

Animal Physiology

Question Paper

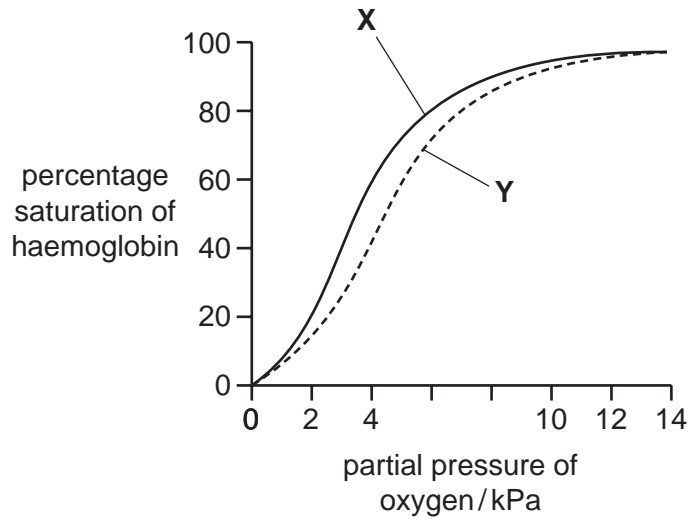
Level	Pre U
Subject	Biology
Exam Board	Cambridge International Examinations
Topic	Animal Physiology
Booklet	Question Paper

Time Allowed: 35 minutes

Score: /29

Percentage: /100

- 1 Curve X shows the oxygen dissociation curve for human haemoglobin. Under certain conditions this curve becomes displaced to the right. This is termed the Bohr effect and is shown by curve Y.



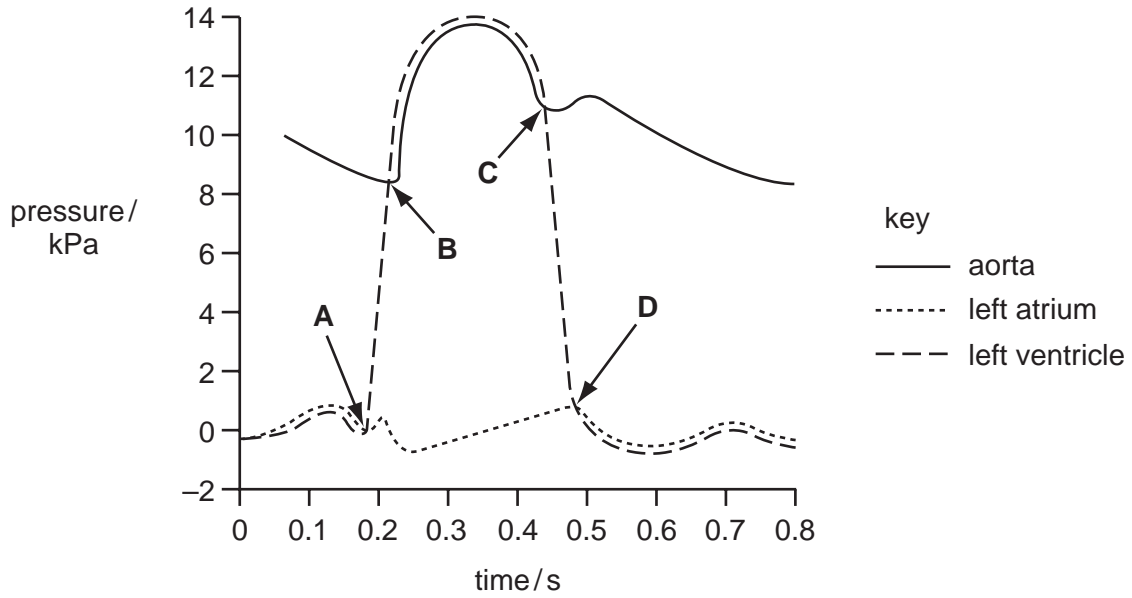
Which change is responsible for the Bohr effect?

- A a decrease in the partial pressure of oxygen
- B a decrease in the temperature of the blood
- C an increase in pH of the blood
- D an increase in the partial pressure of carbon dioxide

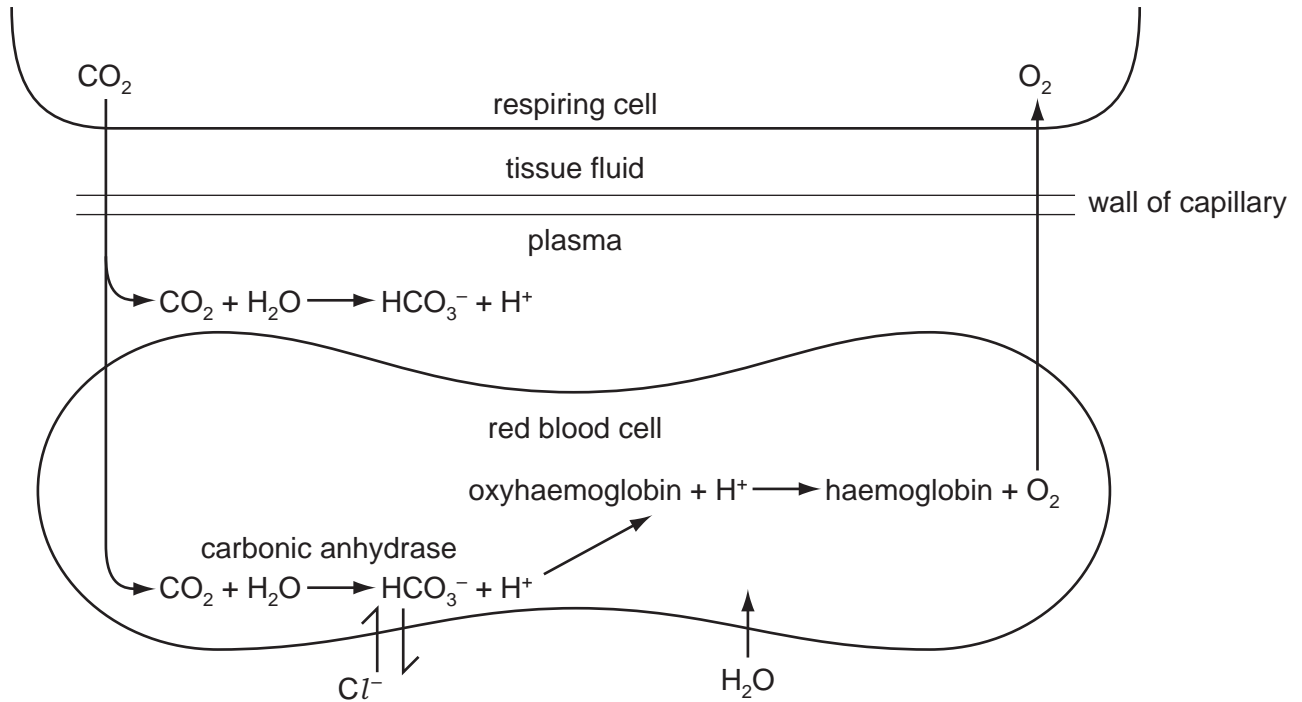
answer [1]

2 The graph shows pressure changes in the aorta, left atrium and left ventricle during one beat of the human heart.

At which point do the semi-lunar valves first begin to close?



3 The diagram shows some of the events occurring in a capillary in a respiring tissue.



Which statement correctly describes one of these events?

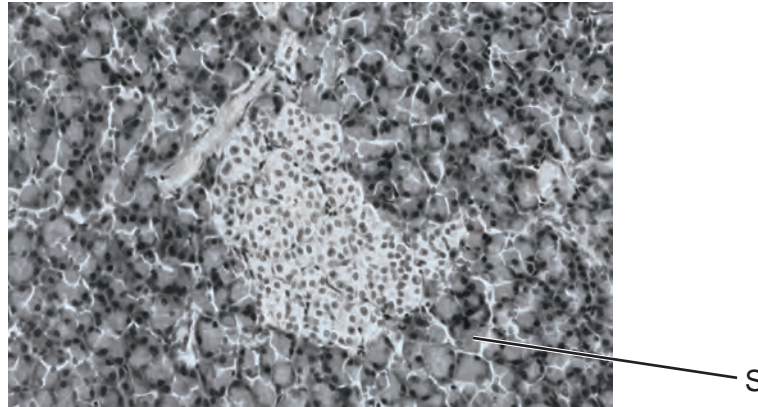
- A Hydrogen carbonate (HCO_3^-) ions and chloride (Cl^-) ions are exchanged through a protein channel in the red blood cell membrane.
- B Hydrogen carbonate ions (HCO_3^-) are formed at a slower rate in the red blood cell than in the plasma.
- C Red blood cells at the venous end of a capillary have a slightly greater volume than those at the arterial end.
- D The increase of chloride ions (Cl^-) causes the water potential of the red blood cell to become less negative.

4 When a person eats a meal, which statement about its digestion is **not** correct?

- A Fat hydrolysis mainly occurs in the small intestine.
- B Protein digestion begins in the stomach.
- C The fats in the meal are digested by lipase, secreted by the pancreas.
- D The meal will be fully digested before it gets to the ileum.

5 The diagram shows some of the cells of an organ which secretes digestive juices.

Some of the secretory cells present in this organ are labelled S.



Which row in the table is correct?

	organ	structure producing the secretion	name of secretion	mode of action
A	stomach	gastric pit	pepsin	endopeptidase
B	pancreas	acini	trypsin	endopeptidase
C	duodenum	mucosa	bile	exopeptidase
D	ileum	villus	chymotrypsin	exopeptidase

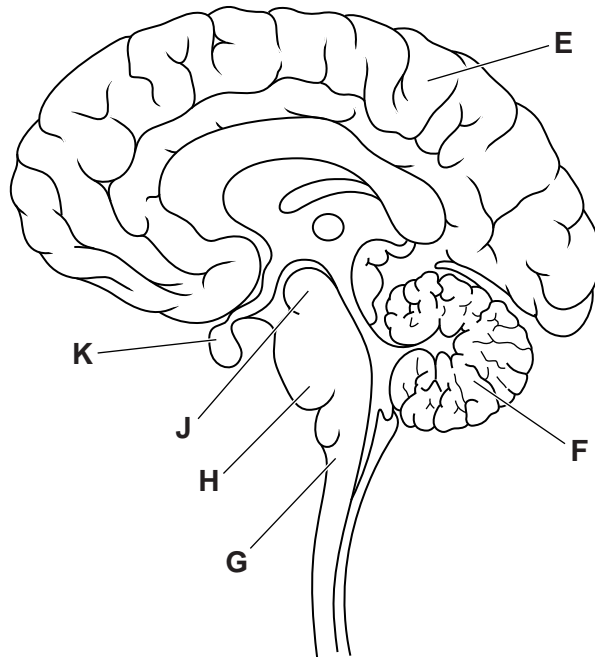
6 An action potential arrives at the synaptic knob increasing the permeability of the membranes to**1**....., which diffuse in and cause vesicles to move to the pre-synaptic membrane and fuse with it.

.....**2**..... occurs and acetylcholine moves across the synaptic cleft by**3**..... and attaches to receptors on the post-synaptic membrane, causing**4**..... channels to open and a post-synaptic potential to be generated.

Which words correctly complete the numbered gaps?

	1	2	3	4
A	sodium ions	endocytosis	active transport	calcium ion
B	calcium ions	exocytosis	diffusion	sodium ion
C	calcium ions	exocytosis	active transport	sodium ion
D	sodium ions	endocytosis	diffusion	calcium ion

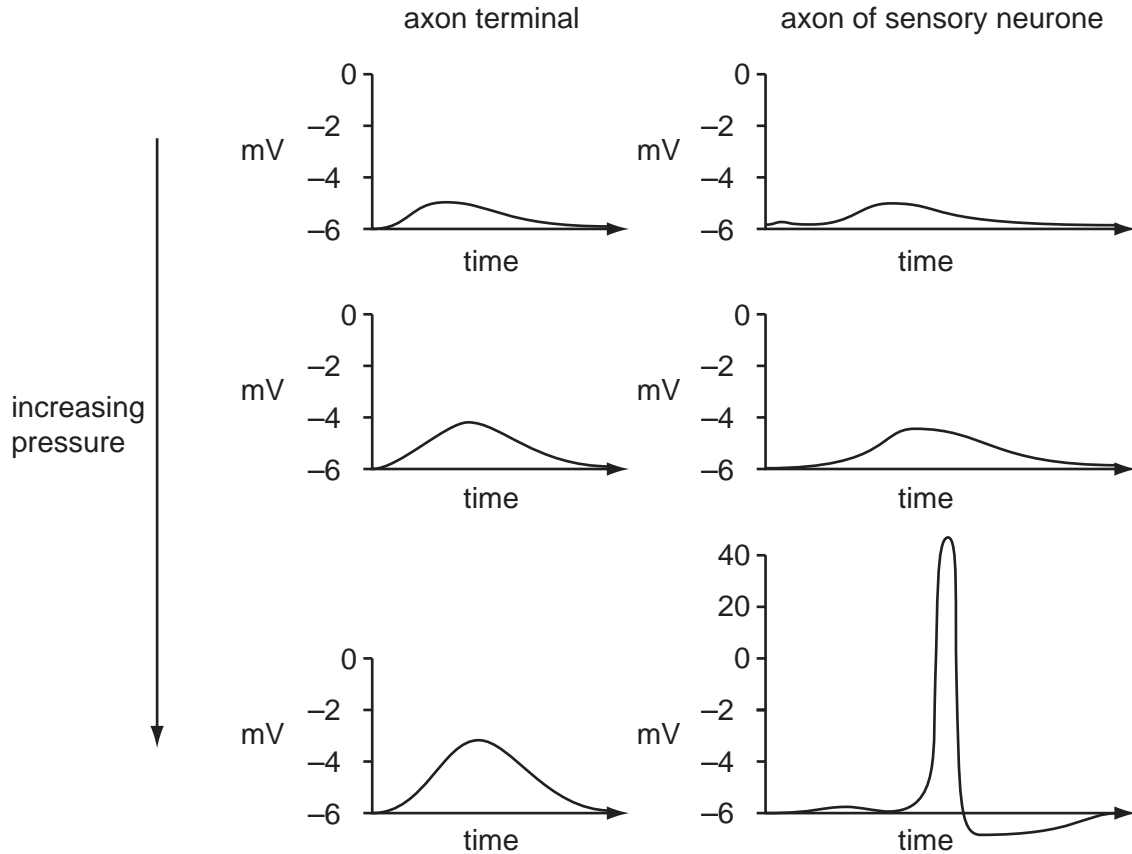
7 Which set of labels is a correct match for the parts of the brain shown below?



	E	F	G	H	J	
A	cerebellum	cerebrum	medulla oblongata	pons varolii	midbrain	pituitary body
B	cerebellum	cerebrum	thalamus	hind brain	pons varolii	midbrain
C	cerebrum	cerebellum	medulla oblongata	pons varolii	midbrain	pituitary body
D	cerebrum	cerebellum	thalamus	hind brain	pons varolii	midbrain

answer [1]

- 8 The graphs show the response of sensory neurones to increasing pressure on the Pacinian corpuscles in mammalian skin.



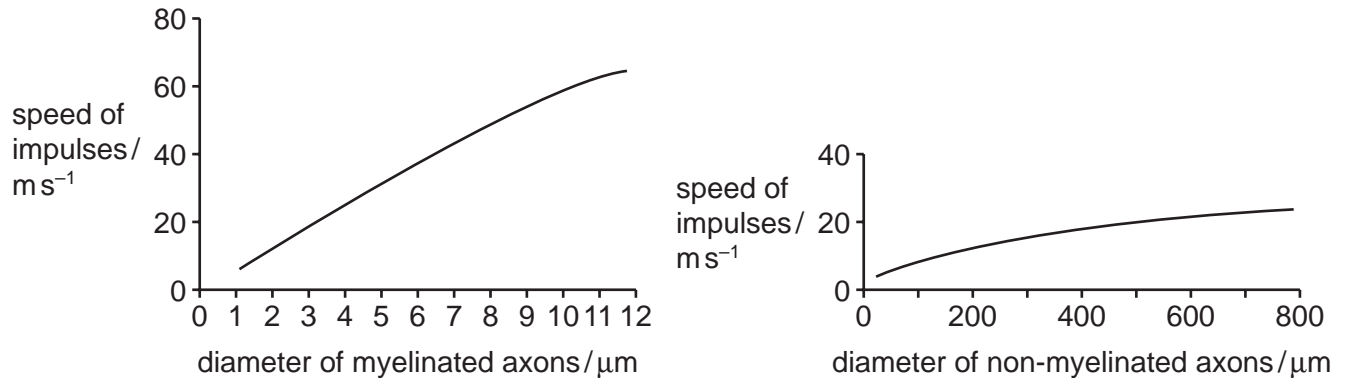
Which conclusion about increasing pressure is correct?

- A** As pressure increases the depolarisation of the corpuscle and sensory neurone increases.
- B** As pressure increases the axon terminal depolarisation reaches a value that depolarises the sensory neurone.
- C** If the corpuscle is stimulated for long enough the depolarisation of the sensory neurone increases.
- D** If the corpuscle is stimulated for long enough the axon terminal depolarisation reaches a value that depolarises the sensory neurone.

- 9 The ability of organisms to respond rapidly to stimuli is limited by the speed of the impulses in their neurones.

The axons of invertebrate neurones lack a myelin sheath. The axons of most vertebrate neurones are myelinated.

The graphs show the speed of impulses in these two types of axon.



Which statements about these data are correct?

- 1 The action potential in myelinated axons is greater than the action potential in non-myelinated axons.
 - 2 The speed of impulses is changed by the diameter of the axon.
 - 3 Increasing the diameter of a myelinated axon causes a greater change to the conduction speed than increasing the diameter of a non-myelinated axon.
 - 4 The presence of myelin increases the speed at which impulses are conducted.
- A** 1, 2 and 3 only
B 1, 2 and 4 only
C 2, 3 and 4 only
D 3 and 4 only

- 10 A particular snake venom causes death by leading to paralysis of muscles. It exerts its effect at synapses.

The statements below were put forward as possible explanations for the effects of this venom.

- 1 It interferes with the binding of neurotransmitter vesicles to the membranes.
- 2 It binds with neurotransmitter receptor sites.
- 3 It blocks calcium and sodium channels.
- 4 It destroys the myelin sheath of the neurone.
- 5 It binds with neurotransmitter.

Which statements should be investigated further?

- A** 1, 2, 3 and 5 only
- B** 2, 4 and 5 only
- C** 4 only
- D** 1, 2, 3, 4 and 5

answer [1]

Questions 11, 12, 13 and 14

For each of the questions 11–14 only one statement is correct. The correct statements describe the sequence of events that occur at a neuromuscular junction, leading to muscle contraction. For each question identify the correct statement.

- 11**
- A** Acetylcholine hydrolysed by acetylcholinesterase on post-synaptic membrane.
 - B** Acetylcholine released from the pre-synaptic membrane of the sensory neurone.
 - C** Neurotransmitter released from the post-synaptic membrane of the motor neurone.
 - D** Neurotransmitter released from the pre-synaptic membrane of the motor neurone.

answer[1]

- 12**
- A** Muscle fibre depolarised.
 - B** Muscle fibre in absolute refractory period.
 - C** Muscle fibre in relative refractory period.
 - D** Muscle fibre repolarised.

answer[1]

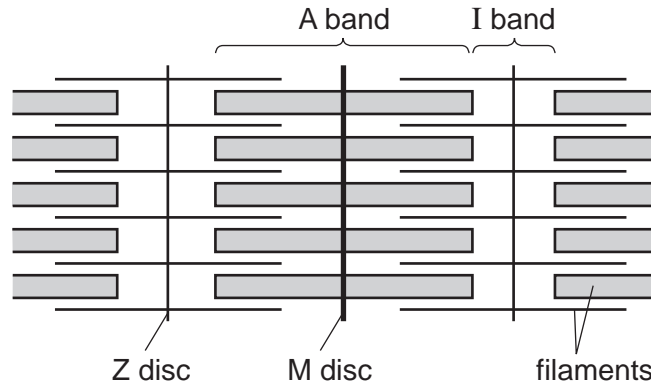
- 13**
- A** Action potential propagation along muscle fibre sarcolemma allows calcium ions to flow in down their concentration gradient from surrounding tissue fluid.
 - B** Action potential propagation along muscle fibre sarcolemma results in active uptake of calcium ions from the sarcoplasmic reticulum.
 - C** Action potential propagation into T-tubules of muscle fibre allows calcium ions to flow out of the sarcoplasmic reticulum, down their concentration gradient.
 - D** Action potential propagation into T-tubules of muscle fibre allows calcium ions to flow into the muscle fibre from surrounding tissue fluid, down their concentration gradient.

answer[1]

- 14**
- A** Binding of calcium ions to myosin heads repels tropomyosin, exposing myosin heads for cross-bridge formation.
 - B** Binding of calcium ions to myosin heads repels troponin, exposing myosin heads for cross-bridge formation.
 - C** Binding of a calcium ion to troponin causes attached tropomyosin to be pulled away from the myosin binding site.
 - D** Binding of a calcium ion to tropomyosin causes a change in shape of the attached troponin, exposing myosin heads.

answer[1]

- 15 The diagram shows the arrangement of thick and thin filaments in a piece of striated (skeletal) muscle.



Which statements about the structure and function of the filaments are correct?

- 1 Filaments of actin are attached to the Z discs of skeletal muscle.
- 2 ATP binds to the heads of the actin filaments.
- 3 Myosin heads are enzymatic and bind to actin when the muscle is stimulated.
- 4 When skeletal muscles contract, the I band gets shorter.

- A** 1, 3 and 4 only
B 1 and 4 only
C 2 and 3 only
D 2, 3 and 4 only

- 16 Which is the correct set of true or false answers concerning cholesterol, LDLs and HDLs?

	LDLs reduce the concentration of blood cholesterol by transporting cholesterol to the liver for breakdown.	Liver cells have receptors for HDLs to allow cholesterol uptake and subsequent addition to bile.	Cholesterol is carried to the ovaries for the synthesis of steroid hormones such as oestrogen.	HDLs take up cholesterol deposited by LDLs in damaged endothelium, reducing the effects of atheroma.	LDLs bind to cell surface membrane receptors for cholesterol uptake into cells.
A	false	false	false	true	true
B	false	true	true	true	true
C	true	true	false	false	false
D	true	true	true	false	false

17 Which processes are promoted by the hormones insulin and glucagon?

- 1 conversion of glycogen to glucose in hepatocytes
- 2 respiration of glucose in hepatocytes
- 3 uptake of glucose by muscle cells
- 4 release of glucose in urine

	insulin	glucagon
A	1	2
B	2	4
C	3	1
D	4	3

18 The table shows some functional features of various structures in the human body.

Which set of features is correct?

	hypothalamus	distal convoluted tubule	medulla oblongata	posterior pituitary
A	lowers heart rate by sending impulses along the vagus nerve	selective reabsorption of amino acids involving active uptake	receives impulses that have originated from chemoreceptors in the aortic arch	secretes ADH into the bloodstream
B	osmoreceptors detect changes in water potential of blood	receptors in cell surface membranes respond to ADH	receives impulses that have originated from carotid baroreceptors	secretes ADH into the bloodstream
C	synthesises and releases ADH in response to increased water potential	aquaporins added to cell surface membranes in response to ADH	osmoreceptors detect changes in water potential of blood	secretes luteinising hormone into the bloodstream
D	synthesises and releases ADH in response to decreased water potential	aquaporins added to cell surface membranes in response to ADH	osmoreceptors detect changes in water potential of blood	secretes follicle stimulating hormone into the bloodstream

- 19 In mammals, why is glucose present in blood plasma but **not** normally in urine?
- A ATP is used in reabsorption from the proximal convoluted tubule.
 - B It is oxidised to supply energy for ultrafiltration.
 - C It is stored in the medulla of the kidney.
 - D It is too large to enter the Bowman’s capsule.
- 20 The drug frusamide is a diuretic used in the treatment of fluid retention. This drug reduces the diffusion gradient in the medulla by blocking some reabsorption of sodium ions. In this way it decreases the reabsorption of water.

In which part of a kidney tubule does frusamide act?

- A collecting duct
 - B distal tubule
 - C loop of Henle
 - D proximal tubule
- 21 Which row shows the features of each heavy and each light chain of a monomeric antibody, e.g. IgG?

	single heavy chain	single light chain
A	2 variable regions present	2 variable regions present
B	1 variable region present	variable region absent
C	variable region absent	1 variable region present
D	1 variable region present	1 variable region present

- 22 Apart from the ABO blood groups, humans can also be Rhesus positive or Rhesus negative.

People with the Rhesus antigen are Rhesus positive. When a Rhesus negative person is given Rhesus positive blood in a transfusion there is no problem. However, a second transfusion of Rhesus positive blood to this Rhesus negative person will result in a reaction between the two types of blood.

Which statements explain this?

- 1 A Rhesus negative person naturally has anti-Rhesus antibodies.
- 2 Exposure to Rhesus antigen causes anti-Rhesus antibody production.
- 3 B-cells make anti-Rhesus antibodies.
- 4 Anti-Rhesus antibody production begins after the second exposure.

A 1, 2, 3 and 4 **B** 1 and 2 only **C** 2 and 3 only **D** 3 and 4 only

- 23 Following a liver allograft, transplant patients are given drugs such as cyclosporin and may remain on the drug for their lifetime.

Which statement best describes the reasons for taking cyclosporin after a liver transplant?

- A** Cyclosporin decreases the activity of all cells in the immune system and improves the patients' artificial passive immunity.
- B** Cyclosporin helps the donated organ to grow and function effectively and increases the patients' quality of life.
- C** Cyclosporin reduces the function of the T-cells and reduces the patients' organ rejection.
- D** Cyclosporin reduces the vulnerability to opportunistic fungal and viral infections and improves the patients' survival rates.

- 24 Various conditions in the human body can be treated by using a transplant. In most cases the part being transplanted is tissue-typed to obtain a good match between donor and recipient and the recipient will need to take immunosuppressant drugs.

However, transplants of the transparent cornea at the front of the eye do not need to come from tissue-typed donors and immunosuppressant drugs are not used.

The photomicrograph shows a section through a cornea, x 150.



A number of corneal transplants are still rejected.

What is the correct explanation for these observations?

- A** The cornea has no cells as it is not living tissue.
- B** The cornea has few antigens as it contains few proteins.
- C** All corneas have the same antigens in them and so very rarely initiate an immune response as they are almost always treated as self.
- D** The cornea has many antigens, but they do not usually come into contact with antibodies as there are no blood vessels in the cornea.

Questions 25, 26, 27 and 28

The graphs on the opposite page show features of the survival and reproductive success of adult males and females of three different species:

- A** barnacle goose
- B** Bewick's swan
- C** dwarf mongoose
- D** red deer

In all of these species, equal numbers of male and female offspring are produced.

Column 1 shows the age-specific survival, which is the probability that adult animals of different ages will survive for a further year.

Column 2 shows survivorship curves. A survivorship curve shows the proportion of a population that survives to different ages.

Column 3 shows the mean annual reproductive success which is the number of offspring produced by adult males and females of different ages.

Study the graphs and then identify which one gives the best match to each of the statements in questions 17 to 20. Record your answer to each question by using a letter for the appropriate species and a number for the appropriate graph, e.g. A1, B2, C3, etc.

25 A species with a higher proportion of females than males in the oldest age groups.

answer [1]

26 A species with a mortality rate above 60% during the first three years of life.

answer [1]

27 A species in which, for every year that data was collected, both males and females are more likely to survive than they are to die.

answer [1]

28 A species that is likely to be polygynous (males mate with more than one female).

answer [1]

- 29 In humans, the female menopause usually occurs between the ages of 45 and 55. After the menopause, the female no longer menstruates or ovulates.

How do the concentrations of reproductive hormones change at the menopause?

	FSH	LH	oestrogen	progesterone
A	fall	rise	fall	rise
B	fall	rise	rise	fall
C	rise	fall	fall	fall
D	rise	fall	rise	rise