HL Paper 1

Which of the following statements is **incorrect**?

A. Active immunity is the stimulation of the immune system to produce antigen-specific antibodies.
B. Vaccines produce immunological memory similar to that acquired by having the natural disease.
C. The most common way to acquire passive immunity is to have the natural disease.
D. Killed forms of a microorganism can act as an antigen.

Where are microvilli located in the nephron?

A. Glomerulus

B. Proximal convoluted tubule

C. Loop of Henle

D. Collecting duct

What is secreted after implantation of the blastocyst in the uterine wall?

A. Estrogen which stimulates the degeneration of the corpus luteum

B. HCG which prevents the degeneration of the corpus luteum

C. Estrogen which prevents the degeneration of the corpus luteum

D. HCG which stimulates the degeneration of the corpus luteum

---

What is the role of HCG in early pregnancy?

A. It prevents the degeneration of the corpus luteum.
B. It initiates the development of the uterus lining.
C. It inhibits the production of estrogen.
D. It stimulates the degeneration of the corpus luteum.

In the production of monoclonal antibodies, B-cells are fused to tumour cells to make hybridoma cells. What can hybridoma cells do?

A. Divide endlessly

B. Ingest antigens

C. Become memory cells

D. Bind to antibodies

What first happens to a B lymphocyte when it becomes activated?

A. It divides by mitosis producing a clone of cells.
B. It begins transcription and produces antigens.
C. It differentiates into memory cells.
D. It produces antibodies using its extensive rough endoplasmic reticulum (rER).

What is clonal selection?

A. Production of memory B cells
B. Production of a group of identical organisms
C. Passive immunity as a result of inoculation with antibodies
D. Mitotic division of B cells activated in response to an infection

---

What is the role of HCG in early pregnancy?

A. HCG stimulates FSH secretions.
B. HCG stimulates ovarian estrogen secretion.
C. HCG stimulates ovarian progesterone secretion.
D. HCG stimulates uterine contractions.

What is the correct order of events in fertilization?

A. fusion of gametes, acrosome reaction and then cortical reaction

B. cortical reaction, fusion of gametes and then acrosome reaction

C. acrosome reaction, fusion of gametes and then cortical reaction

D. fusion of gametes, cortical reaction and then acrosome reaction

---

Which event takes place during normal fertilization?

A. The acrosome fuses with the egg membrane.
B. The entire sperm cell enters the egg cytoplasm.
C. The egg divides to form a blastocyst.
D. The cortical granules fuse with the egg membrane.

Which process is part of the mechanism that controls muscle contraction?

A. Troponin enables actin heads to attach to ATP and slide along myosin.
B. Myosin heads attach to troponin and tropomyosin pulls on actin filaments.
C. Tropomyosin attaches to calcium and breaks the bond between actin and myosin.
D. Calcium frees actin filaments for myosin heads to attach.

Which kidney adaptation would be expected in the desert kangaroo rat (*Dipodomys deserti*)?

A. Increased nephron density
B. Longer proximal convoluted tubule
C. Longer loop of Henle
D. Increased ADH receptors on the collecting duct

Which hormone is inhibited during pregnancy in order to prevent contractions of the uterus?

A. Oxytocin

B. Progesterone

C. Estrogen

D. FSH

What happens during muscle contraction?

A. The number of light bands is reduced.

B. The width of the dark bands is reduced.

C. The lengths of the sarcomeres are reduced.

D. Actin and myosin filaments coil up.

In a mammal that had just ingested a large volume of water, what would be secreted into the bloodstream?

A. More ADH (vasopressin)
B. Less epinephrine (adrenaline)
C. More epinephrine (adrenaline)

D. Less ADH (vasopressin)

A skeletal muscle contains bundles of elongated muscle fibre cells. What is the longest structure within each fibre?

A. A myosin filament

B. The sarcomere

C. A myofibril

D. The Z line

What is required to produce monoclonal antibodies?

A. T-lymphocytes and oocytes
B. T-lymphocytes and early embryo cells
C. B-lymphocytes and tumour cells
D. B-lymphocytes and stem cells

What is the role of testosterone in spermatogenesis?

A. It stimulates interstitial cells.
B. It stimulates Sertoli cells.
C. It inhibits the germinal epithelium.
D. It inhibits the prostate gland.

What would result from drinking large quantities of water?

	ADH	Permeability of the collecting duct to water
A.	secreted	increased
B.	secreted	decreased
C.	not secreted	increased
D.	not secreted	decreased

Which is the sequence of events in muscle contraction?

I. Use of ATP
II. Formation of cross bridges
III. Release of calcium ions from the sarcoplasmic reticulum
IV. Actin filament moves towards the centre of the sarcomere

A. I → II → III → IV
B. III → II → IV → I
C. IV → I → II → III
D. II → IV → I → III

Which structure is acted upon by ADH (vasopressin)?

A. Proximal convoluted tubule
B. Bowman's capsule
C. Loop of Henle
D. Collecting duct

The Bowman's capsule is a cup-shaped structure that is part of the nephron. What is the source of glucose in the fluid in the Bowman's capsule?

A. Blood in the glomerulus

B. Urine in the renal pelvis

C. Filtrate in the distal convoluted tubule

D. Interstitial fluid in the medulla

Which ions are released from the sarcoplasmic reticulum when a skeletal muscle fibre contracts?

A. Sodium
B. Potassium
C. Calcium
D. Chloride

What does the blastocyst secrete?

A. HCG

B. Estrogen

C. ADH

D. Progesterone

Which of the following best describes what happens in the glomerulus?

A. Selective reabsorption of water and molecules by active transport
B. Ultrafiltration introduces water and other molecules into the capillaries
C. Regulation of salt balance leading to the production of urine
D. High blood pressure forces water and other molecules into the tubule lumen

---

From where is human chorionic gonadotropin (HCG) secreted in early pregnancy?

A. Embryo

B. Corpus luteum

C. Ovary

D. Pituitary gland

What is an example of active immunity?

A. Antibodies passed from the mother to fetus across the placenta

B. Antibodies produced by another organism and injected to protect against a disease

C. Antibodies passed from the mother in colostrum during breastfeeding

D. Antibodies produced after the defence mechanisms have been stimulated by antigens

---

What is **directly** responsible for allergic symptoms, including a runny nose or itchy eyes?

A. Pathogens
B. Histamine
C. T-lymphocytes
D. Antigens

What is required for a skeletal muscle to exert force?

A. Extensor and flexor muscles
B. Synovial joints
C. Attachment to bones
D. Ligaments

In a healthy kidney which of these substances would you expect to find in the tubular fluid entering the loop of Henle?

I. Glucose

II. Sodium ions

III. Proteins

A. I only
B. I and II only
C. II only
D. II and III only

What is the function of the knee joint?

A. It permits movement in one plane.
B. It allows bones to glide over each other.
C. It facilitates movement in all planes.
D. It allows a wide range of movement.

What is the function of the epididymis in the male reproduction system?

A. To stimulate sperm production by secreting testosterone

B. To store the sperm in the final stages of maturation

C. To provide fluids to nourish the sperm

D. To transport the sperm from the testes to the urethra

What is a function of synovial fluid in the elbow joint?

A. Joins the humerus to the radius and ulna

B. Grows red blood cells

C. Protects the biceps

D. Allows easy movement

Which of the following events form the basis of immunity upon which the principle of vaccination is based?

	Clonal selection	Production of memory cells	Production of monoclonal antibodies	Challenge and response
A.	no	yes	yes	yes
B.	no	yes	no	yes
C.	yes	yes	yes	yes
D.	yes	yes	no	yes

During urine production, what happens if the water content of the blood is too low?

A. Membrane channels are produced in the cells of the collecting duct.
B. The pituitary gland stops secreting ADH.
C. The collecting duct becomes less permeable to water.
D. Large volumes of dilute urine are formed.

During muscle contraction, what is the role of calcium ions (Ca^{2+}) which are released from the sarcoplasmic reticulum?

A. To cause ATP hydrolysis on myosin filaments
B. To bind to both actin and myosin filaments forming a cross-bridge
C. To cause the cross-bridge to detach itself and start a new cycle
D. To cause binding sites on the actin filaments to be uncovered

---

What helps to prevent polyspermy?

A. The unequal division of oocytes

B. The placental barrier

C. The contraceptive pill

D. The cortical reaction

What is a blastocyst?

A. An unfertilized egg surrounded by follicle cells
B. An unfertilized egg cell expelled by menstruation
C. The follicle when it has swelled up with fluid
D. The embryo when it has become a hollow ball of cells

Which cells activate helper T-cells by antigen presentation?

A. B-cells

B. Bacteria

C. Macrophages

D. Plasma cells

How are B-cells activated?

A. An antibody binds to a B-cell which is activated by a helper T-cell.

B. An antigen binds to a B-cell which is activated by a helper T-cell.

C. An unattached antigen binds to a helper T-cell which activates the B-cell.

D. An antibody binds to a plasma cell which is activated by a helper T-cell.

A secondary immune response occurs when an antigen is encountered on a second occasion, due to exposure to a pathogen that previously caused infection. Which property of some viruses explains the lack of a secondary immune response?

A. Viruses fail to induce a primary response.

B. Viruses can have a high mutation rate.

C. B cells do not interact with viruses.

D. Antibodies cannot interact with viruses.

How can active immunity be acquired?

A. By having the disease
B. Injection of antibodies
C. Through colostrum
D. Via placenta

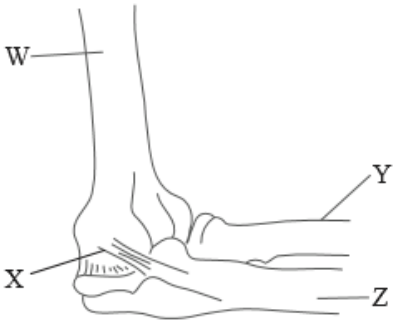
What are fused in the production of monoclonal antibodies?

A. Tumour cells and T-cells
B. Tumour cells and B-cells
C. B-cells and T-cells
D. Antibodies and antigens

What happens **immediately** after the penetration of the egg membrane by a sperm during fertilization?

A. The acrosomal reaction
B. The secondary oocyte develops
C. The blastocyst divides by mitosis
D. The cortical reaction

The diagram below shows the side view of the arm joint.



Which letter is pointing to the ulna?

A. W
B. X
C. Y
D. Z

Which of these statements about the human placenta is **incorrect**?

A. The placenta is the site of nutrient and gas exchange between the mother and fetus.
B. The placenta produces hormones, such as estrogen.
C. The placenta begins to develop after implantation of the blastocyst.
D. The mother's blood and the baby's blood mix in the placenta.

What is the role of ligaments in humans?

A. Linking bones together at a joint
B. Preventing friction at a joint
C. Contracting to move a joint
D. Attaching muscles to bones

Which is the correct sequence of stages in fertilization?

A. cortical reaction → penetration of the egg membrane → acrosome reaction

B. cortical reaction → acrosome reaction → penetration of the egg membrane

C. acrosome reaction → cortical reaction → penetration of the egg membrane

D. acrosome reaction → penetration of the egg membrane → cortical reaction

Which processes are required for the reabsorption of glucose in the kidney tubules?

I. Simple diffusion
II. Facilitated diffusion
III. Active transport

A. I and II only
B. II and III only
C. I and III only
D. I, II and III

What is a difference between spermatogenesis and oogenesis?

	Spermatogenesis	Oogenesis
A.	begins at puberty	begins at birth
B.	takes approximately 70 days	takes approximately 28 days
C.	does not require FSH	requires FSH
D.	produces four gametes per meiosis	produces one gamete per meiosis

Which hormone increases in concentration in the mother's blood during early pregnancy?

A. ADH
B. FSH
C. HCG
D. LH

Which of the following is a term for muscle cell?

A. Muscle bundle
B. Muscle fibre
C. Myofibril
D. Sarcomere

In which region of the kidney is the glomerulus found?

A. Cortex only

B. Medulla only

C. Cortex and medulla

D. Pelvis

What occurs in the body after the injection of a vaccine containing antigens?

A. Activated B-cells divide to form memory cells.
B. The receiver of the vaccine develops passive immunity.
C. Helper T-cells produce specific antibodies.
D. Macrophages are cloned and destroy the antigen.

What is produced in the body during HIV infection?

A. Anti-HIV antibiotics
B. Anti-HIV anticodons
C. Anti-HIV antibodies
D. Anti-HIV antigens

Which processes require calcium?

I. Muscle contraction
II. Movement of an action potential along an axon
III. Production of the skeleton of hard corals

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

Where is human chorionic gonadotrophin (HCG) produced?

A. Ovary
B. Anterior pituitary
C. Embryo
D. Posterior pituitary

What is the role of ligaments in humans?

A. To hold bones together
B. To hold muscles together
C. To attach bones to muscles
D. To attach nerves to muscles

What is the role of calcium in muscle contraction?

A. To release tropomyosin from myosin

B. To bind to troponin so myosin-binding sites on actin are exposed

C. To bind to tropomyosin so ATP can bind to actin

D. To release ATP from actin so myosin can bind to troponin

What is the role of ATP during contraction of a skeletal muscle fibre?

A. To uncover the myosin binding sites on actin filaments
B. To make cross-bridges between actin and myosin filaments
C. To break cross-bridges and re-set myosin heads
D. To cover the myosin binding sites on actin filaments

What is the function of the synovial fluid in the elbow joint?

A. It removes waste products from the surrounding tissue.
B. It provides glucose and oxygen to the cartilage.
C. It lubricates the joint and prevents friction.
D. It prevents the bone from becoming brittle.

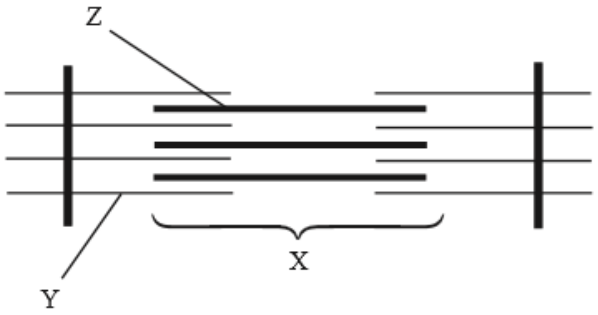
What is the role of calcium ions during muscle contraction?

A. To block the myosin binding site on actin when the muscle is not contracting
B. To move the molecules blocking the myosin binding site on actin
C. To form cross-bridges between the actin and myosin filaments
D. To provide the energy for resetting the myosin heads

What results from the fusion of tumour cells with B-cells?

A. The inability of B-cells to divide
B. The production of monoclonal antibodies
C. The production of antigens
D. The activation of helper T-cells

What is indicated by the letters X, Y and Z?



	X	Y	Z
A.	sarcomere	myosin filaments	actin filaments
B.	sarcomere	actin filaments	myosin filaments
C.	dark band	myosin filaments	actin filaments
D.	dark band	actin filaments	myosin filaments

When a pathogen is ingested by a phagocyte, which event occurs first?

A. T-cell activation
B. Memory cell proliferation
C. Antigen presentation by the phagocyte
D. B-cell activation

Which types of immunity are acquired by each of the following actions?

	Antigens injected into a child by vaccination	Antibodies crossing the placenta to the fetus	Antibodies received by baby from breastfeeding
A.	passive	passive	active
B.	passive	active	passive
C.	active	active	active
D.	active	passive	passive

What is the role of HCG (human chorionic gonadotrophin) in early pregnancy?

A. It stimulates the release of FSH (follicle stimulating hormone).
B. It maintains the corpus luteum.
C. It inhibits the release of progesterone.
D. It stimulates implantation of the blastocyst.

What is the main role of nerves in human movement?

A. To cause muscles to stretch
B. To move joints
C. To transport pain signals that indicate muscle injuries
D. To stimulate muscle contraction

Through what process does a spermatid become a functioning spermatozoan?

A. Mitosis

B. Differentiation

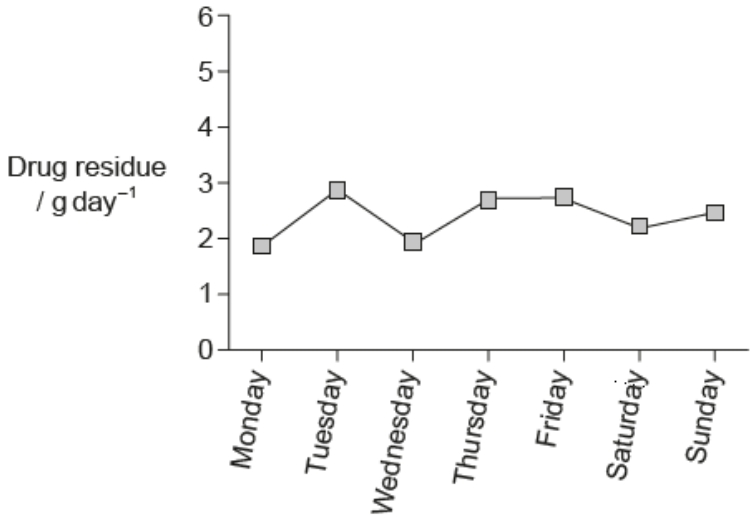
C. Fertilization

D. Meiosis

What forms the basis of immunity after vaccination?

	Production of histamines	Clonal selection	Production of memory cells
A.	yes	no	no
B.	yes	no	yes
C.	no	yes	no
D.	no	yes	yes

The graph shows the daily amount of the residue of a drug in the wastewater of a hospital.



What can be deduced from these data?

A. The drug is not fully reabsorbed by the proximal convoluted tubules.

B. The glomeruli are not permeable to the drug.

C. The collecting ducts reabsorb all of the drug.

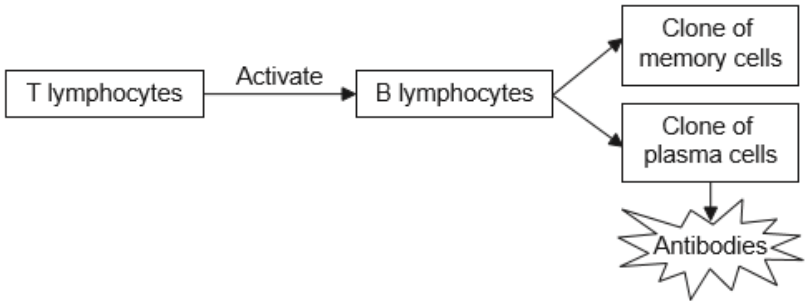
D. The drug is catabolized by the liver.

Which pair of statements best describes oogenesis and spermatogenesis?

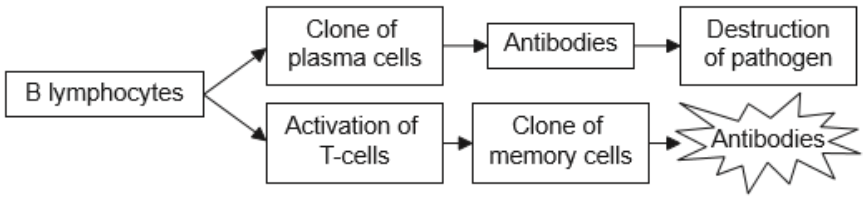
	Oogenesis	Spermatogenesis
A.	Four eggs are produced per mitosis every 28 days	Millions of sperms are produced per mitosis
B.	Four eggs are produced per meiosis every 28 days	One sperm is produced per meiosis
C.	One egg is produced per mitosis every 28 days	Millions of sperms are produced per meiosis
D.	One egg is produced per meiosis every 28 days	Four sperms are produced per meiosis

Which sequence of events leads to the production of antibodies?

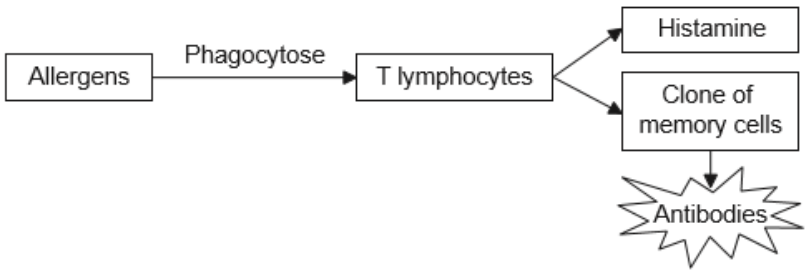
A.



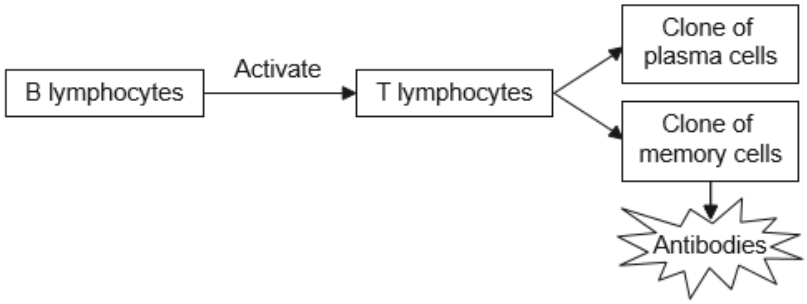
B.



C.



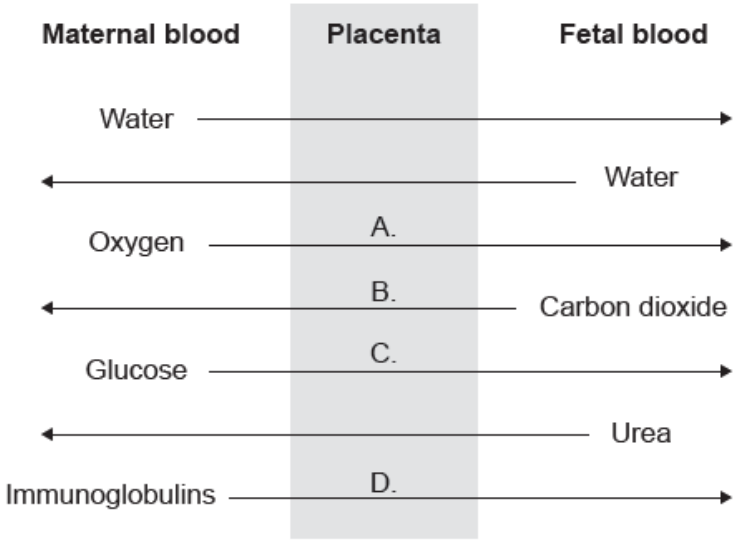
D.



What are the roles of the following structures in the production of semen?

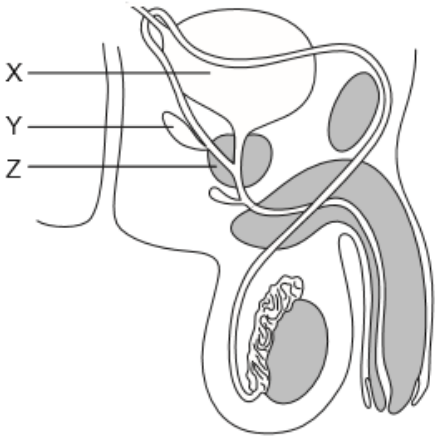
	Epididymis	Seminal vesicle	Prostate gland
A.	production of a fluid containing alkaline minerals	production of fructose	maturation of sperm
B.	maturation of sperm	production of a fluid containing citric acid	production of fructose
C.	maturation of sperm	production of fructose	production of a fluid containing alkaline minerals
D.	production of a fluid containing alkaline minerals	maturation of sperm	production of fructose

The diagram shows the exchange processes that take place in the placenta between the maternal and fetal blood. Which process requires endocytosis?



[Source : © International Baccalaureate Organization, 2017]

The image shows the male reproduction system.

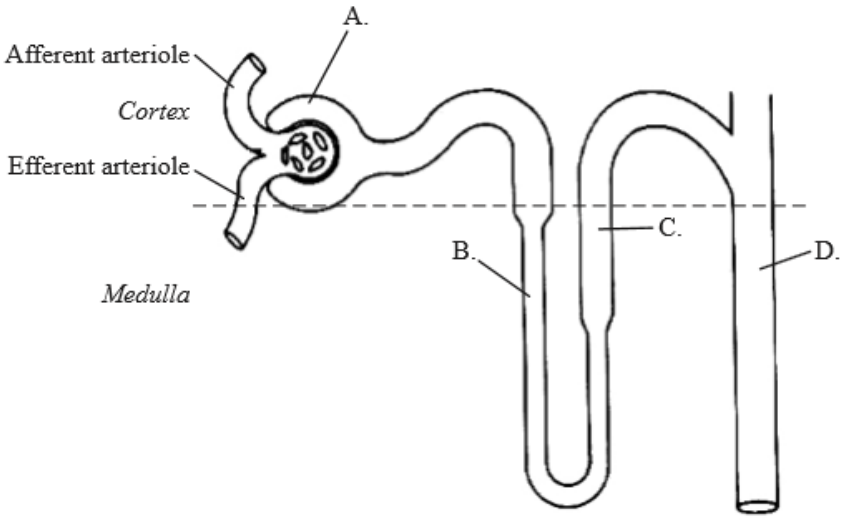


[Source: © International Baccalaureate Organization 2015]

Where is prostate cancer likely to start developing?

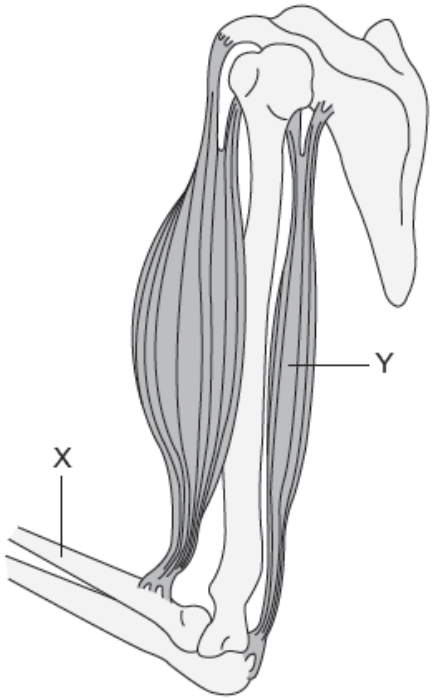
A. In X only
B. In Y and Z only
C. In Z only
D. In X, Y and Z

The diagram shows the nephron in a kidney. Which labelled part is permeable to sodium and not to water?



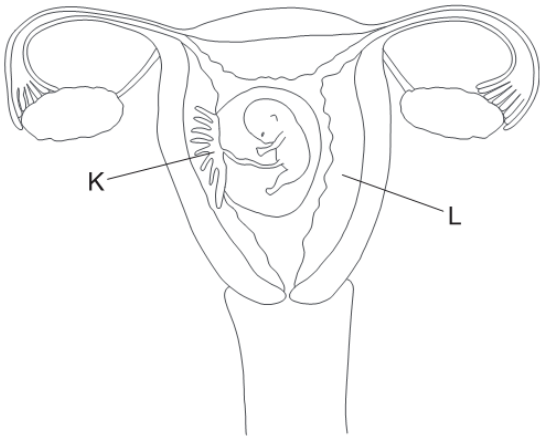
[Source: www.medcyclopaedia.com/upload/book%20of%20radiology/chapter25/nic_k251_295.jpg]

What is bone X and muscle Y in the diagram of the elbow joint?



	Bone X	Muscle Y
A.	radius	biceps
B.	radius	triceps
C.	ulna	biceps
D.	ulna	triceps

The diagram shows the female reproductive system.

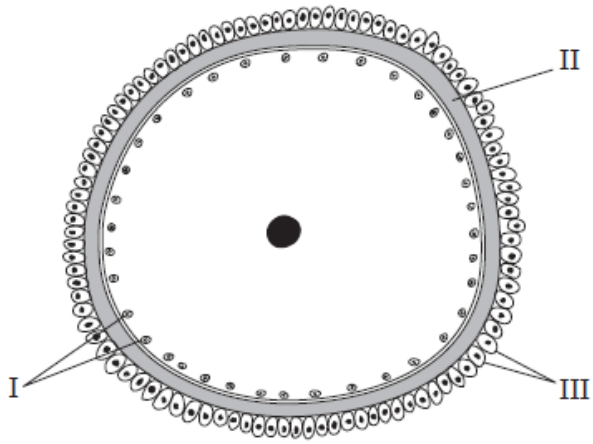


[Source: © International Baccalaureate Organization 2017]

Which structures do K and L identify?

	K	L
A.	endometrium	uterine wall
B.	placenta	endometrium
C.	amnion	placenta
D.	fetus	uterine wall

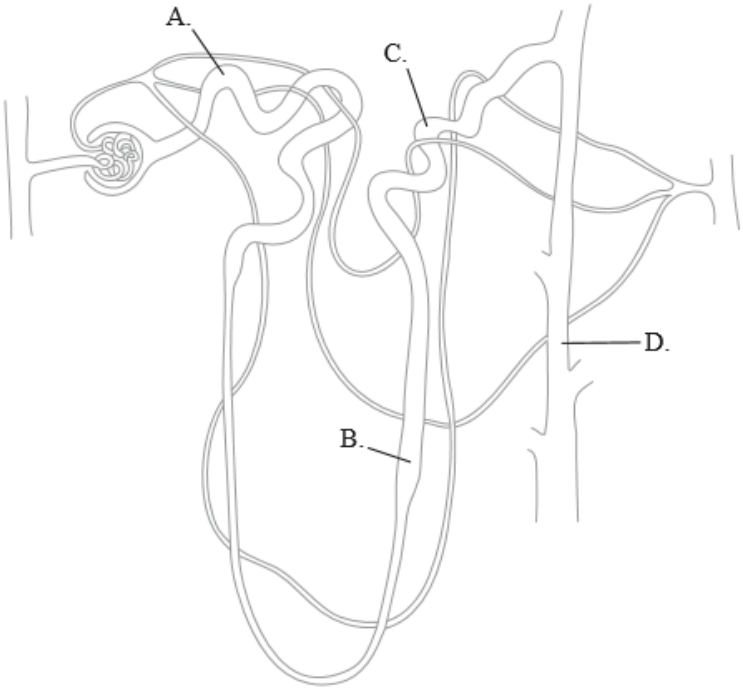
The diagram below shows a human egg.



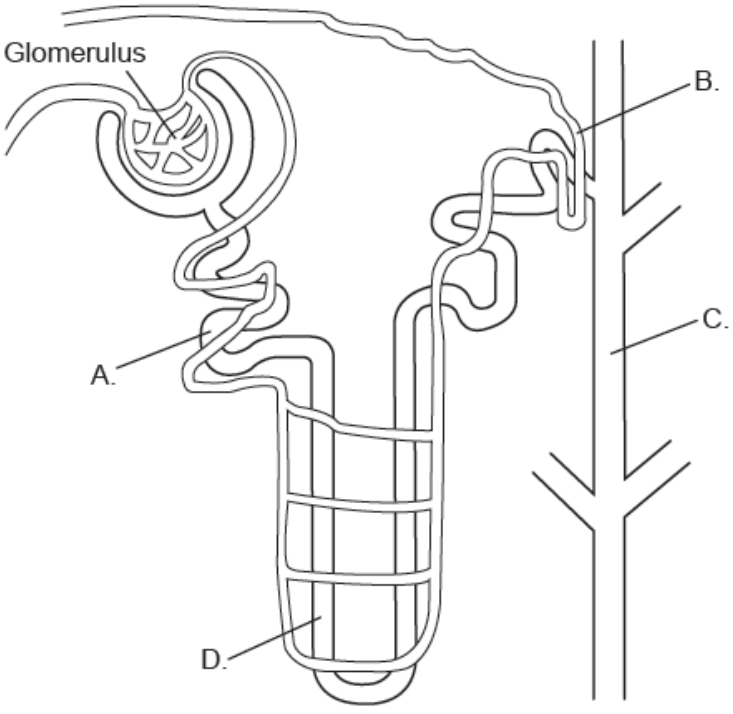
What are the structures labelled I, II and III?

	I	II	III
A.	acrosomes	zona pellucida	follicle cells
B.	acrosomes	cell wall	sperm
C.	cortical granules	cell wall	sperm
D.	cortical granules	zona pellucida	follicle cells

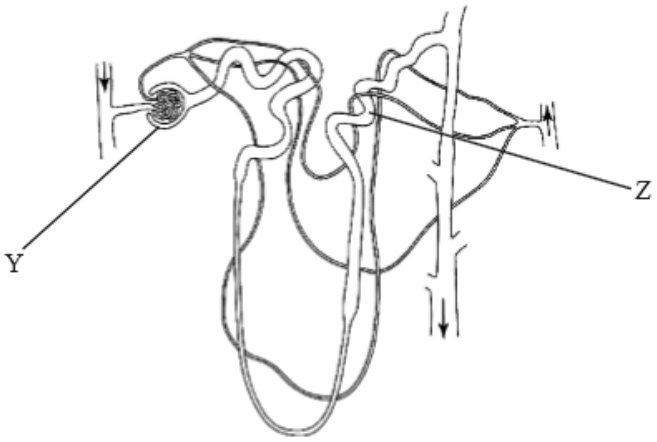
In which part of the nephron is salt secreted from the tubule to increase osmotic potential?



The diagram shows a nephron from a human kidney. In what part of the nephron would most glucose be reabsorbed?



In the diagram of the nephron below, what structures are indicated by the letters Y and Z?



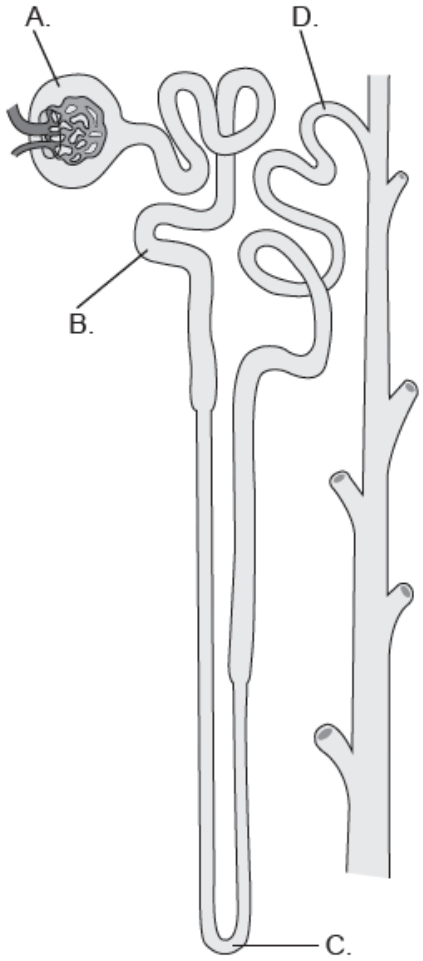
[Source: adapted from http://ex.susd.org/sjones/SGHL12007 files/image005.jpg]

	Y	Z
A.	glomerulus	collecting duct
B.	Bowman's capsule	collecting duct
C.	Bowman's capsule	distal convoluted tubule
D.	glomerulus	distal convoluted tubule

The table shows solute concentrations in normal blood plasma and the fluid in one section of the nephron.

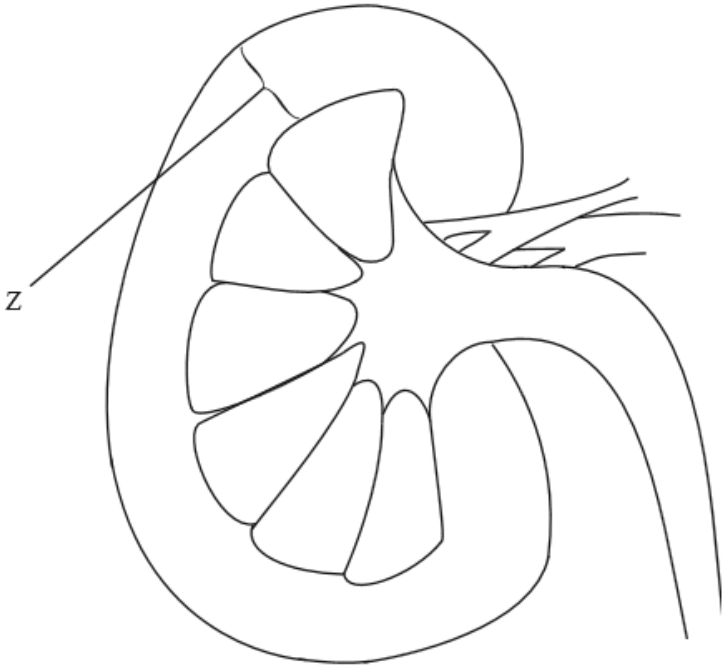
Solutes	Plasma	Fluid inside the nephron
Cl^- ions	110 mol dm^{-3}	110 mol dm^{-3}
Glucose	5 mol dm^{-3}	5 mol dm^{-3}
Urea	5 mol dm^{-3}	5 mol dm^{-3}
Proteins	750 mg dm^{-3}	3–4 mg dm^{-3}

In which section of the nephron would you expect to fi nd these concentrations?



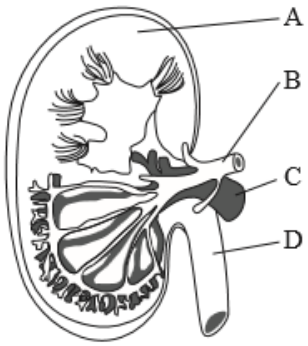
[Source: adapted from www.edu.pe.ca]

The diagram below shows a longitudinal section through a kidney. What is the structure labelled Z and what is its function?

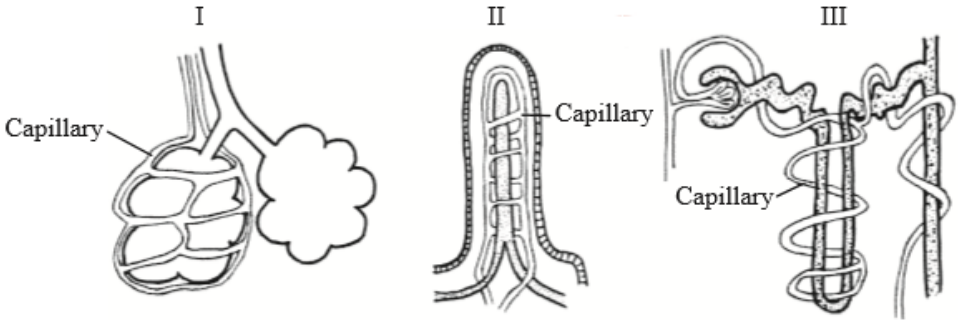


	Structure Z	Function
A.	cortex	osmoregulation
B.	medulla	ultrafiltration
C.	cortex	ultrafiltration
D.	pelvis	osmoregulation

In the following diagram of the kidney, which structure contains urine?

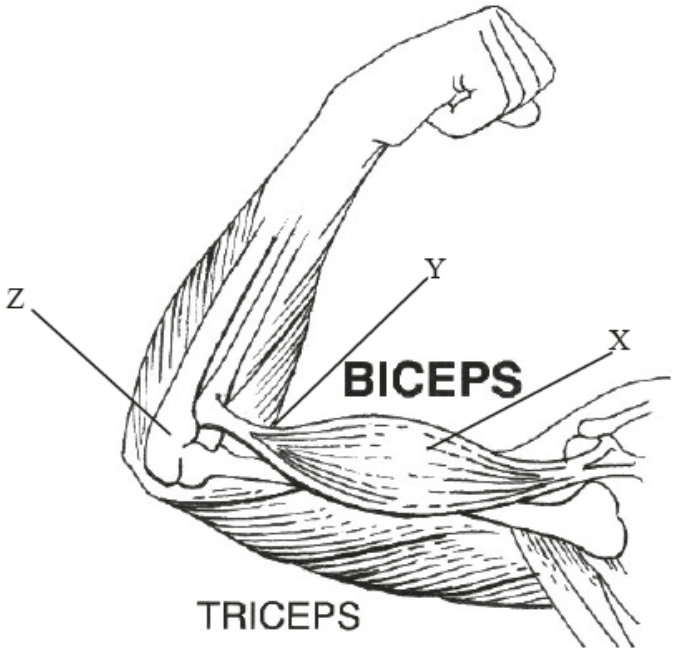


Where are structures I, II and III found in the human body?



	I	II	III
A.	kidney	large intestine	brain
B.	lungs	small intestine	kidney
C.	lungs	large intestine	kidney
D.	kidney	small intestine	brain

The following is a diagram of the elbow joint.

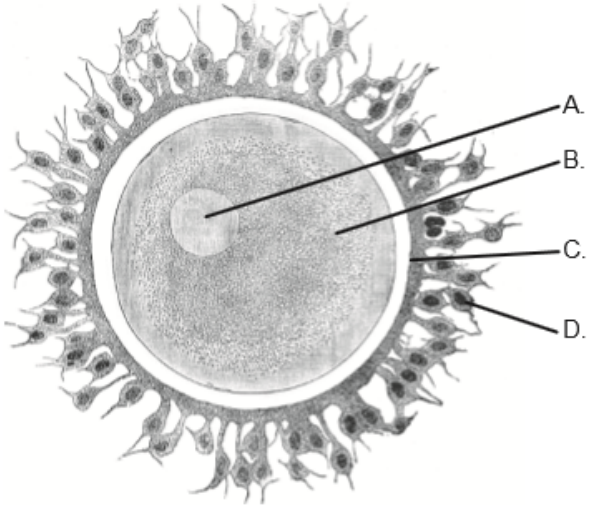


[Source: http://commons.wikimedia.org/wiki/File:Biceps_%28PSF%29.jpg]

What structures are indicated by the letters X, Y and Z?

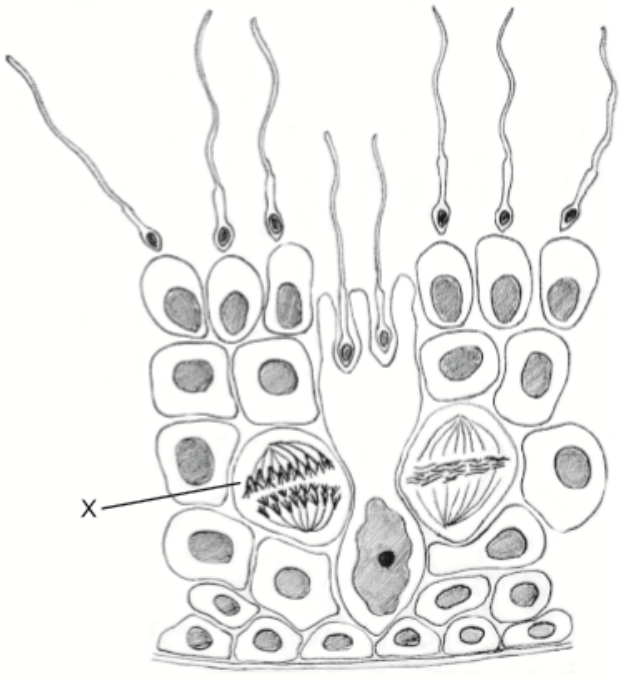
	X	Y	Z
A.	triceps	tendon	radius
B.	biceps	ligament	ulna
C.	biceps	tendon	humerus
D.	triceps	ligament	humerus

Where does the acrosome reaction occur?



[Source: Adapted from http://upload.wikimedia.org/wikipedia/commons/8/81/Gray3.png]

The image shows a section of a seminiferous tubule.

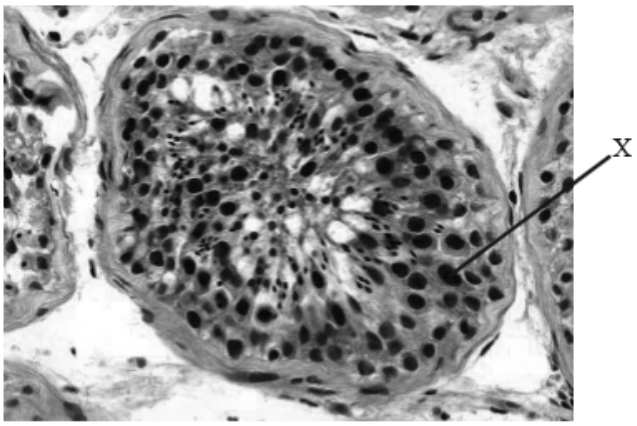


[Source: © International Baccalaureate Organization 2016]

What is shown by the letter X?

A. Meiosis I in a primary spermatocyte
B. A spermatogonium undergoing mitosis
C. Meiosis II in a secondary spermatocyte
D. A spermatid undergoing meiosis

The micrograph shows the structure of a testis undergoing spermatogenesis.

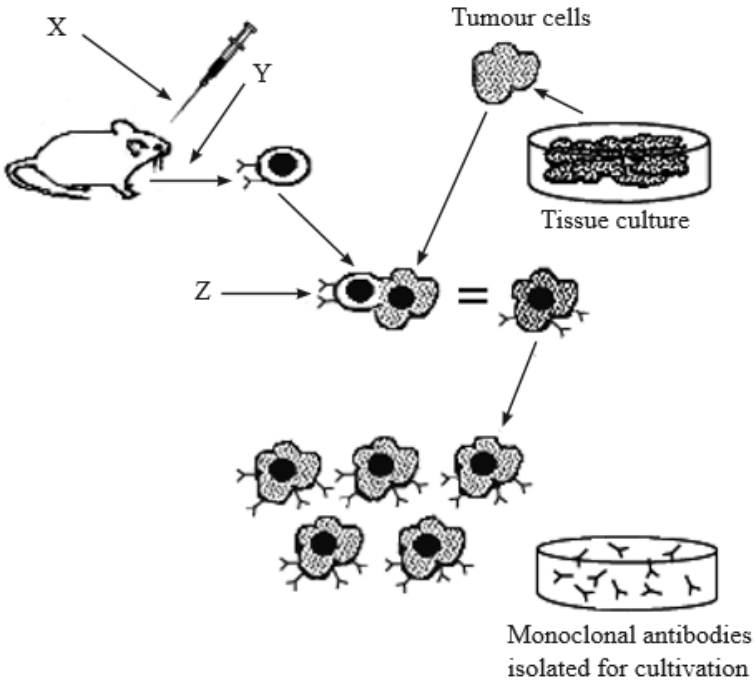


[Image courtesy of WebPathology.com]

What is the structure labelled X?

A. Sperm
B. Sertoli cell
C. Leydig cell
D. Germinal epithelium cell

The diagram below shows some stages in the production of monoclonal antibodies. What are stages X, Y and Z?

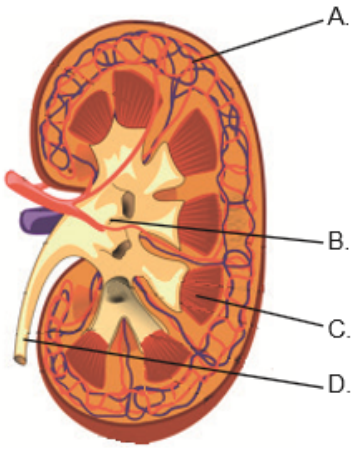


[Source: adapted from http://www.accessexcellence.org/RC/VL/GG/monoclonal.html]

	X	Y	Z
A.	injection of antibody	isolation of B-cell	fusion between B-cell and tumour cell resulting in plasma cell
B.	injection of antibody	isolation of T-cell	fusion between T-cell and tumour cell resulting in plasma cell
C.	injection of antigen	isolation of T-cell	fusion between T-cell and tumour cell resulting in hybridoma cell
D.	injection of antigen	isolation of B-cell	fusion between B-cell and tumour cell resulting in hybridoma cell

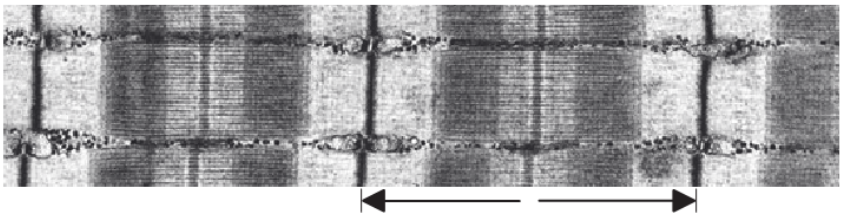
---

Which letter correctly identifies the medulla?



[Source: "KidneyStructures PioM" by Piotr Michał Jaworski; PioM EN DE PL – Own work. Licensed under CC BY-SA 3.0 via Wikimedia Commons – https://commons.wikimedia.org/wiki/File:KidneyStructures_PioM.svg#/media/File:KidneyStructures_PioM.svg]

What structure is indicated by the arrows?



[Source: Courtesy Roger Craig, University of Massachusetts]

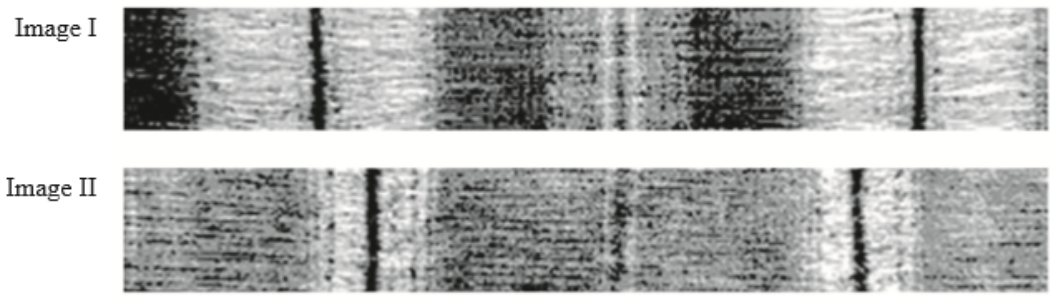
A. One muscle fibre

B. One sarcomere

C. One myofibril

D. One Z line

The images below show muscle tissue.

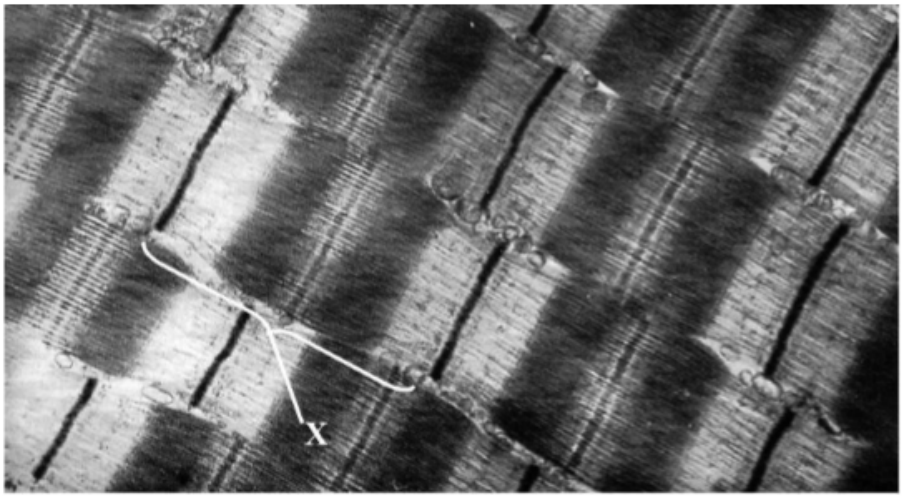


[Source: (Figure) from *Biology Course Companion* by Andrew Allott and David Mindorff (OUP, 2007), copyright © 2007, reprinted by permission of Oxford University Press.]

Which image shows contracted muscle tissue?

A. I because the dark band is narrower.
B. II because the Z lines are closer together.
C. II because there is less overlap between actin and myosin.
D. I because the dark bands are darker.

What does label X indicate?



A. Sarcolemma
B. Sarcomere
C. Sarcoplasmic reticulum
D. Endoplasmic reticulum
