Diploma Programme
Programme du diplôme
Programa del Diploma

Biology
Higher level
Paper 1

Wednesday 11 November 2020 (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]**.

8820 – 6001

1. *Chlorella* and *Paramecium* are both unicellular eukaryotic organisms living in freshwater. *Chlorella* is photosynthetic and has a cell wall. Which organelle will be found in *Paramecium* but not in *Chlorella*?

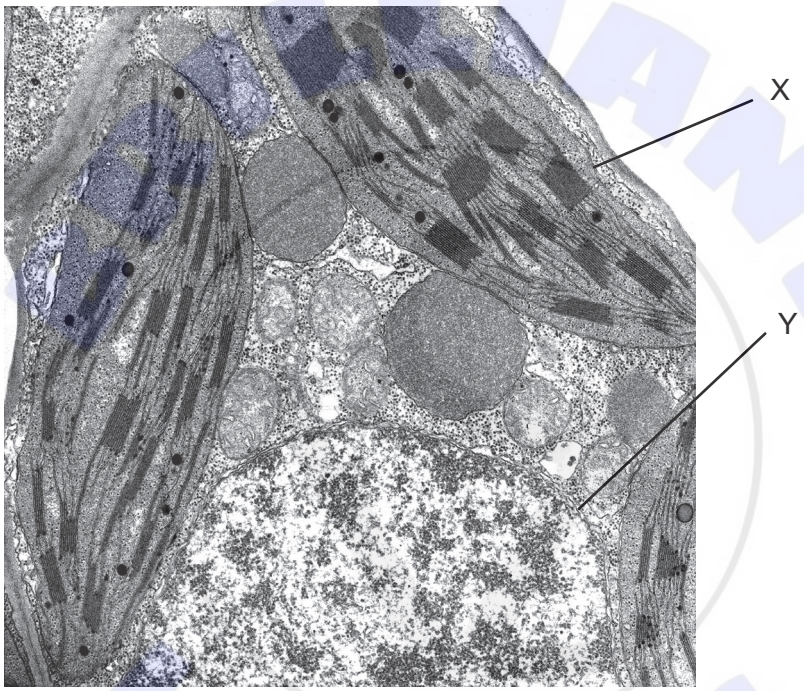
A. Chloroplast

B. Contractile vacuole

C. Rough endoplasmic reticulum

D. Mitochondrion

2. The electron micrograph shows a section through a cell.



Which feature of the cell in the micrograph is consistent with the endosymbiotic theory?

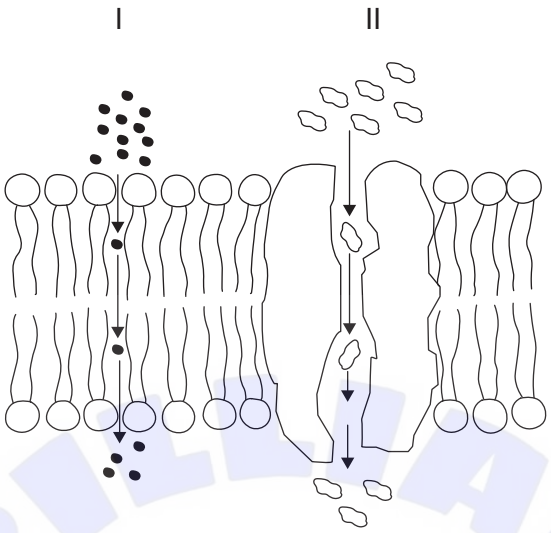
A. X has a single membrane.

B. Y has a double membrane.

C. X contains 70S ribosomes.

D. Y contains 80S ribosomes.

3. The diagram shows a section through a membrane. What are the modes of transport in the diagram?



	I	II
A.	simple diffusion	osmosis
B.	active transport	facilitated diffusion
C.	simple diffusion	facilitated diffusion
D.	facilitated diffusion	active transport

4. What would show that a person has developed metastatic cancer?

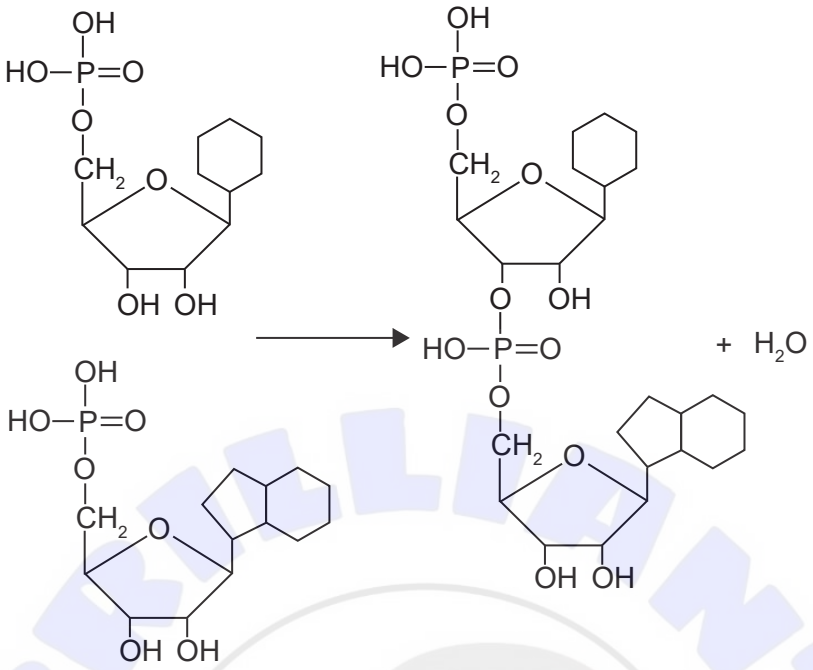
A. Alveolus cells forming a tumour in the lungs

B. Cancer cells producing the skin pigment melanin in the liver

C. A tumour in the prostate gland increasing levels of prostate-specific antigen

D. Cancerous lymphocytes in blood plasma

5. What are the type of reaction and the product(s) shown in this reaction?



	Reaction	Product(s)
A.	condensation	two nucleotides
B.	condensation	one dinucleotide
C.	hydrolysis	two nucleotides
D.	hydrolysis	one dinucleotide

6. The genetic code is shown.

1st base		2nd base U	2nd base C	2nd base A	2nd base G		3rd base
U		Phe	Ser	Tyr	Cys	U	
		Phe	Ser	Tyr	Cys	C	
		Leu	Ser	STOP	STOP	A	
		Leu	Ser	STOP	Trp	G	
C		Leu	Pro	His	Arg	U	
		Leu	Pro	His	Arg	C	
		Leu	Pro	Gln	Arg	A	
		Leu	Pro	Gln	Arg	G	
A		Ile	Thr	Asn	Ser	U	
		Ile	Thr	Asn	Ser	C	
		Ile	Thr	Lys	Arg	A	
		Met	Thr	Lys	Arg	G	
G		Val	Ala	Asp	Gly	U	
		Val	Ala	Asp	Gly	C	
		Val	Ala	Glu	Gly	A	
		Val	Ala	Glu	Gly	G	

In a coding gene, the DNA triplet in the transcribed strand is changed from AGG to TCG. What would be the result of this change in the genome?

A. A non-functional protein

B. A different but functional protein

C. No change in the protein

D. Termination of the polypeptide

7. What is the reason for Taq DNA polymerase being used in the polymerase chain reaction (PCR)?

A. It does not denature at high temperatures.

B. It produces Okazaki fragments more rapidly.

C. It allows translation to proceed rapidly.

D. It works efficiently with helicase in PCR.

8. The table shows the mass of different types of fat in some foods.

	Mass per 100 g food			
Food	**Saturated fat**	**Polyunsaturated fat**	**Monounsaturated fat**	**Trans fat**
Palm oil	50	9	23	0
Canola oil	7	28	63	0
Sunflower oil	10	40	45	0
Partially hydrogenated soybean oil	30	10	15	45

Which oil would be **least** recommended for inclusion in the human diet?

A. Palm oil

B. Canola oil

C. Sunflower oil

D. Partially hydrogenated soybean oil

9. The first iron ore deposits in rocks appeared about 1.8 billion years ago. What took place to make this occur?

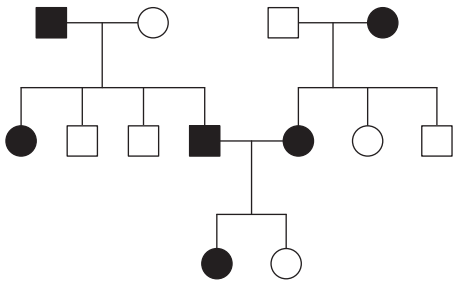
A. Some prokaryotic organisms began to absorb carbon dioxide from seawater.

B. Some eukaryotic organisms began to absorb carbon dioxide from seawater.

C. Some prokaryotic organisms began to release oxygen into seawater.

D. Some eukaryotic organisms began to release oxygen into seawater.

10. In the pedigree chart, individuals affected by a genetic disease are shown as shaded symbols. Squares represent males and circles females.



What is the mode of inheritance of the genetic disease?

A. Inherited as a dominant autosomal allele

B. Inherited as a recessive autosomal allele

C. Inherited as a recessive sex-linked allele

D. Inherited as a dominant sex-linked allele

11. What are all the possible phenotypes of children born to a mother with blood group AB and a father with blood group A?

A. AB only

B. A and B

C. AB, A and B

D. AB, A and O

12. In DNA profiling, short tandem repeats (STRs) of DNA are used, as these vary a great deal between individuals. Some skin cells were retrieved from a crime scene. Three STR sections of the DNA from these cells, from the victim and from a suspect, were analysed and the results are shown in the table.

STR base sequence	**Number of repeats of STR base sequence**		
	Victim	**Skin cells at crime scene**	**Suspect**
GTCA	10	5	30
ATGG	40	50	66
ATTA	24	13	13

What can be concluded from the gel electrophoresis data?

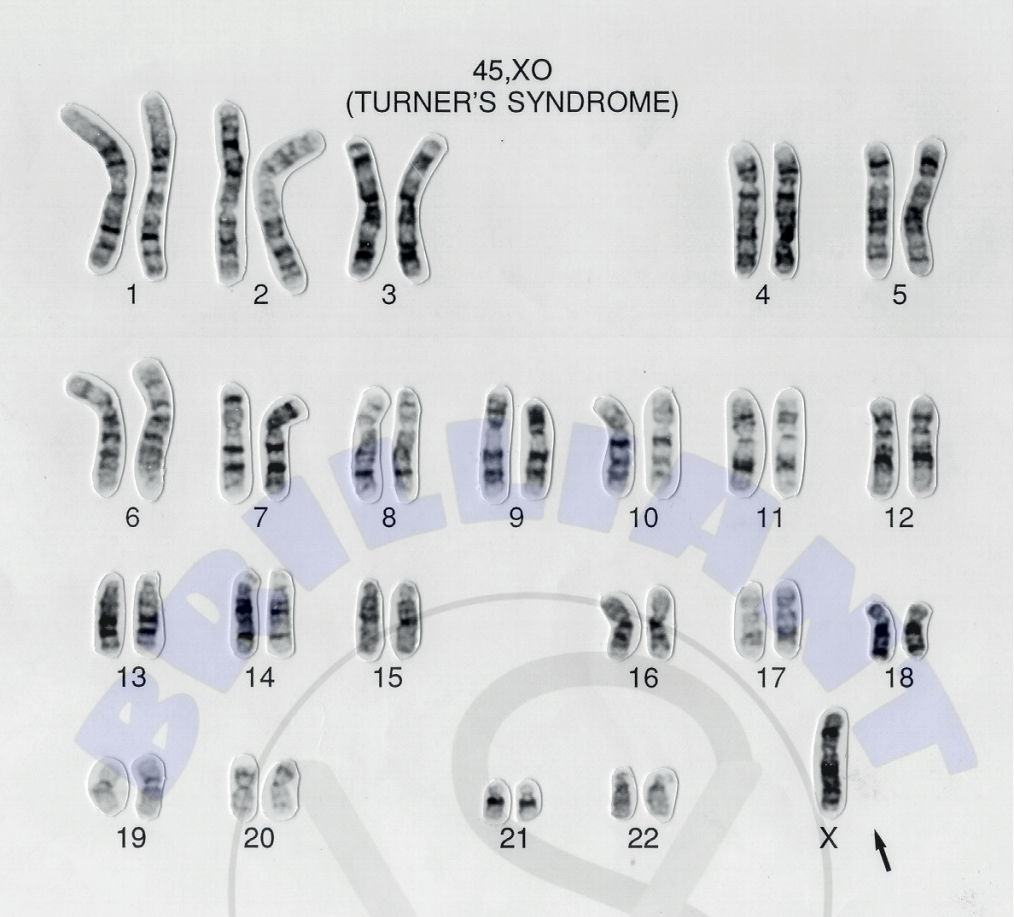
A. The suspect was at the crime scene.

B. The victim has the band moving the least distance.

C. The suspect and the victim have bands moving the same distance.

D. The skin cells have the band moving the greatest distance.

13. Testing the chromosomes of a girl with Turner syndrome produced the following karyogram.



The condition can result from non-disjunction occurring in anaphase I of meiosis in an egg cell. Two cells result from the first division, one of which would lead to Turner syndrome. Which chromosomes will be in the other cell (polar body) at the end of meiosis I?

A. 44 autosomes and X

B. 44 autosomes and XX

C. 22 autosomes and X

D. 22 autosomes and XX

14. How can a chi-squared test be used in ecological research?

A. To test the effect of an abiotic factor on one plant species

B. To test whether two species tend to live together

C. To test whether one population of plants is taller than another

D. To test whether one species is more tolerant to heavy metals than another

15. The oceans absorb much of the carbon dioxide in the atmosphere. The combustion of fossil fuels has increased carbon dioxide ocean concentrations. What adverse effect does this have on marine life?

A. Heterotrophs consume more phytoplankton.

B. Phytoplankton have increased rates of photosynthesis.

C. Corals deposit less calcium carbonate to form skeletons.

D. Increased pH reduces enzyme activity in marine organisms.

16. Plankton are major producers in marine ecosystems. Only a small proportion of the energy harvested by plankton is passed to the primary consumers. Which process in phytoplankton results in the largest loss of energy that could otherwise be utilized by consumers?

A. Reproduction

B. Homeostasis

C. Excretion

D. Respiration

17. What would restrict evolution by natural selection, if a species only reproduced by cloning?

A. Too few offspring would be produced.

B. Mutations could not occur.

C. The offspring would show a lack of variation.

D. The offspring would be the same sex as the parent.

18. An animal has the following characteristics: bilateral symmetry, mouth but no anus, ribbon shape. Which phylum does the animal belong to?

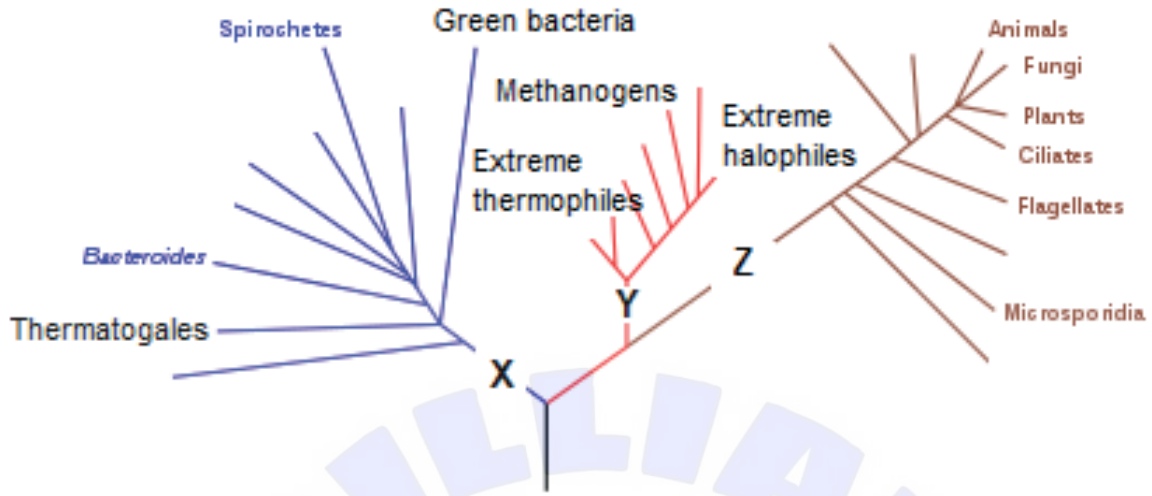
A. Mollusca

B. Cnidaria

C. Annelida

D. Platyhelmintha

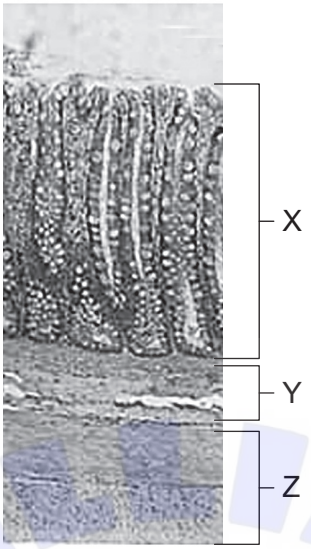
19. The cladogram shows some of the groups in the three domains.



What domains do X, Y and Z represent?

	Domains		
	X	**Y**	**Z**
A.	prokaryote	archaea	eukaryote
B.	archaea	eubacteria	prokaryote
C.	eubacteria	archaea	eukaryote
D.	eubacteria	prokaryote	eukaryote

20. The photomicrograph shows a section through a human small intestine.



Which statement corresponds to the labelled structures?

A. X moves food along the intestine.

B. Y is the mucosa.

C. Y contains lacteals.

D. Z causes peristalsis.

21. What happens in the heart when epinephrine is secreted into the blood?

I. Pressure in the heart falls.
II. The pulmonary artery transports oxygenated blood at a faster rate.
III. The sinoatrial node increases the rate of electrical signals.

A. I only

B. I and II only

C. II and III only

D. III only

22. What is a feature of phagocytic white blood cells?

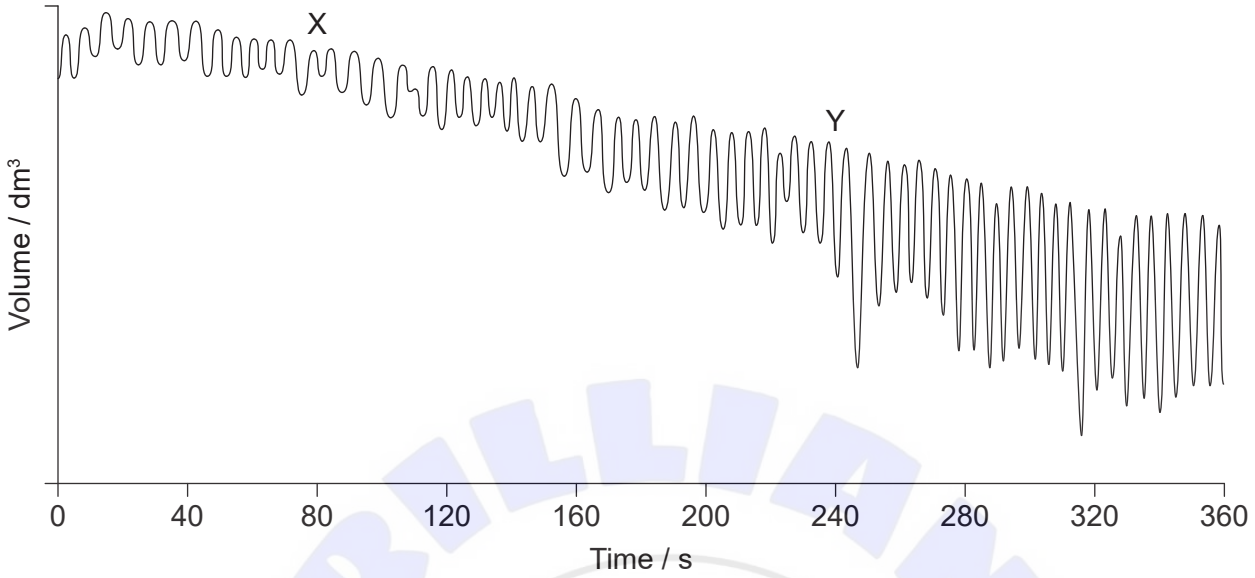
A. Stimulate blood clotting

B. Found only in the circulatory system

C. Form part of non-specific immunity

D. Produce antibodies

23. The graph shows a spirometer trace of oxygen consumption when breathing at rest and during exercise.



What explains the difference between the traces at regions X and Y on the graph?

A. At X, the internal intercostal muscles contract more than the external intercostal muscles.

B. At Y, the ribcage moves up and out more than at X.

C. At X, the diaphragm flattens more per breath than at Y.

D. At Y, the intercostal muscles contract more slowly than at X.

24. In 1940, Florey and Chain tested penicillin on bacterial infections in eight mice, before treating a sick patient. Currently, what is the correct order for testing the effectiveness of an antibiotic or other drug?

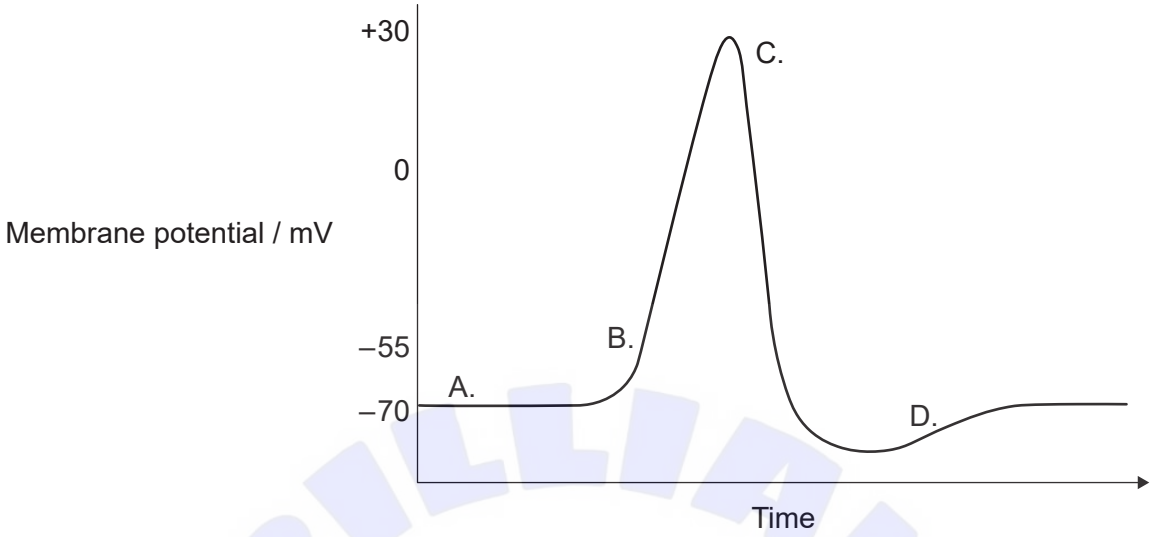
A. Affected patients, animals, healthy people

B. Animals, healthy people, affected patients

C. Healthy people, animals, affected patients

D. Animals, affected patients, healthy people

25. The graph shows the changing membrane potential during a nerve impulse. Which letter indicates when the potassium channels open?



26. The number of protein-coding genes in the human genome is estimated to be about 20 000, which is much less than the size of the proteome. What is one reason for this?

A. Exons are removed from RNA before translation.

B. There are more types of amino acids than nucleotides.

C. mRNA can be spliced after transcription.

D. Base substitutions occur during transcription.

27. Which are two proteins that assist in the unwinding and separation of DNA strands during replication?

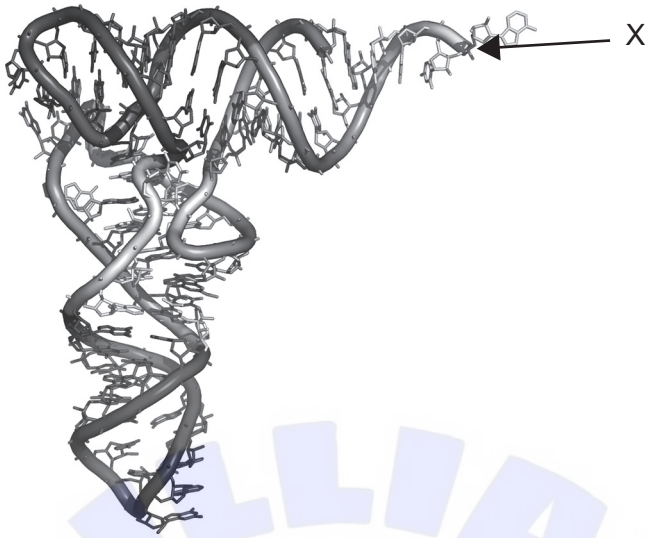
A. Helicase and DNA polymerase III

B. DNA gyrase and DNA polymerase I

C. Helicase and DNA primase

D. Single-strand binding protein and DNA gyrase

28. The diagram shows the three-dimensional structure of tRNA.



What can attach to the region marked X?

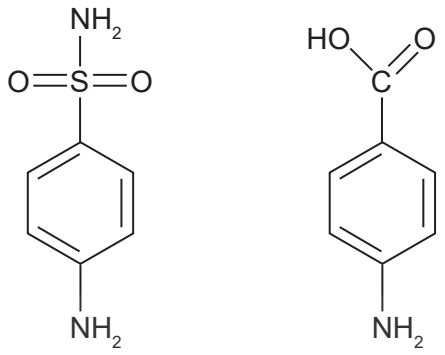
A. mRNA

B. An amino acid

C. An anticodon

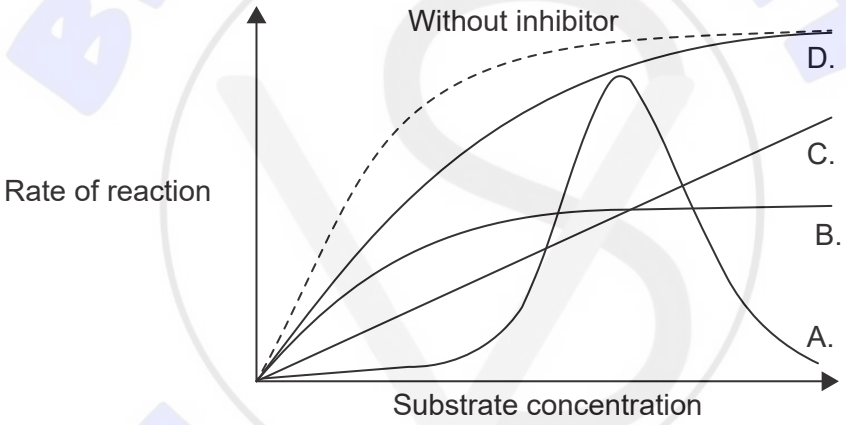
D. The P site of the ribosome

29. Sulfanilamide inhibits an enzyme that catalyses a reaction involving PABA, an intermediate in the synthesis of folate in bacteria. The structures of sulfanilamide and PABA are shown.

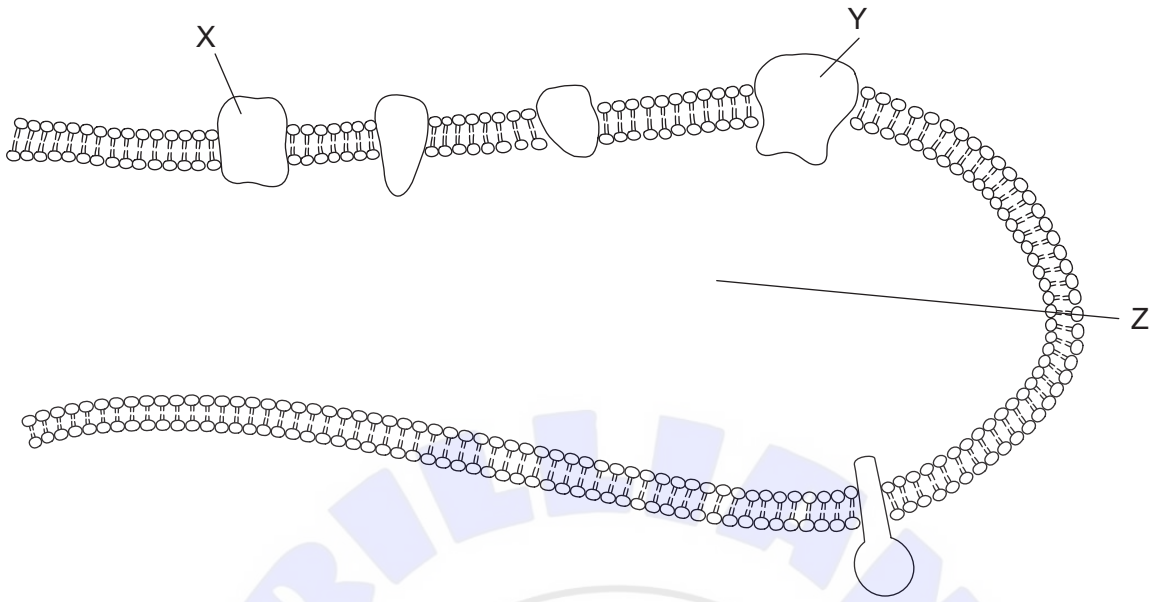


Sulfanilamide PABA

The graph shows the rate of reaction with increasing substrate concentration and with fixed low concentration of different types of inhibitors. Which line on the graph represents the effect of sulfanilamide?



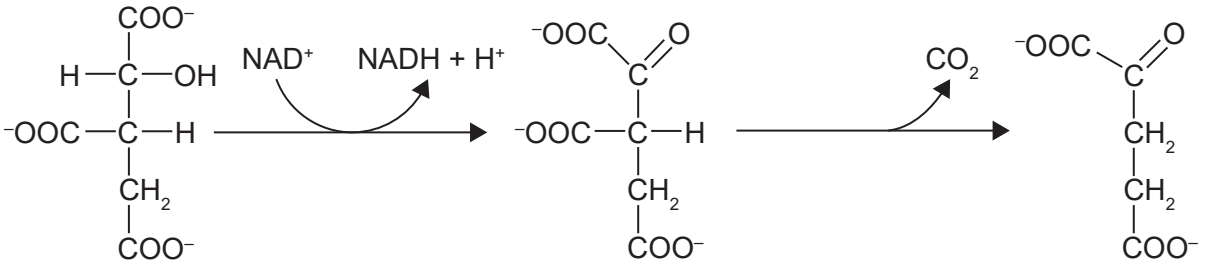
30. The diagram shows a section through a thylakoid. Electrons move from X to Y.



What do the letters X, Y and Z represent?

	X	Y	Z
A.	photosystem I	photosystem II	thylakoid space
B.	photosystem II	photosystem I	thylakoid space
C.	ATP synthase	photosystem II	stroma
D.	photosystem II	ATP synthase	stroma

31. Two reactions of the Krebs cycle are shown.

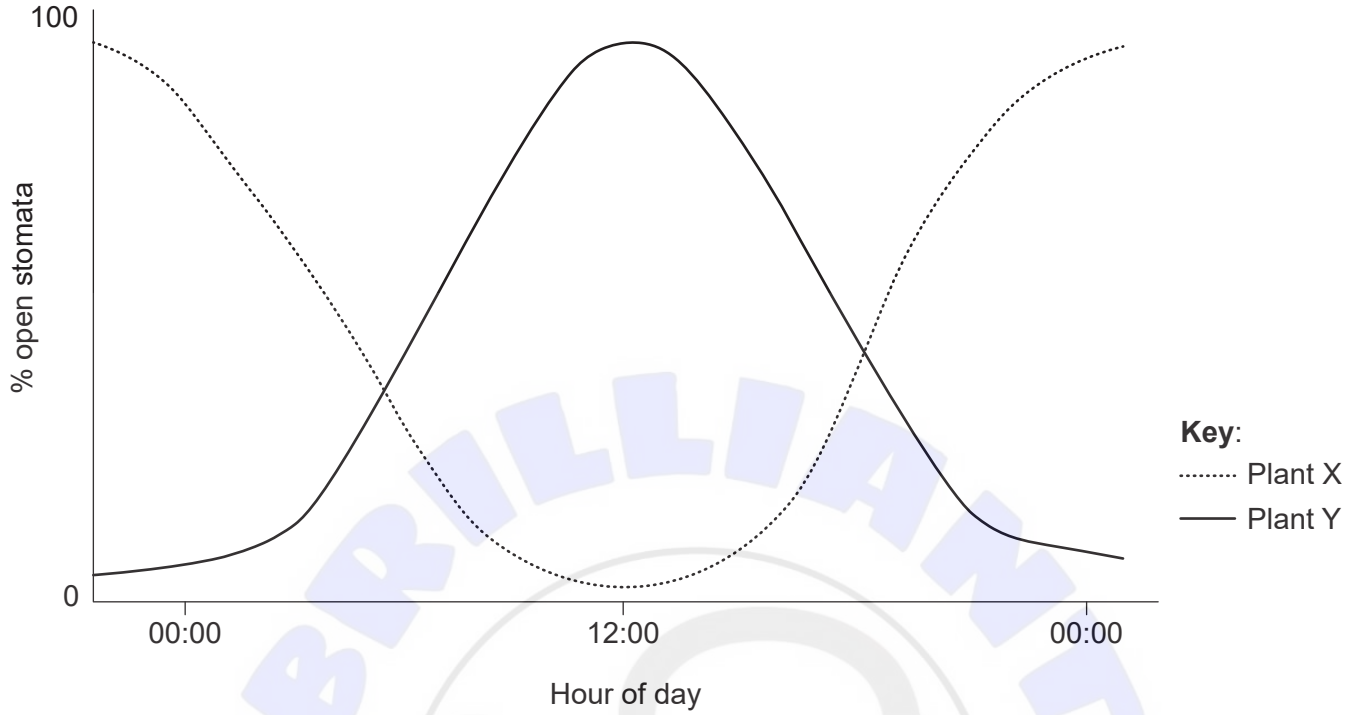


Isocitrate Oxalosuccinate α-Ketoglutarate

What type of reactions are isocitrate and oxalosuccinate undergoing?

	Isocitrate	Oxalosuccinate
A.	oxidation	reduction
B.	reduction	decarboxylation
C.	reduction	oxidation
D.	oxidation	decarboxylation

32. The graph shows the percentage of stomata that are open in two different species of plants over a 24-hour period.



What does this graph show about plants X and Y?

A. Plant X absorbs most carbon dioxide at night.

B. Plant Y is adapted to desert conditions.

C. Plant X photosynthesises most at midday.

D. Plant Y only respires during the day.

33. How does auxin exert its effect on plant cells?

A. Acts directly on the cell wall, causing expansion

B. Binds to a receptor resulting in expression of genes

C. Causes the vacuole to absorb water and expand the cell

D. Causes the cell to undergo cell division

34. Plants were given four different light treatments to investigate the influence of light on flowering. Which method can be used to induce a short-day plant to flower?

A. 8 hours light, 8 hours dark, 8 hours light

B. 14 hours light, 10 hours dark

C. 8 hours light, 16 hours dark

D. 10 hours light, 14 hours dark with a flash of light halfway through

35. Andalusian fowl have varied colours and types of feathers. The allele for black feathers is codominant with the allele for white, producing blue feathers in the heterozygote. The texture of feathers is controlled by another gene, with silky feathers recessive to normal. Blue silky birds are crossed with black silky birds. What is the expected proportion of blue silky offspring?

A. 0 %

B. 25 %

C. 50 %

D. 100 %

36. Many commercially produced bananas are triploid instead of diploid. The nucleus of a triploid cell has three sets of chromosomes. What is the effect of triploidy?

A. Seeds are larger.

B. Chromosomes cannot pair in meiosis.

C. Sexual reproduction is more rapid.

D. Mitosis cannot occur.

37. Hybridoma cells are produced in laboratories for medical diagnostics and treatments. Which two cells are fused to produce a hybridoma cell?

A. Gametes from two phenotypically different parents

B. Two different antigen-secreting cells

C. Two different tumour cells

D. A plasma cell and a tumour cell

38. What is the role of calcium ions in muscle contraction?

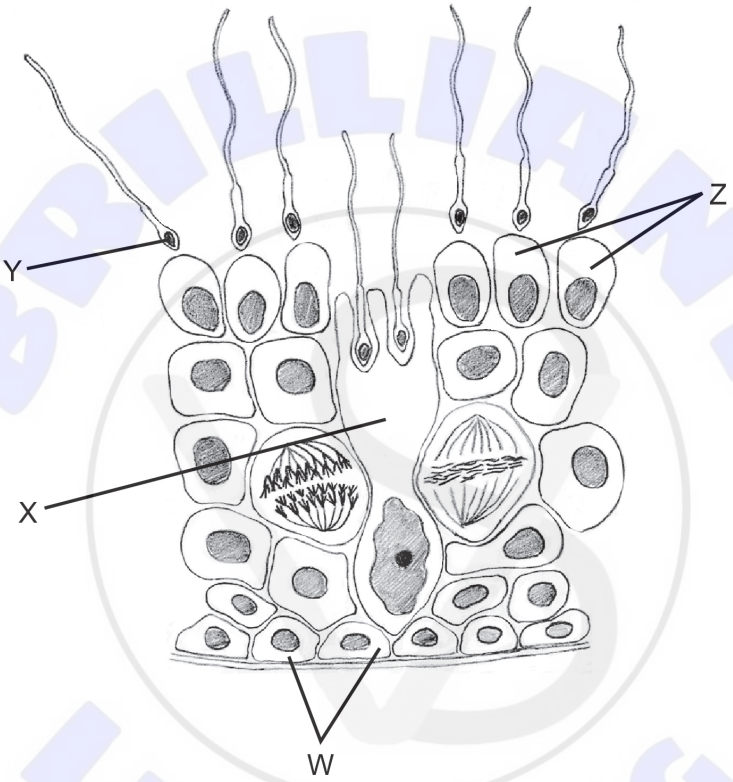
A. To enable actin to expose binding sites on myosin

B. To bind to troponin, exposing binding sites on actin

C. To prevent an action potential in the muscle membrane

D. To bind to tropomyosin, blocking binding sites on actin

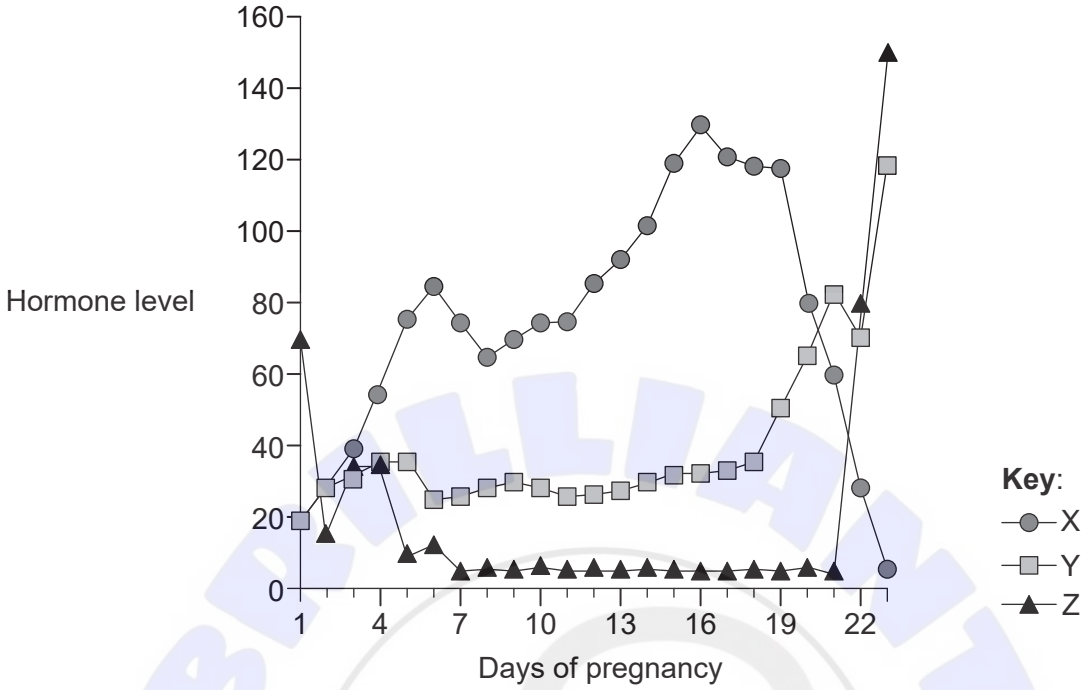
39. The diagram shows a section through a seminiferous tubule.



Which labelled cells are diploid and haploid, respectively?

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

40. The graph shows three hormones circulating during pregnancy in the rat, with birth occurring at 22 days.



What are hormones X and Z?

	X	Z
A.	estrogen	LH
B.	oxytocin	progesterone
C.	LH	estrogen
D.	progesterone	prolactin

References:

2. [**electron micrograph**] Photo © E. Newcomb. Nucleus, glyoxisomes, chloroplasts, and mitochondria - magnification at 13,900x - UWDC - UW-Madison Libraries (wisc.edu) (https://search.library.wisc.edu/digital/AE2SBIWRVTRR5T87).

3. [**diagram: membrane**] © International Baccalaureate Organization 2020.

13. [**karyogram**] Turner's syndrome karyotype 45,XO. This female lacks the second X chromosome present in the normal karyotype. Symptoms include short stature, neck wbbing, elbow deformity, widely spaced nipples with shield chest, primary amenorrhea, sexual infantilism and sterility. The ovaries are reduced to fibrous streaks. Also known as XO syndrome or ovarian short-stature syndrome. Credit: Wessex Reg. Genetics Centre. Attribution 4.0 International (CC BY 4.0).

19. [**cladogram**] Adapted from Eric Gaba (Sting, fr:Sting), Cherkash, Public domain, via Wikimedia Commons. https://commons.wikimedia.org/wiki/File:Phylogenetic_tree.svg.

20. [**photomicrograph: human small intestine**] Chiodini RJ, Dowd SE, Chamberlin WM, Galandiuk S, Davis B, Glassing A (2015) Microbial Population Differentials between Mucosal and Submucosal Intestinal Tissues in Advanced Crohn's Disease of the Ileum. *PLoS ONE* 10(7): e0134382. https://doi.org/10.1371/journal.pone.0134382.

23. [**graph: spirometer trace of oxygen consumption**] Courtesy of Dr. Dafang Wang for his work at University of Utah.

28. [**diagram: tRNA**] Structure reproduced with the kind permission of N.R. Voss.

30. [**diagram: thylakoid**] Courtesy Alyse Da Quynh.

39. [**diagram: seminiferous tubule**] © International Baccalaureate Organization 2020.

40. [**graph: hormones circulating during pregnancy in the rat**] Dr. Paul Kenyon University of Plymouth (retired).