1. March/2023/Paper_ 9700/42/No.1

(a) Fig. 1.1 is a drawing of a longitudinal section (LS) of a human kidney.

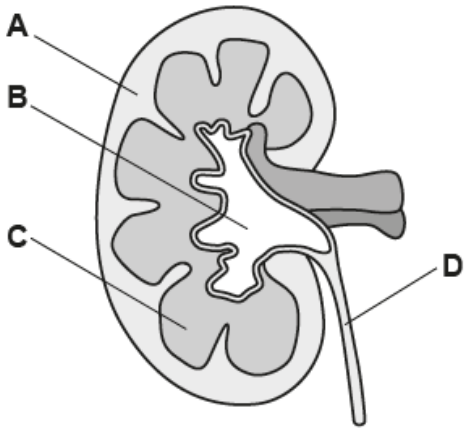

Fig. 1.1

Use the letters **A**, **B**, **C** and **D** in Fig. 1.1 to complete Table 1.1.

Each letter may be used once, more than once or not at all.

For each description, list **all** the letters that are correct.

Table 1.1

description	region of kidney
location of loops of Henle	.....
location of Bowman's capsules	.....
location of glomeruli	.....
contains urine at final concentration	.....

[4]

(b) The volume and water potential of the urine produced by the kidney vary according to the water potential of the blood. This is a result of osmoregulation.

Describe the role of aquaporins in osmoregulation.

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..... [3]

(c) Describe the role of the brain in osmoregulation when the water potential of the blood **increases** above the set point.

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[Total: 10]

2. June/2023/Paper_ 9700/41/No.5

The kidney is an important organ of homeostasis. One role of the kidney is osmoregulation.

(a) Fig. 5.1 is a photomicrograph of part of a kidney nephron.

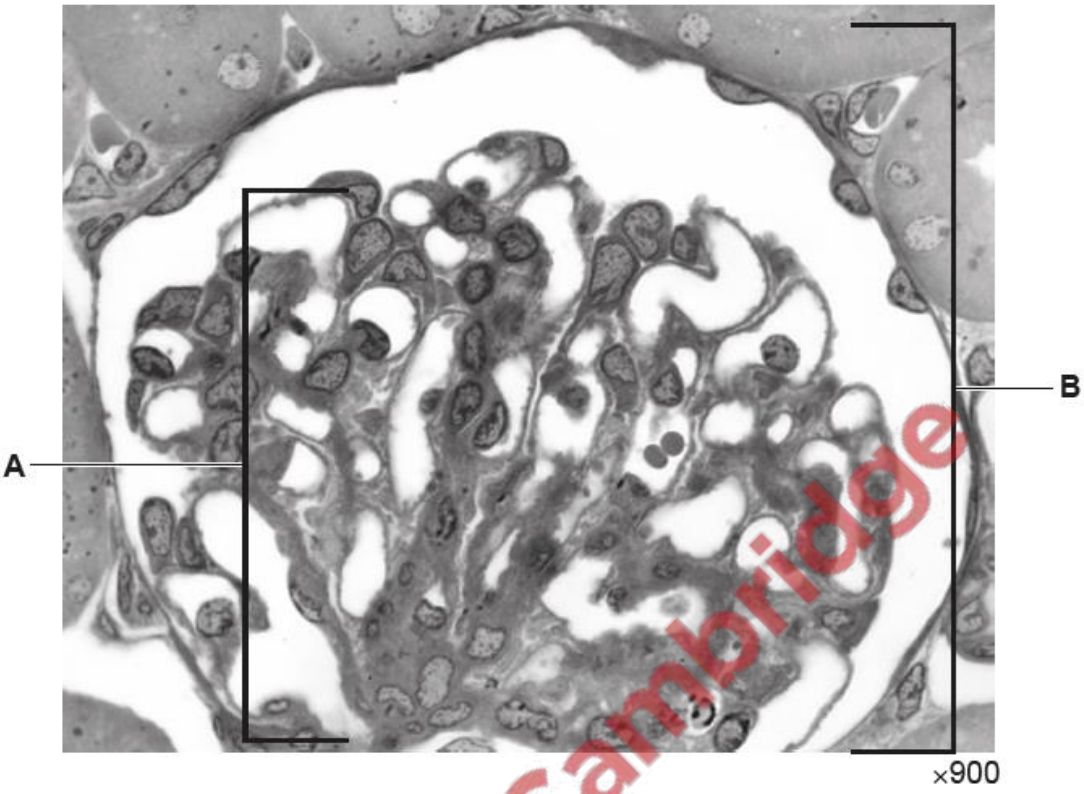

Fig. 5.1

(i) Identify the structures labelled **A** and **B** in Fig. 5.1.

A .....

B .....

[2]

(ii) Describe how blood is filtered by the part of the kidney nephron shown in Fig. 5.1.

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..... [4]

(b) The cell surface membranes of kidney cells have receptors for many molecules, including glucagon and antidiuretic hormone (ADH).

(i) Glucagon binds to G-protein-coupled receptors on kidney cells.

The binding of glucagon to kidney cells activates a cell signalling pathway that is similar to the cell signalling pathway activated when glucagon binds to liver cells.

Fig. 5.2 is an outline of the cell signalling pathway activated when glucagon binds to kidney cells.

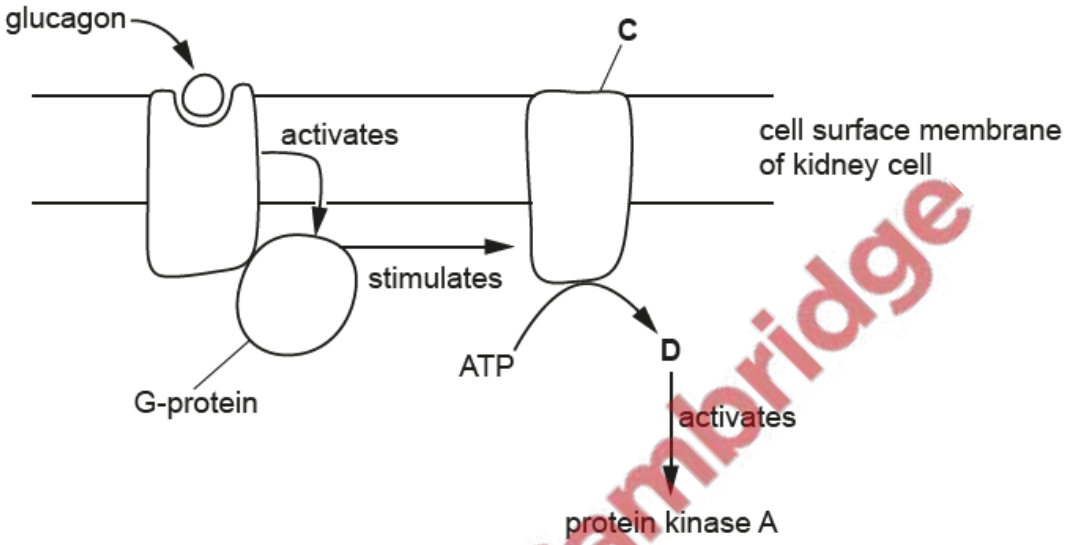

Fig. 5.2

Name the molecules labelled **C** and **D** in Fig. 5.2.

C .....

D .....

[2]

(ii) Syndrome of inappropriate antidiuresis (SIAD) is a condition that affects osmoregulation in the kidney.

Fig. 5.3 shows how sodium ion concentration in the blood affects the ADH concentration in the blood in:

- people with normal homeostasis
- people with one type of SIAD, known as type C SIAD.

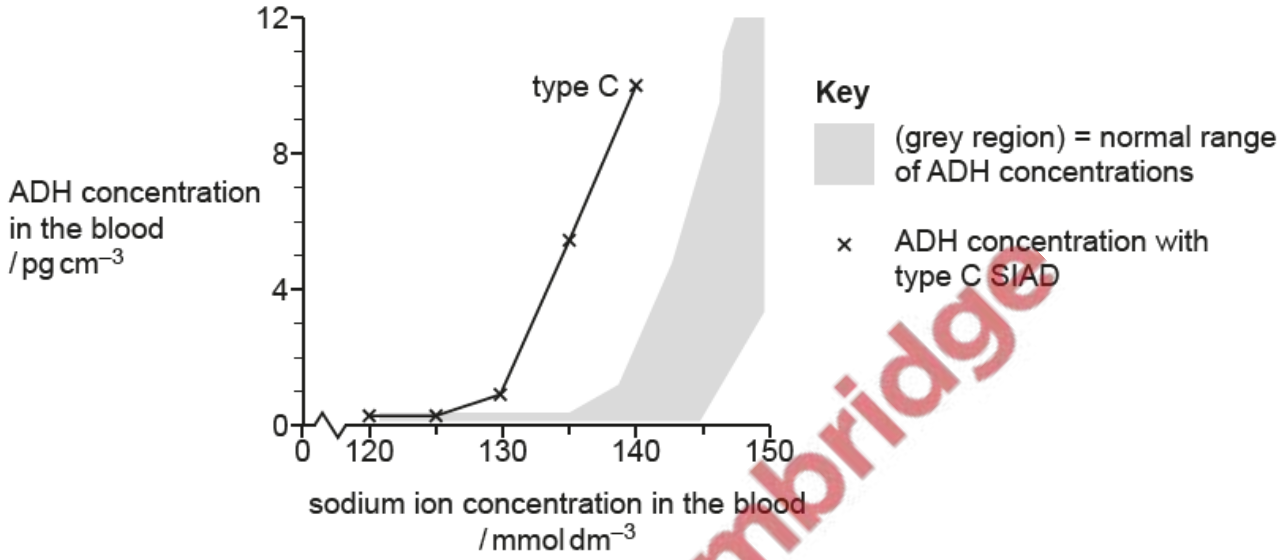

Fig. 5.3

Describe the results shown in Fig. 5.3 **and** explain the effect of type C SIAD on osmoregulation.

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[Total: 12]

3. June/2023/Paper_ 9700/42/No.6

(a) Fig. 6.1 is a photomicrograph of a section through a Bowman's capsule and a glomerulus.

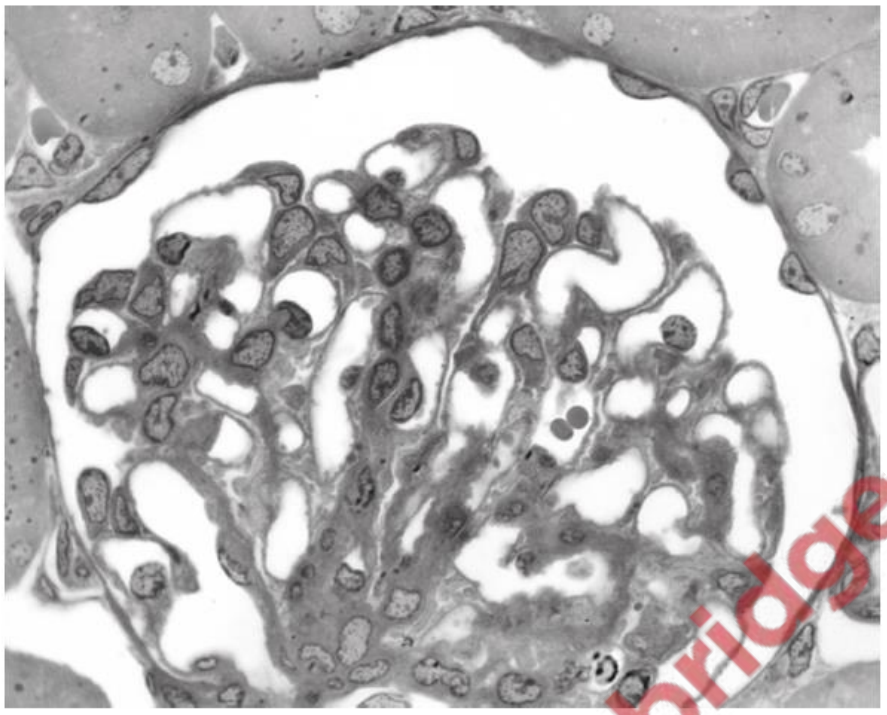

Fig. 6.1

On Fig. 6.1, use label lines and letters to label:

F – the location of the glomerular filtrate

P – the location of the blood plasma. [2]

(b) The glomerular filtration rate (GFR) is the rate at which fluid filters from the blood in the glomerulus into the Bowman's capsule.

Fig. 6.2 shows the mean GFR values for healthy males and females of different age groups.

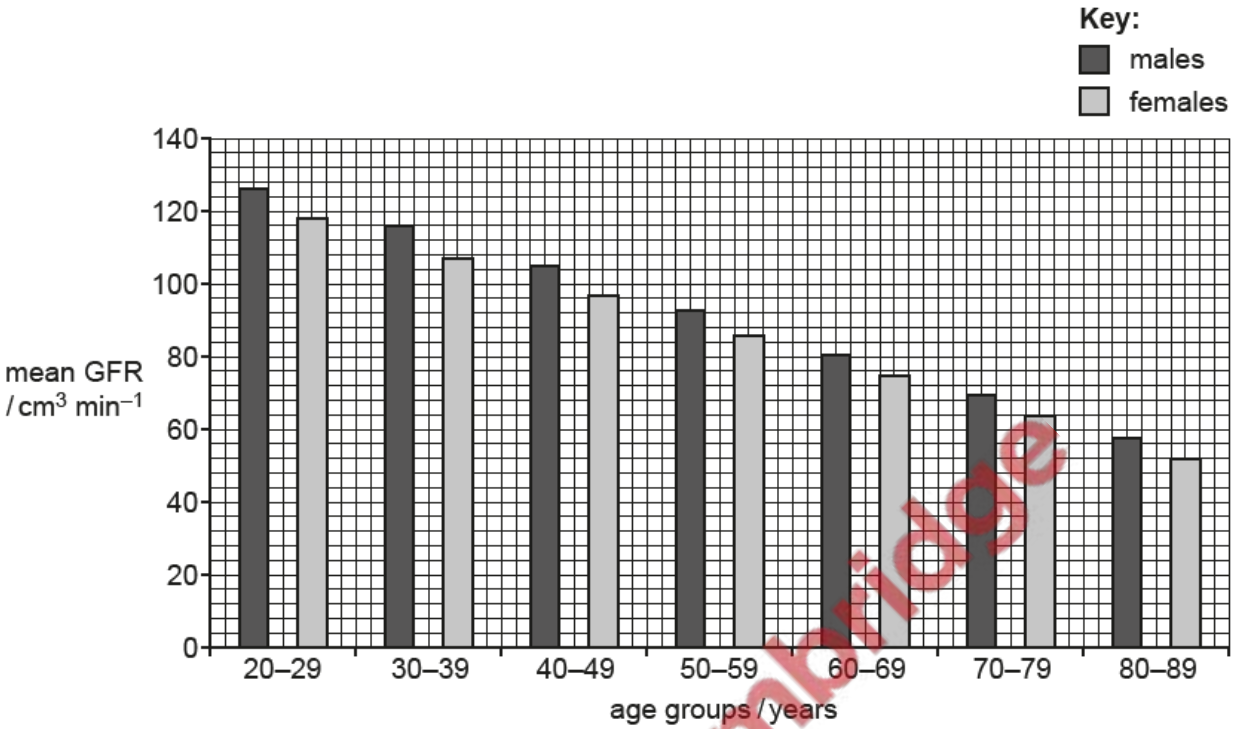

Fig. 6.2

(i) Use Fig. 6.2 to calculate the yearly rate of decrease in mean GFR from the 20–29 age group to the 80–89 age group for **females**.

Show your working.

Give your answer to **one** decimal place and include units.

answer ..... [3]

(ii) The age of a person and whether they are male or female can affect GFR.

Suggest **and** explain other factors that can affect GFR.

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(c) The glomerular filtrate passes from the Bowman's capsule to the proximal convoluted tubule, where selective reabsorption takes place.

Describe the process of selective reabsorption.

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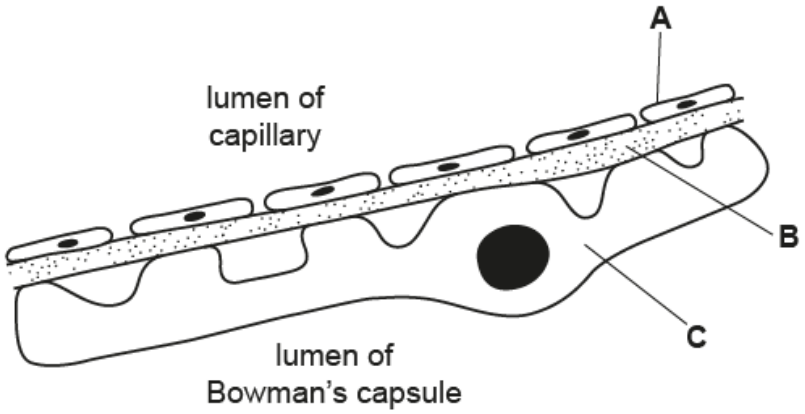
..... [7]

[Total: 15]

(a) Fig. 6.1 shows part of the Bowman's capsule of a kidney nephron.



not to scale

Fig. 6.1

Name structures **A**, **B** and **C**.

A .....

B .....

C .....

[3]

(b) Fluid is forced into the Bowman's capsule by ultrafiltration to form the glomerular filtrate.

Describe the role of structure **B** in ultrafiltration.

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..... [2]

(c) The main component of the glomerular filtrate formed in the Bowman's capsule is water. Most of this water is reabsorbed as the filtrate passes along the nephron.

- 180 dm^3 of water forms part of the glomerular filtrate each day.
- 1.4 dm^3 of water leaves the body in urine each day.

Calculate the percentage of water in the glomerular filtrate that is reabsorbed as the glomerular filtrate passes along the nephron.

Show your working and give your answer to **one** decimal place.

answer ..... % [2]

(d) Describe how the action of antidiuretic hormone (ADH) on the cells of the collecting duct leads to the reabsorption of water in the glomerular filtrate.

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[Total: 14]