Diploma Programme
Programme du diplôme
Programa del Diploma

# Biology
# Higher level
# Paper 1

17 May 2023

**Zone A** afternoon | **Zone B** morning | **Zone C** afternoon

1 hour

**Instructions to candidates**

- Do not open this examination paper until instructed to do so.
- Answer all the questions.
- For each question, choose the answer you consider to be the best and indicate your choice on the answer sheet provided.
- The maximum mark for this examination paper is **[40 marks]**.

2223–6013



19 pages

1. What cell component is found in eukaryotic cells but not in prokaryotic cells?

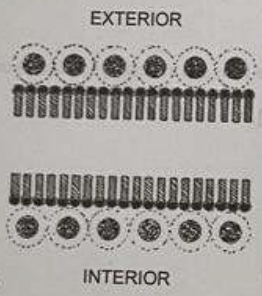
   A. Mitochondria for respiration

   B. DNA containing genetic information

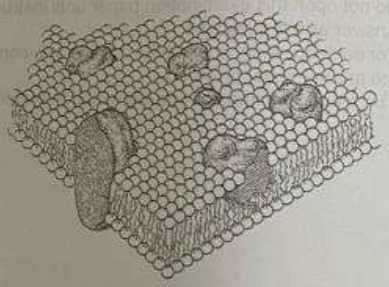
   C. Ribosomes for protein synthesis

   D. Cell wall to maintain shape

2. The drawings are from two original papers that proposed a structure of the cell membrane.




Davson–Danielli



Singer–Nicolson

For what reason is the Singer–Nicolson model considered a better representation of the cell membrane than the Davson–Danielli model?

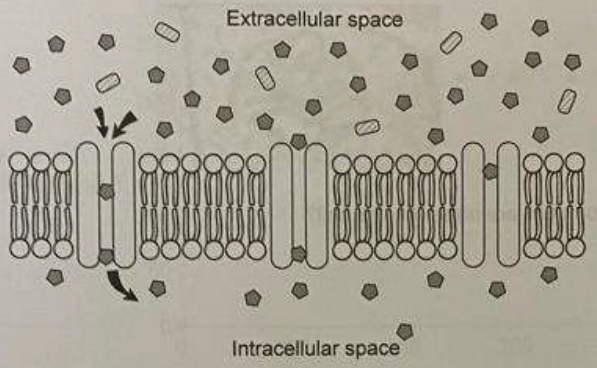
   A. It has extrinsic proteins.

   B. It shows how the phospholipid bilayer is arranged.

   C. It helps in the understanding of the fluidity of the cell membrane.

   D. It shows how oxygen can diffuse into the cell.

3. The diagram shows protein channels involved in the passive movement of a substance into the cell across the cell membrane.




What describes this movement?

A. Energy of ATP is used to transport substances into the cell.

B. Substances can move from areas of low to areas of high concentration.

C. The proteins ensure that movement of substances is only in one direction.

D. Movement occurs until the concentrations in and out of the cell are equal.

4. What is evidence for the endosymbiotic theory?

A. Eukaryote mitochondria contain DNA.

B. Prokaryotes evolved before eukaryotes.

C. Unicellular organisms exist as both prokaryotes and eukaryotes.

D. Prokaryote cells have no double membranes.

5. The image shows a cell from the root tip of an onion (*Allium cepa*) (2n = 16) during late prophase of mitosis.

How many chromatids are present in the cell?

A. 8

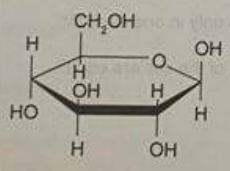
B. 16

C. 32

D. 64

6. Which drawing represents beta-D-glucose?

A.

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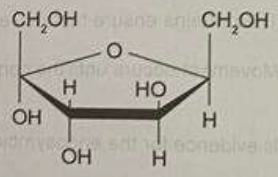


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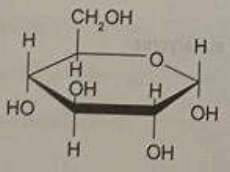


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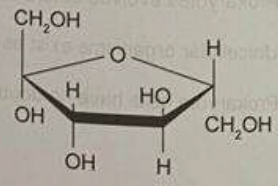



7. What is the proteome of an individual?

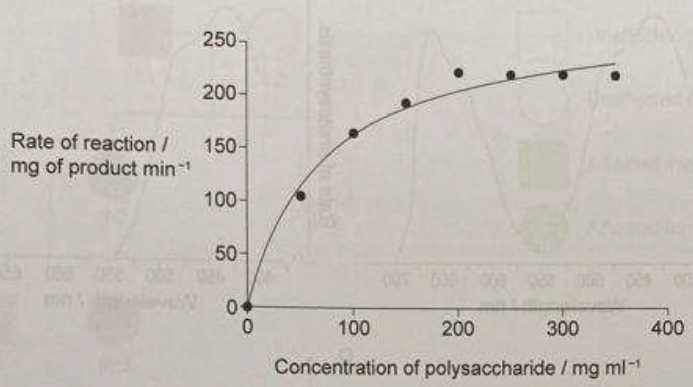
A. The amino acids unique to an individual making up the proteins in cells

B. The way in which an individual's polypeptides are folded into a three-dimensional structure

C. The proteins synthesized as an expression of an individual's genes

D. All possible combinations of amino acids an individual contains

8. In the grass plant *Halopyrum mucronatum*, the enzyme amylase breaks bonds in polysaccharides during germination. The graph shows how the activity of the enzyme varies with the concentration of polysaccharide.




What is the reason for the curve levelling off?

A. There is insufficient substrate for the enzyme to act on.

B. The product acts as an enzyme inhibitor.

C. The enzymes have all been consumed in the reaction.

D. All the enzyme active sites are occupied by substrate.

9. The anticodons of three tRNAs and the amino acids they carry are shown in the table.

| tRNA anticodon | Amino acid |
|---|---|
| GCA | Arginine |
| AAU | Leucine |
| CAG | Valine |

Which base sequence of an mRNA molecule would code for an arginine–leucine–valine tripeptide?

A. GCA AAU CAG

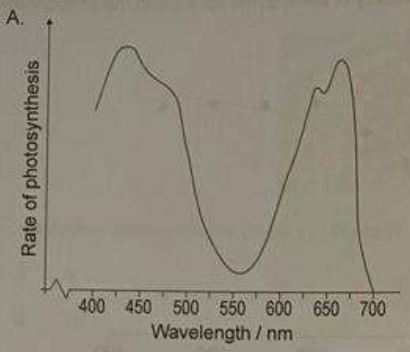
B. GCA AAT CAG

C. CGT TTA GTC

D. CGU UUA GUC

**10.** Which graph represents the action spectrum for a green plant receiving only blue light?

A.

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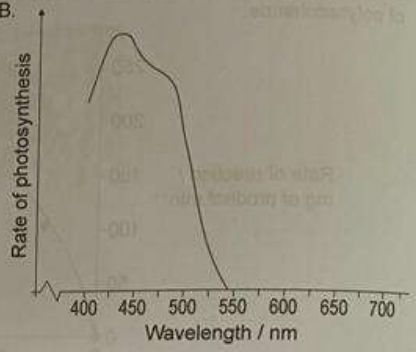


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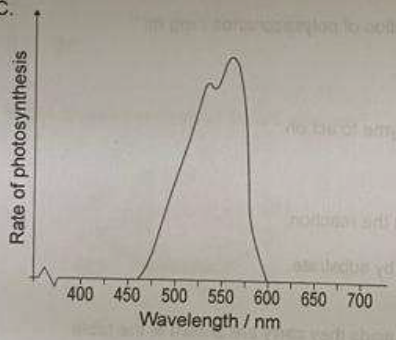


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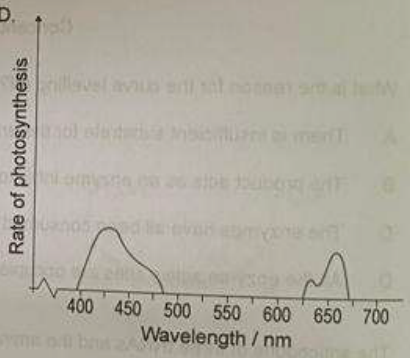



**11.** What change causes sickle cell anemia?

A. One amino acid less in a polypeptide of hemoglobin

B. A mutation leading to an extra codon in the genome

C. Thymine replacing adenine in DNA

D. Failure of tRNA to correctly transcribe the sequence of codons from mRNA

**12.** At what stage of meiosis do chromosome pairing and crossing over occur?

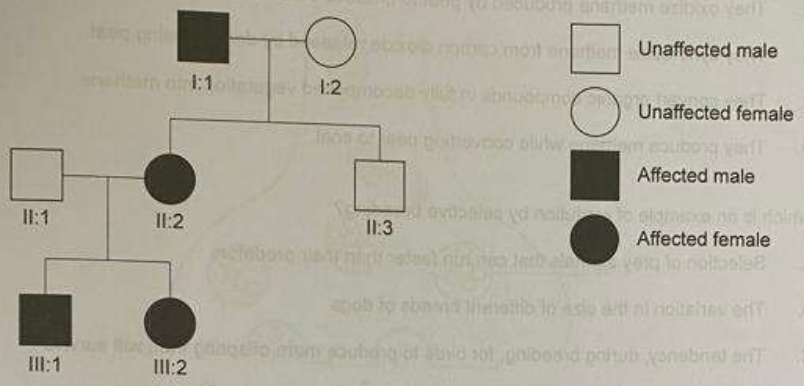
A. Interphase

B. Prophase 1

C. Metaphase 1

D. Prophase 2

**13.** The pedigree chart shows the inheritance of three generations of Duane syndrome, a condition caused by a dominant allele that affects alignment of the eyes.




If individuals II:1 and II:2 had a third child, what is the probability that the child would have Duane syndrome?

A. 25%

B. 50%

C. 75%

D. 100%

**14.** What is combined in the production of cloned embryos by somatic-cell nuclear transfer?

A. An egg cell without a nucleus and the nucleus of a somatic cell

B. An egg cell nucleus and a somatic cell without a nucleus

C. An egg cell with a nucleus and a somatic cell with a nucleus

D. An egg cell nucleus and a somatic cell nucleus

**15.** Which statement applies to transfers in an ecosystem?

A. Green plants can transfer heat energy from the sun into chemical energy.

B. The greatest loss of energy occurs towards the end of a food chain.

C. Production of carbon dioxide by respiration results in loss of biomass in a food chain.

D. Both energy and nutrients are finite and must be recycled.

16. How do methanogenic archaeans living in peat bogs obtain energy to survive?

A. They oxidize methane produced by peat to produce carbon dioxide and water.

B. They synthesize methane from carbon dioxide released by decomposing peat.

C. They convert organic compounds in fully decomposed vegetation into methane.

D. They produce methane while converting peat to coal.

17. Which is an example of evolution by selective breeding?

A. Selection of prey animals that can run faster than their predators

B. The variation in the size of different breeds of dogs

C. The tendency, during breeding, for birds to produce more offspring than will survive

D. Some female spiders only breeding with males which make the right signals

18. Which statement best describes how evolution occurs?

A. Species which produce the most offspring are favoured by natural selection.

B. Mutations in somatic cells are passed on to offspring.

C. Natural selection decreases the frequency of unfavourable characteristics.

D. Changes in species lead towards greater complexity over time.

19. What occurs during inspiration?

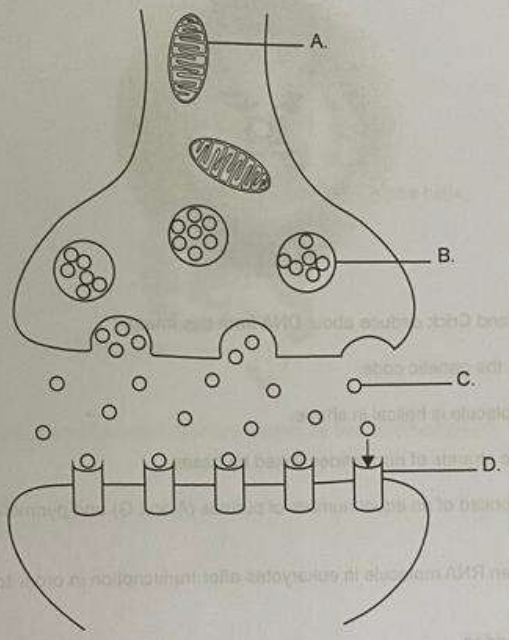
A. Internal intercostal muscles contract, increasing the pressure in the thorax.

B. Internal intercostal muscles contract, decreasing the pressure in the thorax.

C. External intercostal muscles contract, decreasing the pressure in the thorax.

D. External intercostal muscles contract, increasing the pressure in the thorax.

**20.** The diagram represents transmission across a cholinergic synapse. Where would a neonicotinoid pesticide act to prevent synaptic transmission?




**21.** For what reason are daily FSH injections given during IVF treatment?

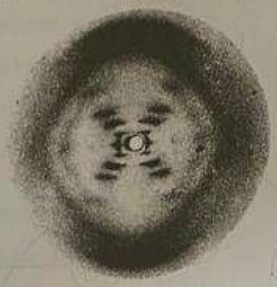
A. To suppress the natural menstrual cycle

B. To induce the ovary to produce more eggs than normal

C. To prepare the lining of the ovary for embryo transfer

D. To prevent the development of multiple embryos

**22.** The image shows an X-ray diffraction photograph produced by Rosalind Franklin.



What did Watson and Crick deduce about DNA from this image?

A. DNA carries the genetic code.

B. The DNA molecule is helical in shape.

C. DNA has two strands of nucleotides linked by bases.

D. DNA is composed of an equal number of purines (A and G) and pyrimidines (C and T).

**23.** What happens to an RNA molecule in eukaryotes after transcription in order to process it into mRNA?

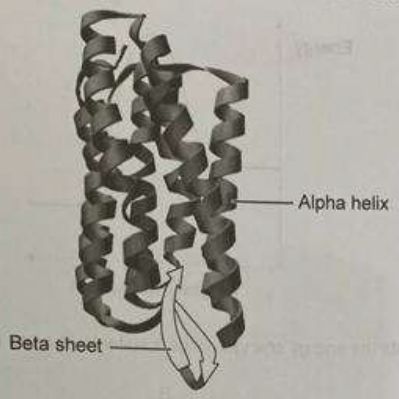
A. Introns are added.

B. Exons are removed.

C. Adenine nucleotides are added at the 3' end.

D. Adenine nucleotides are removed from the 5' end.

24. Bacteriorhodopsin is a membrane protein in bacteria that acts as a protein pump. Its structure consists of a single polypeptide strand. An alpha helix and a beta sheet are labelled.




What is the highest level of protein structure shown by bacteriorhodopsin?

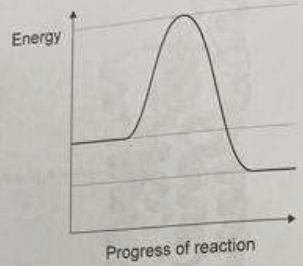
A. Primary

B. Secondary

C. Tertiary

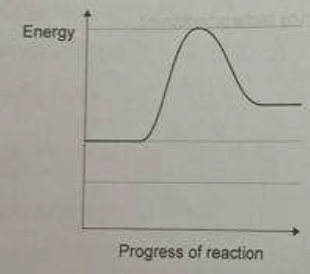
D. Quaternary

**25.** The graph shows the energy changes during a chemical reaction. The horizontal lines represent the original energy values.




Which graph represents the energy changes once a suitable enzyme has been added?

A.

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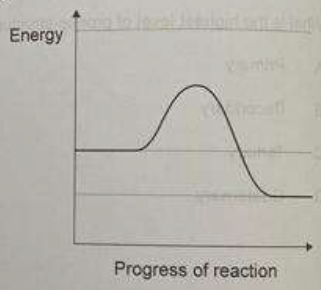


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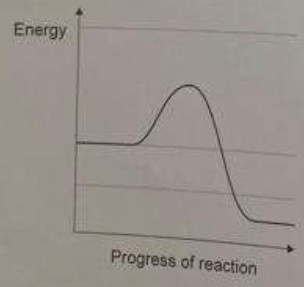


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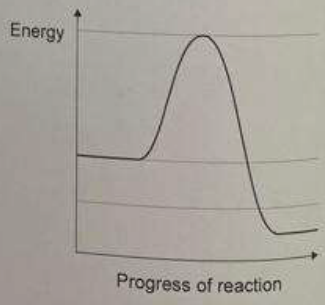



**26.** Which part of aerobi

A. Conversion of

B. Accepting elec

C. Oxidizing acet

D. Production of

**27.** The micrograph sho

What reaction takes

A. Carboxylation

B. Photolysis of

C. Generation of

D. Reduction of

26. Which part of aerobic respiration directly involves oxygen molecules?

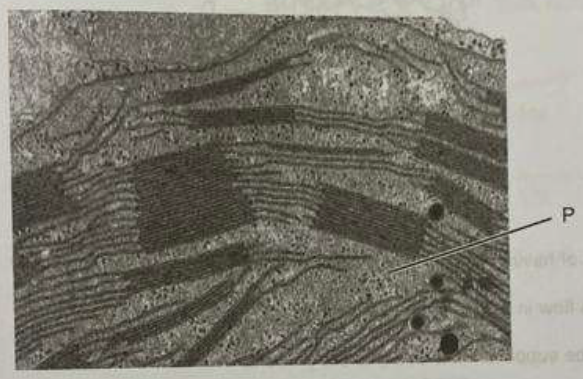
A. Conversion of glucose to pyruvate

B. Accepting electrons from the electron transport chain

C. Oxidizing acetyl groups in the Krebs cycle

D. Production of NAD from reduced NAD

27. The micrograph shows part of a chloroplast.




What reaction takes place in region P?

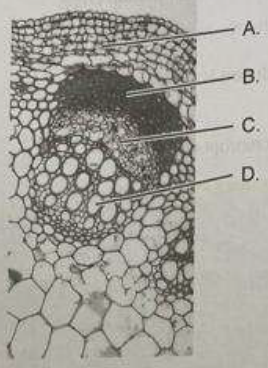
A. Carboxylation of ribulose bisphosphate

B. Photolysis of water molecules

C. Generation of ATP by ATP synthase

D. Reduction of NAD in Photosystem I

**28.** The stem of a young plant is cut through and the cut end is immersed in water containing a red dye. The plant continues to transpire as normal. In what region of the stem would the red colour be visible soon after immersion?




**29.** What is a benefit of having xylem vessels close to phloem sieve tubes in plants?

A. Sugars can flow in both xylem vessels and phloem.

B. Water can be supplied more easily to the phloem.

C. A high concentration of solutes can be established at the source.

D. Hydrostatic pressure can be established to move sugars to the source.

**30.** The gra
was illu

What

A.

B.

C.

D.

**31.** What

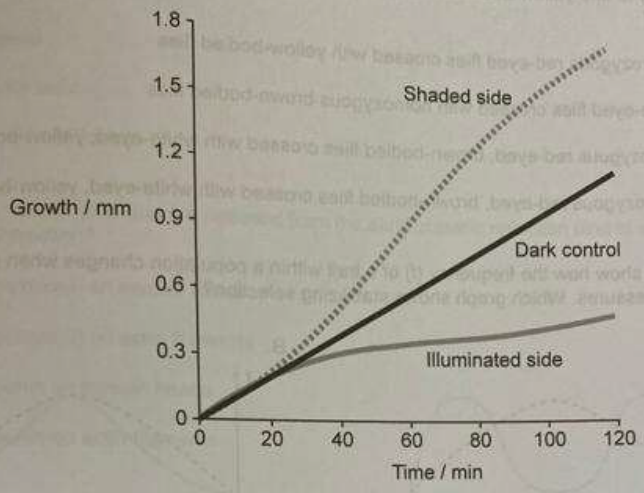
A.

B.

C.

D.

30. The graph shows the increase in length of a shoot (coleoptile) of maize, *Zea mays*, when one side was illuminated. A control shoot was kept in the dark.




What would be a reason for the differences in growth rate?

A. Auxins are inhibited by light.

B. Auxins move from the illuminated side to the shaded side.

C. A phototropic response causes the shoot to bend towards the shaded side.

D. Shoots grow faster in the light than in the dark.

31. What is a result of crossing over in meiosis?

A. Gene linkage

B. Non-disjunction

C. Haploid cells

D. Variation in gametes

**32.** In the fruit fly *Drosophila*, the alleles for red eyes and brown bodies are dominant to the alleles for white eyes and yellow bodies. Which cross would be suitable to determine whether the genes are linked?

A. Heterozygous red-eyed flies crossed with yellow-bodied flies

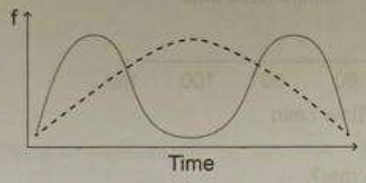
B. White-eyed flies crossed with homozygous brown-bodied flies

C. Homozygous red-eyed, brown-bodied flies crossed with white-eyed, yellow-bodied flies

D. Heterozygous red-eyed, brown-bodied flies crossed with white-eyed, yellow-bodied flies

**33.** The graphs show how the frequency (f) of a trait within a population changes when subjected to selection pressures. Which graph shows stabilizing selection?

A.

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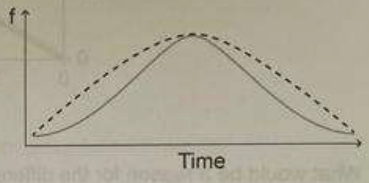


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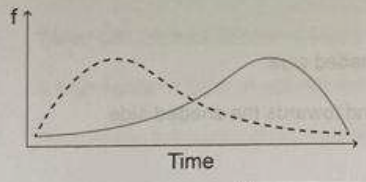


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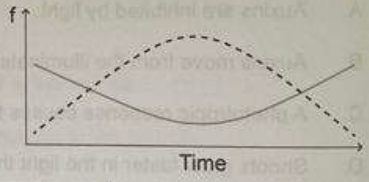



**Key**: ---- Before selection
—— After selection

**34.** What can occur as a result of exposure to an allergen such as pollen?

A. T lymphocytes produce antibodies.

B. Memory cells release antihistamine.

C. The allergen acts directly on the blood vessels, causing vasodilation.

D. White blood cells release histamine.

35. What is fused with tumour cells in the production of monoclonal antibodies?

A. Hybridoma cells

B. Antigens

C. Plasma cells

D. Specific antibodies

36. Where do calcium ions that are released from the sarcoplasmic reticulum bind to stimulate muscle contraction?

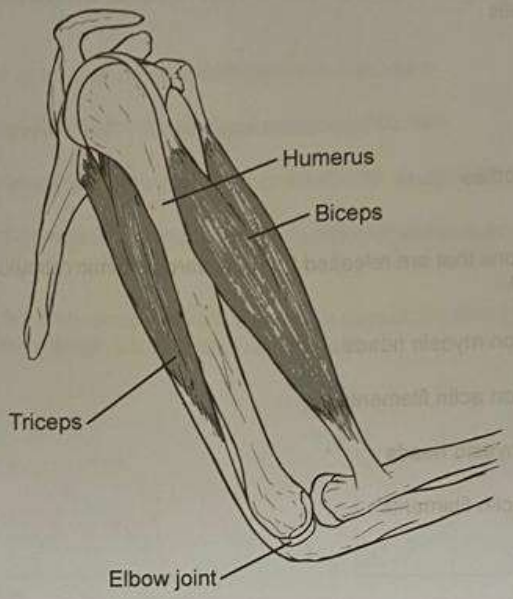
A. Tropomyosin on myosin heads

B. Tropomyosin on actin filaments

C. Troponin on myosin heads

D. Troponin on actin filaments

**37.** The diagram shows the bones, muscles and tendons of the elbow joint.




Which muscle is the extensor and to which bone is it attached?

| | Muscle | Bone |
|---|---|---|
| A. | Biceps | Radius |
| B. | Biceps | Ulna |
| C. | Triceps | Radius |
| D. | Triceps | Ulna |

38. Where is the greatest quantity of water reabsorbed from the nephron?

A. Bowman's capsule

B. Proximal convoluted tubule

C. Loop of Henle

D. Collecting duct

39. At what stage of spermatogenesis does the first division of meiosis occur?

A. Spermatogonium to primary spermatocyte

B. Primary spermatocyte to secondary spermatocyte

C. Secondary spermatocyte to spermatid

D. Spermatid to mature sperm cell

40. Which statement applies to the placenta?

A. Carbon dioxide diffuses from fetus to mother across the placenta.

B. Maternal and fetal blood mix at the placenta.

C. If an ovum is not fertilized the placenta is lost during menstruation.

D. The umbilical cord connects the placenta to the mother's abdomen.