MERU UNIVERSITY OF SCIENCE AND TECHNOLOGY

P.O. Box 972-60200 – Meru-Kenya
Tel: +254(0) 799 529 958, +254(0) 799 529 959, + 254 (0) 712 524 293,
Website: info@must.ac.ke Email: info@must.ac.ke

University Examinations 2023/2024

FIRST YEAR SECOND SEMESTER EXAMINATION FOR THE DEGREE OF BACHELOR OF CLINICAL MEDICINE AND COMMUNITY HEALTH

CCM 3221: HUMAN PHYSIOLOGY

DATE: APRIL 2024 **TIME: 3 HOURS**

INSTRUCTIONS:
Answer ***All*** *questions*
Ensure that all your answers are properly numbered
Part I multiple Choice Questions (MCQ): Write the correct answer on the space provided in the answer booklet. Each MCQ is one mark
Part II: Short Answer Questions – Answer questions following each other on the answer booklet
Part III: Long Answer Questions – Answer each question on the answer booklet

SECTION A: SHORT ANSWER QUESTIONS (Each is marks)

1. Describe the daily fluid intake and output in an adult.
2. Describe the distribution of body fluid in a 70kg man
3. Describe the effects on cells upon addition of isotonic, hypotonic and hypertonic solutions to blood.
4. Describe the causes of intracellular edema
5. Describe the safety factors that prevent edema
6. Describe the functions of the kidneys and one clinical correlate
7. Describe the physiological uniqueness of the renal capillary beds

8. Describe the glomerular filtration barrier and one clinical correlate

LONG ANSWER QUESTIONS (Each is 20marks)

1. Describe the determinants of glomerular filtration rate and how they are influenced by hypoalbuminaemia and renal stones.
2. Describe 5 hormones/autocoids on their effect on glomerular filtration rate.

MULTIPLE CHOICE QUESTIONS (Each is 1 mark)

l. Secretion of K+ by the distal tubule will be decreased by

(A) Metabolic alkalosis

(B) A high-K+ diet

(C) Hyperaldosteronism

(D) Spironolactone administration

(E) Thiazide diuretic administration

2. Subjects A and B are 70-kg men. Subject A drinks 2 L of distilled water, and subject B drinks 2 L of isotonic NaCl. As a result of these ingestions, subject B will have a

(A) Greater change in intracellular fluid (ICF) volume

(B) Higher positive free-water clearance

(C) Greater change in plasma osmolarity

(D) Higher urine osmolarity

(E) Higher urine flow rate

For questions 3 and 4, use the statement below

A 45-year-old woman develops severe diarrhoea while on vacation. She has the following arterial blood values: pH = 7.25 partial pressures of carbon dioxide = 24 mm Hg [HC03-] = 10 mEq/L

Venous blood samples show decreased blood [K+] and a normal anion gap.

3. The correct diagnosis for this patient is

(A) metabolic acidosis

(B) metabolic alkalosis

(C) respiratory acidosis

(D) respiratory alkalosis

(E) normal acid—base status

4. Which of the following statements about this patient is correct?

(A) She is hypoventilating

(B) The decreased arterial [I-IC03-] is a result of buffering of excess 1-1+ by HC03-

(C) The decreased blood [K+] is a result of exchange of intracellular H+ for extracellular K+

(D) The decreased blood [K+] is a result of increased circulating levels of aldosterone

(E) The decreased blood [K+] is a result of decreased circulating levels of antidiuretic hormone (ADH)

5. Use the values below to answer the following question.

Glomerular capillary hydrostatic pressure = 47 mm Hg

Bowman's space hydrostatic pressure = 10 mm Hg

Bowman's space oncotic pressure = 0 mm Hg

At what value of glomerular capillary oncotic pressure would glomerular filtration stop?

(A) 57 mm Hg c

(B) 47 mm Hg

(C) 37 mm Hg

(D) 10 mm Hg

6. The reabsorption of filtered HC03-

(A) Results in reabsorption of less than 50% of the filtered load when the plasma concentration of HC03 - is 24 mEq/L

(B) Acidifies tubular fluid to a pH of 4.4

(C) is directly linked to excretion of H+ as NH4+

(D) is inhibited by decreases in arterial partial pressures of C02

(E) can proceed normally in the presence of a renal carbonic anhydrase inhibitor

7. The following information was obtained in a 20-year-old college student who was participating in a research study in the

Clinical Research Unit:

Plasma

[Inulin] = I mg/mL

[X] 2 mg/mL

Urine

[Inulin] = 150 mg/mL

[X] = 100 mg/mL

Urine flow rate 1 mL/min

Assuming that X is freely filtered, which of the following statements is most correct?

(A) There is net secretion of X

(B) There is net reabsorption of X

(C) There is both reabsorption and secretion of X

(D) The clearance of X could be used to measure the glomerular filtration rate (GFR)

(E) The clearance of X is greater than the clearance of inulin

9. A woman runs a marathon in 400C weather and replaces all volume lost in sweat by drinking distilled water. After the marathon, she will have

(A) Decreased total body water (TBW)

(B) Decreased hematocrit

(C) Decreased intracellular fluid (ICF) volume

(D) Decreased plasma osmolarity

(E) Increased intracellular osmolarity

10. Which of the following causes hyperkalemia?

(A) Exercise

(B) Alkalosis

(C) Insulin injection

(D) Decreased serum osmolarity

(E) Treatment with P-agonists

11. Which of the following is a cause of metabolic alkalosis?

(A) Diarrhea

(B) Chronic renal failure

(C) Ethylene glycol ingestion

(D) Treatment with acetazolamide

(E) Hyperaldosteronism

12. Which of the following is an action of parathyroid hormone (PTH) on the renal tubule?

(A) Stimulation of adenylate cyclase

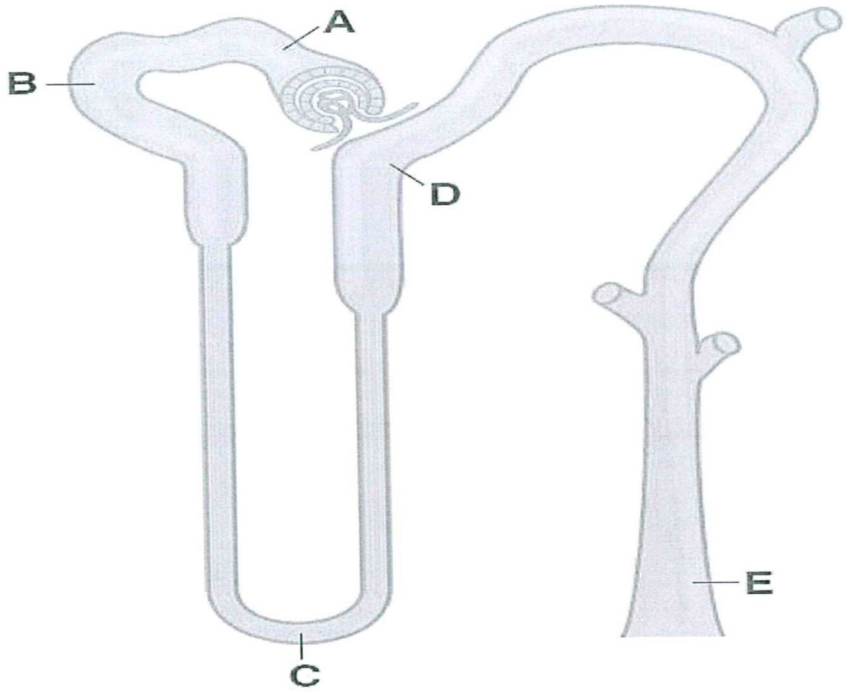
(B) Inhibition of distal tubule K^+ secretion

(C) Inhibition of distal tubule Ca^{2+} reabsorption

(D) Stimulation of proximal tubular phosphate reabsorption

(E) Inhibition of production of 1 ,25-dihydroxycholecalciferol

USE THE FIGURE BELOW TO ANSWER QUESTIONS 13, 14 AND 15



13. At which nephron site does the amount of K+ in tubular fluid exceed the amount of filtered K^+ in a person on a high-K^+ diet?

    (A) Site A

    (B) Site B

    (C) Site C

    (D) Site D

    (E) Site E

14. At which nephron site is the tubular fluid/plasma (TF/P) osmolarity lowest in a person who has been deprived of water?

    (A) Site A

    (B) Site B

    (C) Site C

    (D) Site D

(E) Site E

15. At which nephron site is the tubular fluid glucose concentration highest?

(A) Site A

(B) Site B

(C) Site C

(D) Site D

(E) Site E

16. To maintain normal 1-1+ balance, total daily excretion ofH+ should equal the daily

(A) Fixed acid production plus fixed acid ingestion

(B) HC03 - excretion

(C) HC03-fi1tered load

(D) Titratable acid excretion

(E) filtered load of 1-1+

17. At plasma concentrations of glucose higher than occur at transport maximum (Tm), the

(A) Clearance of glucose is zero

(B) Excretion rate of glucose equals the filtration rate of glucose

(C) Reabsorption rate of glucose equals the filtration rate of glucose

(D) Excretion rate of glucose increases with increasing plasma glucose concentrations

(E) Renal vein glucose concentration equals the renal artery glucose concentration

18. A negative free-water clearance will occur in a person who

(A) Drinks 2 L of distilled water in 30 minutes

(B) Begins excreting large volumes of urine with an osmolarity of 100 mOsm/L after a severe head injury

(C) Is receiving lithium treatment for depression, and has polyuria that is unresponsive to the administration of antidiuretic hormone (ADH)

(D) Has an oat cell carcinoma of the lung, and excretes urine with an osmolarity of 1000 mOsm/L

19. Which of the following would produce an increase in the reabsorption of isosmotic fluid in the proximal tubule?

(A) Increased filtration fraction

(B) Extracellular fluid (ECF) volume expansion

(C) Decreased peritubular capillary protein concentration

(D) Increased peritubular capillary hydrostatic pressure

(E) Oxygen deprivation

20. Which of the following would cause an increase in both glomerular filtration rate (GFR) and renal plasma flow (RPF)?

(A) Hyperproteinemia

(B) A ureteral stone

(C) Dilation of the afferent arteriole

(D) Dilation of the efferent arteriole

(E) Constriction of the efferent arteiole