PEARSON EDEXCEL A-LEVEL BIOLOGY B · 9BI0

BIOLOGY



EXAM QUESTION PACK

TOPIC 9: CONTROL SYSTEMS

OSMOREGULATION AND TEMPERATURE REGULATION

SCORE	PERCENTAGE
/98	%

STEMUP

These questions belong to Pearson Edexcel, not to us.

The examination questions and mark schemes in this pack were written and published by Pearson Edexcel. They are past assessment materials, reproduced here so that students can revise from them.

What we do not own

STEMUP is not affiliated with Pearson Edexcel and does not own, and makes no claim to own, any of the question or mark scheme material in this pack. Pearson has not endorsed, approved or been involved in the production of it. Pearson, Edexcel and the qualification titles used here belong to their respective owners and appear for identification only.

Where to find the originals

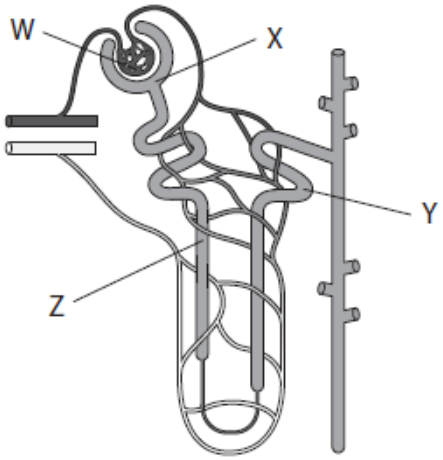
Pearson publishes its past papers and mark schemes free of charge. Always check the current specification at qualifications.pearson.com before you revise, because content and wording can change between series.

If you hold the rights to any material in this pack and would like it amended or removed, contact admin@stemup.co.uk and we will act on it.

Q1.

Answer the question with a cross in the box you think is correct ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

The diagram shows a nephron.



Which labelled parts of this nephron would normally contain glucose?

(1)

☒ **A** W only

☒ **B** W and X

☒ **C** W, X, and Y

☒ **D** W, X, Y, and Z

(Total for question = 1 mark)

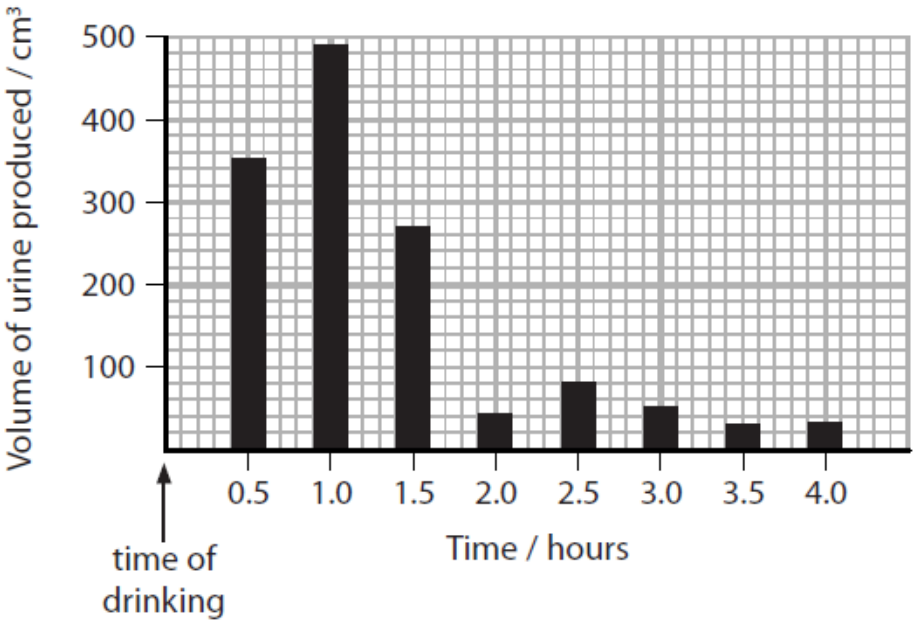
Q2.

Negative feedback control of blood plasma concentration is an example of homeostasis.

A student investigated the effect of drinking water on the volume of urine produced.

The student drank one dm^3 of water and waited for half an hour. The student then collected the urine produced every 30 minutes for four hours.

The graph shows the results of this investigation.



(i) Determine the total volume of urine produced during the first two hours.

(1)

Answer ..... cm^3

(ii) Explain the role of negative feedback in the control of blood plasma concentration during the first hour after drinking water.

(4)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(Total for question = 5 marks)

Q3.

Mammals produce urea as a nitrogenous waste product.

The table shows the concentrations of molecules and ions in the blood plasma of the kidney, in the filtrate produced in Bowman's capsule and in the bladder.

Molecule or ion	Blood plasma of kidney (%)	Filtrate produced in Bowman's capsule (%)	Urine in the bladder (%)
Water	90 to 93	94 to 96	96
Protein	7 to 9	0.0	0.0
Glucose	0.10	0.10	0.0
Urea	0.03	0.03	2.0
Sodium	0.32	0.32	0.30 to 0.35
Chloride	0.37	0.37	0.60

(i) Name the process by which this filtrate is produced in Bowman's capsule.

(1)

.....

(ii) Analyse the data to explain the difference between the protein and the other molecules or ions in the filtrate in Bowman's capsule.

(3)

.....

.....

.....

.....

.....

.....

.....

.....

(iii) Urea and chloride ions both become more concentrated as they pass from Bowman's capsule to the urine in the bladder.

Calculate how many more times urea becomes concentrated compared with chloride ions.

(3)

Answer .....

(iv) Analyse the data to explain the glucose concentration in the bladder.

(2)

.....

.....

.....

.....

(v) Explain how the loop of Henlé is involved in the production of concentrated urine.

(5)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(Total for question = 14 marks)

Q4.

A scientist investigated the oxygen consumption of four different mammals.

The table shows the results of this investigation.

Mammal	Body mass / kg	Oxygen consumption / $dm^3\ h^{-1}$	Oxygen consumption / $dm^3\ kg^{-1}\ h^{-1}$
Shrew	0.002	0.0216	1.08×10^{1}
Cat	3	1.5	5.00×10^{-1}
Human	80	24	3.00×10^{-1}
Elephant	4000	50	

(i) Calculate the oxygen consumption of the elephant.

Convert your answer into standard form.

(2)

Answer ..... dm3 kg^{-1} h^{-1}

(ii) Explain the relationship between body mass and oxygen consumption in these mammals.

(4)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

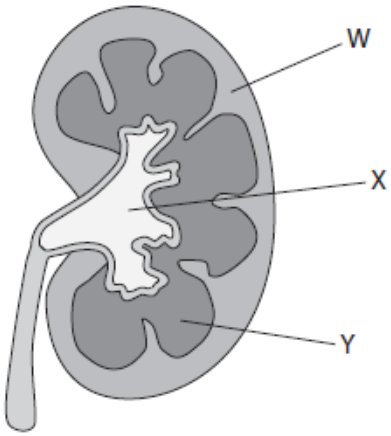
.....

.....

(Total for question = 6 marks)

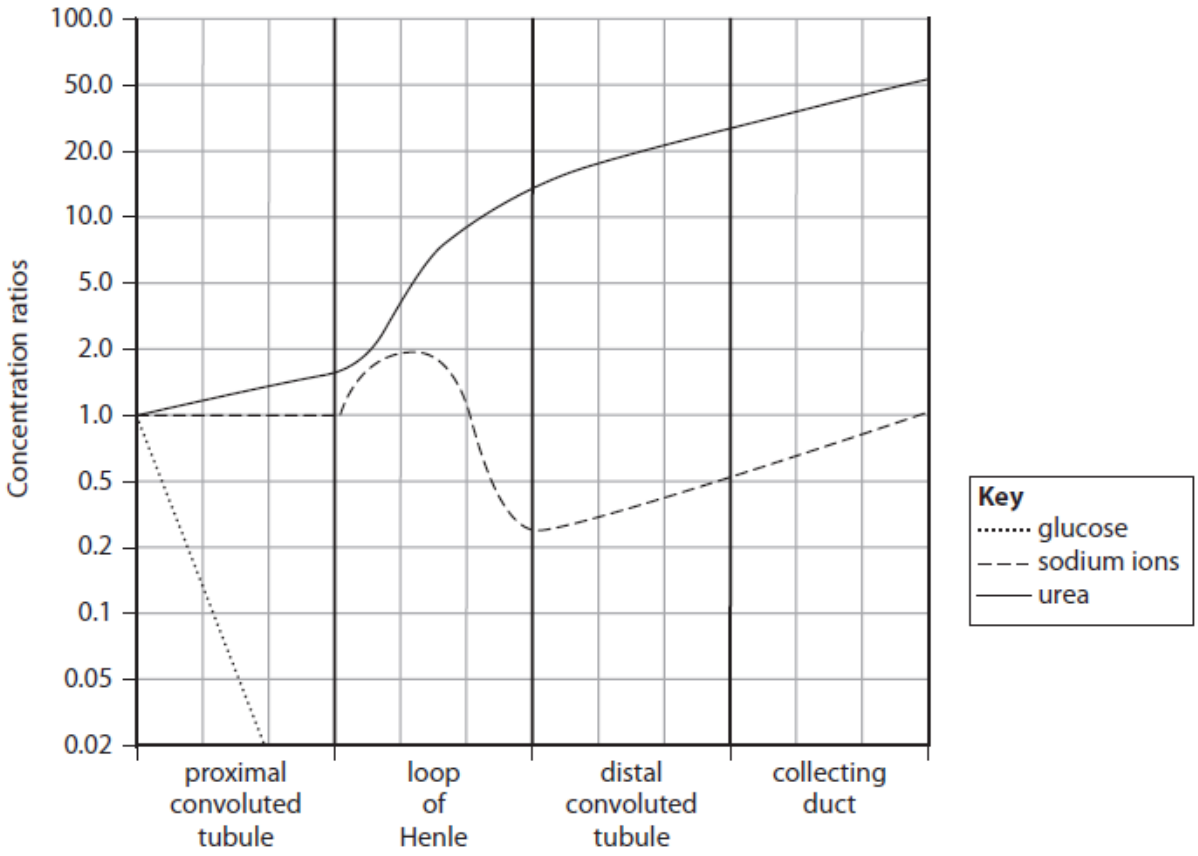
Q5.

The diagram shows a section through a mammalian kidney.



* The renal (Bowman's) capsule is part of each nephron found in the kidney.

The graph shows the concentration ratios of three solutes in different parts of the nephron compared with their concentrations in the renal capsule.



Explain the changes in the concentration ratios of these solutes in the different parts of the nephron.

(6)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(Total for question = 6 marks)

Q6.

Mammals produce urea as a nitrogenous waste product.

Describe how urea is produced in mammals.

(2)

.....

.....

.....

.....

.....

.....

(Total for question = 2 marks)

Q7.

Answer the questions with a cross in the boxes you think are correct ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

(i) Which of the following statements about facilitated diffusion are correct?

(1)

1. substances move through membrane proteins
2. substances move against a concentration gradient
3. substances move down a concentration gradient
4. substances move between phospholipids

☒ **A** 1 and 2

☒ **B** 1 and 3

☒ **C** 2 and 3

☒ **D** 2 and 4

(ii) The collecting duct is also part of the nephron.

Which of the following are the effects of increased release of antidiuretic hormone (ADH)?

(1)

☒ **A** decreased permeability of the collecting duct to water, producing more concentrated urine

☒ **B** decreased permeability of the collecting duct to water, producing more dilute urine

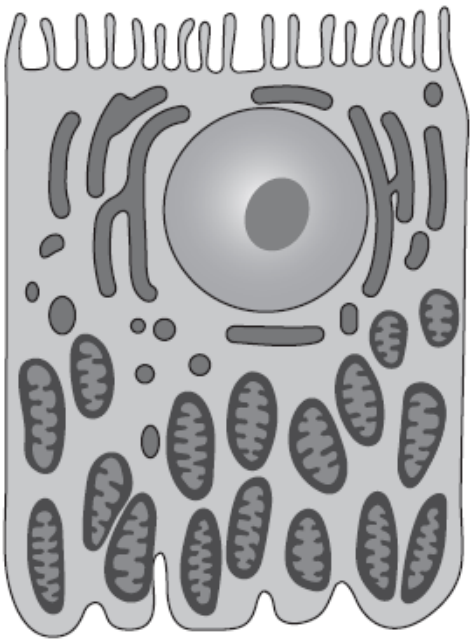
☒ **C** increased permeability of the collecting duct to water, producing more concentrated urine

☒ **D** increased permeability of the collecting duct to water, producing more dilute urine

(Total for question = 2 marks)

Q8.

The diagram shows a cell from the proximal convoluted tubule of the nephron.



Explain how the features shown in the diagram enable this cell to carry out its function.

(4)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

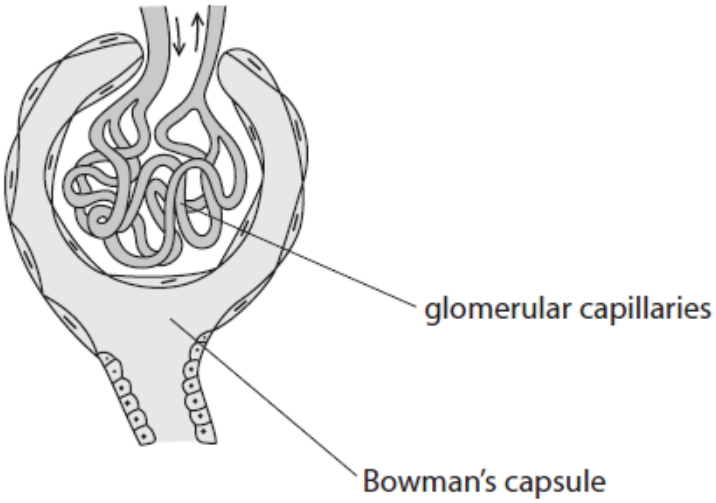
.....

(Total for question = 4 marks)

Q9.

If untreated, high blood pressure can cause kidney damage.

The diagram shows a Bowman's capsule and the glomerular capillaries in a human's kidney.



The table shows the hydrostatic pressure in the glomerular capillaries and in the Bowman's capsule. It also shows the oncotic pressure of the blood in the glomerular capillaries.

Pressure and location in kidney	Pressure / kPa
hydrostatic pressure in glomerular capillaries	+9.2
hydrostatic pressure in Bowman's capsule	+2.0
oncotic pressure in glomerular capillaries	−4.0

Use the data from the table to explain why glomerular filtrate is produced.

(2)

.....

.....

.....

.....

.....

.....

Q10.

The photograph shows a wood mouse, *Apodemus sylvaticus*.



(Source: © Eric Isselee/Shutterstock)

A scientist measured the population size of these mice living in a woodland habitat.

The scientist used the capture-mark-recapture method (CMR) to sample the population.

This is the CMR method used by the scientist:

- randomly place mammal traps in the woodland for one day
- put a coloured band on a leg of each captured mouse (S1)
- release these marked mice
- after one week place mammal traps in the woodland again for one day
- count the number of mice captured (S2)
- count the number of mice with leg bands in this second sample (L).

Wood mice are small mammals.

They cannot maintain their body temperature and will die if left in the trap for a long period of time.

Explain why wood mice cannot maintain their body temperature if left in the trap.

(4)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(Total for question = 4 marks)

Q11.

Mammals produce urea as a nitrogenous waste product.

Bowman's capsule (renal capsule) in the kidney is involved in the excretion of urea in mammals.

Name the cluster of blood capillaries enclosed by Bowman's capsule.

(1)

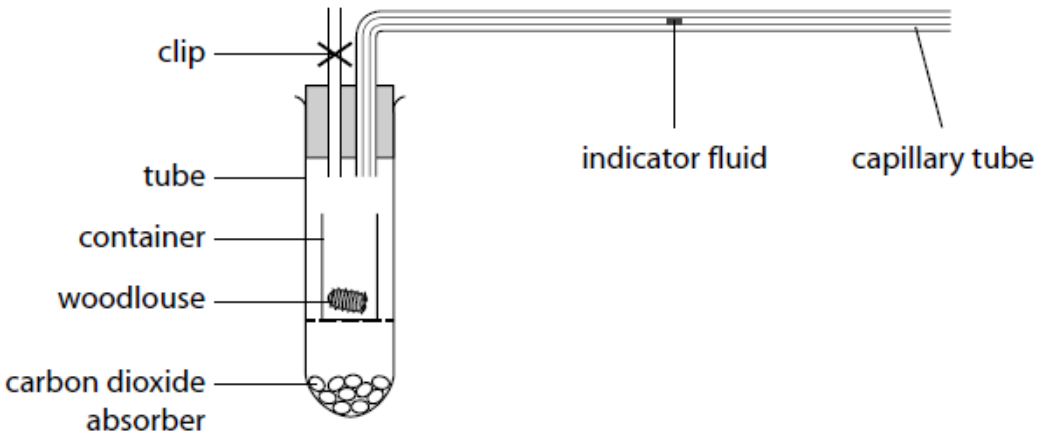
.....

(Total for question = 1 mark)

Q12.

The diagram below shows a simple respirometer used by a student to measure the rate of respiration of a small invertebrate called a woodlouse.

The rate was measured by observing the distance the indicator fluid moved in a known time.



(a) Give one way in which the student could modify the procedure to obtain a better measurement of the rate of respiration.

(1)

.....

.....

(b) Explain what would happen to the indicator fluid after five hours if a culture of green algae was added to the container and the tube was completely covered in light-proof paper.

(4)

.....

.....

.....

.....

.....

.....

.....

.....

(c) (i) The student wanted to compare the rate of respiration of a mouse with that of a woodlouse.

Explain how you could modify the procedure used to measure the rate of respiration of the woodlouse so that it could be used to compare with the rate of respiration of a mouse.

Your answer should explain the reasons for the modifications and include reference to the ethical treatment of the animal, and show how you could produce valid results.

(5)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(ii) Comment on how the results you would expect to obtain for a mouse would differ from the results for a woodlouse.

(2)

.....

.....

.....

.....

.....

(Total for question = 12 marks)

Q13.

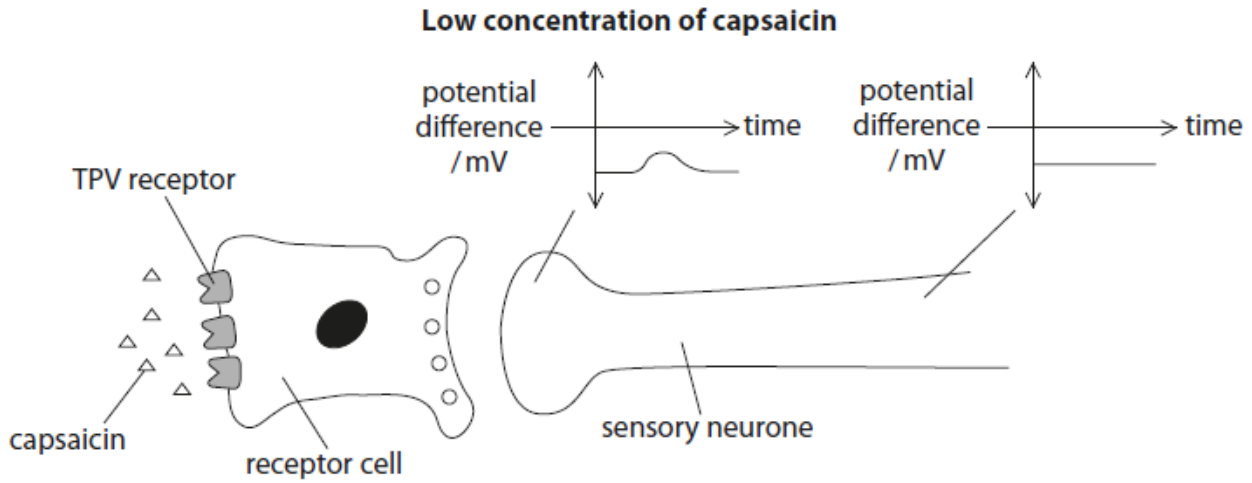
Acetylcholine is a neurotransmitter released by neurones in the autonomic nervous system.

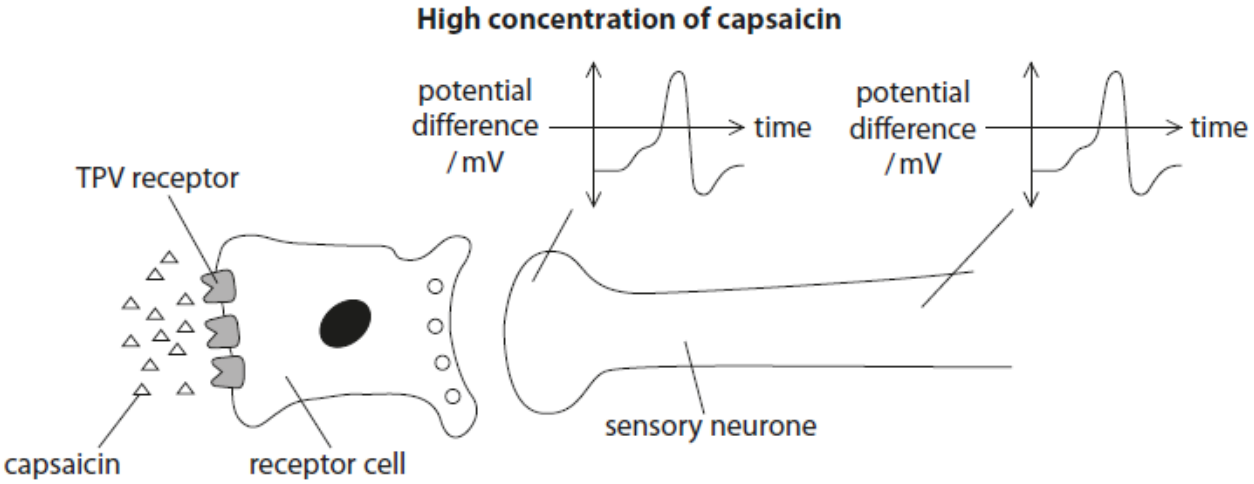
Capsaicin is a substance found in chilli plants that makes them taste 'hot.'

Capsaicin binds to temperature receptor proteins called TPV receptors. This stimulates impulses along sensory neurones that send impulses to the brain.

The effect of capsaicin on the depolarisation of the membrane of a sensory neurone was investigated. The potential difference across the membrane was measured at two places on the sensory neurone after adding capsaicin.

The results for a high concentration and a low concentration of capsaicin are shown in the diagram.





(i) Explain the effect of capsaicin on the depolarisation of the sensory neurone.

(3)

.....

.....

.....

.....

.....

.....

.....

.....

.....

*(ii) Capsaicin affects sweat production. It has been suggested that capsaicin could be used to lower the temperature of people with fevers.

The effect of three different doses of capsaicin on sweat production was investigated.

Five students took one 10 mg tablet of capsaicin each day, for one week.

The mass of sweat produced from a 10 cm^2 area of skin was measured one hour after taking each tablet of capsaicin.

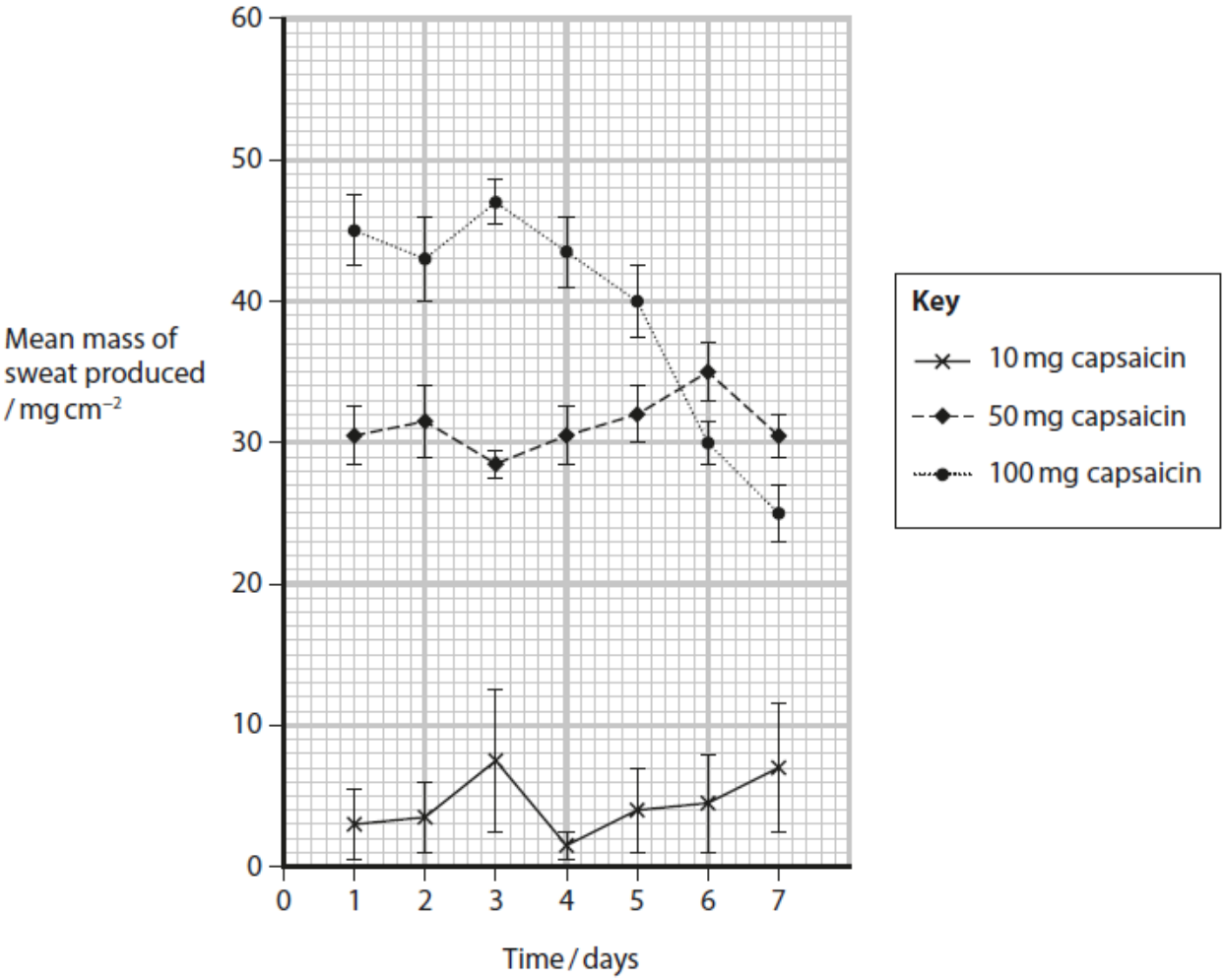
The mean mass of sweat per square centimetre of skin for the group of students was calculated for each day.

This was repeated with different groups of students taking 50 mg of capsaicin and taking 100 mg of capsaicin.

Most of the students who were given 100 mg of capsaicin reported a burning sensation and redness of the skin.

The results are shown in the graph.

Error bars represent standard deviations.



Analyse the data to discuss the use of capsaicin to lower the temperature of people with fevers.

(6)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

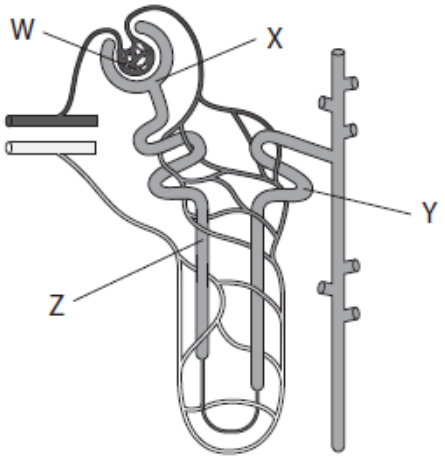
.....

.....

(Total for question = 9 marks)

Q14.

The diagram shows a nephron.



Oedema is an accumulation of tissue fluid. This is due to less tissue fluid being returned to the blood capillaries.

(i) Explain how tissue fluid is returned to capillaries.

(3)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(ii) Furosemides are drugs that are used to reduce oedema. They are diuretics that increase urine production.

Furosemides reduce the active transport of sodium ions by the loop of Henle.

Explain how furosemides cause an increase in urine production.

(4)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

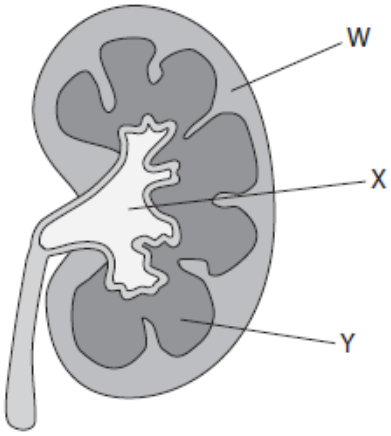
.....

.....

(Total for question = 7 marks)

Q15.

The diagram shows a section through a mammalian kidney.



Which row of the table names the parts of the kidney labelled in the diagram?

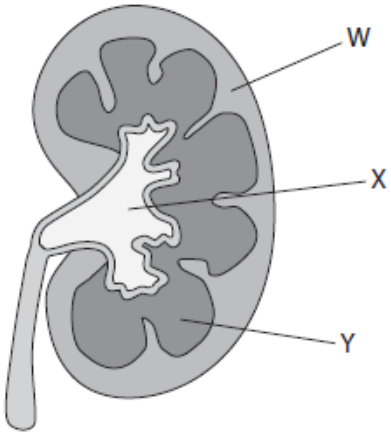
(1)

	W	X	Y
☒ **A**	cortex	medulla	pelvis
☒ **B**	cortex	pelvis	medulla
☒ **C**	medulla	pelvis	cortex
☒ **D**	medulla	cortex	pelvis

(Total for question = 1 mark)

Q16.

The diagram shows a section through a mammalian kidney.



The table shows information about substances found in the blood and in the filtrate in the renal (Bowman's) capsule.

Substance	Relative molecular mass	Ratio of concentration in the filtrate in the renal (Bowman's) capsule : concentration in blood
sodium ions	23	1.00
water	18	1.00
urea	60	1.00
glucose	180	1.00
myoglobin	17000	0.75
plasma proteins	69000	<0.01

Analyse the data to explain the ratios of these substances.

(3)

.....

.....

.....

.....

.....

.....

.....

.....

.....

(Total for question = 3 marks)

Q17.

The photograph below shows a desert mammal.



(Source: http://www.ardea.com)

Some desert mammals do not drink water. They obtain water from the food they eat and from respiration.

(a) Explain how water is formed in respiration.

(2)

.....

.....

.....

.....

(b) The table below shows the percentage of plant roots and insects in the diet of two different species of desert mammal.

Food	Percentage of food in diet (%)	
	M. hurrianae	*T. indica*
Plant roots	40	20
Insects	10	25

(i) The desert mammals eat 8 g of food in one day. Calculate how many more grams of insects are eaten by *T. indica* than by *M. hurrianae*.

(2)

Answer ..... g

(ii) Which species has kidneys that will produce the most concentrated urine?
Justify your answer.

(2)

.....

.....

.....

.....

(c) Which row of the table below shows the correct changes to the concentration of sodium ions as fluid moves along the descending and ascending loop of Henle?

(1)

	Concentration of sodium ions (Na^+) in descending loop of Henle	Concentration of sodium ions (Na^+) in ascending loop of Henle
☒ **A**	increases	increases
☒ **B**	increases	decreases
☒ **C**	decreases	increases
☒ **D**	decreases	decreases

(d) The concentration of urine is controlled by osmoreceptors and the secretion of ADH.

Which row of the table below shows the location of the osmoreceptors and the correct level of ADH secretion in a desert mammal that produces concentrated urine?

(1)

	Location of osmoreceptors	Level of ADH
☒ **A**	carotid body	high
☒ **B**	carotid body	low
☒ **C**	hypothalamus	high
☒ **D**	hypothalamus	low

(e) Explain how the nephrons of desert mammals enable them to survive in a dry environment.

(4)

.....

.....

.....

.....

.....

.....

.....

.....

(Total for question = 12 marks)

Q18.

Which of the following is correct when an individual becomes dehydrated?

(1)

- ☒ **A** decreased secretion of ADH and decreased permeability of the collecting duct
- ☒ **B** decreased secretion of ADH and increased permeability of the collecting duct
- ☒ **C** increased secretion of ADH and decreased permeability of the collecting duct
- ☒ **D** increased secretion of ADH and increased permeability of the collecting duct

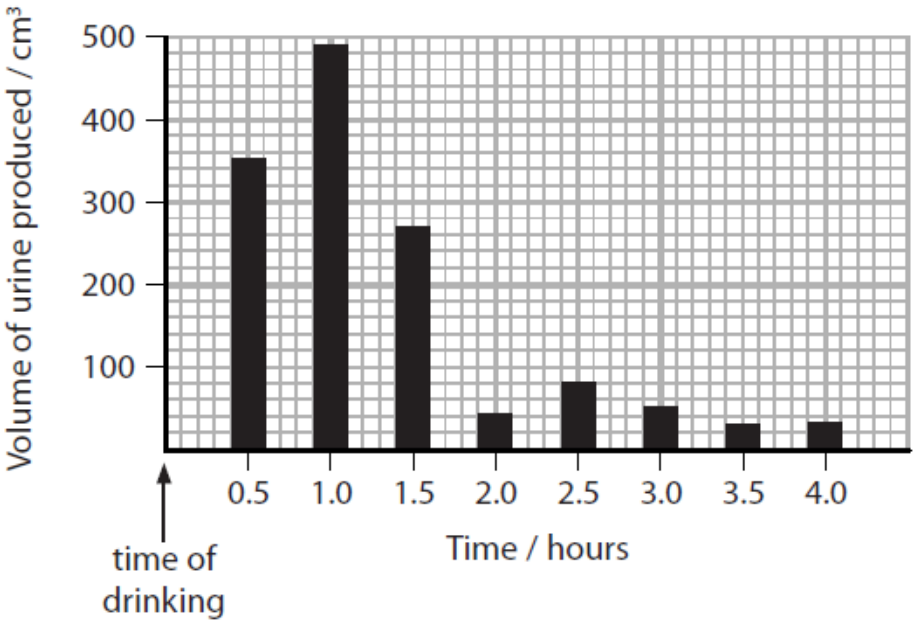
Q19.

Negative feedback control of blood plasma concentration is an example of homeostasis.

A student investigated the effect of drinking water on the volume of urine produced.

The student drank one dm^3 of water and waited for half an hour. The student then collected the urine produced every 30 minutes for four hours.

The graph shows the results of this investigation.

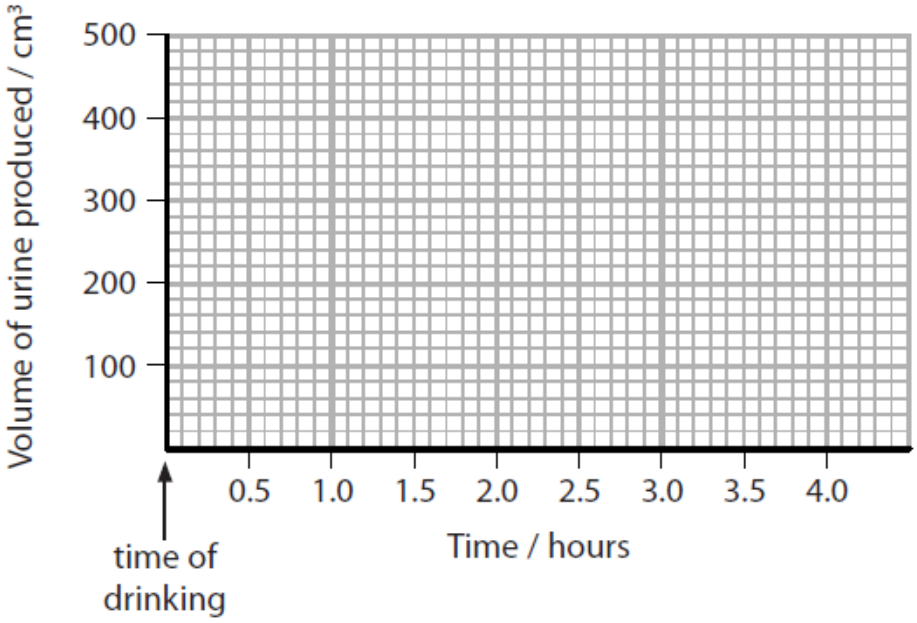


The next day the student drank one dm^3 of dilute salt solution with the same water potential as blood plasma.

The student waited half an hour and collected the urine produced every 30 minutes for four hours.

Sketch a graph to predict the results.

(1)



(Total for question = 1 mark)

Q20.

A student investigated the effect of the concentration of sodium chloride solution on blood.

The student set up six test tubes, each with a different concentration of sodium chloride solution.

Five drops of blood were added to each test tube.

The appearance of the solutions was then recorded.

Samples of each solution were observed using a light microscope.

The table shows the results of this investigation.

Concentration of sodium chloride (%)	Appearance of solution after blood was added	Observation with light microscope
3.0	very cloudy	cells seen with shrunken edges
1.0	very cloudy	cells seen
0.9	very cloudy	cells seen
0.7	slightly cloudy	cells seen
0.5	cloudy at first, then went clear	no cells seen
0.3	clear	no cells seen

(i) State the part of the brain responsible for osmoregulation.

(1)

.....

(ii) Explain how, on a very hot day, the brain ensures that the water potential of the blood remains constant.

(4)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(Total for question = 5 marks)