A2.3 **HOMEOSTASIS**

QUESTIONSHEET 1

Do not write in margin

Read through the following passage on homeostasis and then answer the questions.

Homeostasis is the regulation of the **internal environment** within narrow limits. This gives the organism a degree of independence from the external environment. The regulation is carried out by **negative and positive feedback mechanisms** which when not required are **damped**. All living organisms possess some powers of homeostasis but homeostasis is best developed in birds and mammals.

(a) (i) What do you understand by the term 'internal environment'?

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.....

[2]

(ii) Distinguish negative feedback control from positive feedback control.

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[2]

(iii) Give one example of negative feedback control and one example of positive feedback control in mammals.

Negative feedback control: .....

Positive feedback control: .....

[2]

(iv) What do you understand by the term 'damping'?

.....

[1]

(b) State one example of homeostatic control in each of the following organisms.

Amoeba: .....

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Marram grass: .....

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Human: .....

[3]

TOTAL / 10 _____

HOMEOSTASIS

QUESTIONSHEET 2

Describe the roles of the following in homeostasis in humans.

(a) Thermoreceptors: .....

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..... [3]

(b) Baroreceptors: .....

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..... [3]

(c) Glucoreceptors: .....

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..... [3]

(d) Proprioceptors: .....

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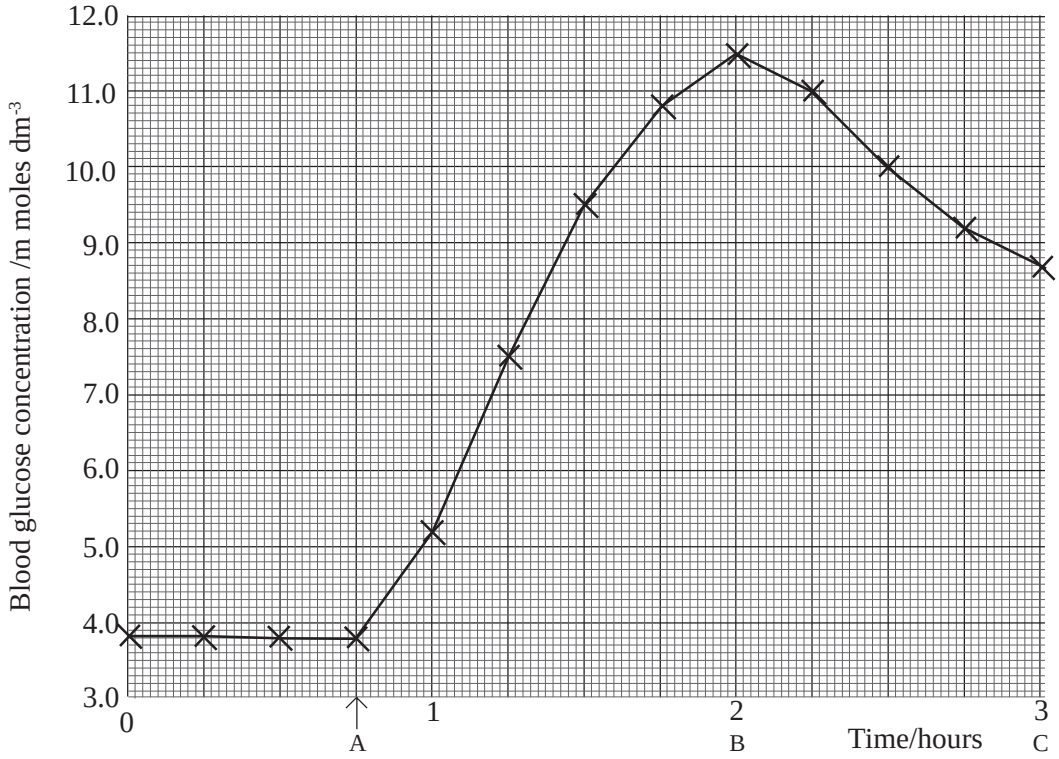
..... [3]

TOTAL / 12

QUESTIONSHEET 3

The graph below shows the changes in blood glucose concentration of a human subject over several hours. Prior to point A the subject had not eaten or drunk for a period of 8 hours. At point A the subject drank 200 cm^3 of a suspension containing 100 mg of glucose.



(a) (i) Comment on the blood glucose concentration prior to point A.

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..... [2]

(ii) By reference to the graph determine the increase in blood glucose concentration between 1 hour and 1 hour 30 minutes.

..... [1]

(b) With reference to the hormones involved, and to the biochemical changes occuring, explain the changes that occur in blood glucose concentration between A and B and B and C.

A and B: .....

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..... [3]

B and C: .....

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..... [3]

TOTAL / 9

HOMEOSTASIS

QUESTIONSHEET 4

Do not write in margin

The following questions relate to regulation of the internal environment.

(a)(i) Distinguish between regulators and non-regulators and give one example of each.

Regulators: .....

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Example: .....

.....

Non-regulators: .....

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Example: .....

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[4]

(ii) Distinguish between exogenous and endogenous rhythms and give one example of each.

Exogenous: .....

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Example: .....

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Endogenous: .....

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Example: .....

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[4]

(b) Long distance air travellers may feel extremely tired due to 'jet lag'. Explain the physiological basis of 'jet lag'.

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[4]

TOTAL / 12

HOMEOSTASIS

QUESTIONSHEET 5

Read through the following passage which refers to ADH and then fill in the spaces with the most appropriate word or words.

The presence or absence of ADH in the blood is controlled by ..... . Receptors in the ..... sense an increase in the ..... of the blood plasma and transmit nerve impulses to the ..... which releases ADH into the blood by ..... . ADH attaches onto target receptors on the ..... cell membranes. It has the effect of making these membranes .....….....which thus allows water to be..... .

TOTAL / 8

HOMEOSTASIS

QUESTIONSHEET 6

The table below lists a number of homeostatic actions which are stimulated by certain hormones. Write the name of one hormone for each action in the appropriate box. Some hormones may be named more than once.

Action	Hormone
Breakdown of glycogen in the liver	
Non-shivering thermogenesis	
Lowering of blood glucose concentration	
Acceleration of heart beat	
Reduction of water loss in urine	
Increase in flow of gastric juice	
Increase in antibody release by plasma cells	

TOTAL / 7

QUESTIONSHEET 7

The table below shows a typical daily water balance of a human body.

Water gain		Water loss	
Food	850cm^3	Faeces	130cm^3
Drink	1450cm^3	Exhaled air	430cm^3
Respiration (all cells)	380cm^3	Sweat	600cm^3
		Urine	1520cm^3
Total	2680cm^3	Total	2680cm^3

(a) (i) Why must water gain be balanced by water loss?

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.....

[2]

(ii) Select two of the above quantities which would increase during a period of vigorous exercise. In both cases explain why the values increase.

Quantity l: .....

Explanation: .....

..... [2]

Quantity 2: .....

Explanation: .....

..... [2]

(iii) Suggest why only small volumes of concentrated urine are produced during very hot weather.

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[3]

(b) Explain how the human controls water loss.

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[5]

TOTAL / 14

HOMEOSTASIS

QUESTIONSHEET 8

Do not write in margin

Distinguish between each of the following pairs:

(a) Diabetes insipidus and diabetes mellitus.

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[4]

(b) Homeostasis and haemostasis.

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[4]

(c) Diuresis and deamination.

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[4]

TOTAL / 12

HOMEOSTASIS

QUESTIONSHEET 9

The table below shows the frequency at which the contractile vacuole of an Amoeba empties in various concentrations of sea water.

Percentage concentration of sea water	Number of times contractile vacuole empties per hour
0 (pure water)	95
10	76
20	69
30	41
40	21
50	9
60	2
70	0
80	0

(a) What is the function of the contractile vacuole in Amoeba?

.....

[1]

(b) Explain how the contractile vacuole carries out its function.

.....

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[2]

(c) Explain the change in the rate of emptying of the contractile vacuole shown in the table.

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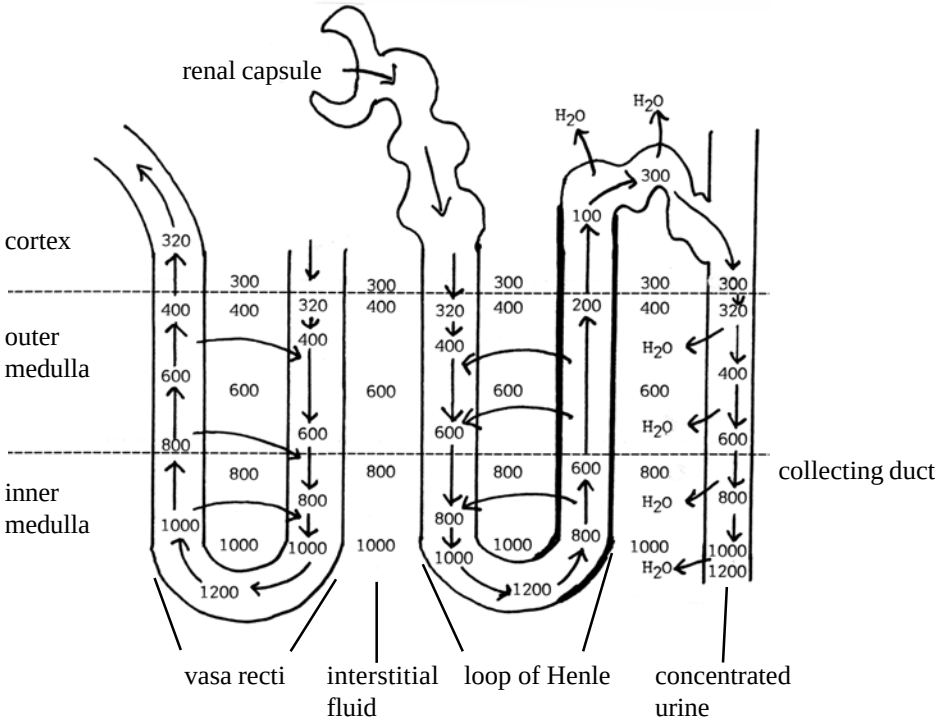
[4]

TOTAL / 7

QUESTIONSHEET 10

Do not write in margin

The diagram below illustrates the counter current principle as it operates in the loop of Henle and in the vasa recti. Figures refer to the NaCl concentration in millimoles dm^{-3}.



(a) (i) Explain the operation of the counter current principle in the loop of Henle.

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.....

.....

[4]

(ii) What are the functions of the counter current principle in the loop of Henle.

.....

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[2]

(iii) What is the function of the counter current principle in the vasa recti.

.....

.....

[2]

(Continued....)

Do not write in margin

(b) What effects do the hormones ADH (antidiuretic hormone) and aldosterone have on the functions of the nephron?

ADH: .....

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[2]

Aldosterone: .....

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[3]

TOTAL / 13

HOMEOSTASIS

QUESTIONSHEET 11

Do not write in margin

Read through the following account of control of kidney function and then answer the questions below.

The presence or absence of ADH in the blood is controlled by negative feedback. Receptors in the hypothalamus sense an increase in the sodium ion concentration and osmolality (osmotic pressure) of the blood plasma and cause the release of ADH by neurosecretion. ADH attaches to target receptors on the collecting duct cell membranes. This makes the ducts permeable to water so allowing the reabsorption of water back to the blood. As a result the blood sodium ion concentration and osmolality fall as the blood volume and pressure rises. Thus the receptors are no longer stimulated and so ADH release is damped.

(a) Explain what is meant by the following terms.

(i) Negative feedback: .....

.....

..... [2]

(ii) Damped: .....

..... [1]

(iii) Neurosecretion: .....

..... [1]

(b) (i) Where is the hypothalamus?

..... [1]

(ii) State one function of the hypothalamus.

..... [1]

(c) Explain why a rise in blood pressure will increase urine production.

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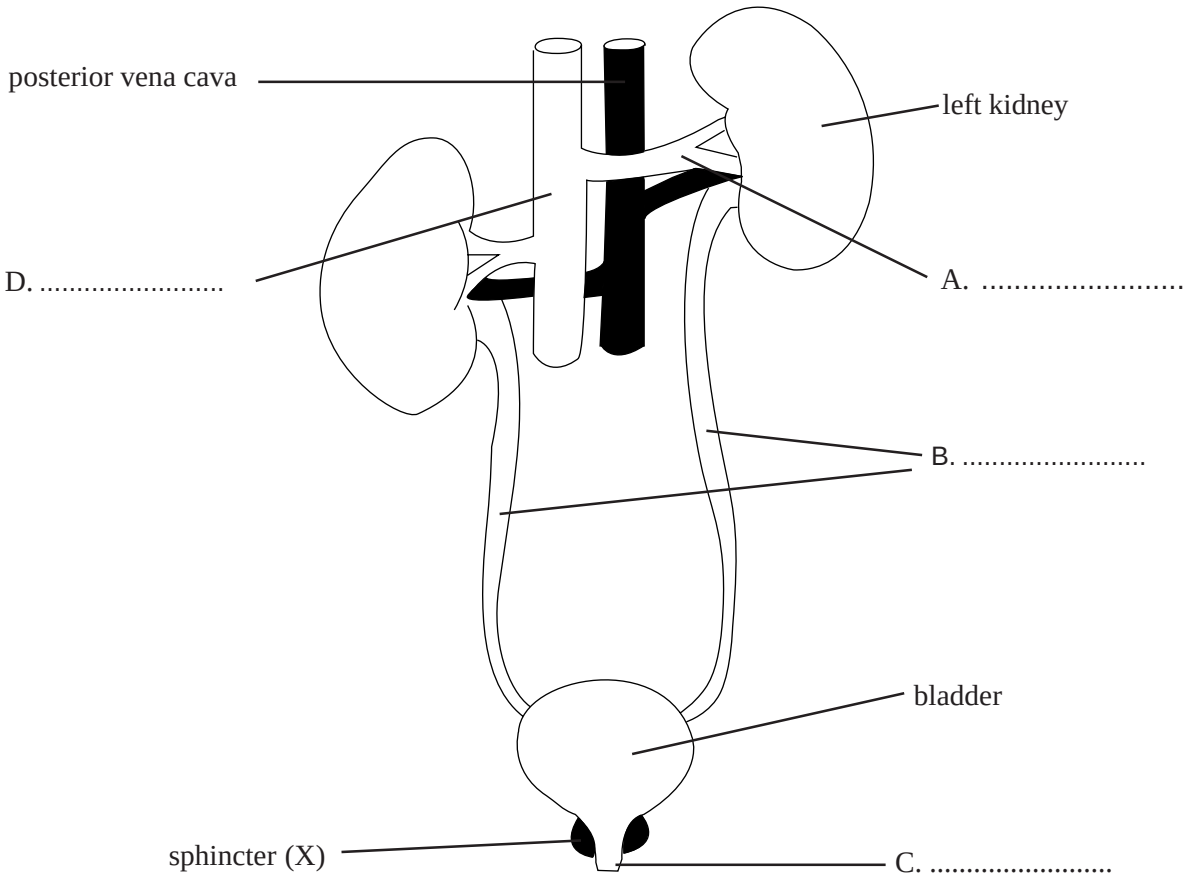
..... [4]

TOTAL / 10

QUESTIONSHEET 12

The diagram below shows the female urinary system in ventral view.



(a) (i) Label A,B, C, and D on the diagram. [4]

(ii) State one way in which the anatomy of the male urinary system differs from that of the female.

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[1]

(b) The kidneys produce urine as a result of carrying out their functions. State the two main functions of the kidneys.

1. .....

[1]

2. .....

[1]

(c) What is the function of the sphincter muscle at X?

.....

[1]

TOTAL / 8

HOMEOSTASIS

QUESTIONSHEET 13

Do not write in margin

In each of the following questions only one of the four responses is correct. In each case indicate the correct response by ringing around A, B, C or D.

(a) In the formation of urine the largest volume of water is reabsorbed from...

A. The ascending limbs of the loops of Henle.
B. The collecting ducts.
C. The proximal convoluted tubules.
D. The distal convoluted tubules.

[1]

(b) The main nitrogenous excretory end product is...

A. Urea in mammals and insects.
B. Uric acid in birds and insects.
C. Uric acid in mammals and insects.
D. Ammonia in fish and mammals.

[1]

(c) In which of the following mammalian organs does the blood gain most urea?

A. Liver.
B. Kidney.
C. Spleen.
D. Pancreas.

[1]

(d) Which of the following structures is lined by a transitional epithelium?

A. The urethra.
B. The bladder.
C. The renal capsules.
D. The collecting ducts.

[1]

TOTAL / 4

QUESTIONSHEET 14

Do not write in margin

The total blood volume of a human averages 60cm^3 per kilogramme of body weight, and the average glomerular filtration rate is 125cm^3 minute^{-1}.

(a) Calculate the total blood volume of a person who weighs 120kg. Show your working.

Answer ..... [2]

(b) Calculate the volume of glomerular filtrate produced per day by this person. Show your working.

Answer ..... [2]

(c) How many times each day will the person's blood be filtered by the kidneys? Show your working.

Answer ..... [2]

(d) Though the glomerular filtration rate averages 125cm^{3}min^{-1} the rate of urine release from the kidneys is only about lcm^{3}min^{-1}. Suggest how this difference in volumes is accomplished.

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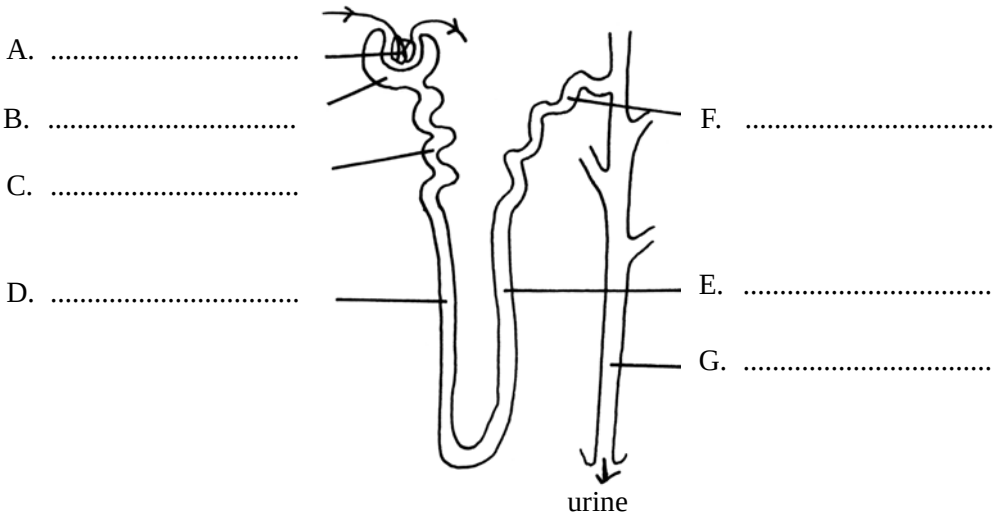
[3]

TOTAL / 9

HOMEOSTASIS

QUESTIONSHEET 15

The diagram below is of a nephron from a mammalian kidney.



(a) (i) Label structures A, B, C, D, E, F and G on the diagram. [7]

(ii) Comment on the permeability to water of structures C, E and G.

C: ..... [1]

E: ..... [1]

G: ..... [1]

(b) (i) Name two substances actively reabsorbed from C.

1: ..... [1]

2: ..... [1]

(ii) Name two substances actively secreted into F.

1: ..... [1]

2: ..... [1]

(c) (i) Structure E has powerful active transport mechanisms for reabsorbing Na^+ and Cl^- ions back into the surrounding tissue fluid. What is the purpose of this?

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[2]

(ii) Explain why the fluid concentration in G may remain the same as that in F?

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[2]

TOTAL / 18

QUESTIONSHEET 16

Do not write in margin

Distinguish between each of the following pairs of structures.

(a) Ureter and urethra.

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[4]

b) Urinary bladder and gall bladder.

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[4]

(c) Glomerulus and vasa recti.

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[4]

(d) Afferent arteriole and efferent arteriole.

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[4]

TOTAL / 16

HOMEOSTASIS

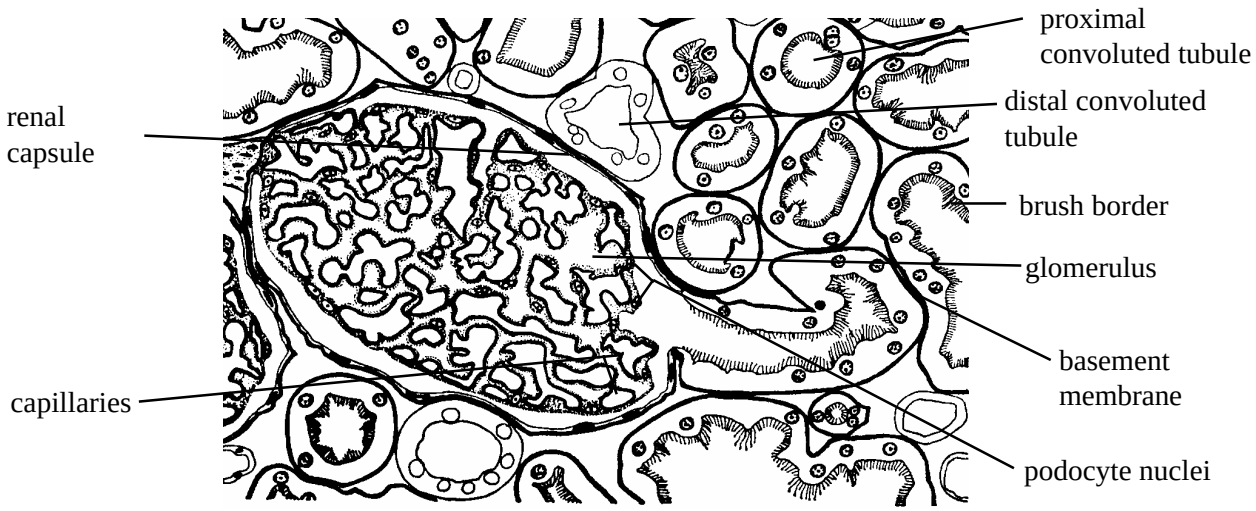
QUESTIONSHEET 17

Read through the following account of kidney function and then fill in the spaces with the most appropriate word or words.

Blood enters the kidney under ..... pressure through the ..... which branches, eventually into afferent arterioles. These give rise to capillaries which form ..... which lie inside ..... capsules. Many of the small components of plasma are forced into the capsules by ..... . Large molecules, such as ..... cannot leave the blood and so exert an ..... which will draw water from the filtrate back into the blood. The filtrate contains salts, excretory products such as ....., sugars such as ..... and amino acids. [9]

TOTAL / 9

The diagram below shows the histological appearance of kidney tissue.



Give explanations for each of the following facts.

(a) Proximal convoluted tubule cells have many mitochondria and bear microvilli on the luminar borders.

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[4]

(b) The glomerular capillaries and inner surfaces of the renal capsule are made of specialised cells, called podocytes.

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[3]

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

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[3]

TOTAL / 10

HOMEOSTASIS

QUESTIONSHEET 19

Do not write in margin

(a) What is meant by homeostasis?

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[2]

(b) Explain how the following assist in homeostasis.

(i) The contractile vacuole in Amoeba:

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[3]

(ii) The elongated loop of Henle found in desert dwelling mammals:

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[3]

(iii) The excretion of uric acid by adult insects:

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[3]

(c) (i) Name the disease in humans in which large volumes of very dilute urine is produced.

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[1]

(ii) What is the cause of this symptom?

.....

[1]

TOTAL / 13

QUESTIONSHEET 20

The table below refers to normal glomerular filtrate and to normal urine. If a feature is correct place a tick (✓) in the box and if it is incorrect place a cross (✗) in the box.

Feature	Glomerular filtrate	Urine
Contains glucose		
Does not contain amino acids		
Has a pH of 3.5		
Has the same composition as blood		
Never contains protein		

[5]

TOTAL / 5

HOMEOSTASIS

QUESTIONSHEET 21

The pH of blood plasma must be maintained in the range 7.35 to 7.45. There are three main physiological ways of achieving this, one of which involves the kidney.

(a) State two ways (not involving the kidney) by which the body controls blood pH.

1: .....

..... [2]

2: .....

..... [2]

(b) Describe how the kidneys adjust the pH of the blood back to normal when it has become too acidic.

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..... [5]

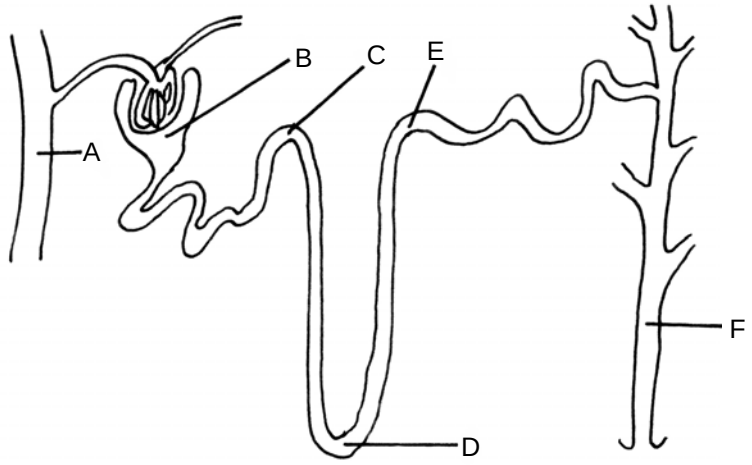
TOTAL / 9

HOMEOSTASIS

QUESTIONSHEET 22

The table below shows the results of an investigation into the flow and composition of the fluids in a nephron. The positions of A, B, C, D, E and F are shown on the nephron diagram.

Position	Total flow rate /$cm^3 min^{-1}$	Solute concentrations /g dm^{-3}			
		Protein	Glucose	Urea	NaCl
A	1200	76	1.1	0.3	18
B	12	0.0	1.1	0.3	18
C	20	0.0	0.0	1.6	18
D	18	0.0	0.0	1.7	72
E	18	0.0	0.0	1.7	16
F	1.0	0.0	0.0	2.1	68



(a) Explain the difference in flow rate between the points:

(i) A and B.

.....

.....

[1]

(ii) C and F.

.....

.....

[1]

(Continued....)

Do not write in margin

(b) Suggest reasons for each of the following.

(i) The changes in urea concentration from A to F.

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[3]

(ii) The change in salt concentration between C and D, and D and E.

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[3]

(iii) The difference in protein concentration between A and B.

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[2]

(iv) The difference in glucose concentration between B and C.

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[1]

TOTAL / 11

QUESTIONSHEET 23

Do not write in margin

(a) Are the following statements true or false? Justify your answer.

(i) The main function of the kidneys is to make urine.

TRUE OR FALSE: .....

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[3]

(ii) A greater volume of urine is produced on a hot day than on a cold day.

TRUE OR FALSE: .....

.....

.....

.....

[3]

(iii) The main excretory end product in reptiles and birds is uric acid.

TRUE OR FALSE: .....

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[3]

(b) (i) Briefly explain what is meant by the term “renal dialysis”.

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[3]

(ii) Under what circumstances would a kidney transplant be performed?

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[3]

TOTAL / 15