Control of Blood Water Potential

These practice questions can be used by students and teachers and is

Suitable for AQA A Level 7402 Biology Topic Question

Level: AQA A LEVEL 7402

Subject: Biology

Exam Board: AQA A Level 7402

Topic: Control of Blood Water Potential

1

(a) Give the location of osmoreceptors in the body of a mammal.

(1)

(b) When a person is dehydrated, the cell volume of an osmoreceptor decreases.Explain why.

(2)

(c) Stimulation of osmoreceptors can lead to secretion of the hormone ADH. Describe andexplain how the secretion of ADH affects urine produced by the kidneys.

(Extra space)

(4)

The efficiency with which the kidneys filter the blood can be measured by the rate at which they remove a substance called creatinine from the blood. The rate at which they filter the blood is called the glomerular filtration rate (GFR).

In 24 hours, a person excreted 1660 mg of creatinine in his urine. The concentration of creatinine in the blood entering his kidneys was constant at 0.01 mg cm^{-3}.

(d) Calculate the GFR in cm^3 $minute^{-1}$.

Answer = _____

(1)

(e) Creatinine is a breakdown product of creatine found in muscle tissues. Apart from age andgender, give **two** factors that could affect the concentration of creatinine in the blood.

1. _____

2. _____

(1)

(Total 9 marks)

2 In a mammal, urea is removed from the blood by the kidneys and concentrated in the filtrate.

(a) Describe how urea is removed from the blood.

_____

_____

_____

_____

(2)

(b) Explain how urea is concentrated in the filtrate.

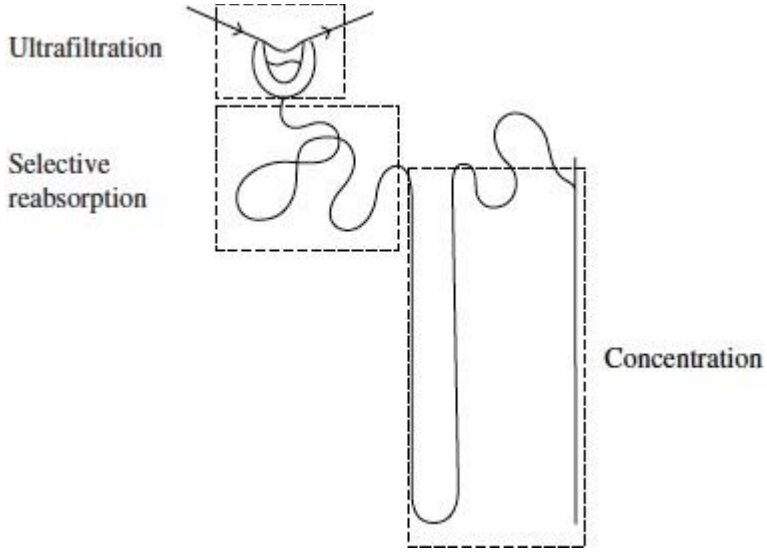
_____

(Extra space) _____

(3)

(Total 5 marks)

3 Three processes are involved in the formation of urine in a mammalian kidney. These are ultrafiltration, selective reabsorption and concentration. The diagram shows where these processes take place in a nephron.



(a) Describe how ultrafiltration produces glomerular filtrate.

(Extra space) _____

(5)

(b) Some people who have diabetes do not secrete insulin. Explain how a lack of insulin affects reabsorption of glucose in the kidneys of a person who does not secrete insulin.

(Extra space) _____

(4)

(c) Some desert mammals have long loops of Henle and secrete large amounts of antidiuretic hormone (ADH). Explain how these two features are adaptations to living in desert conditions.

(Extra space) _____

(6)

(Total 15 marks)

4 (a) A diabetic person and a non-diabetic person each ate the same amount of glucose. One hour later, the glucose concentration in the blood of the diabetic person was higher than that of the non-diabetic person. Explain why.

_____

(Extra space) _____

_____

(3)

(b) (i) The urine of a non-diabetic person does **not** contain glucose. Explain why.

_____

_____

_____

_____

(2)

(ii) A high blood glucose concentration could cause glucose to be present in the urine of a diabetic person. Suggest how.

_____

_____

_____

_____

(2)

(c) A test for glucose in urine uses immobilised enzymes on a plastic test strip. One of theseenzymes is glucose oxidase. Explain why the test strip detects glucose and no other substance.

_____

_____

_____

_____

(2)

(d) If the glomerular filtrate of a diabetic person contains a high concentration of glucose, heproduces a larger volume of urine. Explain why.

_____

_____

_____

_____

_____

_____

(3)

(e) In some forms of kidney disease, proteins from the blood plasma are found in the urine.Which part of the nephron would have been damaged by the disease to cause proteins from blood plasma to be present in the urine? Explain your answer.

_____

_____

_____

_____

_____

_____

(Extra space) _____

_____

(3)

(Total 15 marks)

5 The kangaroo rat is a small desert mammal. It takes in very little water in its food and it rarely drinks. Its core body temperature is 38 °C.

The kangaroo rat takes in some water by feeding and drinking. Describe another method by which the kangaroo rat could obtain water.

_____

_____

_____

_____

(Total 2 marks)

6 (a) The control of water balance in the body involves negative feedback.

(i) Describe what is meant by *negative feedback*.

_____

_____

_____

(1)

(ii) Water is removed from the body via the kidneys. Give **two** other ways in which water is removed from the body.

1. _____

2. _____

(2)

(iii) Name the part of the brain which acts as the coordinator in the control of water balance.

_____

(1)

(b) **Figure 1** shows the cells lining the collecting duct in a human kidney. ADH molecules bind to the receptor proteins and this triggers the vesicles containing aquaporins to bind with the plasma membrane next to the lumen. **Figure 2** shows an aquaporin which is a large channel protein.

Figure 1

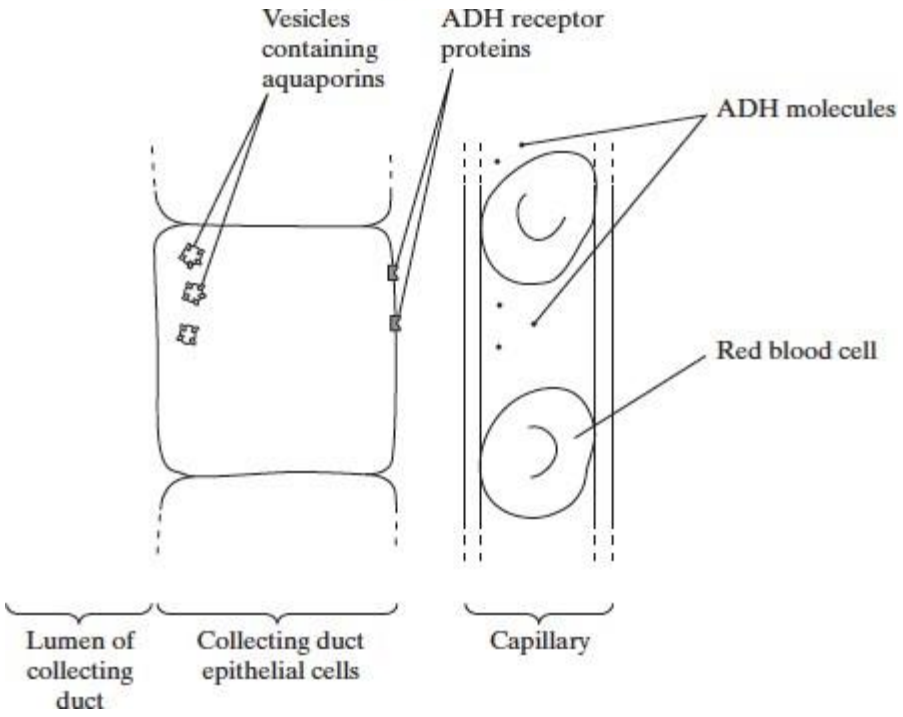
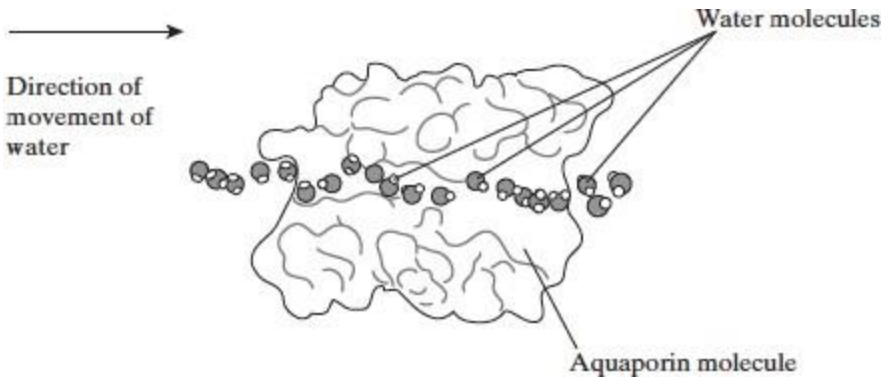


Figure 2



(i) From which gland is ADH released?

_____

(1)

(ii) Use the information given to explain how ADH increases the movement of water fromthe lumen of the collecting duct into the blood.

_____

_____

_____

(4)

(c) The gene for the ADH receptor proteins is found on the X chromosome. One allele of thisgene causes a non-functioning receptor protein to be made. This allele is recessive and is one cause of the condition called diabetes insipidus.

(i) What would be the most obvious symptom of diabetes insipidus?

(1)

(ii) Suggest why diabetes insipidus is more common in males.

(2)

(iii) A recessive allele which has harmful effects is able to reach a higher frequency in apopulation than a harmful dominant allele. Explain how.

(3)

(Total 15 marks)

7 (a) The table shows the concentrations of dissolved substances in different regions of a nephron in a kidney in the presence and in the absence of antidiuretic hormone (ADH).

Region of nephron	Concentration of dissolved substances / arbitrary units	
	ADH present	ADH absent
First convoluted tubule	300	300
Bend of loop of Henle	1000	1000
Start of second convoluted tubule	150	150
Middle of second convoluted tubule	250	90
Start of collecting duct	300	50
End of collecting duct	1000	50

Describe and explain the effect of ADH on the volume and concentration of urine produced by the kidney. Give evidence from the table to support your answer.

_____

_____

_____

_____

_____

_____

(3)

(b) Glomerulosclerosis is a disease in which the glomeruli of the kidney are damaged. Explain why protein is not normally present in the urine of a healthy person but may be present in the urine of a person with glomerulosclerosis.

_____

(2)

(Total 5 marks)

Mammals and fish remove nitrogenous waste from their bodies in different forms.

8

(a) Name **two** polymers present in mammals and fish that contain nitrogen.

1. _____

2. _____

(2)

(b) In a mammal urea is removed from the blood by the kidneys and concentrated in the filtrate.

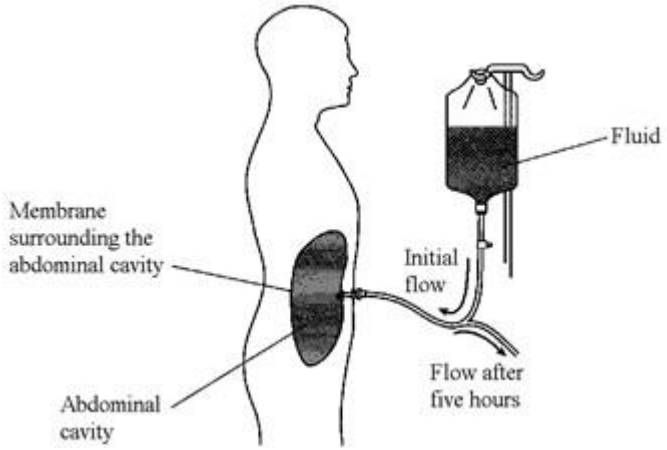
(i) Describe how urea is removed from the blood.

(2)

(ii) Explain how urea is concentrated in the filtrate.

(4)

(c) The diagram shows one way in which a person who has kidney disease can have thecondition managed. In the process a fluid is put into the abdominal cavity. Exchange of materials takes place across the membrane that surrounds the abdominal cavity. This removes waste products from the blood. After five hours the fluid is drained out of the cavity and discarded. The cavity is then refilled with fresh fluid.



The table shows the concentration of solutes in the fresh fluid.

Solute	Concentration / mmol dm^{-3}
Sodium ions (Na^+)	132
Chloride ions (Cl^-)	96
Calcium ions (Ca^{2+})	1.25
Magnesium ions (Mg^{2+})	0.25
Glucose	76
Urea	0

(i) By what process does urea enter the fluid in the abdominal cavity from the blood?

(1)

(ii) Explain why the fluid is changed every five hours.

_____

_____

(1)

(iii) Fluid of the composition shown in the table is used instead of distilled water.Explain why.

_____

_____

_____

_____

(2)

(Total 12 marks)

9 Anti-diuretic hormone (ADH) is released into the blood in response to a shortage of water in the body. ADH enters the collecting duct cells in nephrons and causes the increased synthesis of one type of protein molecule. These protein molecules are inserted into the plasma membranes of the collecting duct cells where they act as channels. Only water molecules can pass through these channels, increasing the reabsorption of water from the kidney filtrate.

(a) Name the gland which releases ADH.

_____

(1)

(b) (i) Explain how the structure of protein molecules allows them to form channels throughwhich only water molecules can pass.

_____

_____

_____

_____

(2)

(ii) Explain how the cells of the collecting duct are able to absorb water from the filtrate through the protein channels in their plasma membranes.

_____

_____

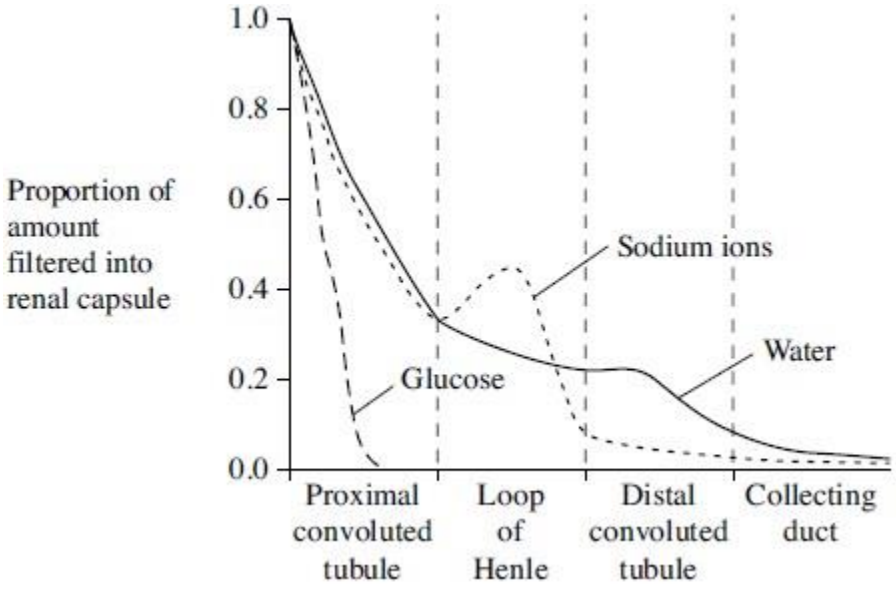
_____

_____

(2)

(Total 5 marks)

10 The graph shows changes in the amounts of water, glucose and sodium ions as fluid passes along a kidney tubule from the renal capsule to the collecting duct.



(a) Which hormone causes the decrease in the water content in the distal convoluted tubule?

_____

(1)

(b) Explain the change in the amount of glucose.

_____

_____

_____

_____

(2)

(c) Explain the shape of the curve for sodium ions in the loop of Henle.

(Extra space) _____

(3)

(Total 6 marks)

11 (a) What is homeostasis?

(1)

(b) Describe the role of the hormone glucagon in the control of blood sugar concentration.

(4)

(c) The kidney removes various substances from the blood plasma. The clearance value for asubstance is the volume of blood cleared of that substance by the kidney in one minute. This clearance value can be calculated using the equation.

$$C = \frac{U \times V}{P}$$

where the concentration of a substance in the blood is P g cm^{-3}

the concentration of a substance in the urine is U g cm^{-3}

the volume of urine produced is V cm^3 per minute

(i) Use the equation to work out the clearance value of glucose.

_____

_____

(1)

(ii) Explain how the activity of the kidney results in this clearance value for glucose.

_____

_____

_____

_____

_____

_____

(3)

(Total 9 marks)

12 In the kidney, ultrafiltration and selective reabsorption are two of the processes involved in the formation of urine.

(a) (i) Where does ultrafiltration occur?

_____

(1)

(ii) Give **one** component of the blood which is not normally present in the filtrate.

_____

(1)

(b) The kidneys remove a substance called creatinine from the blood. The rate of creatinineremoval is a measure of the rate of filtration of the blood.

In one hour, a person excreted 75 mg of creatinine in his urine. The concentration of creatinine in the blood entering his kidneys was constant at 0.01 mg cm^{-3}.

Calculate the rate at which the blood was filtered in $cm^3\ min^{-1}$. Show your working.

Filtration rate = _____ $cm^3\ min^{-1}$

(2)

(c) Reabsorption of glucose takes place in the proximal tubule. Explain how the cells of theproximal tubule are adapted for this function.

_____

_____

_____

_____

(2)

(Total 6 marks)

13 (a) Humans can produce urine which is more concentrated than their blood plasma.

(i) Explain the role of the loop of Henle in the absorption of water from the filtrate.

_____

_____

_____

_____

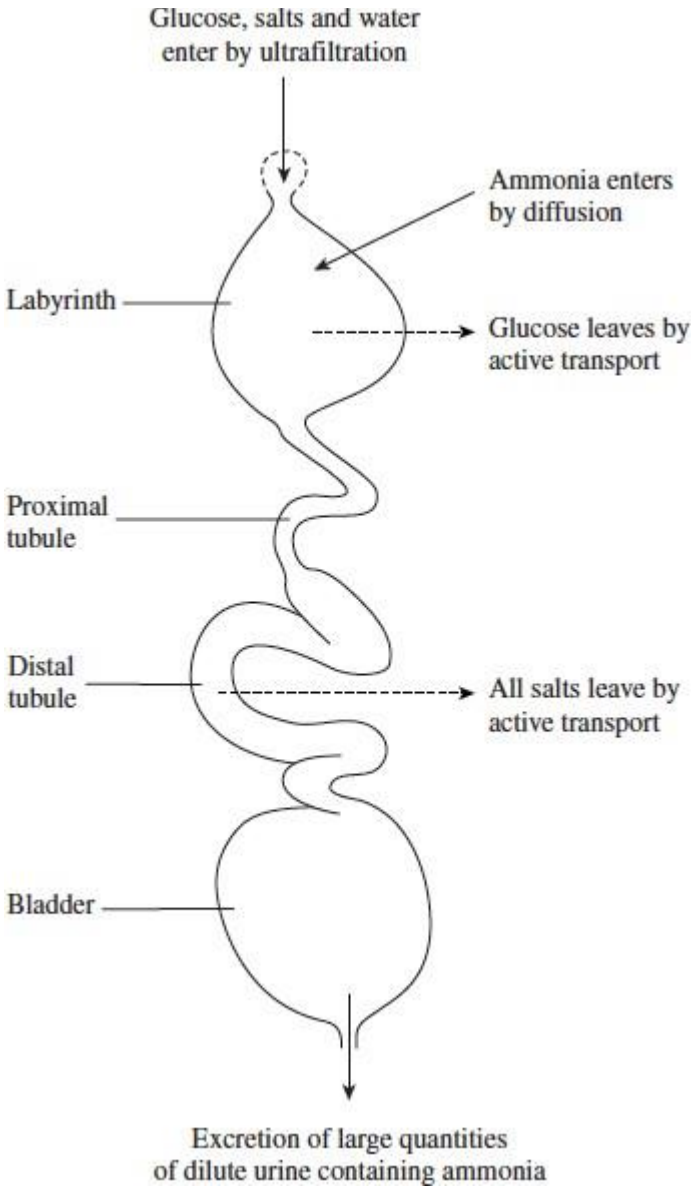
_____

(6)

(ii) Explain the role of ADH in the production of concentrated urine.

(4)

(b) A species of crayfish lives in fresh water. This crayfish does not have kidneys but it does have an organ which excretes nitrogenous waste and controls the amount of water in its body. The diagram shows this excretory organ.



(i) Describe how excretion in this organ differs from excretion in a human nephron.

_____

_____

(3)

(ii) Suggest how the production of large amounts of dilute urine enables the crayfish tosurvive in fresh water.

_____

_____

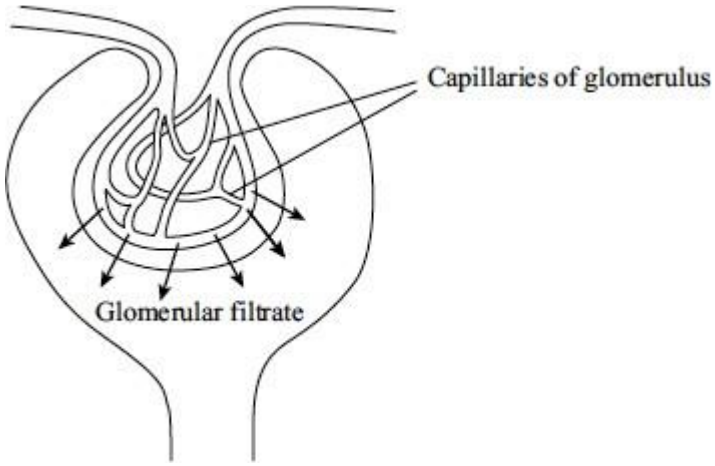
_____

_____

(2)

(Total 15 marks)

14 The diagram shows a renal capsule where ultrafiltration occurs in the kidney.



(a) Apart from water and glucose, name **two** substances which will be present in the glomerular filtrate.

1. _____

2. _____

(1)

(b) The glomerular filtration rate is the total volume of filtrate formed per minute. Explain theeffect on the glomerular filtration rate of a large loss of blood from the body.

_____

_____

_____

_____

(2)

(c) Selective reabsorption from the glomerular filtrate occurs in the proximal convoluted tubule.Explain **two** ways in which the cells of the proximal convoluted tubule are adapted for reabsorption.

1. _____

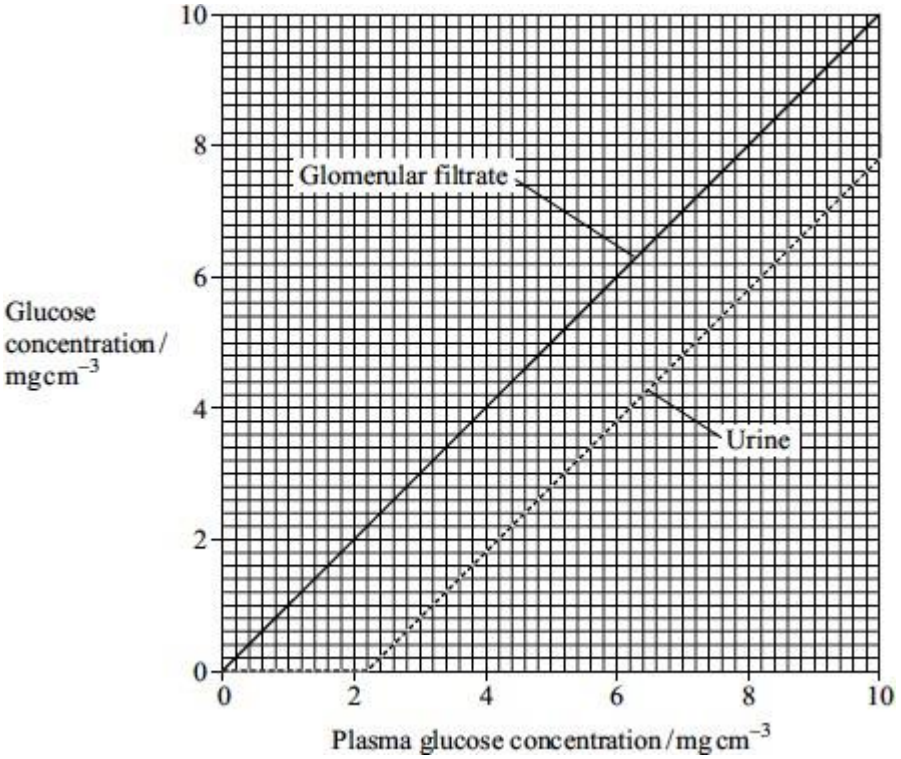
_____

2. _____

_____

(2)

(d) The threshold value is the maximum plasma glucose concentration at which all the glucose can be reabsorbed from the filtrate. An investigation was carried out to determine the threshold value for glucose reabsorption in the kidneys of a mammal.The graph shows the results.



(i) Explain the change in the glucose concentration in the urine as the plasma glucoseconcentration increases from 0 to 4 mgcm^{-3}.

_____

_____

_____

_____

(2)

(ii) A person with diabetes may have a plasma glucose concentration greater than thethreshold value for glucose reabsorption. Explain what causes this raised plasma glucose concentration.

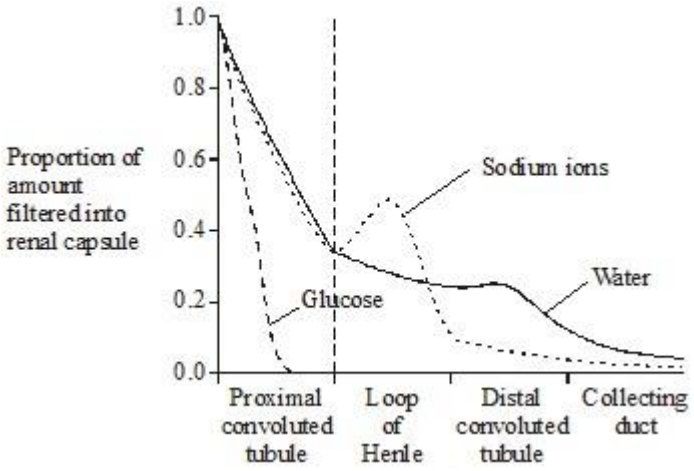
_____

_____

(1)

(Total 8 marks)

16 The graph shows changes in the amounts of water, glucose and sodium ions as fluid passes along a kidney tubule from the renal capsule to the collecting duct



(a) Which hormone causes the decrease in the water content in the distal convoluted tubule?

_____

(1)

(b) Explain the change in the amount of glucose.

(2)

(c) Explain the shape of the curve for sodium ions in the loop of Henle.

(3)

(Total 6 marks)

Answers should be written in continuous prose, where appropriate.

17

Quality of Written Communication will be assessed in these answers.

The kidney plays an important part in the regulation of blood water potential. This involves control of the amount of water reabsorbed from the filtrate produced in the kidney tubules. The amount of water reabsorbed affects the volume of urine produced, the rate at which the bladder fills and how often it has to be emptied.

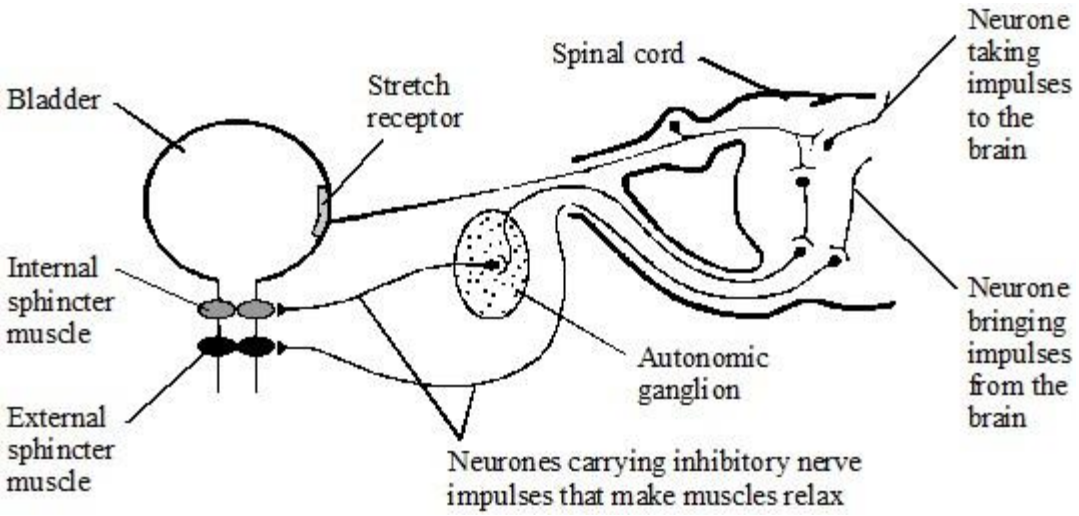
(a) Explain how the loop of Henle maintains the gradient of ions which allows water to be reabsorbed from filtrate in the collecting duct.

(5)

(b) Explain how ADH is involved in the control of the volume of urine produced.

(4)

(c) The diagram shows the systems involved in controlling the emptying of the bladder. Inbabies, emptying of the bladder is controlled by an autonomic reflex involving the internal sphincter muscle. Conscious control is learnt between the ages of two and three and involves the external sphincter as well.



Using information in the diagram,

explain how the autonomic reflex arc is different from a simple reflex arc involving voluntary muscle;

_____

_____

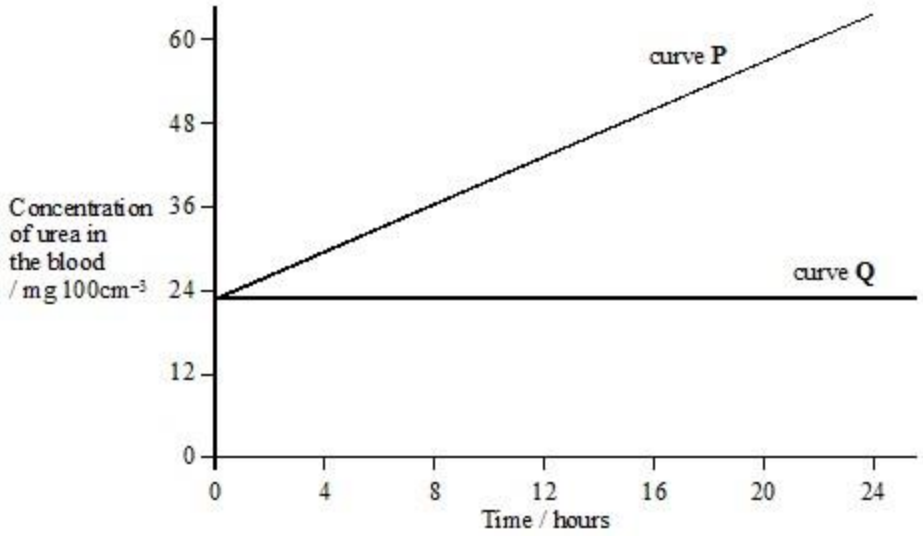
_____

_____

(2)

(Total 11 marks)

18 The graph shows the concentration of urea in the blood of a mammal after the kidneys stopped working (**P**) and after both the kidneys and the liver stopped working (**Q**).



(a) Explain how the evidence from the graph shows **one** function of

(i) the kidneys;

Function _____

Evidence from graph _____

_____

(1)

(ii) the liver.

Function _____

Evidence from graph _____

_____

(1)

(b) On the graph, draw the curve you would expect if the liver stopped working at time 0, andthe kidneys stopped working 12 hours later.

(2)

(Total 4 marks)

Mark schemes

(a) Hypothalamus.

1 1

(b) 1. Water potential of blood will decrease;
2. Water moves from osmoreceptor into blood by osmosis.

2

(c) 1. Permeability of membrane / cells (to water) is increased;
2. More water absorbed from / leaves distal tubule / collecting duct;
3. Smaller volume of urine;
4. Urine becomes more concentrated.

4

(d) 115.2 / 115.3 (cm^3 $minute^{-1}$).

1

(e) Any **two** of the following for 1 mark:
Muscle / body mass
Ethnicity
Exercise
Kidney disease – do not accept 'health'.

1

[9]

(a) Hydrostatic pressure / description of pressure / description of how pressure generated;

2

Causes ultrafiltration (*Allow description of ultrafiltration*) at Bowman's capsule / glomeruli / renal capsule;
Through basement membrane;
Enabled by small size urea molecule;

2 max

(b) Reabsorption of water / by osmosis;
At the PCT / descending LoH;
At the DCT / CD;
Active transport of ions / glucose creates gradient (in context);

Ignore references to facilitated diffusion or to selective reabsorption.

3 max

[5]

(a) 1. Blood pressure / hydrostatic pressure;

3

2. Small molecules / named example;
3. Pass through basement membrane / basement membrane acts as filter;
4. Protein too large to go through / large so stays behind;
5. Presence of pores in capillaries / presence of podocytes;

5

(b) 1. High concentration of glucose in blood;
2. High concentration in tubule / in filtrate;
3. Reabsorbed by facilitated diffusion / active transport;
4. Requires proteins / carriers;
5. These are working at maximum rate / are saturated;
6. Not all glucose is reabsorbed / some is lost in urine;

4 max

(c) For general principle, applied to either example:

1. More water (from filtrate) reabsorbed / returned to blood / less lost in urine;
2. By osmosis;
3. From collecting duct / from end of second convoluted tubule;
4. Due to longer loop of Henle;

For loop of Henle, maximum 2 marks:

5. Sodium / chloride ions absorbed from filtrate in ascending limb;
6. Gradient established in medulla / concentration of ions increases down medulla;For

ADH, maximum 2 marks:

7. Acts on collecting duct / distal convoluted tubule / second convoluted tubule;
8. Makes cells more permeable / inserts aquaporins in plasma membranes;

Note: to score full marks, candidates must make one specific statement about Loop of Henle and one about ADH.

6 max [15]

4

(a) <u>In Diabetic person:</u>

1. Lack of insulin / reduced sensitivity of cells to insulin;
2. <u>Reduced</u> uptake of glucose by cells / liver / muscles;
3. <u>Reduced</u> conversion of glucose to glycogen;

Penalise zero / no
<u>once</u> only

3

(b) (i) Leaves the blood at kidney;
Taken back into blood / reabsorbed (from kidney tubule);

Reject some reabsorption

(Reabsorbed) in <u>1st convoluted tubule</u>;

Kidney / named part needs to be mentioned once

2 max

(ii) Large amount / high concentration of glucose <u>in filtrate</u>;
Cannot all be reabsorbed / 1st convoluted tube too short to reabsorb all of glucose / saturation of carriers;

2

(c) Enzyme has specific <u>shape</u> to <u>active site</u> / active site has specific tertiary structure;
Only glucose fits / has complementary structure / can form ES complex;

2

(d) Glucose in <u>filtrate</u> lowers water potential;
Ignore 'urine'. Accept increase solute potential

<u>Lower</u> Ψ gradient / <u>less</u> difference in Ψ filtrate − Ψ plasma;
Ignore 'concentration'

Less water reabsorbed by osmosis;
Accept diffusion of water. Reject no water reabsorbed if implied

3

(e) 1. Glomerulus / Bowman's capsule / renal capsule;
2. Basement membrane;
3. Proteins are large (molecules) / proteins cannot normally pass through filter /proteins can only pass through if filter damaged;

3 [15]

metabolic water / from respiration;

5

allow condensation reactions. Ignore 'oxidation'.

aerobic / use of oxygen; ('From aerobic respiration' = 2 marks)

[2] (a) (i) where a change triggers a response which reduces the effect of a change;

6 **1**

(ii) e.g. sweating, breathing, defaecating, other valid example;
(reject respiration evaporation not acceptable as a 2nd mark if sweating or breathing given)

2 max

(iii) hypothalamus;

1

(b) (i) pituitary;
(ignore anterior pituitary)

1

(ii) 1. ADH causes vesicles containing aquaporins / aquaporins to be insertedinto membrane / collecting duct wall / plasma;
2. water enters cell through aquaporins;
3. by osmosis / diffusion / down a water potential gradient;
4. (from cell) to capillary;
5. via interstitial fluid;

4 max

(c) (i) excessive urination / drinking / diluted urine / thirst;

1

(ii) because males only have one X chromosome / do not have Y chromosome;a single copy of the recessive allele will be expressed;

2

(iii) recessive alleles can be carried by individuals without showing effects /dominant allele always expressed; organism that are carriers more likely to reproduce / affected organism less likely to reproduce; therefore recessive alleles are more likely to be passed on / dominant alleles less likely to be passed on;

3

[15]

(a) Lower volume AND higher concentration;

7 ADH increases water re-absorption (in 2nd convoluted tubule / collecting duct) / increa

ses water permeability / adds aqua porous;

Evidence: observe increasing concentration (of dissolved substances) (in 2nd convoluted tubule / collecting duct) / concentration increased c.f. ADH absent
Once only for full marks

3

(b) Protein molecule too large (to cross filter in healthy person);
Protein can cross if filter is damaged / protein from damaged glomerulus enters filtrate;

2

[5] (a) any two named polymers [subsets = 1 max. (e.g. protein / haemoglobin)]

8 **2**

(b) (i) hydrostatic pressure / description of pressure;causes ultrafiltration at Bowman's capsule / glomeruli / renal capsule; through basement membrane; enabled by small size of urea molecule;

max 2

(ii) reabsorption of water; [water out] by osmosis; at the PCT / descending LoH; at the DCT / CD;
active transport of ions / glucose creates gradient (in context);

max 4

(c) (i) by (simple) diffusion;
[reject facilitated]

1

(ii) to maintain concentration gradients / stop reaching equilibrium;
[idea of maintaining concentration gradients]

1

(iii) ions, glucose and amino acids would diffuse into the dialysate;because of their concentration gradients; Causing deficiency in these substances;

OR

the WP of the dialysate would be higher / less negative than the WP of the surrounding tissues; therefore osmosis would take place into the cells surrounding the abdominal cavity;
causing these cells to burst / damaging these cells / cannot be excreted;

max 2

[12]

9 (a) Pituitary;

Ignore any reference to lobe / hypothalamus.

1

(b) (i) (Each) protein has a tertiary structure;
Gives specific / correct shape / size to (inside of) channel / pore;

2

(ii) More negative / lower WP (inside tubule cells);
accept Ψ symbol / down a WP gradient

Water enters / moves by diffusion / osmosis;
ignore water concentration, etc.

2

[5]

10 (a) ADH;

Accept vasopressin

1

(b) Reabsorption / passes back into blood / tissue fluid;

1

By active transport;

1

(c) (sodium) ions pumped out of ascending limb;

1

Water passes out of descending limb (into high concentration in tissue fluid / interstitial fluid);

1

Some sodium ions re-enter descending loop (by diffusion);

1

High concentration at base of loop / some ions diffuse out near base increasing concentration outside loop;

3 max

1

[6]

11

(a) Maintaining a constant internal environment;

1

(b) Binds to (specific) receptor;
On muscle / liver cell;
Activation of enzymes (in liver);
Hydrolysis of glycogen;
(Facilitated) diffusion of glucose out of (liver cells) cells;
Increases blood glucose levels;

4

(c) (i) 0 / zero;

1

(ii) 1. Filtration, out of blood (plasma) / into renal capsule;
2. (Hydrostatic) pressure ;
3. PCT;
4. All reabsorbed;
5. Active transport;

3 max

[9]

12

(a) (i) Renal capsule / Bowman's capsule / glomerulus / basement membrane;

1

(ii) blood cells / platelets / proteins / named plasma protein;

1

(b) 75 divided by 60 / 75 divided by 0.01;

1

Answer 125;

(Correct answer gains two marks)

1

(c) (Many) mitochondria provide ATP / energy for active transport;
(Many) carrier proteins for active transport / channel proteins for facilitated diffusion;
Microvilli / brush border provide large surface area (for absorption);

2 max

[6]

(a) (i) 1. In the ascending limb sodium(ions) actively removed;

13

2. Ascending limb impermeable to water;
3. In descending limb sodium(ions) diffuse in;
4. Descending limb water moves out / permeable to water;
5. Low water potential / high concentration of ions in the medulla / tissuefluid;
6. The longer the loop / the deeper into medulla, the lower the waterpotential in medulla / tissue fluid;
7. Water leaves collecting duct / DCT;
8. By osmosis / down water potential gradient;

(credit once only)

6 max

(ii)
1. When water potential of the blood too low;
2. Detected by receptors in the hypothalamus;
3. Pituitary secretes / releases (more) ADH;
4. ADH increases the permeability / recruitment of aquaporins / openschannels for water in the DCT / collecting duct;
5. More water is reabsorbed / leaves the nephron moves into the blood;
6. By osmosis down the water potential gradient;

4 max

(b) (i) Ammonia not urea;
Ammonia (into labyrinth) enters by diffusion, not (ultra) filtration;
Reabsorption of glucose from labyrinth, not PCT / no reabsorption in PCT;
All salt reabsorbed / no salt in urine, comparison to humans;
Concentrated urine not produced;

3 max

(ii) Water potential lower in cytoplasm of cells / fresh water higher water potential than cells / idea of water potential gradient;
(Removal of excess water) prevents osmotic damage;

OR

All salts reabsorbed (because difficult to replace);
Take in excess water and need to remove it;

2

[15] (a) e.g. urea / amino acids / fatty acids / glycerol / ion / small protein;

14

(one mark for two of above)

1

(b) blood pressure decreased;
(less pressure) forms less filtrate;

2

(c) microvilli provide large surface area;carrier proteins (in membrane) for active transport; channel proteins for facilitated diffusion; specific carriers for specific molecules / sodium pumps;
(many) mitochondria for active transport;

2 max

(d) (i) up to 2.2 mg cm^{-3} all glucose reabsorbed / above 2.2 mg cm^{-3} excess glucose not reabsorbed / at 2.2 mg cm^{-3} threshold value reached; saturation of carriers / active transport mechanism;

2

(ii) decrease in insulin production / receptors not responsive to insulin / specific damage to tubule described / membrane less permeable to glucose;

1

[8]

16

(a) ADH;

(accept vasopressin)

1

(b) reabsorption / passes back into blood;by <u>active</u> transport;

2

(c) (sodium) ions pumped out of ascending limb;water passes out of descending limb (into high concentration in tissue fluid / interstitial fluid);
some sodium ions re-enter descending loop (by diffusion); high concentration at base of loop / some ions diffuse out near base increasing concentration outside loop;

3 max

[6]

17

(a) (epithelial cell) of tubule cells carry out active transport;
transport chloride / sodium ions out (of filtrate); against concentration gradient; into surrounding tissue / tissue fluid;
creates / maintains water potential gradient for water reabsorption; countercurrent multiplier;

5 max

(b) if water potential of blood falls, detected by receptors in hypothalamus;leads to ADH released from pituitary gland;
ADH makes cells of collecting duct / distal convoluted tubule permeable to water;

(accept DCT)

water leaves filtrate by osmosis;
smaller volume of urine produced;

(accept converse if water potential of blood rises)

4 max

(c) (autonomic reflex),autonomic ganglion involved; extra synapse outside the spinal cord; inhibitory rather than excitatory neurone; more neurones involved;

2 max

[11]

18 (a) (i) (Kidneys) *function*: removes urea from blood, *evidence from graph*: when kidneys not working the level of (blood) urea rises;

1

(ii) (Liver) *function*: makes urea / adds urea to blood, *evidence from graph*: no rise in urea (when liver not working) OR when working, urea not removed, so level rises;

1

(b) *Shown on graph. Firstly need to demonstrate change in gradient at 12 hours.*
Time 0 to 12 hours − steady decline in urea level (below line Q);
Curve horizontal from 12 hours;
Still award full credit if the line falls to x axis within first 12 hours and remains on the x axis thereafter.

2

[4]