A LEVEL Cambridge Topical Past Papers

BIOLOGY

2017 — 2023

P2

BIOLOGY 9700

TOPICAL PAST PAPER WORKSHEETS

2017 - 2023 | Questions + Mark scheme

AVAILABLE PAPERS

P1	P2	P4
1676 Questions	409 Questions	403 Questions

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TOPICS	P1	P2	P4
CELL STRUCTURE	214	40	2
BIOLOGICAL MOLECULES	255	50	2
ENZYMES	119	31	13
CELL MEMBRANES AND TRANSPORT	127	33	2
THE MITOTIC CELL CYCLE	127	33	9
NUCLEIC ACIDS AND PROTEIN SYNTHESIS	134	42	8
TRANSPORT IN PLANTS	178	37	4
TRANSPORT IN MAMMALS	149	35	3
GAS EXCHANGE AND SMOKING	145	29	4
INFECTIOUS DISEASE	114	36	0
IMMUNITY	114	43	1
ENERGY AND RESPIRATION			44
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1 – (9700/23_Summer_2017_Q1) – *Cell Structure, Nucleic Acids And Protein Synthesis*

Mammals have a closed double circulation system.

(a) Explain what is meant by a *closed double circulation*.

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.....[2]

(b) Table 1.1 shows some structures in the mammalian circulatory system.

Complete Table 1.1 to show the sequence of structures through which blood flows, starting with the pulmonary vein.

Use the numbers 2 to 5 to indicate the correct sequence.

Table 1.1

structure	sequence of blood flow
left ventricle	
vena cava	
pulmonary vein	1
aorta	
right atrium	

[2]

(c) (i) Explain why arteries have thicker walls than veins.

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.....[2]

(ii) Smoking causes carbon monoxide and nicotine to enter the blood.

Describe the short-term effects of each of these substances on the cardiovascular system.

carbon monoxide

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nicotine

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.....[4]

2 – (9700/21_Summer_2017_Q2) – *Cell Structure, Enzymes, Nucleic Acids And Protein Synthesis*

Phosphatases are enzymes that catalyse the removal of phosphate groups from organic compounds.

Some students investigated the effect of substrate concentration on the rate of the reaction catalysed by an acid phosphatase (enzyme **A**). The results are shown in Fig. 2.1.

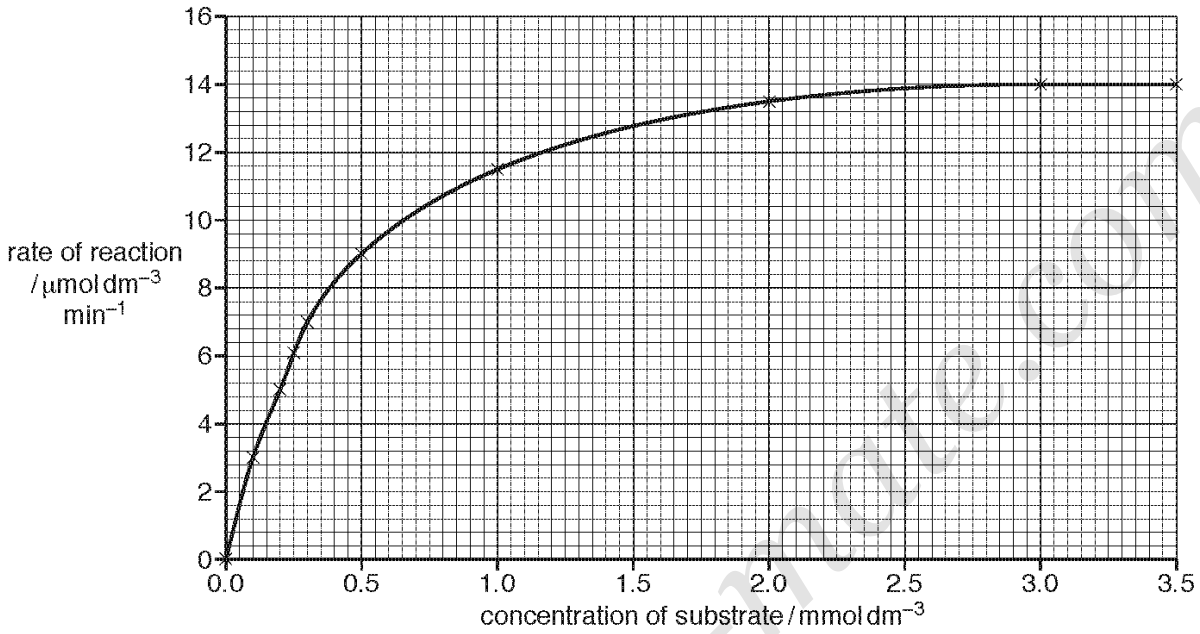

Fig. 2.1

(a) The students used Fig. 2.1 to derive the Michaelis-Menten constant (K_m) for enzyme **A** as 0.3 mmol dm^{-3}.

Explain how they derived K_m.

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.....[2]

(b) The students investigated a different phosphatase enzyme (enzyme **B**) and found the value of K_m to be higher than $0.3\,mmol\,dm^{-3}$.

Explain the difference between the values of K_m for these two phosphatase enzymes.

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.....[2]

(c) The students repeated their investigation on enzyme **A** with a competitive inhibitor.

They used the same concentrations of substrate as before, but added a competitive inhibitor to each reaction mixture.

They used the same concentration of the inhibitor in each reaction mixture.

The students found that V_{max} was the same as before, but K_m was higher than $0.3\,mmol\,dm^{-3}$.

Explain how the addition of the competitive inhibitor results in the same value for V_{max} but a higher value for K_m.

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.....[4]

3 – (9700/22_Summer_2017_Q3) – *Cell Structure, Infectious Disease*

Malaria is a disease caused by the protoctist, *Plasmodium*. The organism has a very complex life cycle as it has two hosts, a human and a mosquito.

(a) Name **one** of the four species of *Plasmodium* that infects humans.

.....[1]

(b) State the name of the mosquito that is host to *Plasmodium.*

.....[1]

Fig. 3.1 is a transmission electron micrograph showing the developing *Plasmodium* cells inside a protective structure known as an oocyst. In this stage of the life cycle the oocysts are found in the mosquito gut. When mature, the *Plasmodium* cells are released and travel to the salivary glands of the mosquito.

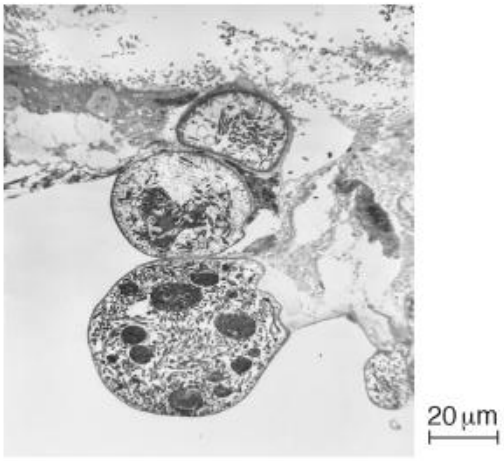

Fig. 3.1

(c) The magnification used in Fig. 3.1 can also be obtained using a light microscope.

Suggest why an electron microscope was used to obtain this image instead of a light microscope.

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.....[2]

(d) Use the scale bar to calculate the magnification of the image shown in Fig. 3.1.

Write down the formula and use it to make your calculation. Show your working.

formula

magnification × .....[3]

(e) Outline the role of the mosquito in the transmission of malaria.

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.....[2]

4 – (9700/21_Summer_2017_Q4) – *Cell Structure*

(a) Fig. 4.1 shows part of a DNA molecule.

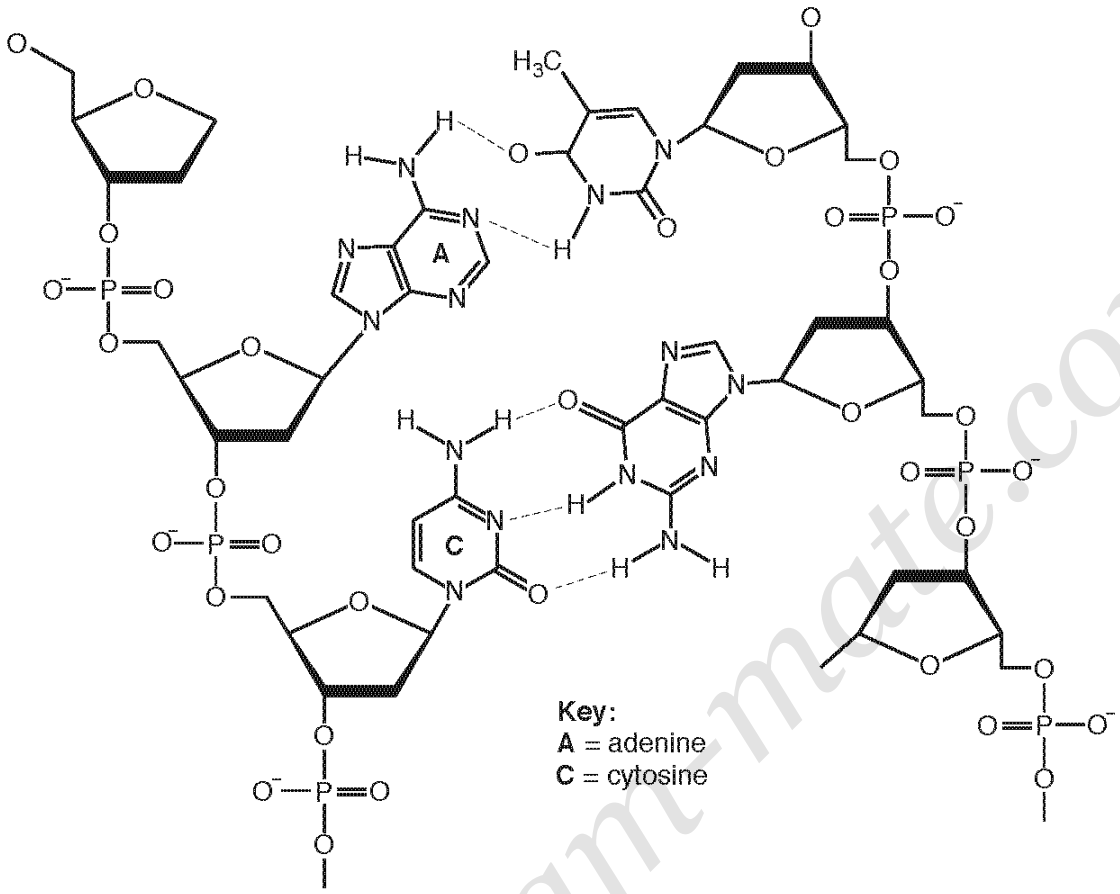

Fig. 4.1

Use Fig. 4.1 to explain how the structure of mRNA differs from the structure of DNA.

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.....[4]

(b) Fig. 4.2 shows:

- the first seven amino acids of the β chain of haemoglobin
- the first amino acid in the sequence is valine (Val)
- the 21 base pairs in the sequence of DNA that code for these seven amino acids.

amino acid sequence	Val	His	Leu	Thr	Pro	Glu	Glu
base sequence in DNA	CAC	GTG	GAC	TGA	GGA	CTC	CTC
	GTG	CAC	CTG	ACT	CCT	GAG	GAG

Fig. 4.2

Table 4.1 shows the triplets of bases that code for seven amino acids.

Using Fig. 4.2 and Table 4.1, state what will happen to the sequence of amino acids in the first part of the β chain of haemoglobin:

(i) if the base pair at position 6 is deleted

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.....[1]

(ii) if the three base pairs at positions 7, 8 and 9 are deleted.

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.....[1]

Table 4.1

amino acid		DNA triplets
cysteine	(Cys)	TGT TGC
glutamic acid	(Glu)	GAA GAG
histidine	(His)	CAT CAC
leucine	(Leu)	CTT CTC CTA CTG
proline	(Pro)	CCT CCC CCA CCG
threonine	(Thr)	ACT ACC ACA ACG
valine	(Val)	GTT GTC GTA GTG
no amino acid	STOP	TAA TAG TGA

(c) DNA is involved in the processes of replication and transcription.

Complete Table 4.2 by using a tick (✓) to indicate which features apply to each of the processes. Use a cross (✗) for features that do **not** apply.

The first row has been completed for you.

Table 4.2

feature	replication	transcription
a single-stranded molecule is produced	✗	✓
hydrogen bonds are broken		
both strands of DNA act as templates		
phosphodiester bonds are formed		
DNA polymerase is used		

[4]

(d) Telomeres are parts of chromosomes. Describe the function of telomeres.

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.....[2]

(e) Describe the function of ribosomes in protein synthesis.

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.....[4]

5 – (9700/23_Winter_2017_Q1) – *Cell Structure*

Fig. 1.1 is a transmission electron micrograph of a part of an animal cell.

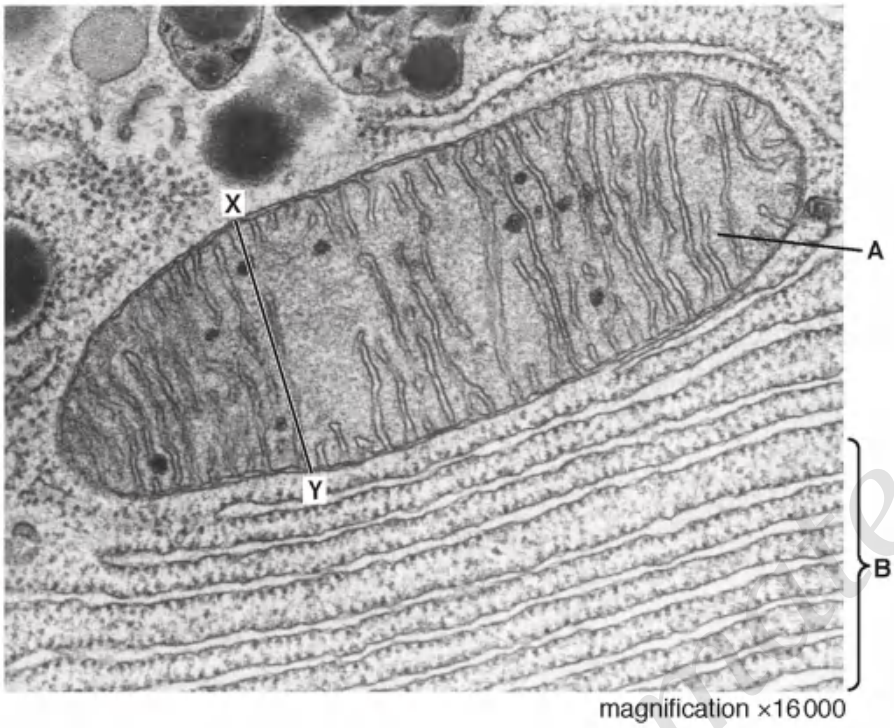

Fig. 1.1

(a) Calculate the actual width of the organelle labelled **A**, as shown by line **X–Y**.

State the formula that you will use and show your working.

Give your answer in μm and to one decimal place.

formula

..... μm [3]

(b) (i) Name the organelle **A** and state its role in cells.

name .....

role .....

.....

.....[2]

ANSWERS

1 – (9700/23_Summer_2017_Q1) – *Cell Structure, Nucleic Acids And Protein Synthesis*

(a)	blood contained in (blood) vessels AW or blood contained in *any three of* heart, arteries, veins, capillaries ; systemic and pulmonary, systems / circulation ; **A** described *if circulations not named* e.g. for each complete circuit (round the body) blood passes through heart twice blood transported from heart to lungs and back, then to (rest of) body and back	2
(b)	2 4 1 3 5 1st and 5th boxes (2 and 5) correct ; 2nd and 4th boxes (4 and 3) correct ;	2
(c)(i)	*assume answer refers to arteries unless stated otherwise* withstand / AW, higher pressure (of blood) ; prevent rupturing / bursting (from high blood pressure) ; **I** collapsing *one from* thicker / AW, tunica media ; more elastic, tissue / fibres, and (smooth) muscle tissue ; more / AW, elastic, tissue / fibres, to maintain, blood pressure / blood flow ; more (smooth) muscle to maintain, blood pressure / blood flow ;	max 2
(c)(ii)	*carbon monoxide max 3* forms carboxyhaemoglobin ; **A** binds to haemoglobin less haemoglobin available to bind oxgen / haemoglobin has greater affinity for carbon monoxide / AW ; reduces, percentage saturation of haemoglobin (with oxygen) / AW **A** less oxygen binds to haemoglobin **I** prevents oxygen binding or reduces oxygen carrying capacity of, haemoglobin / blood ; *nicotine max 3* increases heart rate ; increases blood pressure ; constricts, arteries / arterioles ; **A** vasoconstriction makes platelets sticky / promotes clotting / promotes thrombosis ; *for either* damages, endothelium / tunica intima / lining of blood vessels ;	max 4

2 – (9700/21_Summer_2017_Q2) – *Cell Structure, Enzymes, Nucleic Acids And Protein Synthesis*

(a)	half V_{max} / AW, = 7 (μmol dm^{-3} min^{-1}) / take half of V_{max} of 14 (μmol dm^{-3} min^{-1}) ; **A** description of using the graph to find ½ V_{max} without reference to figures read (substrate concentration) from *x*-axis / AW ; *alternative* plot 1 / [S] = x	2

(b)	***allow*** *phosphate group(s) / organic compound for substrate* *if affinity not used, accept idea of ability to form ESC* *check for* ***ora*** I *ref. to* competitive inhibition 1 enzyme **B** has a lower affinity for its substrate (than enzyme **A**) or the higher the K_m the lower the affinity of the enzyme for its substrate ; **R** if substrate has affinity for the enzyme 2 enzyme **B** needs a higher concentration of substrate to reach, V_{max} / ½V_{max} / K_m (than enzyme **A**) ; 3 AVP ; e.g. enzyme **B** forms fewer ESC in the same unit of time enzyme **B** active site is a less good fit for substrate *idea that* in normal cell enzyme **A** is saturated (with substrate) so works at a constant rate variations in substrate concentration will have less effect on the rate of formation of product by enzyme **A** I *ref. to* turnover number(s)	max 2
(c)	*marks can be taken from a sketch graph* 1 competitive inhibitor, occupies / competes with substrate for / AW, active site (of the enzyme) ; 2 reduces frequency of collisions (with substrate) / fewer ESCs form ; **R** no ESCs form 3 reduces reaction rate at low substrate concentrations ; 4 *idea that* curve with inhibitor is to the right of the curve without inhibitor ; 5 at high substrate concentration / with increasing substrate concentration, the inhibitor has, no / less, effect ; **A** *idea that* substrate outcompetes inhibitor at high substrate concentration 6 therefore V_{max} is the same as it is determined by the enzyme concentration / AW ; **A** explanation in terms of active sites, saturated / fully occupied 7 *idea of* intercept to curve gives a higher value for K_m ;	max 4

3 – (9700/22_Summer_2017_Q3) – *Cell Structure, Infectious Disease*

(a)	*(Plasmodium) falciparum / malariae / ovale / vivax* ;	1
(b)	*Anopheles* ; I female / male I specific epithet e.g. *gambiae*	1
(c)	*look for ora* 1 higher / better / AW, resolution / resolving power ; 2 { 0.5 nm (**A** 0.2–1 nm) compared to, 200 nm 0.2 μm (**A** range 100–300 nm) or electrons have shorter wavelength ; **R** electron microscope has a shorter wavelength or *idea that* cell structures too small to interfere with light waves ora } 3 better able to distinguish between two points ; **A** as a definition if mp 1 achieved 4 (can see) more detail ; *treat 'clearer' as neutral* 5 able to make thinner sections / able to see inside (oocyst) ; 6 can continue to obtain higher magnifications and see more detail ;	max 2
(d)	(magnification =) $\frac{\text{image / scale bar (length)}}{\text{actual / object (length)}}$; **A** triangle / letters only (x) 500 ;; *using 10 mm as measured length* **A** calculated values for measured length of 9 mm or 11 mm *allow one mark if correct answer given with units* *allow one mark if incorrect answer and* *correct measurement and correct working* *correct measurement and formula but incorrect conversion* *measurement ±2 mm and correct working*	3