodium, potassium and chloride out of the lumen
  - tubular fluid becomes concentrated as it passes through the ascending limb
  - the ascending limb removes approximately 15% of filtered water

- 28 Mesangial cells:
- a) are specialised cells that are characterised by numerous pseudopodia
  - b) are made to contract by dopamine
  - c) are made to contract by angiotensin II
  - d) lie within the renal medulla
  - e) decrease the area for filtration when they relax
- 29 Regarding the proximal tubule, the following statements are true EXCEPT:
- a) sodium is co-transported out of the tubule with glucose
  - b) sodium is actively transported into the intercellular spaces by Na-K-ATPase
  - c) the cells are characterised by a brush border and tight junctions
  - d) vasopressin increases the permeability to water by causing the rapid insertion of water channels into the luminal membrane
  - e) water moves passively out of the tubule along osmotic gradients
- 30 Renal autoregulation of GFR helps prevent large fluctuations in GFR despite wide variations in arterial blood pressure. With regard to autoregulation, which is TRUE?
- a) the macula densa cells sense change in afferent arteriolar pressure
  - b) falling GFR results in a feedback to decrease efferent arteriolar pressure
  - c) falling GFR results in an increase in renin secretion from macula densa cells
  - d) decreased macula densa concentration of NaCl results in dilatation of afferent arterioles
  - e) decreased GFR decreases NaCl reabsorption in the ascending loop of Henle
- 31 Aldosterone has its principle effect in the:
- a) proximal convoluted tubule
  - b) descending loop of Henle
  - c) thick ascending loop of Henle
  - d) distal convoluted tubule
  - e) collecting ducts
- 32 85% of  $\text{NaHCO}_3$  in the filtrate is reabsorbed in the:
- a) proximal convoluted tubule
  - b) descending loop of Henle
  - c) thick ascending loop of Henle
  - d) distal convoluted tubule
  - e) collecting ducts

- 33 Thiazide diuretics exert their main effect in the:
- a) proximal convoluted tubule
  - b) descending loop of Henle
  - c) thick ascending loop of Henle
  - d) distal convoluted tubule
  - e) collecting ducts
- 34 Ethacrynic acid exerts its principle effect in the:
- a) proximal convoluted tubule
  - b) descending loop of Henle
  - c) thick ascending loop of Henle
  - d) distal convoluted tubule
  - e) collecting ducts
- 35 When considering fluid balance, which of the following is INCORRECT?
- a) the minimum daily fluid output may normally be estimated by measuring the urine output and adding 500ml
  - b) urine output is always the single largest contributor to fluid output
  - c) fluid intake and output may be altered in response to a change in extracellular osmolarity
  - d) fluid intake and output may be altered in response to a change in extracellular volume
  - e) the hypothalamus is an important regulator of fluid intake
- 36 Which of the following does NOT stimulate erythropoietin secretion?
- a) cobalt salts
  - b) thromboxanes
  - c) androgens
  - d) adenosine
  - e) prostaglandins
- 37 Glomerular filtration rate is best measured using:
- a) inulin
  - b) glucose
  - c) PAH
  - d) urea
  - e) creatinine
- 38 "Renal dose" dopamine increases glomerular filtration rate by:
- a) dilating the renal arteries
  - b) dilating the vasa recta
  - c) constricting the efferent arteriole
  - d) relaxing glomerular perivascular mesangial cells
  - e) all of the above

- 39 Regarding the kidney:
- a) the glomerular filtration rate is 125mls/hr
  - b) the renal threshold for glucose 300mg/dL
  - c) glucose transport is an example of secondary active transport
  - d) the blood flow in the renal medulla is greater than in renal cortex
  - e) a high protein diet decreases renal blood flow
- 40 Which of the following substances is not excreted by the kidney in a normal adult on an average diet?
- a) K<sup>+</sup>
  - b) uric acid
  - c) creatinine
  - d) glucose
  - e) urea
- 41 Which of the following statements regarding erythropoietin is INCORRECT in an adult?
- a) half-life of about 5 hours
  - b) hypoxia can increase secretion within minutes
  - c) is secreted by spleen and salivary glands
  - d) is secreted in adequate amounts by liver in absence of kidneys
  - e) is a glycoprotein
- 42 "Renal dose" dopamine is:
- a) 1-2 mcg/kg/min
  - b) 1-5 mcg/kg/min
  - c) 1-10 mcg/kg/min
  - d) 1-20 mcg/kg/min
  - e) greater than 20 mcg/kg/min
- 43 Frusemide acts as a diuretic primarily by:
- a) inhibiting Na<sup>+</sup>/K<sup>+</sup>/Cl<sup>-</sup> co-transport in loop of Henle
  - b) inhibiting action of vasopressin on collecting duct
  - c) decreasing H<sup>+</sup> secretion with resultant increase in Na<sup>+</sup>/K<sup>+</sup> excretion
  - d) inhibiting vasopressin secretion
  - e) inhibiting Na<sup>+</sup>/K<sup>+</sup> exchange in collecting ducts by inhibiting the action of aldosterone
- 44 Regarding the osmolality of renal tubular fluid, is it?
- a) hypotonic in loop of Henle
  - b) isotonic in proximal tubule
  - c) hypertonic in distal tubule
  - d) hypotonic in collecting duct
  - e) hypotonic in proximal tubule

- 45 Which of the following statements regarding renal tubular glucose absorption is INCORRECT?
- binds to SGLT-2 in luminal membrane
  - example of secondary active transport
  - transported out of luminal cell by GLUT-2
  - about 100% reabsorption in proximal tubule if less than transport maximum
  - linked to sodium reabsorption
- 46 Which of the following does NOT increase renal tubular sodium reabsorption?
- cortisol
  - oestrogen
  - growth hormone
  - insulin
  - glucagon
- 47 Regarding renal handling of glucose, which is INCORRECT?
- transport maximum varies depending on sex
  - proximal tubular absorption is an example of a symport mechanism
  - not all nephrons handle glucose filtration and reabsorption equally
  - phlorhizin inhibits distal tubular reabsorption
  - GLUT-2 transports glucose into interstitial fluid
- 48 Regarding renal handling of sodium, which is INCORRECT?
- more than 95% of filtered sodium is reabsorbed
  - proximal tubular reabsorption is an example of secondary active transport
  - aldosterone increases reabsorption despite increasing GFR
  - glucocorticoids may increase or decrease urinary excretion
  - renal oxygen consumption is directly proportional to sodium reabsorption
- 49 Which of the following agents cause relaxation of mesangial cells of the glomerulus?
- angiotensin II
  - dopamine
  - endothelins
  - vasopressin
  - noradrenaline
- 50 Regarding renal handling of bicarbonate ion, which is INCORRECT?
- small size of bicarbonate ion affects reabsorption
  - reabsorption is reciprocally related to chloride ion reabsorption in proximal tubule
  - most reabsorption occurs in proximal tubule
  - reabsorption requires carbonic anhydrase
  - reabsorption is decreased by ECF expansion

- 51 Regarding renal handling of ammonia, which is INCORRECT?
- a) ammonia is not filtered at the glomerulus
  - b) ammonia is synthesised in proximal and distal tubules
  - c) glutaminase plays a role in ammonia excretion
  - d) non-ionic diffusion of ammonia maintains a concentration gradient for further diffusion
  - e) ammonia diffusion can increase up to 30 fold
- 52 Regarding renal handling of calcium, which is INCORRECT?
- a) metabolic acidosis decreases reabsorption
  - b) growth hormone increases reabsorption
  - c) calcium is actively reabsorbed
  - d) about 60% of filtered calcium load is reabsorbed in proximal tubules
  - e) glucocorticoids increase calcium reabsorption
- 53 Regarding renal handling of chloride, which is INCORRECT?
- a) about 25% of filtered load is actively reabsorbed in thick ascending limb
  - b) proximal tubular reabsorption is reciprocally related to bicarbonate reabsorption
  - c) it is actively secreted in distal tubule
  - d) two chloride per sodium are reabsorbed in thick ascending limb
  - e) chloride-hydroxide antiport are present in the kidney
- 54 Regarding glomerular filtration:
- a) the glomerular filtration rate varies less than the renal plasma flow
  - b) inulin is stored in the kidney
  - c) sialoproteins in the glomerular capillary wall are positively charged
  - d) dopamine causes contraction of mesangial cells
  - e) changes in renal blood flow do not affect glomerular filtration rate
- 55 Regarding renal handling of phosphate, which is INCORRECT?
- a) no tubular secretion occurs
  - b) most reabsorption occurs actively in proximal tubule
  - c) parathyroid hormone inhibits tubular reabsorption
  - d) less than 5% of filtered load is excreted
  - e) phosphate is a much more powerful buffer in tubular fluid than in blood
- 56 Regarding renal handling of hydrogen ion, which is INCORRECT?
- a) acetazolamide decreases tubular secretion
  - b) aldosterone increases distal tubular secretion
  - c) much more acid secretion occurs in proximal than distal tubule
  - d) lowest tubular fluid pH achievable is 4.5
  - e) secondary active transport mechanism operates in distal tubule

- 57 In diabetes insipidus:
- a) percentage of filtered water reabsorbed is increased compared to normal
  - b) there is a net gain of water in excess of solute (L/day)
  - c) urine volume (L/day) is decreased
  - d) urine concentration (msom/L) is markedly reduced
  - e) glomerular flow (ml/min) is increased
- 58 Which site of diuretic action is INCORRECT?
- a) antidiuretic hormone antagonists act in collecting duct
  - b) loop agents act in thin ascending limb
  - c) carbonic anhydrase inhibitors act in proximal tubule
  - d) thiazides act in early distal tubule
  - e) aldosterone antagonists act in cortical collecting tubule
- 59 Which of the following statements regarding angiotensin is INCORRECT?
- a) angiotensin II has a half-life of about 1-2 minutes
  - b) angiotensin I is physiologically inactive
  - c) angiotensin III has equivalent pressor activity to angiotensin II
  - d) angiotensinogen mainly comes from the liver
  - e) angiotensin converting enzyme is a dipeptidyl carboxypeptidase angiotensin converting enzyme
- 60 Regarding renal tubular function:
- a)  $\text{Na}^+$  is actively transported out of the thin portions of the loop of Henle
  - b)  $\text{Na}^+ \text{-K}^+$  ATPase pumps  $\text{Na}^+$  out of the renal tubule
  - c)  $\text{Cl}^-$  is transported only by co-transport
  - d) glucose is reabsorbed mainly in the distal tubule
  - e) penicillin is not actively secreted into tubular fluid
- 61 Regarding the actions of angiotensin II, which is INCORRECT?
- a) selective renal efferent arteriolar constriction
  - b) acts on CNS without crossing blood-brain barrier
  - c) contract mesangial cells
  - d) direct positive chronotropic action on heart
  - e) increases conversion of cholesterol to pregnenolone
- 62 Normal values for renal function include all of the following EXCEPT:
- a) filtration fraction =0.2
  - b) 22% of cardiac output
  - c) GFR = 180 litres/day
  - d) RPF = 900 litres/day
  - e)  $T_m$  glucose = 450 mg/minute

- 63 Regarding renal handling of potassium, which is INCORRECT?
- a) 10 to 15% of filtered load may be excreted in urine
  - b) two potassium per sodium are reabsorbed in thick ascending limb
  - c) excretion decreased in acidosis
  - d) distal tubular secretion is capable of "adaptation" depending on demand
  - e) aldosterone increases distal tubular secretion in exchange for sodium
- 64 Normal urinary values include all of the following EXCEPT:
- a) albumin  $\leq$  150mg/day
  - b) pH = 4.5 to 8.0
  - c) volume = 0.5 to 2.4 litres/day
  - d) specific gravity = 1.010 to 1.035
  - e) osmolality = 3 to 1400 millismol/litres
- 65 Regarding the kidney:
- a) prostaglandins decrease blood flow in renal cortex
  - b) acetylcholine produces renal vasoconstriction
  - c) angiotensin II causes constriction of efferent arterioles
  - d) angiotensin II causes constriction of afferent arterioles
  - e) glomerular capillary pressure normally is about 100mmHg
- 66 Glucose reabsorption is most marked in which segment of the glomerulus?
- a) the proximal convoluted tubule
  - b) the distal convoluted tubule
  - c) the descending loop of Henle
  - d) the ascending loop of Henle
  - e) the collecting system
- 67 Why is NSAIDs use a relative contraindication in patients with chronic renal failure?
- a) direct toxic effects on proximal tubule
  - b) direct toxic effects on collecting ducts
  - c) indirect toxic effects on loop of Henle
  - d) inhibition of prostaglandin synthesis which is an important regulator of renal blood flow in arterioles
  - e) inhibition of prostaglandin synthesis which is an important regulator of renal blood flow in main renal arteries
- 68 Characteristics of a substance suitable for measuring GFR do NOT include:
- a) freely filtered
  - b) not toxic
  - c) no effect on filtration rate
  - d) not metabolised
  - e) of low molecular weight

- 69 Amino acid reabsorption is most marked in which segment of the glomerulus?
- a) the proximal convoluted tubule
  - b) the distal convoluted tubule
  - c) the descending loop of Henle
  - d) the ascending loop of Henle
  - e) the collecting duct
- 70 Which of the following substances would NOT cause contraction of mesangial cells?
- a) angiotensin II
  - b) dopamine
  - c) vasopressin
  - d) histamine
  - e) platelet activating factor
- 71 Chloride may be reabsorbed in the nephron by:
- a) passive reabsorption
  - b) active co-transport with  $K^+$  and  $Na^+$
  - c)  $OH^-/Cl^-$  antiport
  - d) all of the above
  - e) none of the above
- 72 Which of these factors do NOT affect GFR?
- a) renal blood flow
  - b) ureteral obstruction
  - c) dehydration
  - d) a neutral molecule measuring 4 manometer
  - e) angiotensin II effects on mesangial cells
- 73 The collecting duct is the main site of action for which of the following drugs?
- a) ethanol
  - b) demeclocycline
  - c) thiazide diuretics
  - d) ethacrynic acid
  - e) caffeine
- 74 Which is NOT true of osmotic diuresis?
- a) osmotic diuresis is due to the quantity of unreabsorbed solutes
  - b) decreased water reabsorption in proximal tubules and loops
  - c) reduced  $Na^+$  reabsorption as the limiting concentration gradient is exceeded
  - d) net loss of  $Na^+$  in urine
  - e) normal water reabsorption in proximal portion of tubules

75 Which of these is NOT a factor affecting acid secretion?

- a) intracellular PCO<sub>2</sub>
- b) carbonic anhydrase level
- c) K<sup>+</sup> concentration
- d) aldosterone concentration
- e) none of the above

76 Regarding the kidney:

- a) glucose is reabsorbed mainly in distal tubule
- b) normal GFR is 125ml/hour
- c) glomeruli filter 180L fluid per day
- d) Na<sup>+</sup> is actively transported out of thick loop of Henle
- e) ethanol promotes vasopressin secretion

77 Regarding renal blood flow:

- a) blood flow greatest to medulla
- b) pressure in renal vein is about 20mmHg
- c) angiotensin II constricts efferent arterioles
- d) prostaglandins increase blood flow in cortex and medulla
- e) renal blood flow = renal plasma flow ×  $\frac{1}{\text{haematocrit}}$

78 Osmolality of tubular fluid:

- a) isotonic in proximal tubule
- b) isotonic in loop of Henle
- c) hypertonic in ascending limb loop of Henle
- d) hypotonic in collecting duct
- e) hypotonic in proximal tubule

79 Regarding the kidney and urine formation:

- a) specific gravity is measure of osmolality
- b) thin ascending limb relatively impermeable to water
- c) thin ascending limb relatively impermeable to Na<sup>+</sup> Cl<sup>-</sup>
- d) water diuresis begins about 1 hour after ingestion of a water load
- e) high protein diet does not affect concentrating ability of kidney

80 Regarding tubular reabsorption in kidney:

- a) glucose and amino acids passively reabsorbed
- b) Cl<sup>-</sup> mainly actively reabsorbed
- c) only passive reabsorption occurs in proximal tubule
- d) urea is not passively reabsorbed
- e) Na<sup>+</sup> actively reabsorbed in most parts of tubule

- 81 In the presence of vasopressin, most filtered water is absorbed in the:
- proximal tubule
  - loop of Henle
  - distal tubule
  - cortical collecting system
  - medullary collecting system
- 82 All of the following affect glomerular filtration, EXCEPT:
- changes in renal blood flow
  - urethral obstruction
  - dehydration
  - oedema outside the renal capsule
  - glomerular capillary permeability
- 83 The thick ascending limb of the loop of Henle:
- is impermeable to water
  - has maximal permeability to NaCl
  - is relatively permeable to water
  - is impermeable to NaCl
  - is a site where there is no active transport of sodium
- 84 In the normal bladder, micturition:
- is initiated by the pelvic nerves
  - is co-ordinated in the lumbar portion of the spinal cord
  - is initiated at a volume of 600mls
  - is significantly affected by sympathetic nerves
  - is not facilitated at the level of the brain stem
- 85 All the following statements regarding the atrial natriuretic peptide (ANP) are true EXCEPT:
- it causes natriuresis
  - it lowers blood pressure
  - circulating ANP has a short half-life
  - ANP has the greatest affinity for the ANPR-B receptor of the glomerulus
  - it is released when atrial muscle is stretched

## Section 2

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

## Section 3

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- 1 Which part of the renal tubule is  $\text{Na}^+$  NOT actively transported out of?
  - a) proximal convoluted tubule
  - b) thin portions of the loop of Henle
  - c) thick ascending limb of loop of Henle
  - d) distal convoluted tubule
  - e) collecting duct
  
- 2 Where is the macula densa located?
  - a) afferent arteriole
  - b) efferent arteriole
  - c) proximal convoluted tubule
  - d) thick ascending limb of loop of Henle
  - e) distal convoluted tubule
  
- 3 What percentage of cardiac output goes to the kidneys at rest?
  - a) 10%
  - b) 15%
  - c) 25%
  - d) 35%
  - e) 45%
  
- 4 Which factor increases renal blood flow?
  - a)  $\alpha_1$  adrenergic stimulation
  - b)  $\alpha_2$  adrenergic stimulation
  - c) reduced systemic blood pressure
  - d) exercise
  - e) lying down
  
- 5 Angiotensin II:
  - a) constricts afferent arterioles only
  - b) constricts efferent arterioles only
  - c) constricts afferent and efferent arterioles
  - d) dilates afferent arterioles
  - e) dilates efferent arterioles

- 6 Regarding nephrons permeability:
- a) glomerular capillaries are 100 times more permeable than skeletal muscle capillaries
  - b) anionic substances are more permeable than neutral substances
  - c) N (?normal) glomerular concentration of albumin is 0.2% of plasma concentration
  - d) neutral substances are freely filtered with diameters < 8nm
  - e) 100mg/d of protein is filtered at the glomerulus
- 7 Where does glucose reabsorption occur?
- a) proximal convoluted tubule
  - b) thin descending limb of loop of Henle
  - c) thick ascending limb of loop of Henle
  - d) distal convoluted tubule
  - e) collecting duct
- 8 Vasopressin acts as the:
- a) proximal convoluted tubule
  - b) loop of Henle
  - c) distal convoluted tubule
  - d) cortical portion of the collecting duct
  - e) medullary portion of the collecting duct
- 9 Regarding the bladder:
- a) the external urethral sphincter is made up of smooth muscle cells
  - b) the internal urethral sphincter does not encircle the urethra
  - c) pelvic nerves (S2-S4) supply the external sphincter
  - d) when the bladder is stretched, tension is maintained
  - e) relaxation of the internal urethral sphincter assists micturition
- 10 Which substance relaxes mesangial cells?
- a) angiotensin II
  - b) ADH
  - c) noradrenaline
  - d) thromboxane A2
  - e) ANP
- 11 Concerning the kidneys:
- a) normal glomerular filtration rate is 250ml/minute
  - b) normal renal plasma flow is 125ml/minute
  - c) normal filtration fraction is 0.19
  - d) blood flow is normally higher in the medulla than the cortex
  - e) normal blood volume in the kidneys at any one time is 250ml

- 12 Regarding renal handling of substances:
- a) urea is filtered, but not secreted
  - b) most sodium is resorbed in the loop of Henle
  - c) creatinine is not filtered, but is resorbed
  - d) potassium is filtered, but not secreted
  - e) chloride is secreted and resorbed
- 13 Which of the following is transported via active transport?
- a) chloride
  - b) hydrogen
  - c) glucose
  - d) urea
  - e) bicarbonate
- 14 Concerning the respiratory exchange ration (R)
- a) it falls during exercise
  - b) it falls in metabolic acidosis
  - c) the stomach has a positive R during secretion of acid
  - d) it rises after ingestion of alkali
  - e) at steady state, it equals the respiratory quotient
- 15 Regarding fat metabolism, all are true EXCEPT:
- a) brown fat is characterised by a  $H^+$  short circuit protein in the mitochondria
  - b) heparin is a cofactor for lipoprotein lipase
  - c) ketone bodies accumulate in diabetic ketoacidosis due to reduced removal from the circulation
  - d) the essential fatty acids are used to produce autocoids
  - e) there is no major pathway for converting fat to carbohydrate
- 16 Triiodothyronine:
- a) is less potent than thyroxine
  - b) deficiency causes yellow skin due to keratin buildup
  - c) acts via a tyrosine kinase predominantly
  - d) causes an increase in  $Na^+/K^+$  ATPase activity
  - e) in both, deficiency but no excess leads to muscle weakness
- 17 Mesangial cells:
- a) have a role in the control of GFR
  - b) are similar to other endothelial cells in the vascular tree
  - c) are responsible for tubuloglomerular balance
  - d) contract in response to dopamine
  - e) relax in response to vasopressin

- 18 With regard to water excretion:
- a) 280 l is filtered per day
  - b) it is impossible to excrete more than 23 l/day
  - c) most regulation is via manipulation of the gradients along the loop of Henle
  - d) vasopressin acts to insert water channels into the basolateral cell membrane of the collecting ducts
  - e) water reabsorption in the collecting ducts can alter by a factor of 2.5 dependent on the presence of vasopressin
- 19 All of the following are transported across renal tubular cell membranes by secondary active transport, using the energy of the active transport of  $\text{Na}^+$ , EXCEPT:
- a) glucose
  - b) lactate
  - c) citrate
  - d)  $\text{H}^+$
  - e)  $\text{K}^+$
- 20 Regarding the control of GFR:
- a) increasing ANP causes contraction of mesangial cells
  - b) glomerular cap are less permeable than skeletal
  - c) oedema of kidney causes increase in renal intent po????
  - d) efferent arterioles have low reninlard
  - e) hypoproteinaemia increases GFR
- 21 Regarding osmotic diuresis:
- a) is secondary to decreased ADH
  - b) results in hypertonic urine
  - c) increased water reabsorption in PCT
  - d) may be seen in patients with diabetes ketoacidosis
  - e) may be seen in patients with diabetes insipidis
- 22 Effective renal plasma flow is best measured using:
- a) inulin
  - b) glucose
  - c) PAH
  - d) urea
  - e) creatinine

For questions 23 – 26

Substance X is freely filtered by the glomerulus and is not reabsorbed, nor secreted nor metabolised.

If -     serum x concentration     = 0.020 mg/ml  
renal artery x concentration = 0.020 mg/ml  
renal vein x concentration = 0.002 mg/ml  
urine x concentration     = 14 mg/ml  
urine flow                 = 54 ml/hr  
lymphatic x concentration = 0.00001 mg/ml  
haematocrit                 = 0.45

23 Then the CLEARANCE of X is:

- a) 10.5 ml/min
- b) 630 ml/min
- c) 10.5 mg/min
- d) 630 mg/min
- e) 60 ml/min

24 Renal plasma flow is:

- a) 10.5 ml/min
- b) 630 ml/min
- c) 700 ml/min
- d) 11.7 ml/min
- e) 21.2 ml/min

25 Renal blood flow is:

- a) 10.5 ml/min
- b) 21.2 ml/min
- c) 11.7 ml/min
- d) 700 ml/min
- e) 1273 ml/min

26 The GFR is:

- a) 10.5 ml/min
- b) 700 ml/min
- c) 11.7 ml/min
- d) 630 ml/min
- e) 778 ml/min

## **Section 3**

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1	B
2	D
3	C
4	E
5	C
6	C
7	A
8	D
9	B
10	E
11	C
12	A
13	B
14	E
15	D
16	E
17	A
18	E
19	E
20	C
21	D
22	C
23	B
24	C
25	E
26	D