

CANDIDATE'S
NAME

HOMEOSTASIS, EXCRETION & OSMOREGULATION

Paper 1

UACE
Aug./Sept. 2024
2Hours 30Minutes

INSTRUCTIONS TO CANDIDATES

This paper consists of Sections A and B

*Answer **all** questions in both sections*

Write answers to Section A in the boxes provided and answers to section B in the spaces provided.

SECTION A (40 MARKS)

1. Which one of the following occur when adrenaline is released in the mammalian body?

- A. Reduction in oxidation of glucose
 - B. Conversion of glucose to glycogen
 - C. Conversion of fat in adipose tissue into glucose
 - D. Increase in uptake of glucose by tissue cells
2. An efficient physiological homeostatic mechanism is one which....

- A. allows large fluctuations
 - B. respond to deficiency faster than excess
 - C. responds to small fluctuations
 - D. allow positive feedback
3. A mammal eats more food than a reptile of equivalent body weight because the mammal is

- A. lives longer
 - B. controls its body temperature
 - C. egests more food
 - D. does not absorb heat from its surrounding
4. Glucose is small enough to be filtered from the blood in glomeruli in the kidney but is not normally found in urine. This is because glucose is

- A. reabsorbed in distal convoluted tubules
 - B. reabsorbed in proximal convoluted tubules
 - C. reabsorbed along the whole length of the nephron
 - D. respired by cells in the kidney
5. In response to dehydration, antidiuretic hormone is released by the posterior pituitary gland. One of its effects is to stimulate:

- A. a reduction in the glomerular filtrate rate

- B. an increase in the number of aquaporins in the cell membrane of cells of the collecting duct
- C. an increase in the uptake of water by cells in the proximal convoluted tubules of nephron
- D. an increase in volume of urine produced by the kidney.
6. The following are examples of countercurrent exchange except?
- A. Gas exchange in human lungs
- B. Gas exchange in fish gills
- C. Movement of blood through the fins and tails of marine mammals
- D. Movement of blood through the legs of wading birds
7. Which part of the brain is responsible for thermoregulation?
- A. Cerebrum
- B. Hypothalamus
- C. Corpus callosum
- D. Medulla oblongata
8. Loss of water from the blood in a human body can result into
- A. lowering of body temperature
- B. slowing down the rate of breathing
- C. lowering of blood pressure
- D. slowing down of the heart rate
9. A desert mammal's lower lethal temperature is higher than that of a mammal living in cold regions because a desert mammal has
- A. small extremities
- B. poor insulation mechanisms
- C. thick fur
- D. a small surface area to volume ratio
10. A fresh water bony fish solves its osmoregulatory problems by
- A. possessing few glomeruli
- B. having long loop of Henle
- C. possessing many glomeruli
- D. actively secreting salts into water
11. The u-shape of the loop of Henle serves to
- A. Speed up the filtration
- B. Increase the content of the filtrate
- C. Reduce the concentration of the filtrate
- D. Create a region of high salt concentration
12. The following are advantages of excreting uric acid by flying organisms except...
- A. it is insoluble in water and non-toxic
- B. it requires very little water for its removal
- C. it requires less energy for its formation
- D. its storage does not osmoregulatory effect.
13. Diapause and hibernation are similar in that both are
- A. triggered off by low light intensity
- B. responses to humidity changes

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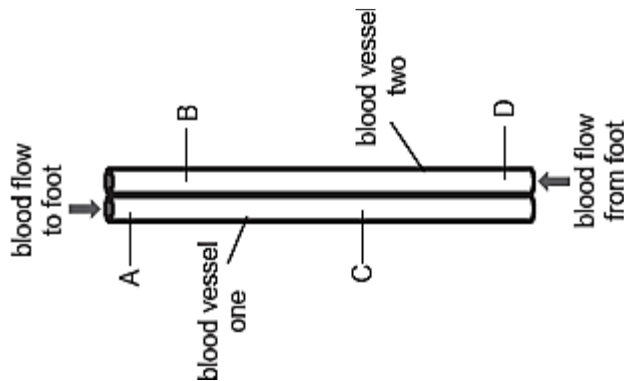
- C. artificially induced by removal of part of the brain
D. characterized by low body metabolism
14. Which one of the following parts of the nephron contributes to the production of hypertonic urine?
A. Bowman's capsule
B. Proximal convoluted tubules
C. Distal convoluted tubules
D. Loop of Henle
15. Which one of the following is not an adaptation of cells lining the proximal convoluted tubules for reabsorption?
A. Possession of numerous mitochondria
B. Closeness to blood capillaries
C. Having numerous pinocytic vesicles
D. Large fluid filled spaces separate cells
16. The sodium ion concentration is higher in the descending limb than in the ascending limb of the loop of Henle due to...
A. active pumping of sodium ions out of the ascending limb.
B. increased permeability of ascending limb to water.
C. descending limb being impermeable to sodium ions resisting outflow.
D. renal fluid in the descending limb lying in the medulla with high ion concentration.
17. Which of the following statements explains why insulin must not be taken orally by a diabetic patient?
A. It easily breaks down when mixed with saliva
B. It can easily be digested in the gut
C. The alkalinity in the mouth may destroy it
D. Saliva inactivates insulin
18. In which part of the mammalian kidney is blood likely to be most viscous as it flows.
A. In the afferent vessel
B. In the capillaries at the proximal convoluted tubule
C. In the efferent vessel
D. In the capillaries at the distal convoluted tubule
19. Heat loss is most efficiently reduced in body extremities of endotherms by having
A. Veins and arteries parallel and close to each other
B. Thick fur
C. Thick subcutaneous fat layer
D. Few sweat glands
20. Which one of the following nitrogenous wastes is suitable for elimination by a fresh water teleost?
A. Urea
B. Uric acid
C. Ammonia
D. Trimethylamine oxide

21. Which one of the following concentrations of proteins in mammals is correctly indicated? High in
- A. the glomerular filtrate and urine
 - B. the blood plasma, usually absent in glomerular filtrate and urine
 - C. both blood plasma and glomerular filtrate but low in urine
 - D. blood plasma, glomerular filtrate and urine.
22. The plants living in dry places such as deserts and steep hills and face scarcity of water are termed as?
- A. Halophytes
 - B. Xerophytes
 - C. Hydrophytes
 - D. Mesophytes
23. Animals having isotonic body fluid with no osmoregulatory mechanisms are...
- A. Osmoconformers
 - B. Osmoretractors
 - C. Osmocongeners
 - D. Osmodilutors
24. Which of the following increases the excretion of calcium ions in the kidney?
- A. Prostaglandin
 - B. Renin
 - C. Thyrocalcitonin
 - D. Angiotensin
25. According to solubility in water?
- A. Ammonia > uric acid > urea
 - B. Ammonia > urea > uric acid
 - C. Uric acid > urea > ammonia
 - D. Uric acid > ammonia > urea
26. Urine of a person undergoing prolonged fasting will be found to contain abnormal quantities of.....
- A. fats
 - B. amino acids
 - C. glucose
 - D. ketones
27. Which one of the following is responsible maximum amount of heat loss in humans at an ambient temperature of 21°C?
- A. Radiation and conduction
 - B. Respiration
 - C. Urination and defecation
 - D. Vaporization of sweat
28. In which of the following parts does nitrogenous waste in the Malpighian tubule flow?
- A. Proximal convoluted tubule
 - B. Intestine
 - C. Haemocoel

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D. Distal convoluted tubule

29. Diagram shows counter –current heat exchange system in the legs of birds living in cold environment.



In which position is the temperature of blood lowest?

30. Which of the following substances is both an osmoregulator and a nitrogenous waste?

A. Ammonia
B. Urea
C. Uric acid
D. Trimethylamine oxide

31. What happen if the stretch receptors of the urinary bladder wall are totally removed?

A. Micturition will continue
B. Urine will continue to collect normally in the bladder
C. There will be no micturition
D. Urine will not collect in the bladder

32. In the ornithine cycle, which of the following wastes are removed from blood?

A. Carbon dioxide and urea
B. Carbon dioxide and ammonia
C. Ammonia and urea
D. Urea and uric acid

33. Table below shows the relative rate at which fluid flows through each part of the nephron.

Part of nephron	Diameter(μm)	Flow rates (ml/min)
Proximal tubule	30	24-125
Loop of Henle	12	17-24
Distal tubule	20	7-17
Collecting duct	100	1-7

Why do the flow rates decrease in the more distal parts of the nephron?

A. Tubules become wider
B. Tubules become more numerous
C. Hydrostatic pressure decreases
D. Water is reabsorbed

- 34.** The most important adaptation of a plant in a salty environment is possession of
- A. deep roots
 - B. root hair sap with low water potential
 - C. many superficial adventitious roots
 - D. tissue with large air spaces

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- 35.** Which of the following best describes the range of thermoneutrality in a homeostatic system?
- A. Range of temperature in which a system consumes the least energy.
 - B. Highest temperature a system can reach before shutting down
 - C. Range of temperature at which physical means alone cannot regulate body temperature.
 - D. Range of temperature at which physical means alone can regulate body temperature.

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- 36.** Which of these is the most efficient method of minimizing water loss in terrestrial animals?
- A. Burrowing in the desert frog
 - B. Waxy chitinous exoskeleton in insects
 - C. Humidity seeking behaviours in wood lice
 - D. Thick fur in kangaroos

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- 37.** Capillary hydrostatic pressure during filtration is built in the glomerulus as
- A. size of the Bowman's capsule is significantly large
 - B. an afferent arteriole is narrower compared to efferent arteriole
 - C. Bowman's capsule is cup-shaped
 - D. an efferent arteriole is narrower compared to afferent arteriole

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- 38.** Which of the following nephrons are specifically instrumental in the production of concentrated urine?
- A. Cortical nephrons
 - B. Juxtamedullary nephrons
 - C. Proximal nephrons
 - D. Distal nephrons

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- 39.** The following statements are correct except.....
- A. Birds and snails are uricotelic animals
 - B. Mammals and frogs are ureotelic animals
 - C. Aquatic amphibians and aquatic insects are ammonotelic
 - D. Birds and reptiles are ureotelic animals

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- 40.** Which one of the following is correct about ectotherms?
- A. Have cold blood which is warmed by the surrounding
 - B. Regulate body temperature mainly by metabolic reactions
 - C. Much of the heat in their bodies is gained from the surrounding
 - D. Lack means to regulate body temperature

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SECTION B (60 MARKS)

- 41.(a) State any **two** factors which must be kept constant in the internal environment of an organism. (01 mark)

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- (b) Of what significance is maintenance of a constant internal environment to living organisms? (03 marks)

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- (c) Explain how the following adaptations might assist in maintenance of a constant internal environment.

- (i) an elongated loop of Henle in a desert mammal. (02 marks)

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- (ii) the thick fur coat in an artic mammal. (02 marks)

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(iii) the subcutaneous fat in a marine mammal. (02 marks)

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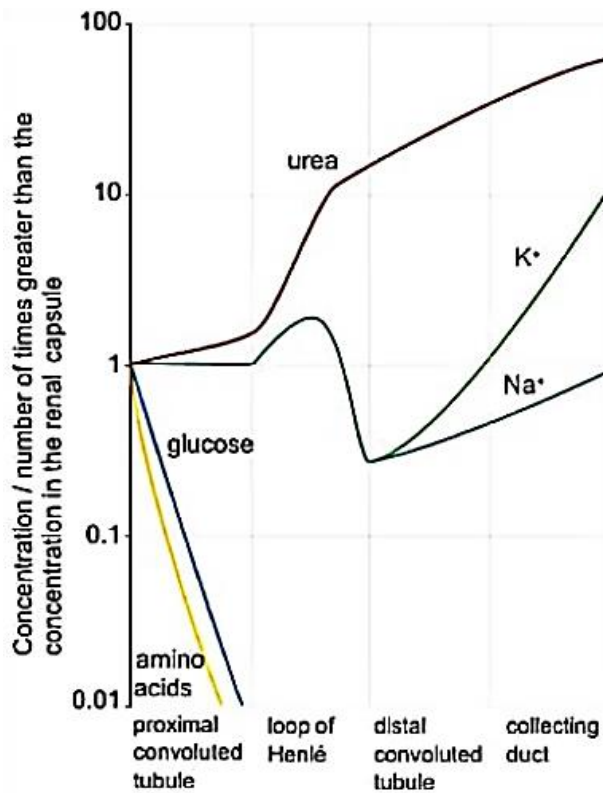
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42. The graph shows the relative concentrations of four substances in the filtrate as they pass along a nephron.



(a) Explain the changes in relative concentrations of the substances in the filtrate as they flow along the nephron.

(i) Urea. (02 marks)

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(ii) Glucose. (02 marks)

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(iii) Sodium ions. (03 marks)

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(b) Explain the difference in the concentration of ions in the distal convoluted tubule and collecting duct. (02 marks)

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43. (a) Giving **one** example in each case, distinguish between **negative feedback control** and **positive feedback control**. (04 marks)

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- (b) Explain why negative feedback is important in maintaining a system at a set point. (02 marks)

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- (c) Explain the following observations.

- (i) Drinking coffee increases the volume of urine produced per unit time.

(03 marks)

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- (ii) Tropical rodent, Panama rat has higher low critical temperature than arctic rodent, Lemming.

(01 mark)

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44. A biologist measured the rectal temperature of a rabbit in an outdoor area every half-hour for three hours. The biologist also measured the temperature of the air and at the tip of one of the rabbit's ears. The data are shown in the table below.

		Time of day						
		13:00	13:30	14:00	14:30	15:00	15:30	16:00
Row A	Temperature (°C)	39.1	38.8	38.6	38.3	38.5	38.8	39.1
Row B	Temperature (°C)	26.7	27.2	28.9	24.2	21.3	20.7	20.0
Row C	Temperature (°C)	15.3	15.4	14.8	14.0	13.1	12.8	11.7

- (a) Explain why rectal temperature and not skin temperature was used in the experiment. (04 marks)

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(b) Giving reasons, state the row that gives the rectal temperature for the rabbit.

(04 marks)

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(c) Rabbits have the ability to control the amount of blood flow to their ears.

Explain how this can help to thermoregulate.

(02 marks)

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45. (a) Differentiate between;

(i) **water stress** and **physiological drought**.

(02 marks)

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(ii) **drought evaders** and **drought endurers**.

(02 marks)

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(b) Under what conditions do plants experience physiological drought? (02 marks)

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(c) Suggest ways by which plants are adapted to physiological drought in their habitats. (04 marks)

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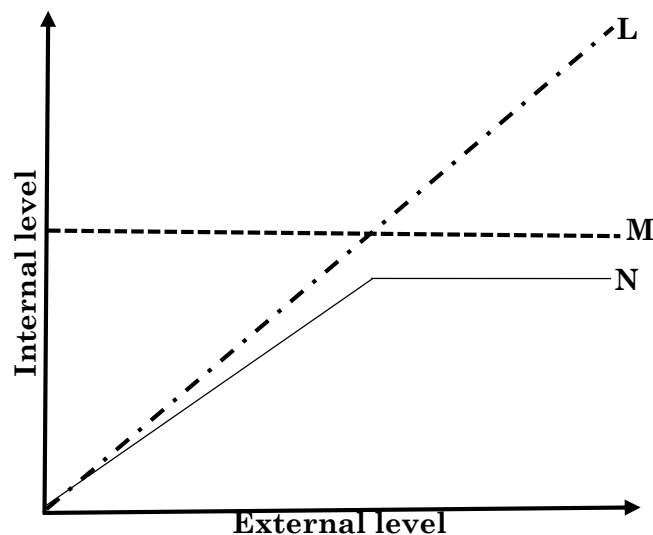
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46. The graph shows organismic responses to cope with stressful conditions in their habitats. Study it and answer the questions that follow.



(a) Suggest the category for each organism, giving a reason in each case. (06 marks)

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- (b) Give **one** advantage and disadvantage associated with organisms in category **L**.
(02 marks)

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- (c) How have the marine elasmobranchs overcome their osmoregulatory challenges?
(02 marks)

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