Diploma Programme
Programme du diplôme
Programa del Diploma

Biology
Standard level
Paper 1

Friday 28 October 2022 (morning)

45 minutes

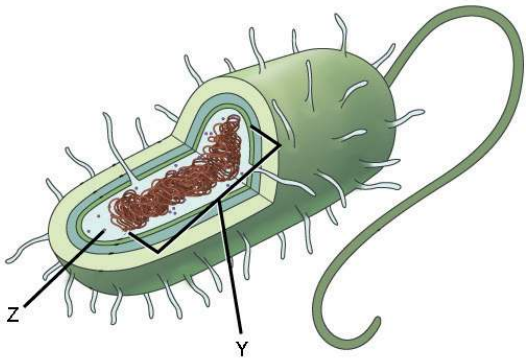
Instructions to candidates

- 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 **[30 marks]**.

8822 – 6004

19 pages

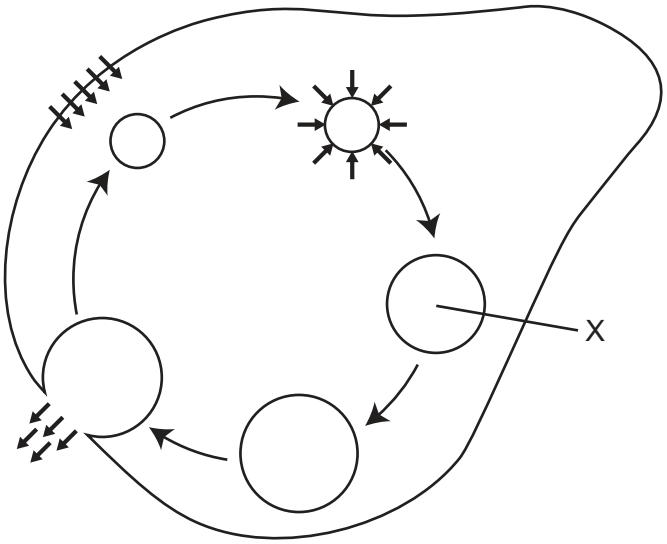
1. The diagram shows a prokaryotic cell.



What are the structures labelled Y and Z?

	Y	Z
A.	Nucleus	70 S ribosome
B.	Nucleoid	80 S ribosome
C.	Nucleus	80 S ribosome
D.	Nucleoid	70 S ribosome

The diagram refers to questions 2 and 3. It shows a heterotrophic, unicellular, freshwater organism that has been placed in distilled water. The short arrows show movement of water and the long arrows show a sequence of steps.



2. What life function is illustrated?

A. Nutrition

B. Homeostasis

C. Endocytosis

D. Response

3. What would happen if the unicellular organism was placed in a solution slightly less concentrated than the cytoplasm of the cell, rather than in distilled water?

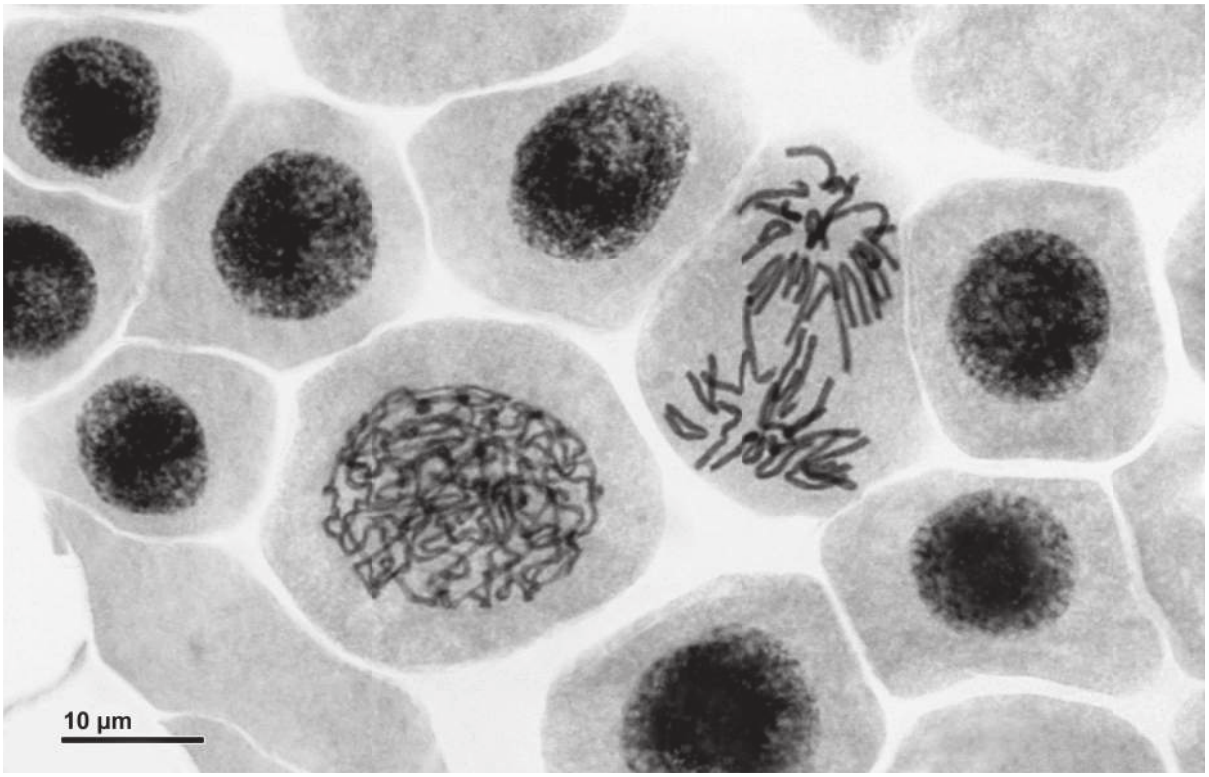
A. The cell would become larger.

B. More water would be expelled from the cell.

C. X would fill more slowly.

D. X would not appear.

4. The micrograph shows some onion (*Allium cepa*) cells undergoing mitosis.



What is the mitotic index, taking into account all visible nuclei?

A. 0.1

B. 0.2

C. 0.4

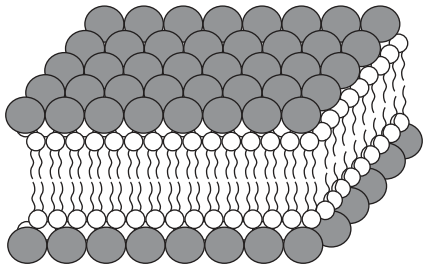
D. 0.6

5. In 1925, Gorter and Grendel carried out an experiment to study the structure of cell membranes in different mammals. The total surface area of red blood cells was measured in a sample and compared to the surface area formed by a single layer of lipid extracted from cell membranes and floated on water.

Source of red blood cell samples	Total surface area of single layer of extracted lipid on water / arbitrary units	Total surface area of membrane on red blood cells / arbitrary units
Dog	62.0	31.0
Goat	6.8	3.4
Rabbit	9.8	4.9

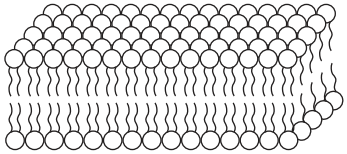
Which diagram best illustrates Gorter and Grendel's conclusion drawn from this experiment?

A.

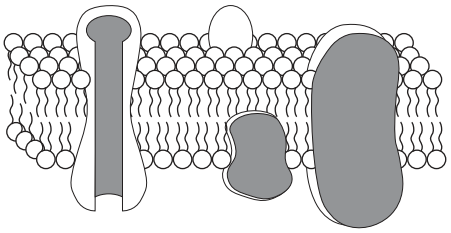


B.

C.



D.



6. What is the arrangement of subunits in a DNA nucleotide?

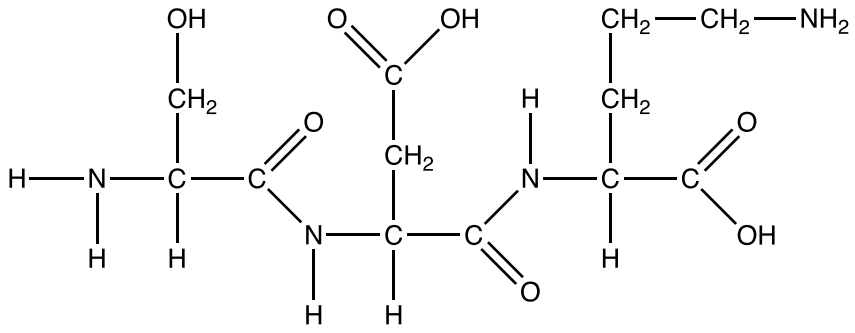
A. sugar – base – phosphate

B. sugar – phosphate – base

C. phosphate – sugar – base

D. sugar – phosphate – base – base – phosphate – sugar

7. The diagram shows the product of a polymerization reaction.



What is formed in this polymerization reaction?

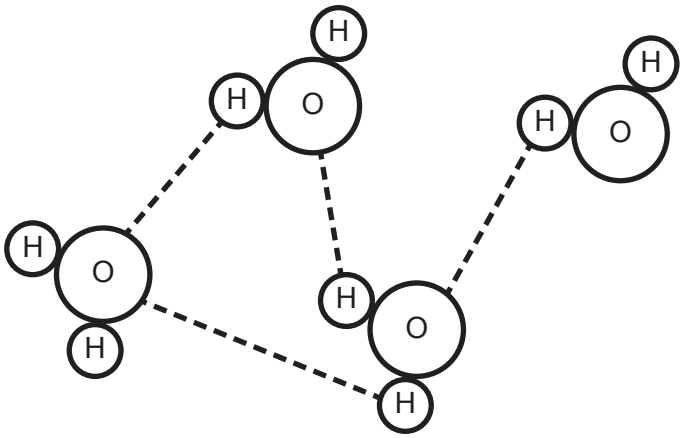
A. A dipeptide formed by the hydrolysis of two nucleotides

B. A tripeptide formed by the hydrolysis of three amino acids

C. A dipeptide formed by the condensation of two amino acids

D. A tripeptide formed by the condensation of three amino acids

8. The diagram shows water molecules.



Which property of water is **not** illustrated?

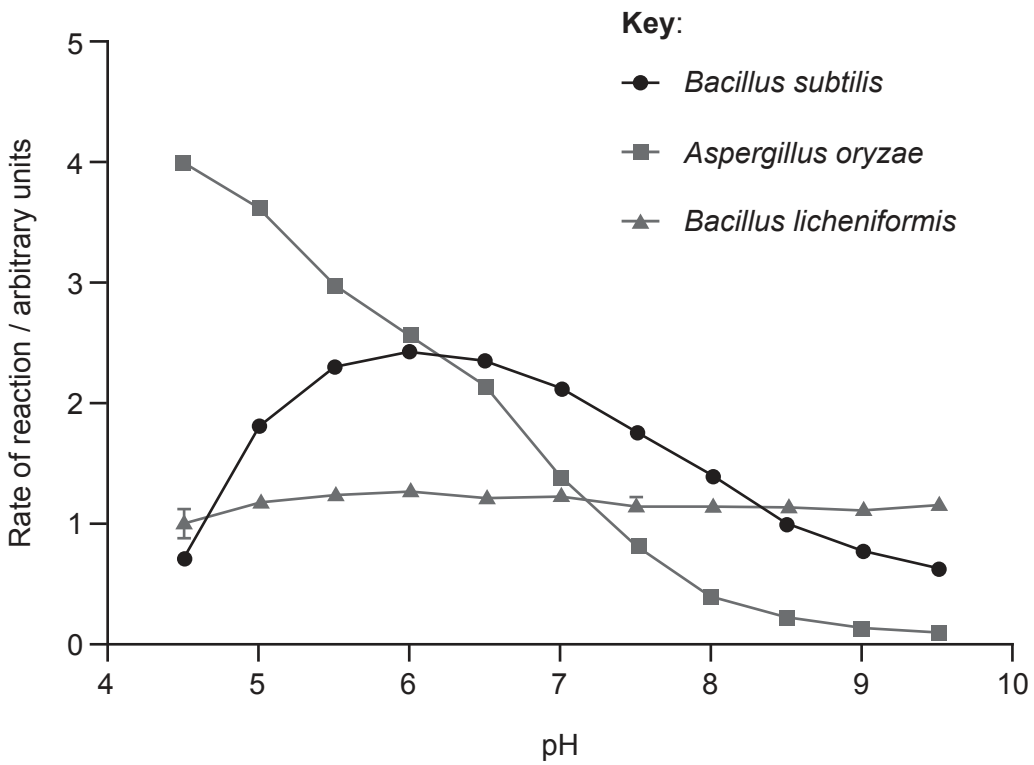
A. Cohesion

B. Dipolarity

C. Hydrogen bonding

D. Adhesion

9. The activity of amylase from two bacterial species and a fungus was measured at different pH levels and constant temperature. The results are shown in the graph.



Which statement about the effect of pH on amylase can be concluded?

A. *A. oryzae* amylase has the highest optimum pH.

B. A change in pH affects amylase most in *B. licheniformis.*

C. The optimum pH is 6 in *B. subtilis.*

D. Amylase activity at pH 8 is the lowest in *B. licheniformis*.

10. A DNA triplet on the strand that is transcribed has the bases TAG. Which anticodon on tRNA is used in translation?

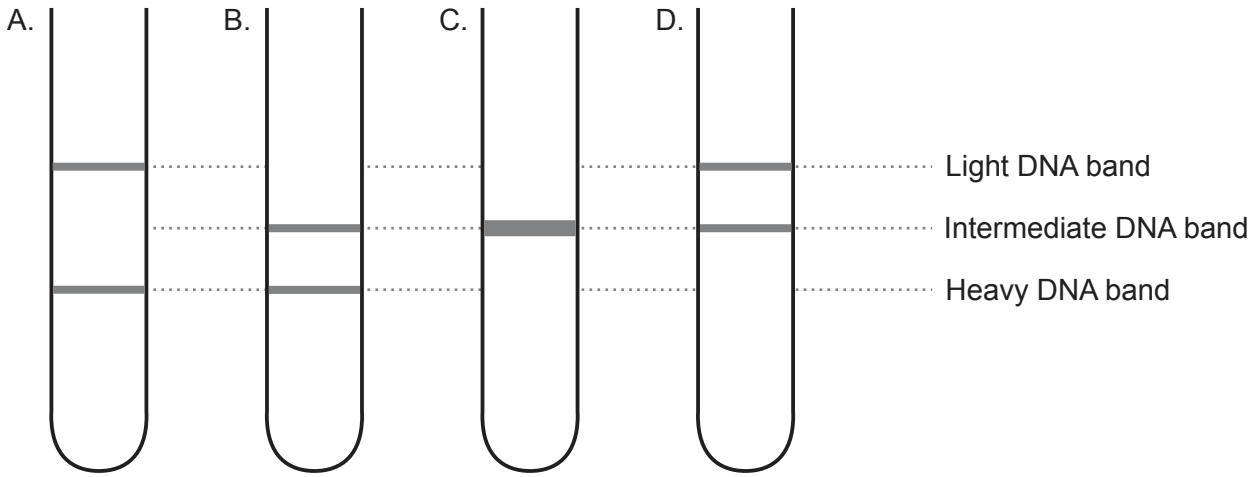
A. AUC

B. UAG

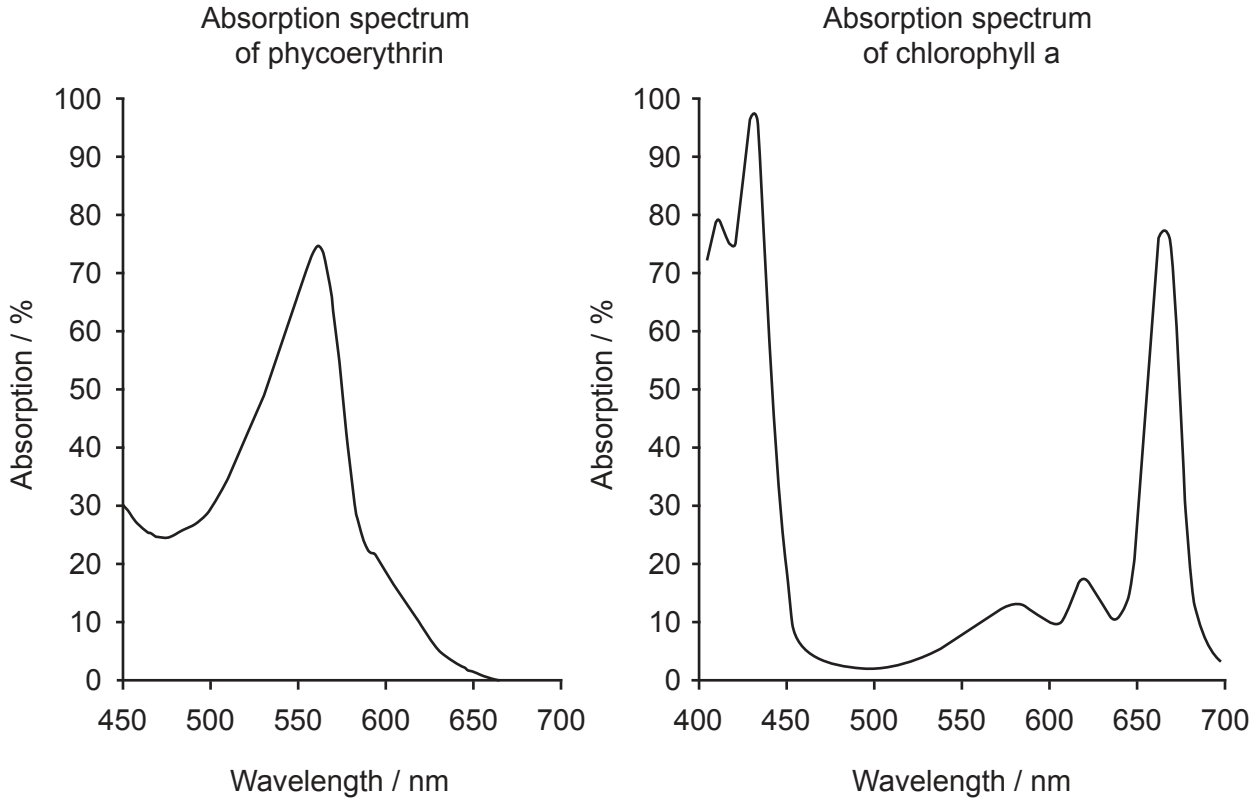
C. TAG

D. ATC

11. Cells were grown in heavy nitrogen (^{15}N) for many generations and then grown in light nitrogen (^{14}N) for **two** rounds of DNA replication. Which diagram shows the result of the centrifuged DNA?



12. Absorption spectra of two photosynthetic pigments are shown. Phycoerythrin is a red pigment found in many marine red algae, while chlorophyll a is the major pigment in green plants and algae.



What do the absorption spectra show about the pigments?

A. Phycoerythrin absorbs mostly red light.

B. Chlorophyll a reflects more green light than phycoerythrin.

C. Chlorophyll a photosynthesizes more at 550 nm than phycoerythrin.

D. Phycoerythrin does not absorb blue light.

13. What is a difference between two alleles of a gene?

A. Their positions on homologous chromosomes

B. Their amino acid sequence

C. The characteristic they influence

D. Their base sequence

14. Which event occurs in the first division of meiosis?

A. Synthesis of DNA

B. Pulling apart of sister chromatids

C. Halving of the chromosome number

D. Division of centromeres

15. A couple have four children whose blood groups are A, B and AB. What is the likely combination of the parents' genotypes?

A. I^Ai and I^Bi

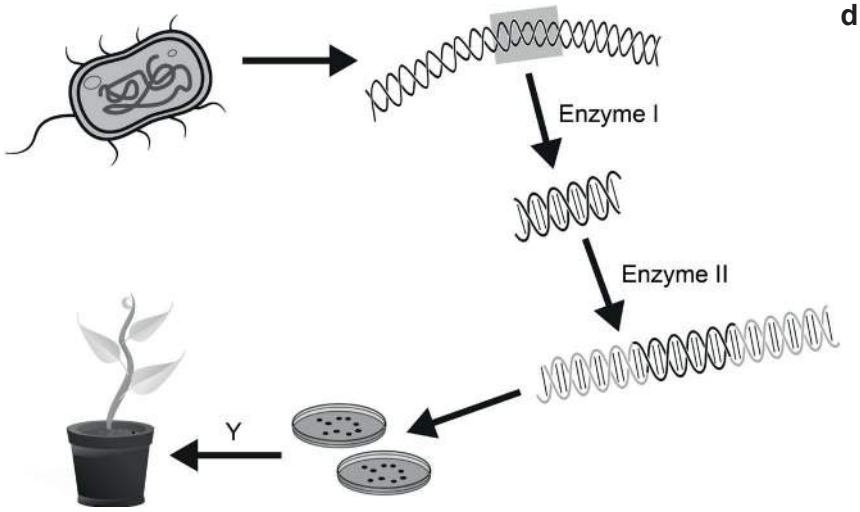
B. I^Ai and I^BI^B

C. I^AI^B and ii

D. I^AI^A and I^BI^B

16. A process for genetically modifying a plant is shown.

diagram not to scale



What is the name of enzyme II and the name of process Y?

	Enzyme II	Process Y
A.	Helicase	Fertilization
B.	Restriction endonuclease	Tissue culture
C.	RNA polymerase	Fertilization
D.	Ligase	Tissue culture

17. What is a difference between detritivores and saprotrophs?

	Detritivores	Saprotrophs
A.	Feed on living organic matter	Feed on dead organic matter
B.	Autotrophic	Heterotrophic
C.	Ingest organic matter and then digest it	Digest organic matter and then absorb it
D.	Include fungi and bacteria	Include plants and animals

18. A self-sustaining system is set up in a sterile, sealed, transparent glass bottle with damp, sterilized soil and a small garden plant. If the system remains sterile, what could be the reason that the plant fails to grow and dies?

A. Lack of soil nutrients

B. Lack of oxygen

C. Lack of space

D. Lack of water

19. Carbon sinks are any reservoirs that absorb and store carbon dioxide from the atmosphere. Which process increases the size of the carbon sink in oceans?

A. Photosynthesis

B. Respiration

C. Ocean acidification

D. Decomposition

20. By the end of the 19th century in England, the dark form of the moth *Biston betularia* formed up to 98 % of the total population in industrial areas. From 1970, the percentage of dark forms decreased significantly. What is an explanation for the decrease?

A. An increase in environmental pollution killed the dark forms more than the light forms.

B. Reduction of pollution resulted in greater camouflage for light forms of the moth.

C. Dark forms could no longer find mates.

D. Light forms had superior feeding mechanisms.

21. The table shows the presence or absence of four finches from the *Geospizinae* subfamily on seven of the Galapagos Islands. Cactus finches feed on cacti and warbler finches feed on insects or seeds. Presence on an island is indicated by a tick.

Finch species \ **Island**	Española	Fernandina	Floreana	Daphne Major	Genovesa	Isabela	Pinta
Common cactus finch			✓	✓	✓	✓	✓
Large cactus finch	✓						
Green warbler finch	✓	✓	✓		✓	✓	
Grey warbler finch	✓		✓		✓		✓

What might be a reason for the distribution of the large cactus finch?

A. Cacti are only found on Española.

B. Large cactus finches on other islands all flew to Española.

C. The beaks of large cactus finches on Floreana changed in order to feed on other sources.

D. A variation of the beak in a finch on Española enabled it to feed successfully on a cactus.

22. The foxglove, *Digitalis purpurea*, was once classified in the figwort family. The figwort family has been reclassified and is now much smaller.

Foxglove

Figwort species

Why were species such as the foxglove moved into other families?

A. The appearance was too dissimilar.

B. The plants are found in different locations.

C. The genera were different.

D. The DNA sequences indicated different ancestry.

23. What is a recognition feature for both of the plant phyla indicated?

	Filicinophyta	**Angiospermophyta**
A.	Produce seeds	Produce seeds
B.	Produce spores	Produce flowers
C.	No vascular tissue	Vascular tissue
D.	Vascular tissue	Produce spores

24. A short sequence of amino acids (represented by letters) in cytochrome c is shown for six vertebrates. Letters in bold indicate identical amino acids for all species.

	20	30	40
Amino acid number	90123456789012345678901		
Human	V**EKGGKHKTGPNLHGLFGRKTGQ**		
Rhesus monkey	V**EKGGKHKTGPNLHGLFGRKTGQ**		
Chicken	V**EKGGKHKTGPNLHGLFGRKTGQ**		
Snapping turtle	V**EKGGKHKTGPNLNGLIGRKTGQ**		
Bullfrog	C**EKGGKHKVGPNLYGLIGRKTGQ**		
Tuna	V**ENGGKHKVGPNLWGLFGRKTGQ**		

Which statement refers to this section of cytochrome c?

A. The DNA base sequences for human and rhesus monkey are different.

B. The most DNA base changes are between humans and snapping turtles.

C. The largest number of amino acid differences is two.

D. The amino acid at position 32 is the most variable.

25. The digestive system hydrolyses macromolecules into monomers for absorption. Which chemical(s) produced by humans can perform hydrolysis?

I. Cellulase

II. Glycogen

III. Amylase

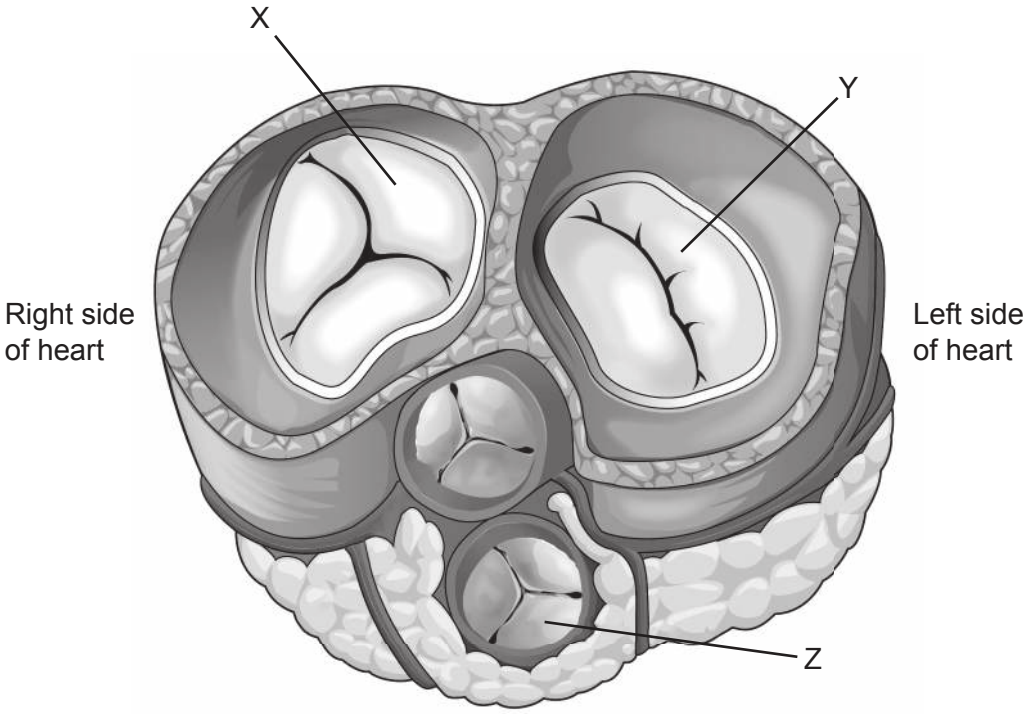
A. I and III only

B. II and III only

C. III only

D. I, II and III

26. The diagram shows a staggered transverse section (cut across rather than down) through the heart.



In what state are the valves when the ventricles are contracting?

	X	Y	Z
A.	Open	Closed	Closed
B.	Closed	Closed	Open
C.	Closed	Open	Open
D.	Open	Open	Closed

27. Despite continuous scientific research into the control of pathogens, it has proved very difficult to eliminate them. What is/are the reason(s) for this?

I. Development of antibiotic resistance in viruses

II. Development of antibiotic resistance in bacteria

III. Mutations of pathogens

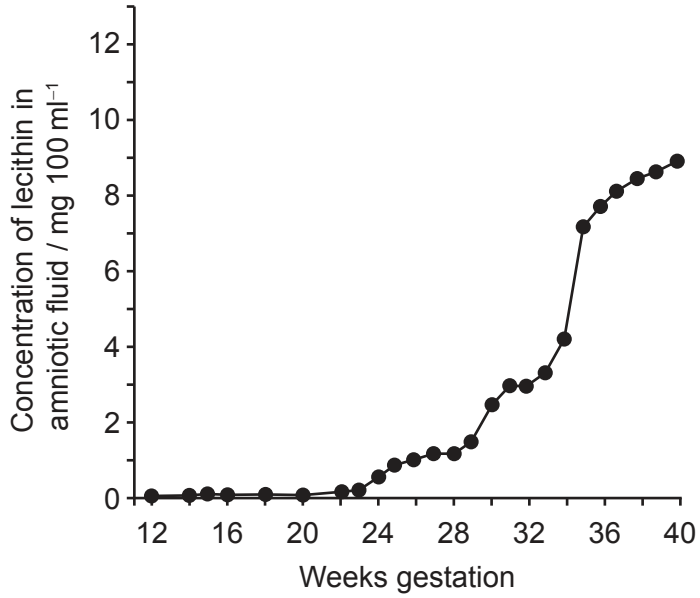
A. II only

B. I and II only

C. II and III only

D. I, II and III

28. The graph shows the concentration of the lipid lecithin in the amniotic fluid surrounding the fetus during normal gestation. This lipid is produced in the lungs of the fetus and acts as a surfactant.



What problem may occur in a baby born before 34 weeks gestation?

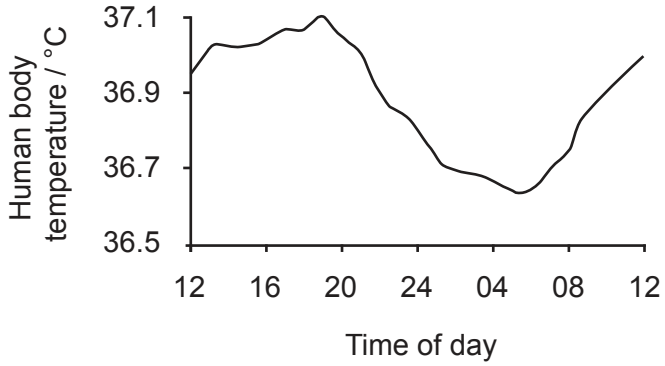
A. Type I pneumocytes do not produce sufficient surfactant for lungs to inflate.

B. There are no type II pneumocytes.

C. The alveolar walls stick together.

D. The alveoli are too large.

29. The graph shows human body temperature variation in a daily rhythm of 24 hours.



Which hormone controls this variation?

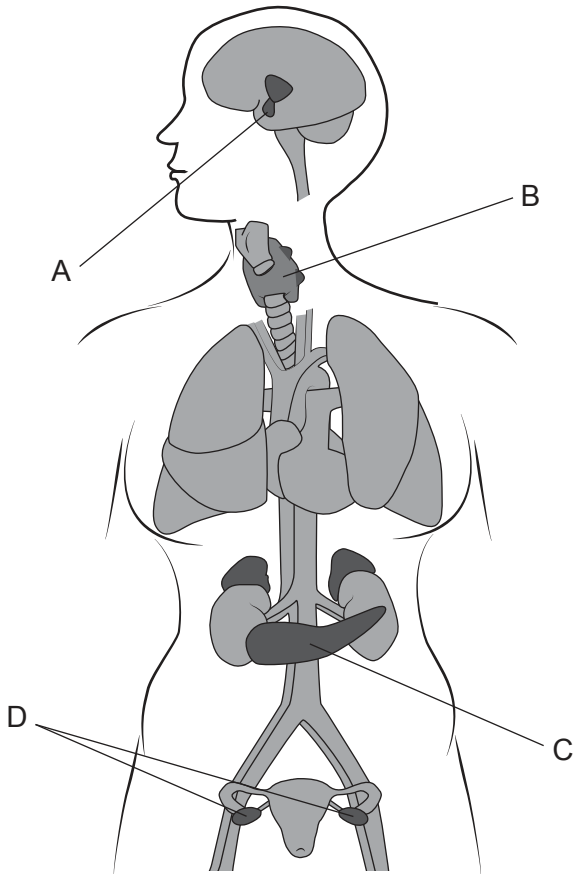
A. Leptin

B. Insulin

C. Glucagon

D. Thyroxin

30. The diagram shows organs that produce hormones in a female human. Which organ is the source of the hormone used in IVF treatment to produce many ova?



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References:

1. © Rice University. 1999–2023 *Figure 4.5 Prokaryotic cell*. [image online] Available at: https://openstax.org/apps/archive/20220815.182343/resources/50163f8ff80f335574f41bfc10cc49a1e87cf9df [Accessed 13 January 2023].

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