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Biology
Higher level
Paper 1

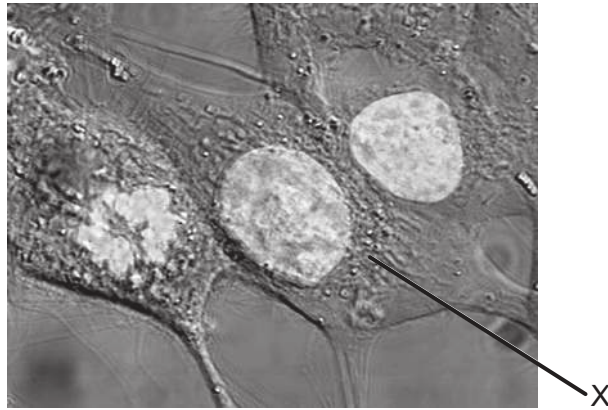
Thursday 9 May 2019 (afternoon)

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]**.

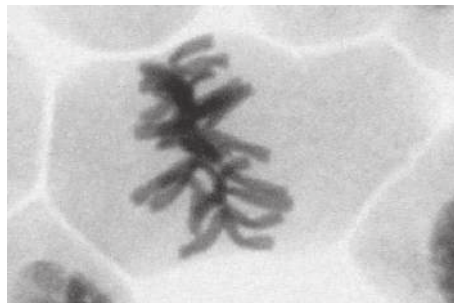
1. The magnification of the micrograph is 2000 \times .



[Source: https://upload.wikimedia.org/wikipedia/commons/6/6c/HeLa_cells_stained_with_Hoechst_33258.jpg by TenOfAllTrades.]

What is the maximum diameter of the nucleus in the cell labelled X?

- A. 10 μm
 - B. 10 nm
 - C. 20 μm
 - D. 20 nm
2. The image shows a micrograph of a cell.



[Source: © 2014, [https://commons.wikimedia.org/wiki/File:Mitosis_\(261_13\)_Pressed;_root_meristem_of_onion_\(cells_in_prophase,_metaphase,_anaphase,_telophase\).jpg](https://commons.wikimedia.org/wiki/File:Mitosis_(261_13)_Pressed;_root_meristem_of_onion_(cells_in_prophase,_metaphase,_anaphase,_telophase).jpg) by Doc. RNDr. Josef Reischig, CSc.]

What explains the appearance of the cell in the micrograph?

- A. The cell is dying.
- B. The DNA is replicating.
- C. The cell is in metaphase.
- D. The cell is in telophase.

3. Which processes are involved in the development of cancer?

- I. Mutations occur in oncogenes.
- II. Oncogenes prevent cancer.
- III. Oncogenes affect cell cycle regulatory proteins.

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

4. The table shows concentrations of potassium ions and sodium ions inside and outside human cells.

Ions	Concentration of ions / $10^{-3} \text{ mol dm}^{-3}$	
	Intracellular	Extracellular
Potassium ions	135	4
Sodium ions	10	145

[Source: © International Baccalaureate Organization 2019]

What explains these concentrations?

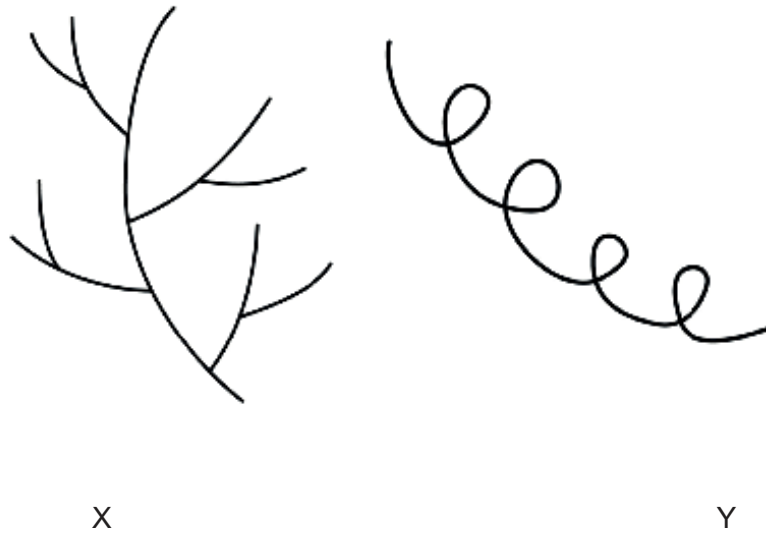
- A. Potassium ions diffuse in and sodium ions diffuse out.
- B. Sodium ions diffuse in and potassium ions diffuse out.
- C. Active transport pumps sodium ions in and potassium ions out.
- D. Active transport pumps sodium ions out and potassium ions in.

5. Where do hydrogen bonds form?

- A. Between the slight negative charge of hydrogen and slight positive charge of oxygen within a water molecule
- B. Between the slight positive charge of hydrogen and slight negative charge of oxygen within a water molecule
- C. Between the slight positive charge of hydrogen and slight negative charge of oxygen in different water molecules
- D. Between the slight negative charge of hydrogen and slight positive charge of oxygen in different water molecules

Turn over

6. The diagram shows two polysaccharides, formed from condensation of many glucose molecules.



[Source: © International Baccalaureate Organization 2019]

What are the names of X and Y?

	X	Y
A.	glycogen	amylose
B.	amylopectin	amylase
C.	amylase	glycogen
D.	amylose	amylopectin

7. Which statement correctly describes genome and proteome?
- A. Only the genome but not the proteome can be analysed using gel electrophoresis.
 - B. The genome and the proteome are the same in all tissues in an organism.
 - C. In cells of different tissues, the genome is the same while the proteome varies.
 - D. Only mutations in the proteome but not in the genome cause any variability.

8. The base sequences of a short section of DNA are shown, together with mRNA that has been transcribed from it and one of the tRNA anticodons that could be used to translate the mRNA.

DNA strand 1 A-C-G-G-C-A-T-T-A-G-C-T-A

tRNA anticodon U-U-A

DNA strand 2 T-G-C-C-G-T-A-A-T-C-G-A-T

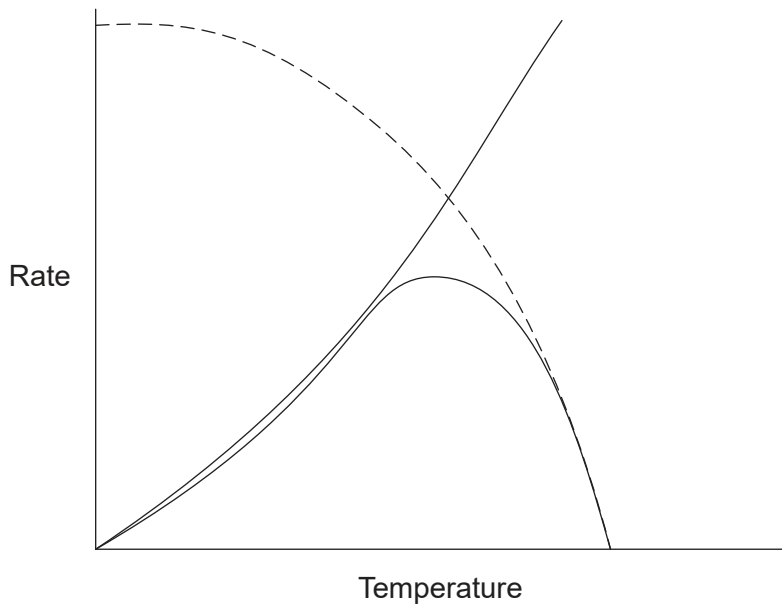
mRNA

U-G-C-C-G-U-A-A-U-C-G-A-U

Which strand of DNA is transcribed and to which codon in the mRNA would the tRNA anticodon bind during translation?

	DNA strand transcribed	mRNA codon that tRNA anticodon binds to
A.	DNA strand 1	second
B.	DNA strand 2	second
C.	DNA strand 1	third
D.	DNA strand 2	third

9. The graph shows the activity of an enzyme at different temperatures.



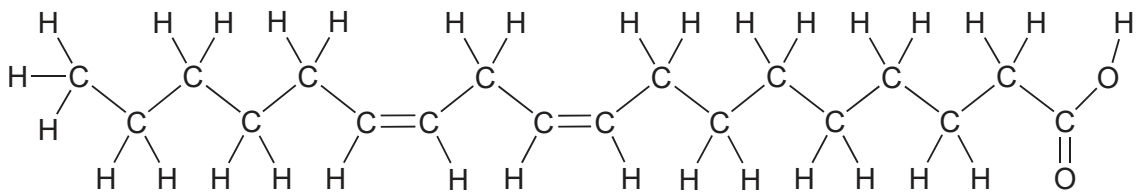
[Source: © International Baccalaureate Organization 2019]

What does the dashed line in the graph represent?

- A. Increasing temperature increases substrate concentration.
- B. Increasing temperature affects the active site.
- C. Increasing temperature increases the rate of reaction.
- D. Increasing temperature decreases the movement of particles.

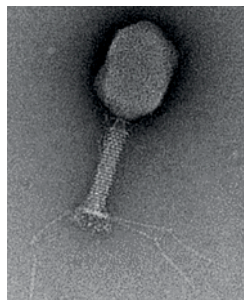
Turn over

10. The diagram shows a type of fatty acid.



What type of fatty acid is shown?

- A. Trans unsaturated
 - B. Cis unsaturated
 - C. Trans saturated
 - D. Cis saturated
11. Hershey and Chase used a bacteriophage (a virus that infects bacteria) to investigate the chemical nature of genes. The diagram shows a bacteriophage.



[Source: Graham Knott and Christel Genoud, 'Commentary: is EM dead?', *Journal of Cell Science* (2013), 126: 4545–4552, reproduced with permission. <http://jcs.biologists.org/content/126/20/4545.figures-only> doi: 10.1242/jcs.124123 <http://www.biologists.com/journal-of-cell-science>]

The sulphur in the protein and the phosphorus in the DNA of the bacteriophage were radioactively labelled. The data obtained after bacterial infection and centrifugation are shown in the table.

Sample source	Supernatant	Pellet
Radioactive sulphur	80 %	20 %
Radioactive phosphorus	30 %	70 %

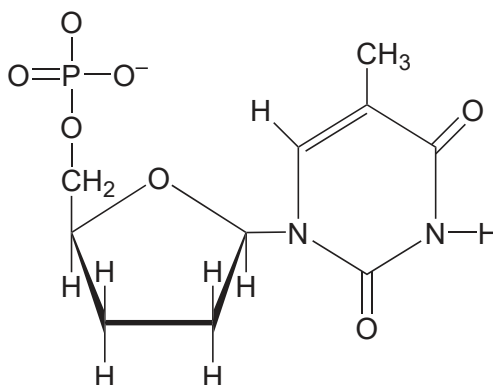
What did Hershey and Chase conclude from their experiment?

- A. DNA was mainly outside the bacterial cells.
- B. Viruses infect bacterial cells with proteins.
- C. Viral DNA was found within the bacterial cells.
- D. Neither protein nor DNA were chemicals making up genes in viruses.

12. What are the functions of DNA primase and DNA polymerase I in DNA replication?

	DNA primase	DNA polymerase I
A.	adds a short DNA primer to the template strand	replaces RNA with DNA in the Okazaki fragments of the leading strand
B.	adds a short DNA primer to the template strand	replaces DNA primers with RNA
C.	adds a short RNA primer to the template strand	replaces RNA with DNA in the Okazaki fragments of the leading strand
D.	adds a short RNA primer to the template strand	replaces RNA primers with DNA

13. A nucleotide containing dideoxyribose is shown.



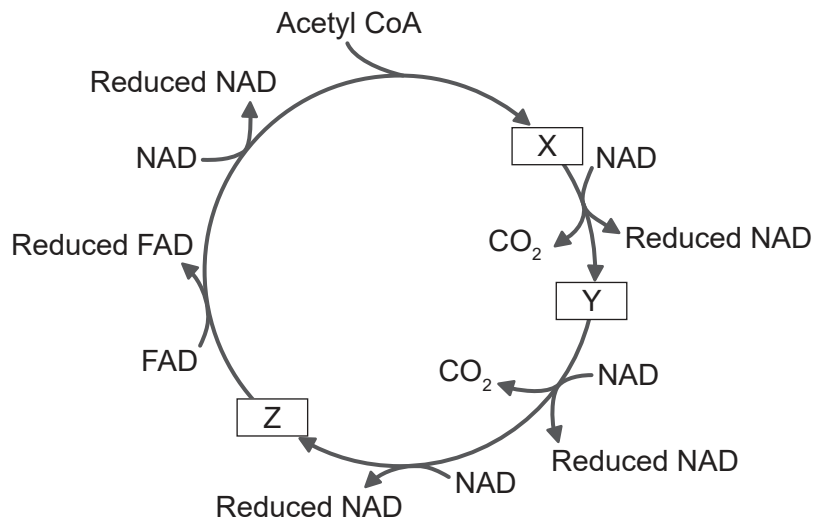
What is the reason for the use of dideoxynucleotides to terminate sequences in base sequencing?

- A. Nucleotides cannot form 5' to 3' linkages with dideoxynucleotides.
- B. Nucleotides cannot form base pairs with dideoxynucleotides.
- C. Dideoxynucleotides cannot form hydrogen bonds with deoxyribose.
- D. Dideoxynucleotides do not have all four nitrogenous bases.

Turn over

14. What applies to DNA base sequences?
- I. Some genes do not code for proteins.
 - II. Promoters are transcribed along with the gene.
 - III. Introns are only found within genes coding for proteins.
- A. I only
 - B. II only
 - C. II and III only
 - D. I, II and III

15. The diagram shows compounds in the Krebs cycle labelled as X, Y and Z.



[Source: © International Baccalaureate Organization 2019]

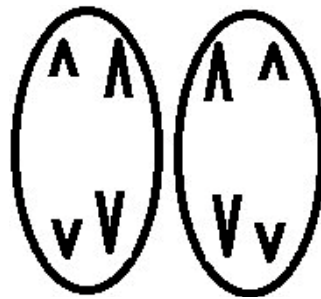
How many carbon atoms are there in Y and in the acetyl group of acetyl CoA?

Number of carbon atoms	
Y	Acetyl CoA
A. 5	2
B. 4	2
C. 5	3
D. 4	3

16. Which protein is identified with its function?

	Protein	Function
A.	collagen	provides strength and support for tissues and organs
B.	rhodopsin	enzyme found in tears
C.	insulin	raises blood glucose concentrations
D.	immunoglobulin	helps in blood clotting

17. The diagram shows a stage in cell division.



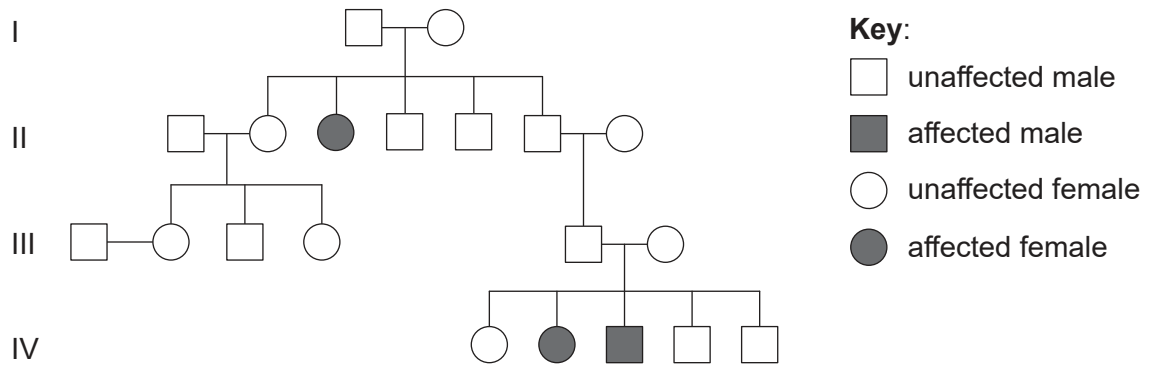
[Source: © International Baccalaureate Organization 2019]

What is the stage shown?

- A. Anaphase I of mitosis
- B. Anaphase II of mitosis
- C. Anaphase I of meiosis
- D. Anaphase II of meiosis

Turn over

18. The pedigree chart shows a family affected by cystic fibrosis.



[Source: © International Baccalaureate Organization 2019]

What is the genotype of the affected boy's father?

- A. AA only
 - B. Either AA or Aa
 - C. Aa only
 - D. aa only
19. The cheetah (*Acinonyx jubatus*) is a large cat found in Africa. It has been discovered that organs could be transferred between any two individuals without rejection of the organ. What is the probable reason for this?
- A. Cheetahs have poor reproductive success.
 - B. Cheetahs have high heterozygosity.
 - C. Cheetahs have a large gene pool.
 - D. Cheetahs have a small gene pool.

20. William Bateson and Reginald Punnett used the sweet pea (*Lathyrus odoratus*) in genetics studies in the early 20th century. Pure-breeding plants that produced purple flowers and long pollen grains were crossed with pure-breeding plants that produced red flowers and round pollen grains. The resulting offspring all produced purple flowers and long pollen grains. Two of the F₁ generation plants were crossed. The table shows the ratio of phenotypes in the F₂ generation.

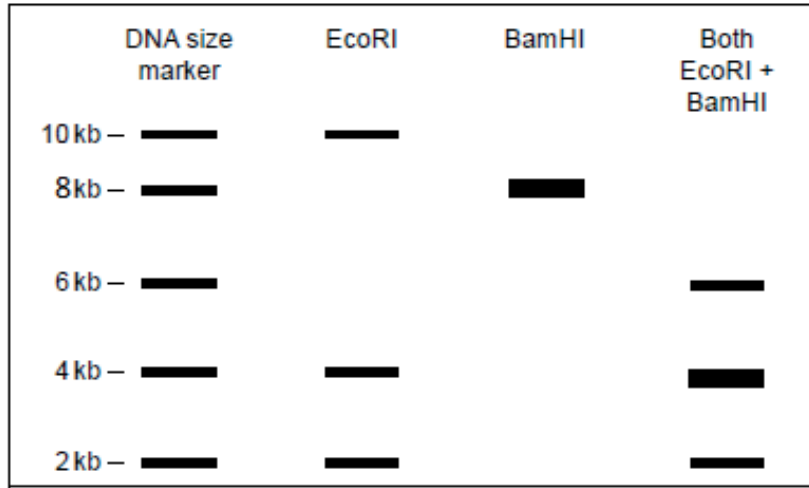
Flower colour	Pollen grain shape	Number of plants
purple	long	4831
purple	round	390
red	long	393
red	round	1138

What is an explanation for these experimental results?

- A. Purple flowers and long pollen grains are dominant and the alleles have assorted independently.
 - B. The genes for flower colour and pollen shape are linked and all plants producing long pollen grains are recombinants.
 - C. The genes for flower colour and pollen shape are linked and all plants producing red flowers are recombinants.
 - D. Plants producing purple flowers and round pollen grains arose through crossing over.
21. Genetically modified maize, called Bt maize, is thought to be affecting the monarch butterfly (*Danaus plexippus*) in the USA. What is the reason for this?
- A. The monarch butterfly feeds on maize nectar, which contains Bt toxin.
 - B. The monarch caterpillar feeds on maize leaves, which contain Bt toxin.
 - C. Bt toxin kills the plants that the monarch caterpillar usually eats.
 - D. Bt toxin is in maize pollen, which blows on to plants that the monarch caterpillar eats.

Turn over

22. Two restriction endonucleases (EcoRI and BamHI) were used to cut a DNA sample into smaller fragments. These were then subjected to gel electrophoresis and the results are shown. The lengths of the DNA fragments are measured in kilobases (kb). One kilobase is 1000 DNA bases.



[Source: © International Baccalaureate Organization 2019]

Which statement is supported by the data?

- A. The DNA sample is approximately 16 kb in size.
 - B. Each endonuclease produces a 2 kb fragment.
 - C. Both endonucleases produce the same number of fragments.
 - D. The fragments produced using both endonucleases are all different from those produced by the individual endonucleases.
23. The global carbon cycle involves sinks where carbon is stored, and fluxes where carbon is transferred. What are the largest sink and flux?

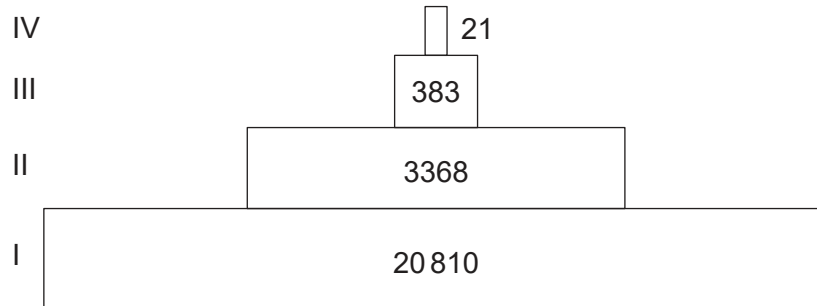
	Sink	Flux
A.	atmosphere	combustion
B.	oceans	respiration
C.	oceans	photosynthesis
D.	limestone	photosynthesis

24. In an ecosystem, in the transfer of carbon from producers to consumers, what is carbon transferred as?

- I. Carbon dioxide
- II. Protein
- III. Hydrogencarbonate ions

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

25. The Silver Springs feed into the Silver River in Florida. The diagram shows a pyramid of energy for the Silver Springs ecosystem. The units are $\text{kJ m}^{-2} \text{y}^{-1}$.

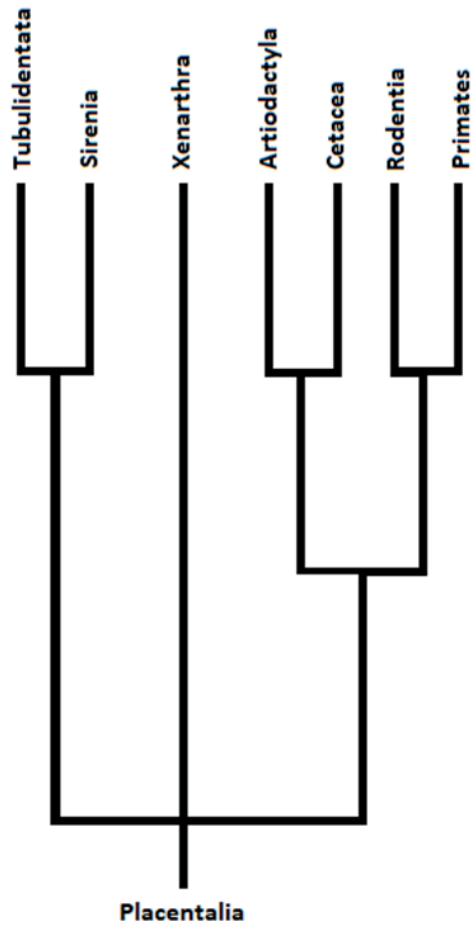


[Source: © International Baccalaureate Organization 2019]

What do level I and level III represent in the pyramid of energy?

	I	III
A.	sunlight	secondary consumer
B.	producer	tertiary consumer
C.	producer	secondary consumer
D.	primary consumer	tertiary consumer

26. The cladogram shows some major orders of placental mammals and is based on biochemical evidence.



[Source: © International Baccalaureate Organization 2019]

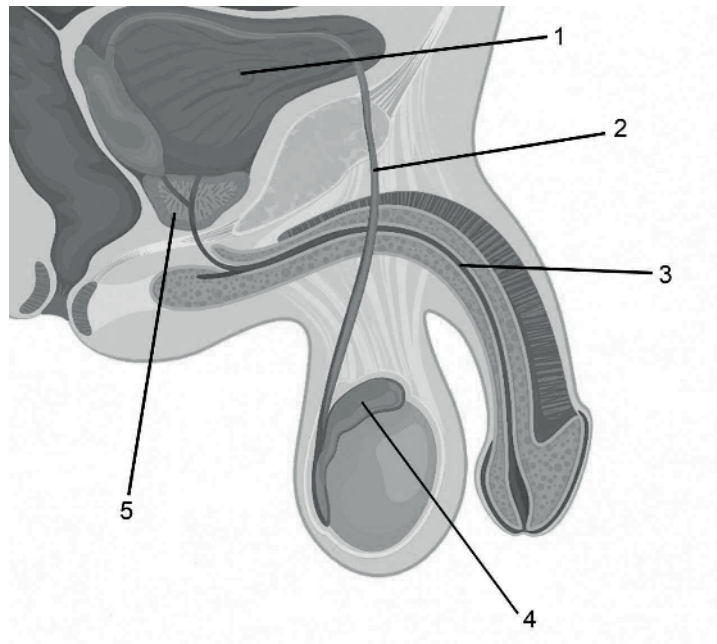
Which conclusion can be drawn from evidence in the cladogram?

- A. Primates and Sirenia have not evolved from a common ancestor.
 - B. Primates and Cetacea do not form part of any clade.
 - C. Cetacea are less closely related to Sirenia than to Primates.
 - D. Xenarthra have not been changed by evolution for longer than other clades.
27. If seeds of an unknown species of plant are discovered, what assumption can be made about the species?
- A. Its male gametes are contained within pollen.
 - B. Its seeds are contained within fruits.
 - C. It is in the domain archaea.
 - D. It is in the phylum angiospermophyta.

28. Which is the hierarchy of taxa in order of increasing numbers of species?
- A. genus, family, order, class
 - B. class, order, genus, family
 - C. genus, family, class, order
 - D. class, order, family, genus
29. What causes the atrioventricular valves to close during a heartbeat?
- A. Pressure in the atria is higher than in the ventricles.
 - B. Pressure in the atria is lower than in the ventricles.
 - C. Pressure in the arteries is higher than in the ventricles.
 - D. Pressure in the arteries is lower than in the ventricles.
30. What observation did William Harvey use as evidence for the circulation of blood?
- A. The ventricles of the heart pump blood out into arteries.
 - B. Valves ensure unidirectional flow of blood.
 - C. Capillaries carry blood from arteries to veins.
 - D. All organs of the body have a separate blood supply.

Turn over

31. The diagram shows the human male reproductive system.



[Source: logika600/Shutterstock]

Which numbers indicate a gland providing fluid for sperm and a tube that transports sperm only?

	Gland providing fluid for sperm	Tube transporting sperm only
A.	1	2
B.	5	3
C.	4	3
D.	5	2

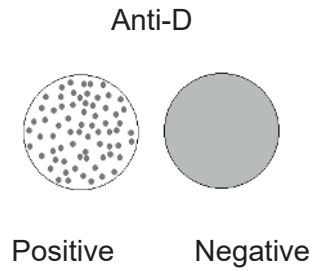
32. The hormones insulin, glucagon, thyroxin and leptin can all affect energy storage in the body. Which hormone increases the rate of energy release and use?

- A. Insulin
- B. Glucagon
- C. Thyroxin
- D. Leptin

33. What is the function of the loop of Henle?
- A. To reabsorb salt
 - B. To maintain a hypertonic solution in the medulla
 - C. To transport liquid from the collecting ducts to the convoluted tubules
 - D. To reabsorb glucose
34. What is the nitrogenous waste excreted in insects?
- A. Urea
 - B. Uric acid
 - C. Ammonia
 - D. Urine
35. What are features of both endoskeletons of mammals and exoskeletons of insects?
- A. They are both made of bone.
 - B. They both have cartilage.
 - C. They are both moved by antagonistic sets of muscles.
 - D. Both consist of dead tissue.

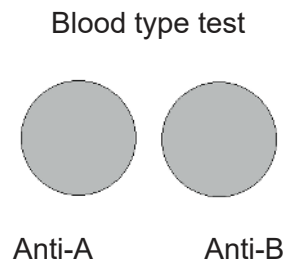
Turn over

36. The blood of two men was tested and the results are shown. Anti-D refers to the rhesus blood group. Clotting indicates that antigens associated with a particular factor or blood group are present in a blood sample.



[Source: © International Baccalaureate Organization 2019]

The man who tested positive for anti-D was then tested for ABO blood group. These results were obtained.

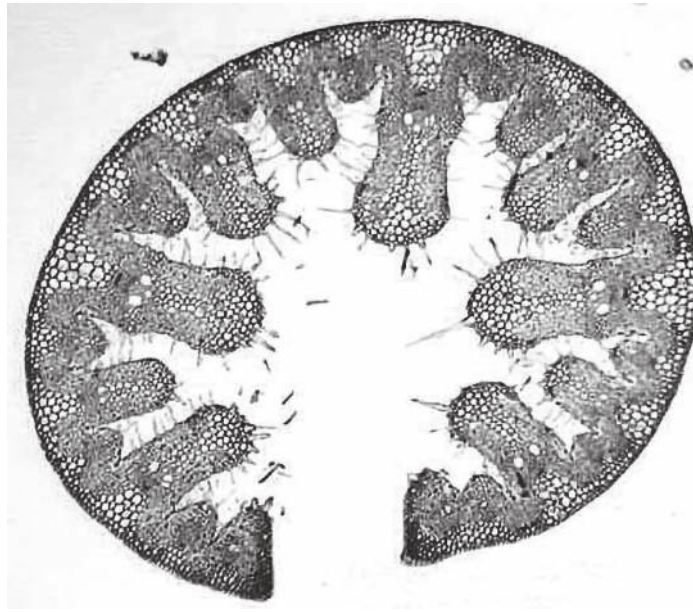


[Source: © International Baccalaureate Organization 2019]

What ABO blood group does the man testing positive for anti-D have?

- A. A
 - B. B
 - C. AB
 - D. O
37. What is the order of increasing size of muscle structures?
- A. muscle, muscle fibre, myofibril, sarcomere
 - B. myofibril, muscle fibre, sarcomere, muscle
 - C. sarcomere, myofibril, muscle fibre, muscle
 - D. muscle fibre, sarcomere, myofibril, muscle

38. The image is a cross section through an *Ammophila* leaf, which grows on coastal sand dunes.



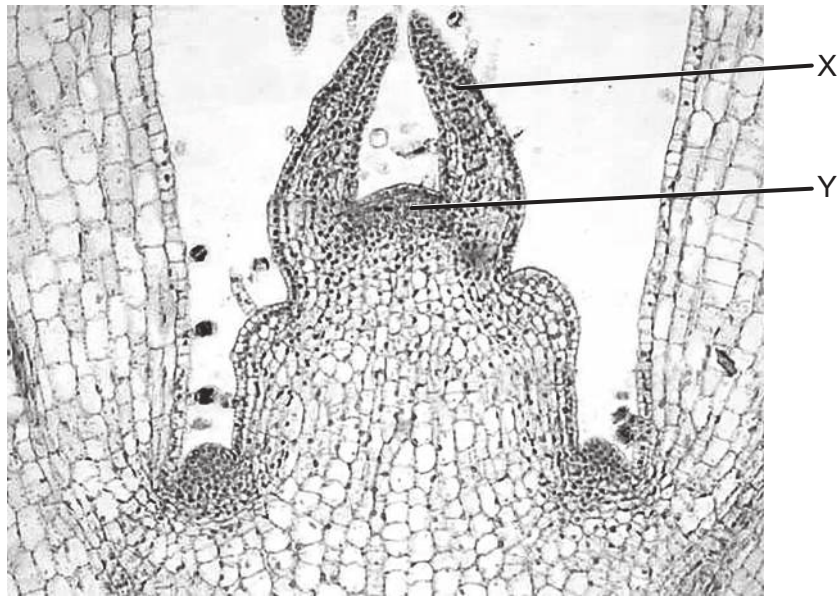
[Source: Charles Good: The Ohio State University at Lima]

What feature suggests that *Ammophila* is a xerophyte?

- A. The leaf surface area is increased.
- B. The rolled leaf reduces the upper epidermis area.
- C. The rolled leaf protects the lower epidermis from the wind.
- D. The lower epidermis can transpire more easily.

Turn over

39. The photomicrograph shows a section through the top of a plant shoot.



[Source: Charles Good: The Ohio State University at Lima]

What are the structures labelled X and Y?

	X	Y
A.	developing bud	xylem
B.	developing leaf	xylem
C.	developing bud	meristem
D.	developing leaf	meristem

40. What could be used in a technique for measuring flow rates in phloem?

- I. Potometers
 - II. Aphid stylets
 - III. $^{14}\text{CO}_2$
- A. I and II only
- B. I and III only
- C. II only
- D. II and III only