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Biology
Higher level
Paper 1

Thursday 9 May 2019 (afternoon)

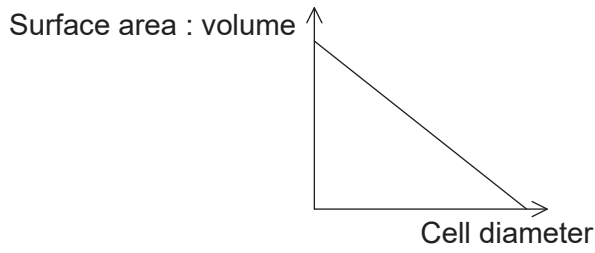
1 hour

Instructions to candidates

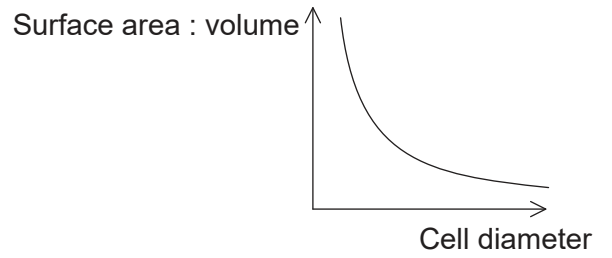
- Do not open this examination paper until instructed to do so.
- Answer all the questions.
- For each question, choose the answer you consider to be the best and indicate your choice on the answer sheet provided.
- The maximum mark for this examination paper is **[40 marks]**.

1. Which graph represents the change in cell surface area to volume ratio with increasing cell diameter?

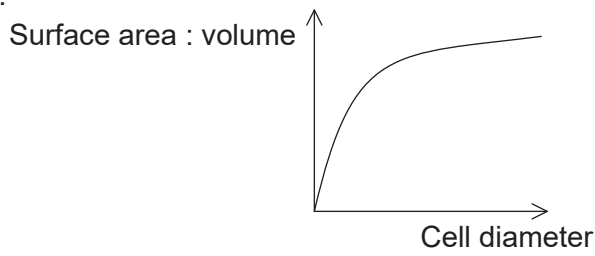
A.



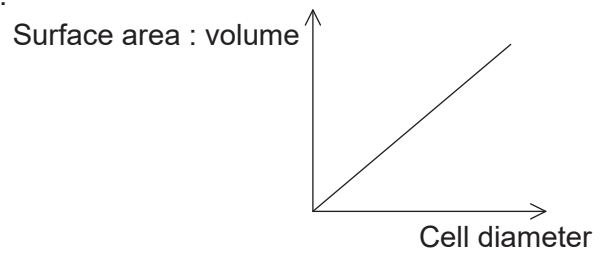
B.



C.

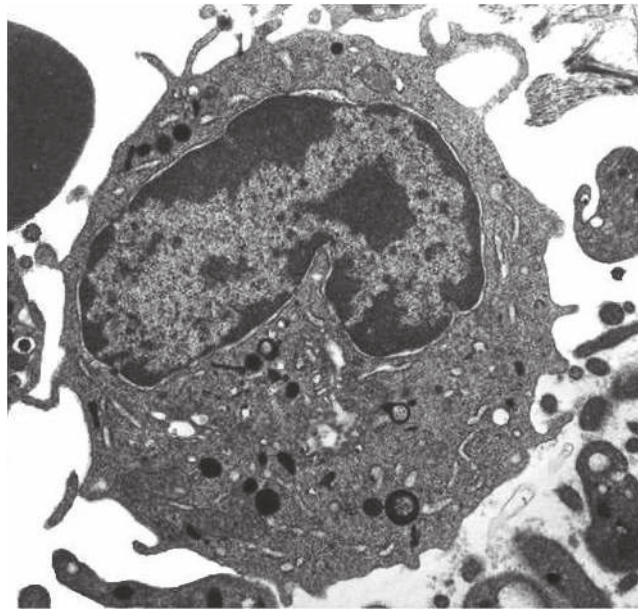


D.



[Source: © International Baccalaureate Organization 2019]

2. The image shows a phagocytic white blood cell as seen with a transmission electron microscope.



[Source: http://www.wikidoc.org/index.php/File:Monocyte_TEM_0002.jpg, by Cafer Zorkun is licensed under the Creative Commons Attribution/Share-Alike License]

Which features can be found both within this cell and in a photosynthetic bacterium?

- A. Chloroplasts
 - B. Multiple nuclei
 - C. 70S ribosomes
 - D. Lysosomes
3. Which is an essential feature of the Davson–Danielli model of membrane structure?
- A. A phospholipid monolayer with intrinsic and extrinsic proteins
 - B. A layer of protein sandwiched between two layers of lipid
 - C. A phospholipid bilayer with intrinsic and extrinsic proteins
 - D. A layer of lipid sandwiched between two layers of protein

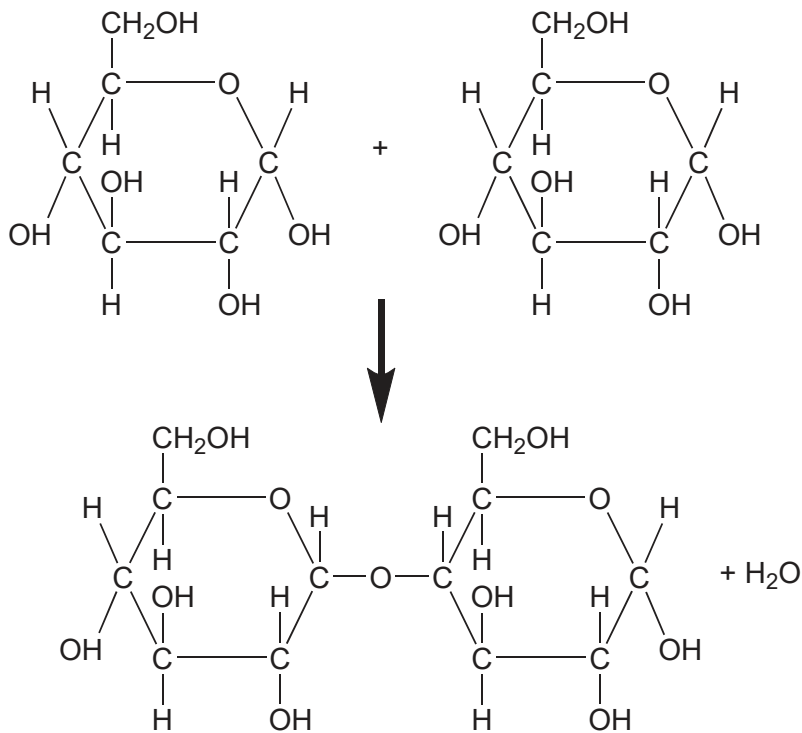
Turn over

4. Which process(es) occur(s) by osmosis?

- I. Uptake of water by cells in the wall of the intestine
- II. Loss of water from a plant cell in a hypertonic environment
- III. Evaporation of water from sweat on the skin surface

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

5. What type of molecule is formed by the chemical reaction shown in the diagram?



- A. Dipeptide
- B. Disaccharide
- C. Diglyceride
- D. Cellulose

6. Water has a specific heat capacity of $4.2 \text{ J g}^{-1} \text{ K}^{-1}$ at room temperature, a latent heat of vaporization equal to 2257 J g^{-1} , and a boiling point of 100°C . What are the specific heat capacity, latent heat of vaporization and boiling point of methane?

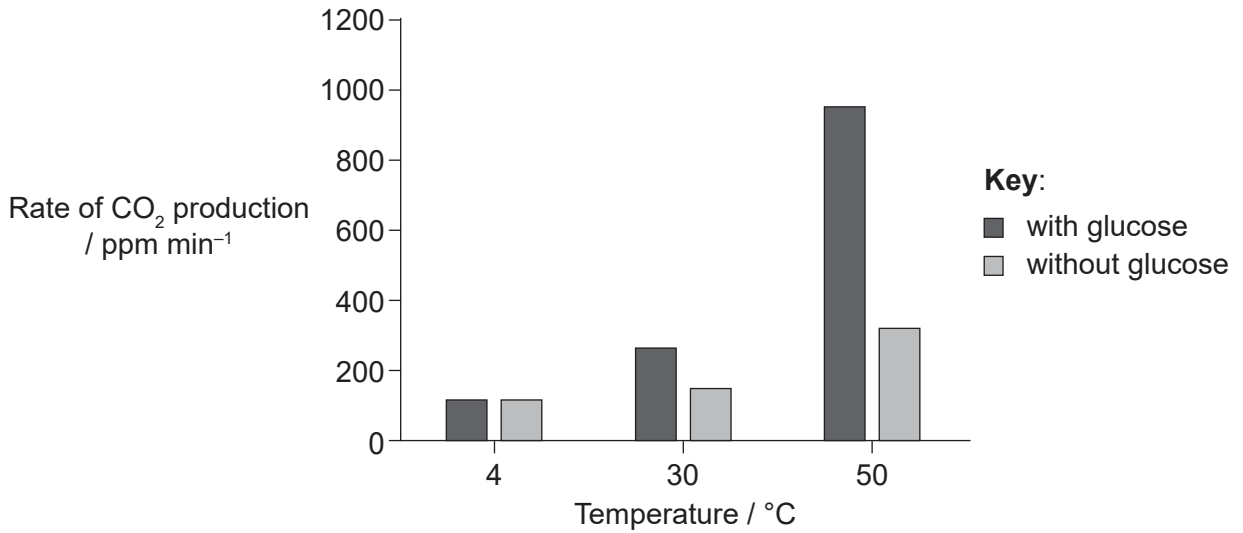
	Specific heat capacity at room temperature / $\text{J g}^{-1} \text{ K}^{-1}$	Latent heat of vaporization / J g^{-1}	Boiling point / $^\circ\text{C}$
A.	2.2	760	–160
B.	4.2	2257	100
C.	6.2	2760	97
D.	1.8	1257	260

[Source: © International Baccalaureate Organization 2019]

7. What is common to RNA and DNA?
- A. Thymine
 - B. Nitrogenous bases
 - C. Histones
 - D. Deoxyribose

Turn over

8. Yeast cells, *Saccharomyces cerevisiae*, were incubated with and without glucose at three different temperatures for a period of four minutes, during which the rate of CO₂ production was measured with a CO₂ sensor.



[Source: © International Baccalaureate Organization 2019]

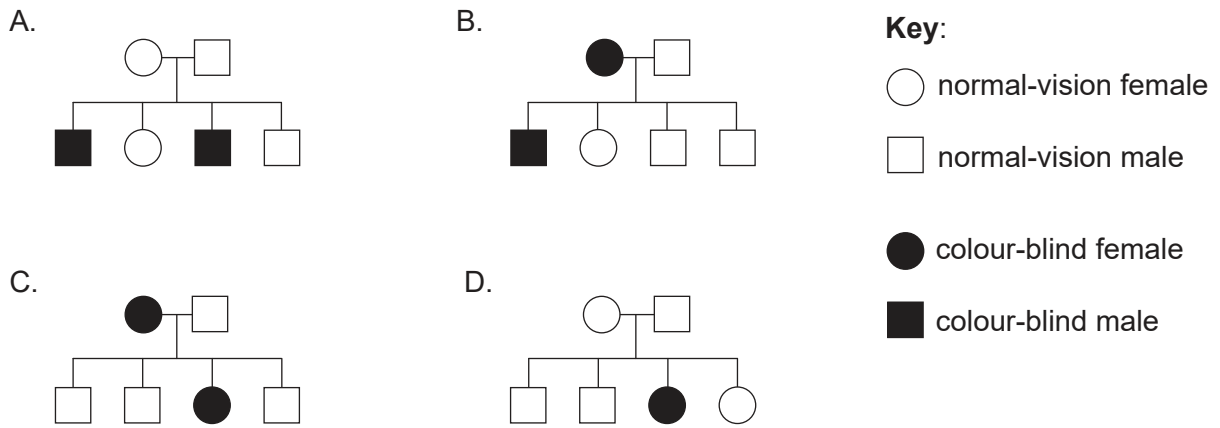
What conclusion can be drawn from the results of this experiment?

- A. Yeast uses lipids rather than glucose in respiration at low temperatures.
 - B. Addition of glucose has a greater impact on rates of cell respiration at lower temperatures.
 - C. Rates of cell respiration increase with temperature.
 - D. More glucose is produced at higher temperatures.
9. Which wavelength of electromagnetic radiation is absorbed efficiently by chlorophyll for photosynthesis?
- A. 45 nm
 - B. 45 μm
 - C. 450 nm
 - D. 450 μm

10. The system of sex determination in chimpanzees (*Pan troglodytes*) is the same as in other mammals. A chimpanzee has 48 chromosomes in the nuclei of its body cells. What can be deduced from this information?
- A. The sex of the chimpanzee
 - B. The number of genes in each chromosome
 - C. Whether non-disjunction has occurred
 - D. The number of autosomes in a diploid cell
11. What technique was used by John Cairns to measure the length of the DNA molecule in *Escherichia coli*?
- A. Autoradiography
 - B. Chromatography
 - C. Genome sequencing
 - D. Karyotyping
12. Creeper in chickens is a condition in which the chickens are born with very short legs. The creeper allele (C) is dominant over the normal allele (c). Embryos which are homozygous for the dominant allele fail to develop into viable chickens and die before they hatch. What phenotypic ratio would you expect in the live offspring of a cross between two creeper chickens?
- A. All creeper
 - B. 1 creeper; 2 normal
 - C. 2 creeper; 1 normal
 - D. 3 creeper; 1 normal

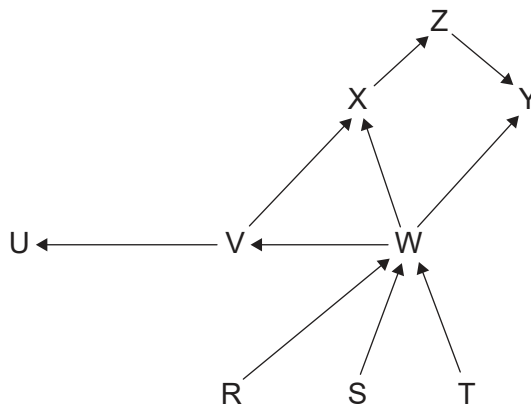
Turn over

13. Which pedigree chart is consistent with the inheritance of red-green colour blindness?



[Source: © International Baccalaureate Organization 2019]

14. The diagram shows the food web for an aquatic ecosystem in which letters R–Z represent individual species.



[Source: © International Baccalaureate Organization 2019]

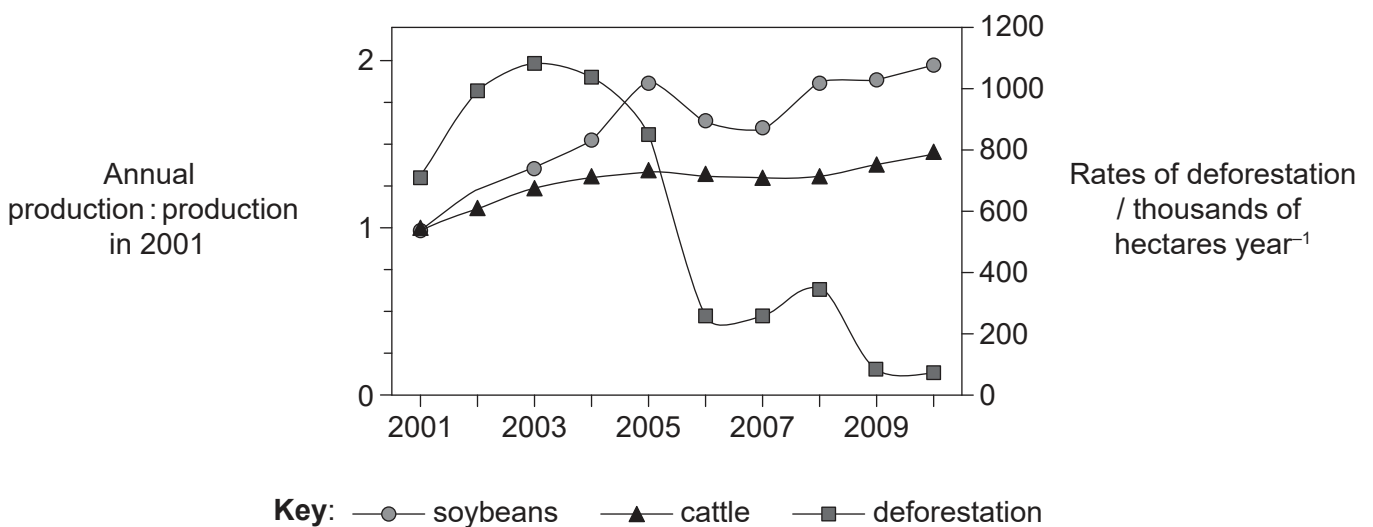
Which organism is a tertiary consumer?

- A. Organism T
- B. Organism U
- C. Organism W
- D. Organism Y

15. Which organisms produce methane in anaerobic environments such as waterlogged soils?

- A. Archaea
- B. Fungi
- C. Eukaryotes
- D. Eubacteria

16. Deforestation and agricultural activities including the production of crops and livestock are thought to play a major role in the greenhouse effect. The graph shows annual trends in rates of deforestation and the production of soybeans and cattle in the state of Mato Grosso in Brazil in the period from 2001 to 2010.



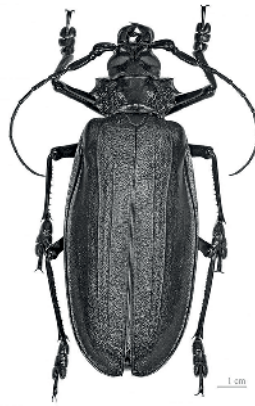
[Source: 'Decoupling of deforestation and soy production in the southern Amazon during the late 2000s.' Marcia N. Macedo, Ruth S. DeFries, Douglas C. Morton, Claudia M. Stickler, Gillian L. Galford, and Yosio E. Shimabukuro *PNAS* January 24, 2012, 109 (4) 1341–1346; <https://doi.org/10.1073/pnas.1111374109>, used with permission]

What conclusion can be drawn from the information in this graph?

- A. The decline in rates of deforestation led to an increase in production of CO₂.
- B. Soybean production accounted for a greater proportion of deforestation than cattle production.
- C. Forest habitats declined during the first few years of the study.
- D. The decline in rates of deforestation is due to an increase in soybean production.

Turn over

17. Which are examples of homologous structures?
- A. The wings of bats and butterflies
 - B. The fins of fish and whales
 - C. The hindlimbs of frogs and grasshoppers
 - D. The forelimbs of primates and penguins
18. The image shows an organism belonging to the Kingdom Animalia.



[Source: Titan beetle male. Locality: "RK4,5 route Cacao", French Guiana © 2011, Didier Descouens
<https://creativecommons.org/licenses/by-sa/4.0/>]

What feature does this organism have in common with all members of the phylum chordata?

- A. Legs and wings
- B. Mouth but no anus
- C. Bilateral symmetry
- D. Chitinous exoskeleton

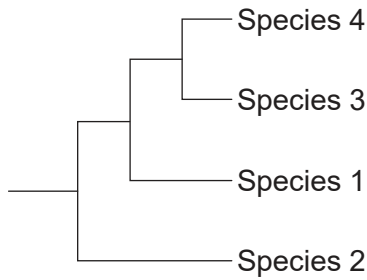
19. The DNA base sequences in a gene coding for a particular protein in four different species are shown. Locations where mutations have occurred resulting in changes to the base sequences are outlined in boxes.

Species 1	TATA	GC	T	A	CGG	ATG	GCT
Species 2	TATA	CA	T	C	CGG	TAA	GCT
Species 3	TATA	CC	T	C	CGG	TAA	GCT
Species 4	TATA	GA	T	C	CGG	TAG	GCT

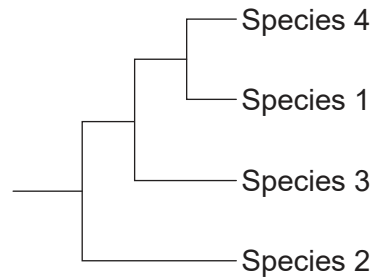
[Source: © International Baccalaureate Organization 2019]

Which cladogram shows the most likely phylogenetic relationship between the four species, based on the data provided?

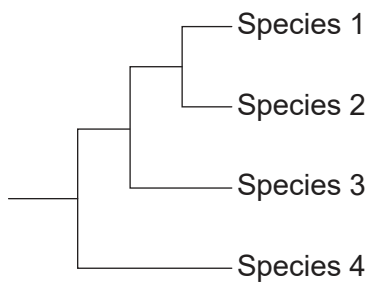
A.



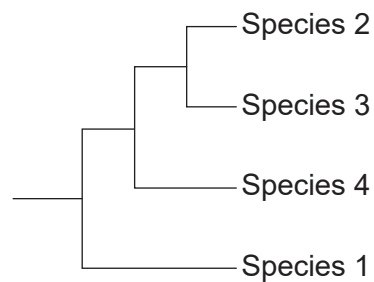
B.



C.



D.

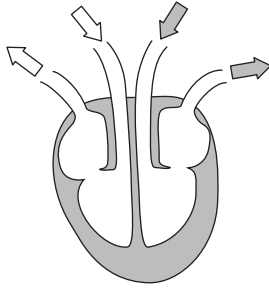


[Source: © International Baccalaureate Organization 2019]

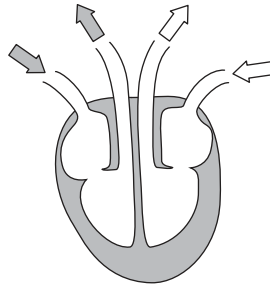
Turn over

20. Which diagram represents blood flow through the mammalian heart?

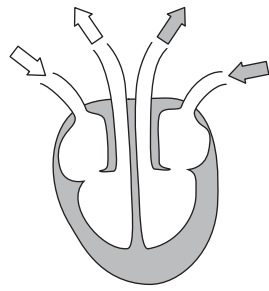
A.



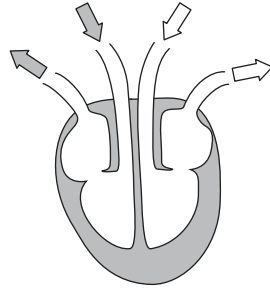
B.



C.



D.



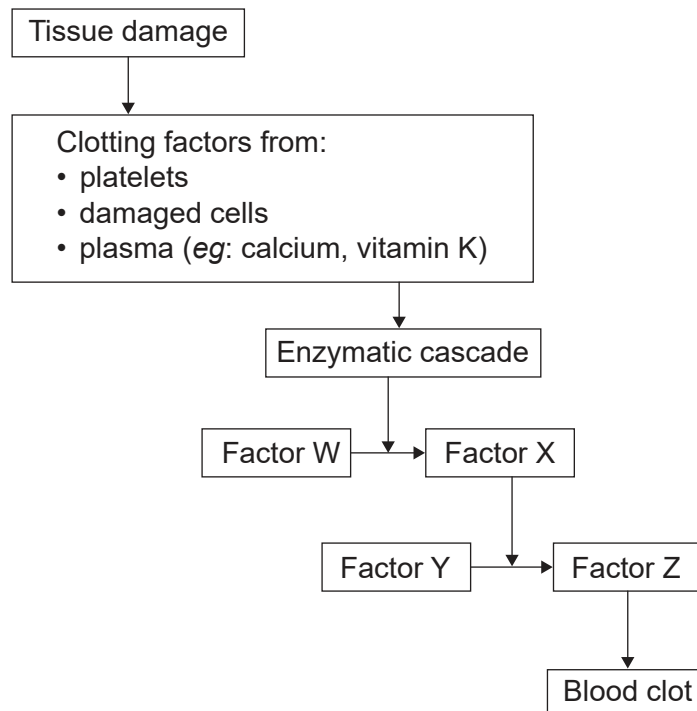
Key:

⇨ oxygenated blood

⇨ deoxygenated blood

[Source: © International Baccalaureate Organization 2019]

21. The diagram shows the major events involved in the formation of a blood clot.



[Source: © International Baccalaureate Organization 2019]

What is Factor Y?

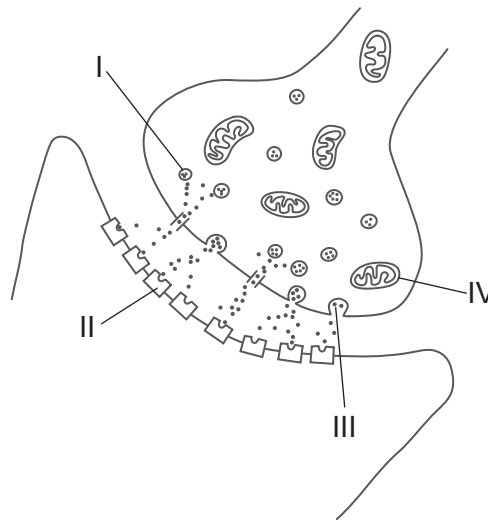
- A. Fibrin
 - B. Prothrombin
 - C. Fibrinogen
 - D. Thrombin
22. Which statement applies to HIV?
- A. HIV infects red blood cells resulting in decreased production of hemoglobin.
 - B. HIV can be effectively treated using antibiotics.
 - C. HIV can only be transmitted by sexual intercourse.
 - D. HIV causes a reduction in production of antibodies.

Turn over

23. What is produced by type II pneumocytes?

- A. Epinephrine
- B. Elastase
- C. Pulmonary surfactant
- D. Alpha 1-antitrypsin

24. The diagram shows a neural synapse in the central nervous system of a honey bee (*Apis mellifera*).

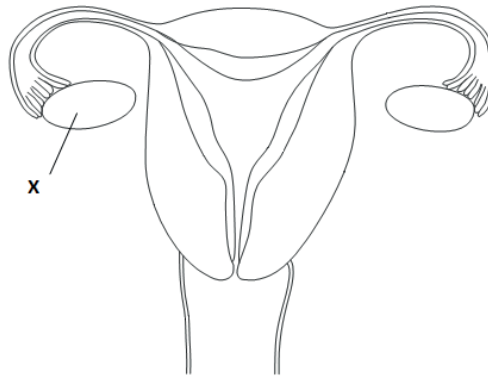


[Source: © International Baccalaureate Organization 2019]

How do neonicotinoid pesticides cause paralysis and death of honey bees?

- A. They destroy I.
- B. They bind to II.
- C. They inhibit the release of III.
- D. They block the activity of IV.

25. The diagram shows the human female reproductive system.



[Source: © International Baccalaureate Organization 2019]

What is produced by structure X?

- A. FSH
 - B. X chromosomes
 - C. Fertilized eggs
 - D. Estrogen and progesterone
26. What contribution did the X-ray diffraction conducted by Rosalind Franklin make to our understanding of DNA?
- A. It identified DNA as the genetic material.
 - B. It indicated the helical shape of the molecule.
 - C. It showed that the DNA of eukaryotes was associated with histone proteins.
 - D. It showed that replication was a semi-conservative process.

Turn over

27. The diagram shows the arrangement of introns and exons in a segment of pre-mRNA. Pre-mRNA is immature mRNA containing introns and exons.

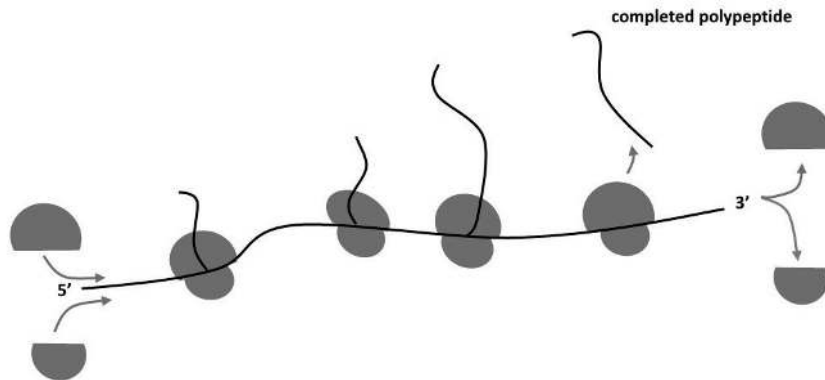


Which is a mature mRNA molecule derived from the pre-mRNA by splicing?

- A. 5' Exon A Exon B Exon C Exon D 3'
- B. 5' Intron A Intron B Intron C Exon A Exon B Exon C Exon D 3'
- C. 5' Exon A Exon B Intron A Intron B Intron C Exon C Exon D 3'
- D. 5' Intron A Intron B Intron C 3'

[Source: © International Baccalaureate Organization 2019]

28. The image shows a polysome in a bacterial cell.

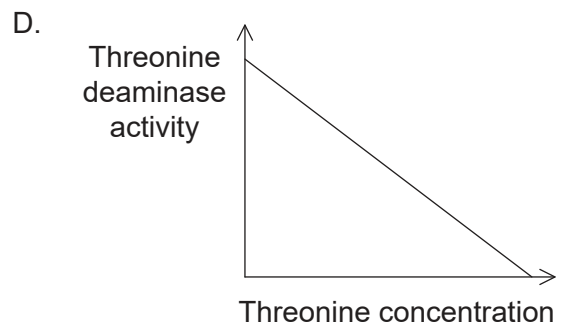
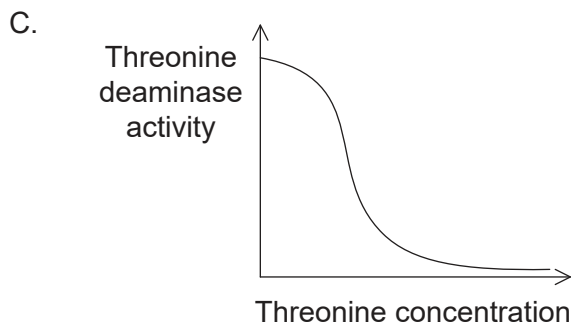
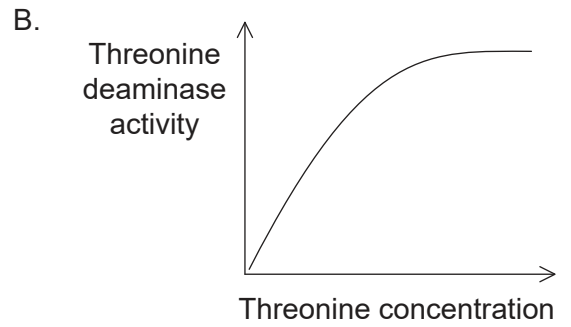
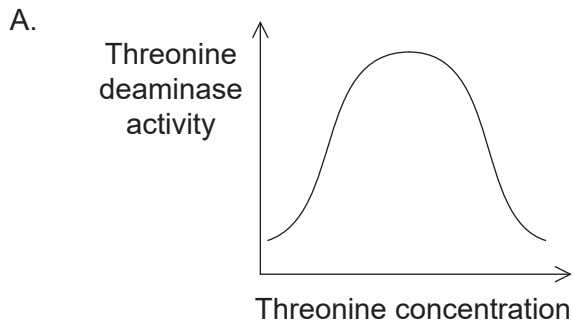


[Source: © International Baccalaureate Organization 2019]

How many genes have been transcribed?

- A. 1
- B. 2
- C. 3
- D. 4

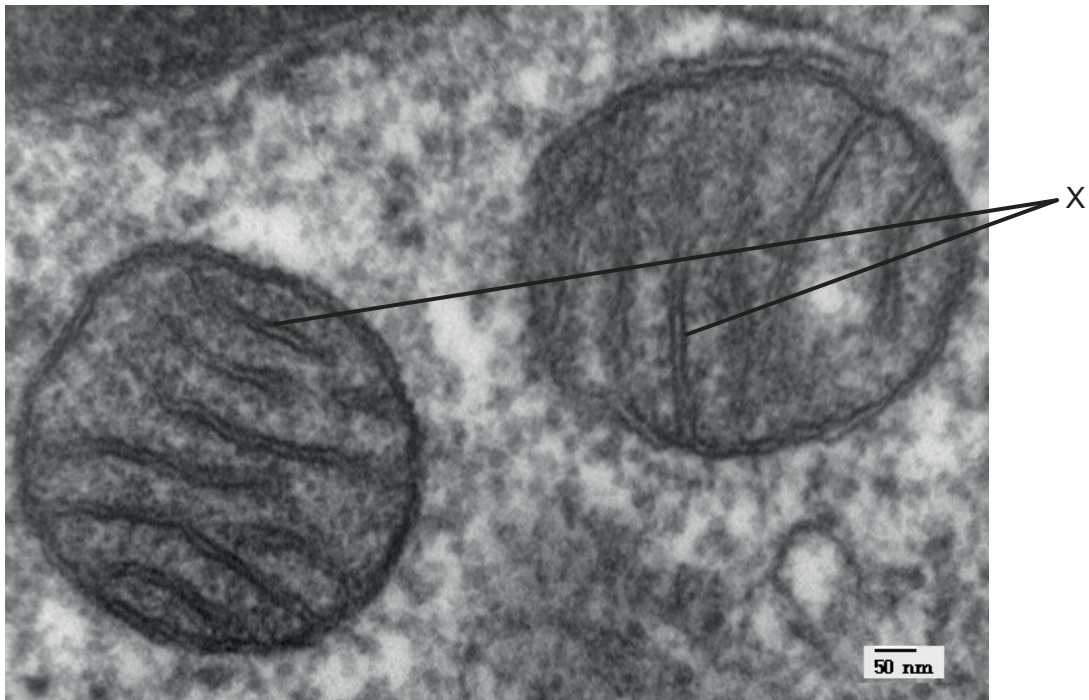
29. The first enzyme in the metabolic pathway that produces isoleucine is threonine deaminase. Which graph illustrates the relationship between threonine deaminase activity and threonine concentration?



[Source: © International Baccalaureate Organization 2019]

Turn over

30. The electron micrograph shows a section through part of an animal cell.

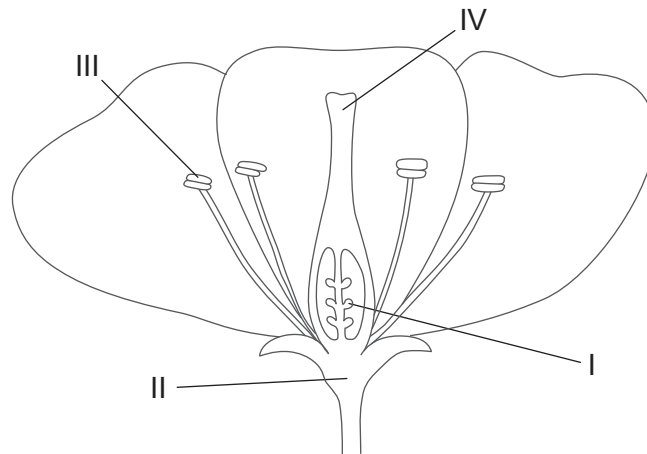


[Source: https://en.wikipedia.org/wiki/Mitochondrion#/media/File:Mitochondria,mammalian_lung_-TEM.jpg, by Louisa Howard.]

Which process is occurring on the structures labelled X?

- A. The Krebs cycle
 - B. The link reaction
 - C. Glycolysis
 - D. Phosphorylation of ADP
31. Which process is common to photosynthesis and cell respiration?
- A. Photolysis
 - B. The Calvin cycle
 - C. The Krebs cycle
 - D. Chemiosmosis

32. The image shows a cross-section of a flower.



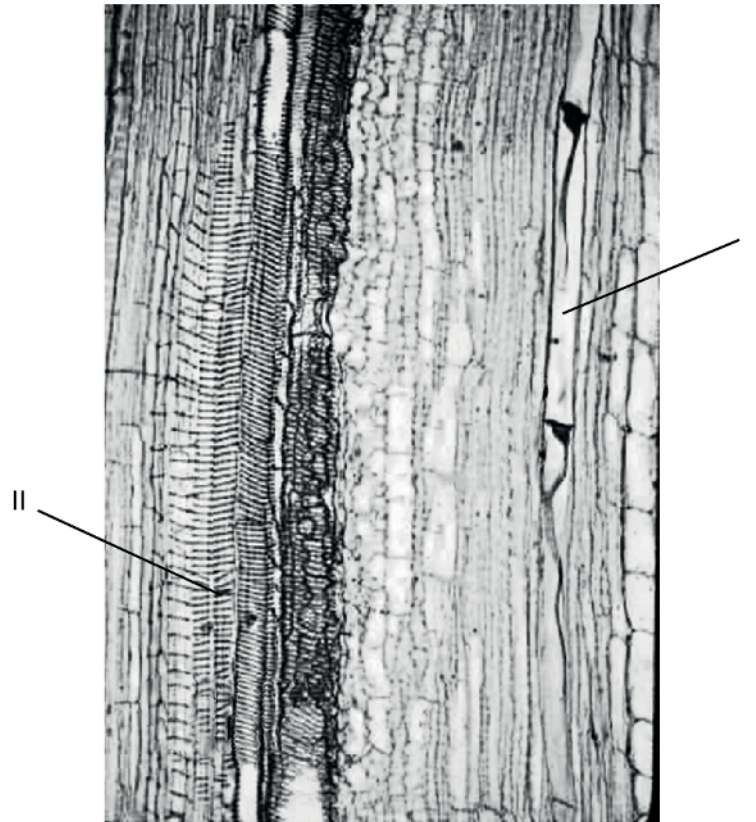
[Source: © International Baccalaureate Organization 2019]

Where does production of haploid gametes occur?

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

Turn over

33. The image shows part of a section through the stem of a non-woody plant.

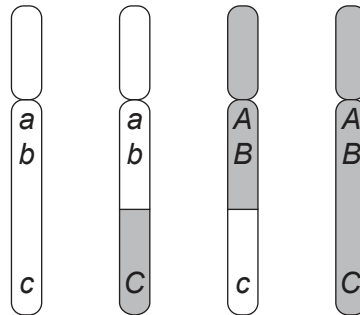


[Source: © Ross Koning. Image used with the kind permission of the author. <http://plantphys.info>.]

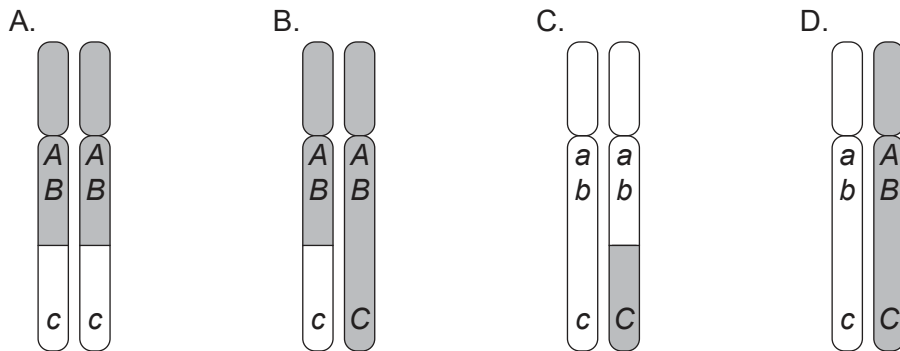
Which feature distinguishes the transport of materials in the tissue labelled I from that in the tissue labelled II?

- A. In II, active transport is used.
 - B. In II, products of photosynthesis are transported.
 - C. In I, movement of materials is the result of transpiration.
 - D. In I, there is a higher solute concentration.
34. Which statement describes the control of reproduction in flowering plants?
- A. Flowering in short-day plants results from changes in gene expression in the shoot apex.
 - B. Flowering in long-day plants is controlled by the production of auxins in the shoot apex.
 - C. All flowering plants depend on the duration of periods of light and darkness to regulate the timing of reproduction.
 - D. Flowering in short-day plants occurs when day length is longer than 12 hours.

35. Natural selection can operate in different ways. What is the effect of disruptive selection?
- A. It eliminates individuals with intermediate forms of a characteristic.
 - B. It eliminates individuals at random regardless of their characteristics.
 - C. It favours individuals with intermediate forms of a characteristic.
 - D. It favours individuals at one extreme of the range of variation in a characteristic.
36. The diagram shows the chromosomes derived from a single homologous pair following meiosis in a diploid cell.

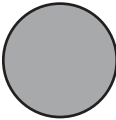
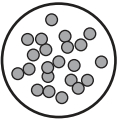
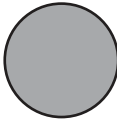
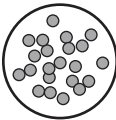
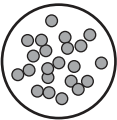
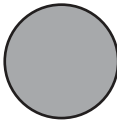
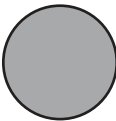
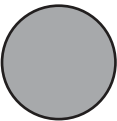
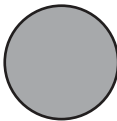
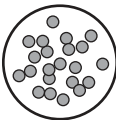
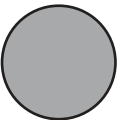
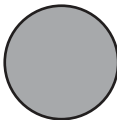




Which diagram represents the homologous pair from which these chromosomes were derived?



[Source: © International Baccalaureate Organization 2019]

37. The table shows the results of blood type tests on samples from four individuals. Which row represents an individual who can accept transfusions from people with blood type AB?

	Anti-A	Anti-B	Control, no antibody
A.			
B.			
C.			
D.			

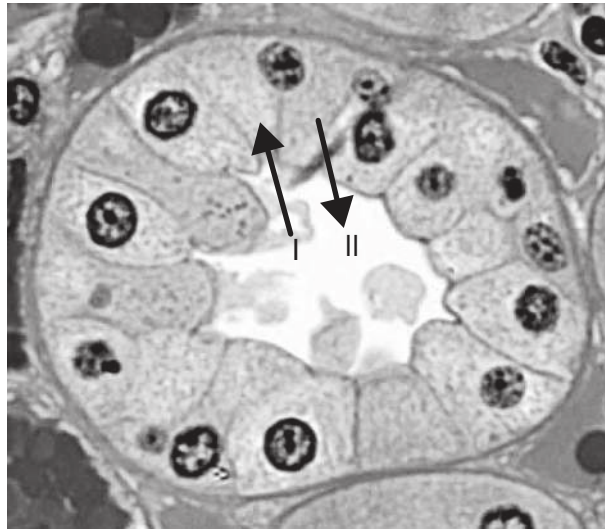
Key:
 No clumping, no antibody reaction
 Clumping due to antibody reaction

[Source: © International Baccalaureate Organization 2019]

38. What is the role of the joint capsule in an elbow joint?

- A. It seals the joint to retain the synovial fluid.
- B. It provides a point of attachment for muscles.
- C. It produces cartilage to reduce friction during movement.
- D. It directs the formation of bone tissue during growth and development.

39. The image shows a transverse section through a collecting duct in a vertebrate kidney.



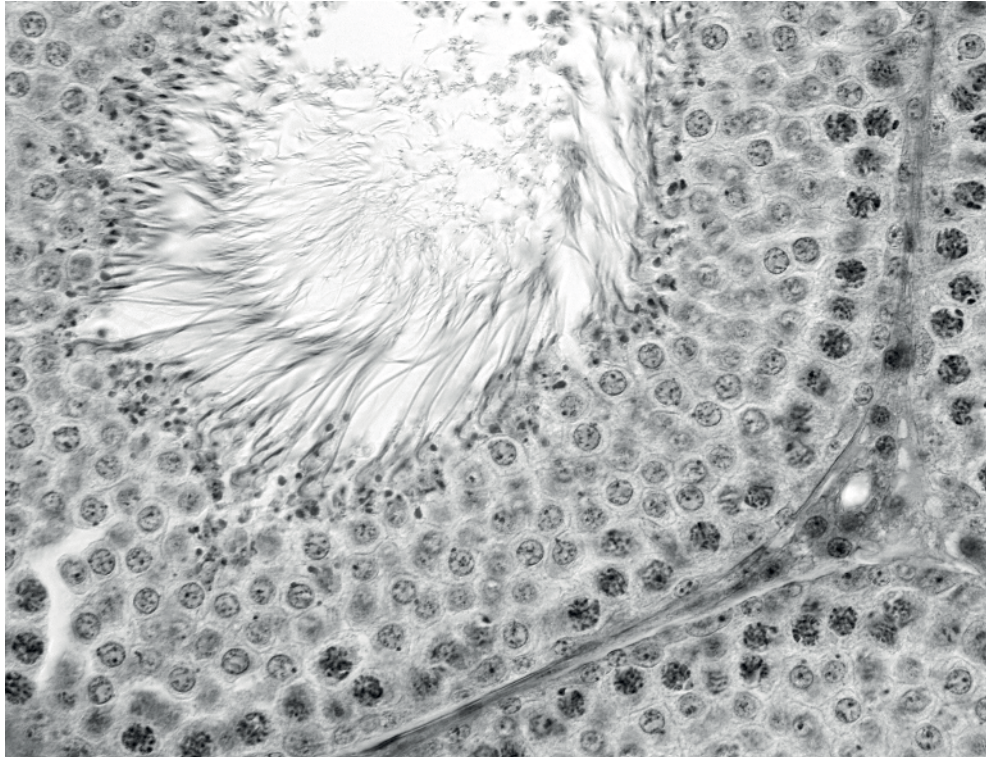
[Source: Professor Peter Takizawa, Yale University]

How is the movement of materials across the wall of the collecting duct affected by the release of ADH from the pituitary gland?

- A. There is increased movement of water in the direction of arrow I.
- B. There is increased movement of sodium in the direction of arrow I.
- C. There is increased movement of water in the direction of arrow II.
- D. There is increased movement of sodium in the direction of arrow II.

Turn over

40. The image shows a light micrograph of tissue stained with a dye that binds to the nucleic acids in a cell.



[Source: by Jose Luis Calvo/Shutterstock]

What is the major purpose of the tissue depicted in the image?

- A. Absorption of digested food
- B. Production of insulin
- C. Spermatogenesis
- D. Fertilization