

CANDIDATE NAME		CT GROUP	17\$7
CENTRE NUMBER	INDEX NUMB	ER	

BIOLOGY

BIOLOGY	8876/01
Paper 1 Multiple Choice Questions	20 September 2018
Additional Materials: Optical Mark Sheet	1 hour

INSTRUCTIONS TO CANDIDATES

- 1. Write your **name** and **CT group** in the spaces provided at the top of this cover page.
- 2. Fill in your particulars on the Optical Mark Sheet. Write your NRIC number and shade accordingly.
- There are thirty questions in this paper. Answer all questions. For each question, there are 3. four possible answers, A, B, C and D.

Choose the one you consider correct and record your choice in soft pencil on the separate Optical Mark Sheet.

4. At the end of the paper, you are to submit **only** the Optical Mark Sheet.

INFORMATION FOR CANDIDATES

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.

Any rough working should be done in this booklet.

The used of an approved scientific calculator is expected, where appropriate.

1 The electron micrographs 1, 2 and 3 show three different types of cells.



2



Which row is correct?

	electron micrograph of cell type	organelle found in cell type	description of organelle
A	1, 2 and 3	ribosomes	embedded on the smooth endoplasmic reticulum for synthesis of polypeptides
в	1 and 2 only	vacuoles	membrane-bound fluid-filled sacs
С	3 only	nucleoli	dense masses within the nuclei
D	2 only	centrioles	found in animal cells but absent in plant cells

2 Sometimes scientists need to isolate organelles. This can be achieved by taking a number of cells and breaking their cell surface membranes to release the contents of the cells into a buffer solution.

In zonal centrifugation, the suspension of cell contents is placed on top of a sucrose density gradient. The tube is then placed in a centrifuge and spun at high speed. As shown, the heavier particles will move towards the bottom of the tube faster than lighter particles.



If a sample of intact prokaryotes had been added to a suspension of eukaryotic cell contents, where would you expect them to be found?

3 The diagram shows a section through a cell surface membrane from an animal cell.

When compared to the more fluid cell surface membrane of a phagocytic cell, a number of differences in the membrane composition can be observed.



Which is the most likely set of differences that will be observed in the phagocytic cell?

- A a complete absence of component Q and a higher proportion of component P
- B a higher proportion of component S and a higher proportion of component T
- ${\bf C}$ a lower proportion of component ${\bf V}$ and a higher proportion of component ${\bf U}$
- ${\bf D}$ $\;$ an increased distance across ${\bf R}$ and a higher proportion of component ${\bf V}$

4 In an experiment, potato cylinders were placed in sucrose solutions of different concentrations. The potato cylinders were measured before and after immersion into each sucrose solution.

The graph shows the effect of different sucrose concentrations on the length of the potato cylinders.



When the sucrose solution was less than 0.3 mol dm⁻³, water molecules moved from a region of ...1... negative water potential to a region of ...2... negative water potential. Hence, water molecules moved from the ...3... into the ...4....

If the initial length of the potato cylinder in 0.1 mol dm^{-3} sucrose solution is 5.0 cm, the final length will be ...5...cm.

Which words correctly fill gaps 1, 2, 3, 4 and 5?

	1	2	3	4	5
Α	less	more	sucrose solution	potato cells	5.5
в	less	more	sucrose solution	potato cells	4.5
С	more	less	potato cells	sucrose solution	5.5
D	more	less	sucrose solution	potato cells	4.5

5 Fatty acid chains of natural membrane phospholipids may be saturated or unsaturated.



Which statements regarding fatty acid chains A and B are correct?

- 1 The presence of phospholipids with mainly fatty acid chain A in cell membranes have increased membrane viscosity.
- 2 Fatty acid chain B is unsaturated because it contains one double bond creating a kink in the fatty acid structure.
- 3 A membrane containing predominantly fatty acid chain B has a greater fluidity than one which predominantly contains fatty acid chain A.
- 4 The presence of phospholipids with fatty acid chain B eases the passage of small, non-polar molecules, such as oxygen through membranes.

Α	1, 2, 3 and 4	Α	1, 3 and 4	Α	1 and 2 only	Α	2 and 4 only
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6 The diagram shows the ribbon model of the cell surface membrane receptor, HLA-DR1.

HLA-DR1 consists of two polypeptides, where parts of the protein are labelled P, Q and R.



Which statement regarding the cell surface membrane receptor HLA-DR1 is correct?

- A In the formation of structure P, each hydrogen bond is formed between the –NH of one amino acid and the C=O group of another amino acid.
- **B** Q is important for the folding of the polypeptide into a specific 3D conformation of its active site.
- **C** R-group hydrogen bonding is involved in the formation of structure R.
- **D** Structures P, Q and R play a role in the formation of the quaternary structure of HLA-DR1.

7 The graph shows the effect of an enzyme on a reaction.



Which row correctly identifies the labels?

	reaction with enzyme	difference in activation energy	energy released during reaction
Α	Х	1	2 + 3
в	Y	1 + 2	3
С	х	1 + 2	1 + 2 + 3
D	Y	1	3

8 Poison ivy plant releases an oily substance known as urushiol, which results in poison ivy rash. A student accidentally brushed against some poison ivy leaves and developed poison ivy rash.

The student had read that:

- an enzyme found in banana peel, catechol oxidase, could act on urushiol, thereby preventing its entry into the skin
- one recommendation to avoid a rash is to use alcohol to dissolve the urushiol.

The student decided to rub banana peel soaked in red wine on to the affected skin to decrease the chance of developing a rash, but unfortunately a rash still developed.

In the laboratory, the student made some catechol oxidase solution and measured the rate of reaction at different urushiol concentrations, with and without red wine added to the reaction mixture. The graph shows the results of the experiment.



Which of the statements are true?

- 1 It would have been better for the student if banana peel had been rubbed onto the skin without first soaking in red wine.
- 2 Red wine likely contained an inhibitor of catechol oxidase.
- 3 There was a compound within the red wine that competes for the active site of urushiol.

Α	1 only	В	1 and 2 only	С	2 and 3 only	D	1, 2, and 3
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9 Once most stem cells differentiate, they lose their ability to turn into other types of cells. However, some fully differentiated cells can be stimulated to change back into stem cells in tissue culture. Such cells are called induced pluripotent stem cells (iPS cells).

In experiments with mice, it was discovered that the introduction of four genes would cause certain fully differentiated cells to change to iPS cells. Genes were introduced into host mouse cells using artificially synthesised plasmids.

There is evidence to suggest that the introduction of the four genes caused an increase in the production of telomerase reverse transcriptase (TERT) in the fully differentiated cells.

Which statements are correct?

- 1 The iPS cells are useful for research because they have the ability to differentiate into cells of the extra-embryonic membranes.
- 2 Only a few genes were required to be added because these genes were likely able to influence the activity of many other genes by coding for transcription factors.
- 3 TERT, which plays a part in maintaining the length of the telomere at the end of a chromosome, is not normally switched on in differentiated cells.
- 4 This method of creating iPS cells has less ethical concerns than harvesting embryonic stem cells.
- **A** 1, 2 and 3 **A** 1, 2 and 4 **A** 1, 3 and 4 **A** 2, 3 and 4
- **10** A key feature of most multicellular organisms is the ability to differentiate and produce specialized cells.

	totipotent	pluripotent	multipotent	
Α	\checkmark	\checkmark	\checkmark	key
В	\checkmark	×	\checkmark	✓ = ability
С	\checkmark	×	×	× = no ability
D	×	\checkmark	\checkmark	

Which row best describes the ability of zygotic cells to differentiate?

11 Meselsohn and Stahl investigated DNA in bacteria.

They grew bacteria in a medium with only heavy nitrogen, 15N, until all of the bacterial DNA was heavy.

These bacteria were moved from a heavy nitrogen medium and cultured in a medium with only light nitrogen, 14N. A sample of bacteria was collected from the first generation in the medium containing light nitrogen and their DNA was analysed.

Hybrid DNA contains both heavy and light DNA.

Which row shows the percentage of heavy DNA strands and the percentage of hybrid DNA molecules in the second generation produced in the medium containing light nitrogen?

	percentage of heavy DNA strands	percentage of hybrid DNA molecules
Α	25	50
в	50	50
с	50	100
D	75	100

12 The diagram shows the replication bubble of part of a DNA molecule.



Which statements regarding the replication of DNA are correct?

- 1 At replication fork 1, synthesis of the complementary strand of DNA strand 1 is continuous.
- 2 At replication fork 2, DNA strand 1 requires multiple primers for the replication process.
- 3 Four DNA molecules are newly formed upon the completion of replication.

Α	1, 2 and 3	Α	2 and 3 only	Α	1 and 2 only	Α	1 only
---	------------	---	--------------	---	--------------	---	--------

13 The diagram shows the transcription of a gene in a eukaryotic cell.



Which statements are correct?

- 1 X is not transcribed except for the transcription start site.
- 2 RNA polymerase and transcription factors bind to Y to initiate transcription.
- 3 Z comprises the promoter, coding region and termination sequence.
- **A** 1, 2 and 3
- **B** 1 and 3 only
- C 2 and 3 only
- D 1 only

14 A bacteria colony produces a normal protein with a known amino acid sequence.

The bacteria colony was treated with the same chemical mutagen twice. This gave rise to two mutant strains of bacteria where each had a single nucleotide change at a particular mRNA codon resulting in a change of amino acid as shown in the diagram.



The mRNA codons for some amino acids are shown in the table.

alanine (ala)	leucine (leu)	threonine (thr)	valine (val)
GCU	UUU	ACU	GUU
GCC	UUC	ACC	GUC
GCA	UUA	ACA	GUA
GCG	UUG	ACG	GUG

Assuming that both treatments resulted in a single nucleotide change each, which diagram correctly shows the codons that were translated into alanine, methionine, threonine and valine?

В

D







С





15 Multigene families are defined as groups of genes with sequence homology and related overlapping functions. It is thought that these genes arose from a common ancestral gene that has accumulated mutations over time.

The globin gene family is one such example and the diagram shows how the gene family arose.



Which mechanism best explains how the globin gene family was formed?

- A Multiple unequal crossovers of the α and β globin RNA occur during mitosis to result in the different gene families.
- **B** A germline mutation occurred where the ancestral globin gene was duplicated forming α and β globin gene, each with their own subsequent point mutations.
- **C** A point mutation in the ancestral gene promoter resulting in the formation of a new origin of replication, and hence the repeated replication of a specific portion of the genome.
- **D** Several copies of the α and β globin genes are duplicated over time, each with different degree of nonsense mutation leading to globin chains of varying functions.

16 Two enzymes, X and Y, are each encoded by different alleles of the same gene. The amino acid sequences of the two enzymes differ between positions 87 and 91 of the polypeptides.

The amino acid sequences of enzymes X and Y, and the corresponding DNA sequence of enzyme X from position 86 to position 93 of the polypeptides, are shown in the table below.

	← N ter	minal en	d a	amino acid position C terminal end \rightarrow				ıd →
	86	87	88	89	90	91	92	93
DNA triplet								
codes for	TTT	TCA	GGT	AGT	GAA	TTA	CGA	CGA
enzyme X								
amino acid								
sequence of	lys	ser	pro	ser	leu	asn	ala	ala
enzyme X								
amino acid								
sequence of	lys	val	his	his	leu	met	ala	ala
enzyme Y								

The actual mRNA codons for the same amino acids in these positions for enzymes X and Y, are shown in the table below:

amino acid	lys	ser	pro	leu	asn	ala	val	his	met
mRNA	AAA	AGU	CCA		AAU	GCU	GUC		AUG
couori(s)		UCA		UUA				UAC	

What could account for the difference in amino acid sequence of enzymes X and Y?

- **A** A single frame shift by deletion in the DNA code at position 87.
- **B** Frame shift mutations in the DNA code at position 87 and position 90.
- **C** A change in the sequences of the second and third nucleotides at positions 87 and 88 of the DNA codes and frame shifts at positions 89 and 91.
- **D** A deletion in the DNA code at position 87 and an insertion into the DNA code at position 92.
- 17 Which statements increase the chance of cancer formation?
 - 1 accumulation of mutations in somatic cells of both parents
 - 2 overexposure to ionizing radiation from the sun
 - 3 long term exposure to second hand cigarette smoke
 - **A** 1, 2 and 3
 - B 2 and 3 only
 - C 1 and 3 only
 - D 1 only

- 17
- **18** The diagram shows the progression of colon cancer represented in four different stages.



Which statements can be concluded from the diagram?

- 1 The accumulation of mutations in a single cell lineage is required for the progression of normal cells to adenoma cells.
- 2 The enzyme telomerase is present only in cells undergoing metastasis.
- 3 Mutations inhibit the process of angiogenesis and hence nutrients are delivered to cells of the carcinoma.
- A 1 and 3 only B 2 and 3 only C 2 only D 1 only
- **19** The diagram shows the chromosomes of one cell during mitosis.



Which stage of mitosis is shown and what is the haploid chromosome number in this species?

	stage of mitosis	haploid chromosome number		
Α	anaphase	5		
в	anaphase	10		
С	metaphase	5		
D	metaphase	10		

20 The electron micrograph shows plant cells undergoing mitosis. Cells undergoing different stages of mitosis are labelled W, X, Y and Z.



Which statements are correct?

- 1 Cell W shows the formation of chromosomes and the re-formation of the nuclear envelope.
- 2 Cell X shows the condensation of chromatin and is the stage where spindle fibers start to assemble.
- 3 Cell Y shows the stage that occurs after anaphase where chromosomes line up along the equator of the cell and attach to the spindle.
- 4 Cell Z shows homologous chromosomes moving towards opposite poles, pulled by the spindle fibres.
- **A** 2 and 4
- **B** 1 and 3
- C 2 only
- **D** 3 only

- 21 Read the following statements.
 - Gibberellins belong to a group of chemicals known as terpenoids and are made up of the elements carbon, hydrogen and oxygen only.
 - In the pea plants that Mendel studied, the stem length gene, *Le / le*, controls the length between nodes.
 - Pure-breeding, tall pea plants were crossed with pure-breeding, dwarf pea plants. The F1 generation plants were all of the same height. When these were crossed, the numbers of tall and dwarf plants in the F2 generation were counted. There were 787 tall and 277 dwarf plants.
 - The dwarf variety of the pea plant lacks gibberellin.
 - Addition of gibberellin to the dwarf plants results in conversion of the dwarf to the tall phenotype.

What can be concluded from these statements?

- A Heterozygous genotypes for the stem length gene are of an intermediate height, as only 50% of the product of gene expression is synthesised.
- **B** The lack of a ratio of 3 tall pea plants to 1 dwarf pea plant in the F2 generation means that there is an environmental effect contributing to height in pea plants.
- **C** The *Le* / *le* gene codes for the protein gibberellin, with only the *LeLe* or *Lele* genotypes expressing gibberellin and with the *lele* genotype unable to express gibberellin.
- **D** There is at least one altered triplet code in the dwarf allele of the *Le / le* gene, producing a polypeptide with an altered tertiary structure and resulting in a non-functioning protein.
- 22 The table shows the results of a series of crosses in a species of small mammal.

coat colour phenotype					
male parent	female parent	offspring			
dark grey	light grey	dark grey, light grey, albino			
light grey	albino	light grey, white with black patches			
dark grey	white with black patches	dark grey, light grey			
light grey	dark grey	dark grey, light grey, white with black patches			

What explains the inheritance of the range of phenotypes shown by these crosses?

- **A** one gene with a pair of co-dominant alleles
- **B** one gene with multiple alleles
- **C** sex linkage of the allele for grey coat colour
- **D** two genes, each with a dominant and recessive allele

23 The diagram shows the light-dependent reaction of photosynthesis.



Which statements are true?

- 1 Molecule A, which is a by-product of photolysis of water, contributes to the generation of a proton gradient.
- 2 Molecule B is produced in the light independent reaction of photosynthesis.
- 3 Molecule C will act as a reducing power in the light independent reaction of photosynthesis.
- **A** 1, 2 and 3
- B 1 and 3 only
- C 2 and 3 only
- D 2 only

24 Chloroplasts contain chlorophyll a and chlorophyll b. Scientists found tobacco plants with a mutation that caused them to make more chlorophyll b than normal tobacco plants. They investigated the effect of this mutation on the rate of photosynthesis.

The scientists carried out the following investigation.

- They grew normal and mutant tobacco plants. They grew some of each in low light intensity and grew others in high light intensity.
- They isolated samples of chloroplasts from mature plants of both types.
- Finally, they measured oxygen production by the chloroplasts they had isolated from the plants.
- In each trial, the scientists collected oxygen for 15 minutes.

The graph shows the scientists' results.



What can be concluded by the scientists based on the results they obtained?

- 1 The mutant plants that produced more chlorophyll b would grow faster than normal plants in all light intensities.
- 2 At all light intensities, chloroplast from mutant plants have a faster production of ATP and NADPH, leading to the faster rate of light-independent reaction.
- 3 The difference in the oxygen produced by the chloroplasts over 15 minutes from the mutant plants grown in low and high light intensities at a light intensity of 500 μ mol photons m⁻² s⁻¹ during these trials is 35 μ mol O₂ mg⁻¹.
- A 1, 2 and 3
- **B** 1 and 2
- **C** 1 and 3
- D 2 and 3

25 The table shows the occurrence of ATP production, NAD reduction and decarboxylation in different stages of aerobic respiration.

Which row is correct?

stage	ATP	reduction	decarboxylation
	production	UNAD	
glucose → pyruvate	yes	yes	yes
pyruvate → lactate	no	no	no
pyruvate → acetyl coenzyme A	no	no	yes
pyruvate \rightarrow ethanol	no	yes	yes
	stage glucose → pyruvate pyruvate → lactate pyruvate → acetyl coenzyme A pyruvate → ethanol	ATP productionstageATP productionglucose \rightarrow pyruvateyespyruvate \rightarrow lactatenopyruvate \rightarrow acetyl coenzyme Anopyruvate \rightarrow ethanolno	$\begin{array}{c} \text{ATP} & \text{reduction} \\ \text{production} & \text{of NAD}^+ \end{array} \\ \\ \text{glucose} \rightarrow \text{pyruvate} & \text{yes} & \text{yes} \\ \text{pyruvate} \rightarrow \text{lactate} & \text{no} & \text{no} \\ \text{pyruvate} \rightarrow \text{acetyl coenzyme A} & \text{no} & \text{no} \\ \text{pyruvate} \rightarrow \text{ethanol} & \text{no} & \text{yes} \end{array} \end{array}$

26 Chemiosmosis is the term used to describe the synthesis of ATP using a proton gradient across a membrane in a mitochondrion or chloroplast. It was first demonstrated by Peter Mitchell in 1961.

In some of his experiments, Peter Mitchell carried the following steps:

- He used mitochondria that had been isolated from cells.
- The mitochondria were kept in liquid, in glass tubes, to which ADP, Pi and other substances were added.
- The temperature, pH and water potential were kept constant.
- After a period of time, he checked for the presence of ATP.

The table shows the contents of the tubes.

tube	tube contents
1	mitochondria + ADP + Pi + acetyl CoA + oxygen
2	mitochondria + ADP + Pi + acetyl CoA
3	mitochondria + ADP + Pi + low concentration of protons
4	mitochondria + ADP + Pi + high concentration of protons

Based on the information and table provided, which statements are true?

- 1 ATP is produced in tubes 1 and 4 only.
- 2 In tube 1, oxygen acts as the final electron donor in oxidative phosphorylation.
- 3 If the water potential of the liquid in the glass tube is higher than the water potential of the mitochondrial matrix, water enters the mitochondria by osmosis, rupturing the mitochondrial membrane and hence, bursting the mitochondria.

A 1 only **B** 3 only **C** 1 and 3 **D** 1, 2 and 3

27 Some plant species have evolved flowers suited to pollination by certain hawk moths, which are fluid-feeders. These moths have a high energy demand, feed at night and hover in front of the flowers while they feed.

Which of the following flower characteristics is most likely to be possessed by a plant species that is pollinated by these hawk moths?

- A brightly coloured petals and high pollen production
- **B** flower parts shaped to resemble the female hawk moth
- **C** production of odours during the day that mimic rotting flesh
- **D** white petals with high nectar production
- **28** A student recorded the shell colour and banding pattern of all empty shells of the brownlipped snail, *Cepaea nemoralis*, found in a small deciduous wood. Wide variation in shell colour and banding pattern, which are genetically controlled, was shown. Of the shells collected, 38% were damaged and 62% were intact.

Gene **C** codes for the colour of the shell. There are six alleles.



Gene **B** codes for the presence or absence of bands. There are two alleles.

 \mathbf{B}^{O} = unbanded, dominant allele \mathbf{B}^{B} = banded, recessive allele

Which conclusion drawn from this information is valid?

- A In the wood, brown, unbanded phenotypes will occur in the highest frequency and banded, pale yellow phenotypes will occur in the lowest frequency.
- **B** More than one selection pressure is likely to be acting to maintain the polymorphism shown in shell colour and banding pattern in the wood.
- **C** Predation by birds, such as the song thrush, is the only selection pressure acting on *C. nemoralis* in the small deciduous wood.
- **D** The proportion of each phenotype in the population of *C. nemoralis* in the wood will be similar to the proportion of each phenotype recorded for the empty shells.

29 The diagram shows an arctic food web. It features two primary producers that fix carbon by photosynthesis. Ice algae thrive in nutrient-rich pockets in the ice, while phytoplankton are found freely floating in the ocean.



Which of the following is not true regarding the effect of climate change on this arctic habitat?

- A Decline in ice algae can lead to the decline in polar bear population.
- **B** Decline in ice algae will lead an increase in phytoplankton because there is less competition between phytoplankton and ice algae for resources.
- **C** The effect on arctic cod, seal, and polar bear populations depends on how much zooplankton population is affected by the decline in ice algae.
- **D** Decline in zooplankton may lead to decline in seal population.

30 With climate change, some regions on Earth are experiencing warmer temperatures. Warmer temperatures favour some species of pest, for example the spruce beetle, *Dendroctonus rufipennis*.

Since the first major pest outbreak, the spruce beetles have severely destroyed approximately 400,000 hectares of trees in Alaska and the Canadian Yukon.

The graphs show the drought index, a combination of temperatures and precipitation and the area of spruce trees destroyed annually.



Which statement best explains the trends observed in the graphs?

- A From the late 1980s, prolonged period of drought and warm weather led to tree mortality because warmer climate resulted in an increased number of generations of the spruce beetles.
- **B** Between 1930 and 1970, there was no tree mortality because the spruce beetles had other food sources.
- **C** The pest outbreak occurred because wet, cool climate caused the spruce beetles to be more active and thus reproduce at a faster rate.
- **D** The spike in tree mortality was likely not related to climate, but due to a random catastrophic event that wiped out an entire patch of forest.

---END OF PAPER---

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Copyright Acknowledgements: Acknowledgement is herein given to third-party sources for the use of third-party owned material protected by copyright in this document, which is administered internally for assessment purposes only.

Qn	Paper 1 topic	source
1	Euk. & Prok. Cell Structure and Function	novel
2	Euk. & Prok. Cell Structure and Function	9790/01/SP/19 Q11
3	Transport Across Membrane	AQA Jan 2003, Unit 1, STQ mod
4	Transport Across Membrane	9790/01/M/J/14
5	Biomolecules Structure and Function	Adapted from 9790 S12 QP3
6	Biomolecules Structure and Function	Adapted from 9790 / Y16 / QP1 (STQ)
7	Mode of Action of Enzyme	9790 / S11/ QP1 / Q28 Modified
8	Mode of Action of Enzyme	Adapted from 9790/S14/QP1/Q22(d)
9	Stem Cells	Adapted from 9790 S12 QP3 Q6
10	Stem Cells	9790 / S12 / QP1 /Q9
11	DNA Structure, Function and Replication	9700/11/M/J/18 Qn 22 mod
12	DNA Structure, Function and Replication	Novel
13	Central Dogma of Molecular Biology (Gene Expression)	Novel
14	Central Dogma of Molecular Biology (Gene Expression)	Modified from Alberts 6-57
15	Mutations	Novel, modified 2008 promos
16	Mutations	9648 N13 / Q10
17	The Molecular Biology of Cancer	Novel
18	The Molecular Biology of Cancer	Novel
19	Cell & Nuclear Division	Novel
20	Cell & Nuclear Division	UCLES 2005 9700/01/M/J/05
21	Inheritance	Nov 16 / 9790 Biology / P1 / Q2
22	Inheritance	9790 2012 / P1 / Q18
23	Photosynthesis	Diagram adapted from AQA 2013 / Q5
24	Photosynthesis	Adapted from STQ8 of AQA Specimen
25	Cellular Respiration	2014 9790 / P1 / Q19
26	Cellular Respiration	Adapted from STQ6 2017 9700/43/Q6
27	Biological Evolution (evidence of evolution)	2014 9790 M/J P1 Q7
28	Biological Evolution (natural selection)	2016 9790 P1 Q15
29	Impact of Climate Change on Animals and Plants	2014 Edition Oxford IB Diploma Programme Biology TextBook Pg 234, Pg 239
30	Impact of Climate Change on Animals and Plants	



HWA CHONG INSTITUTION JC2 Preliminary Examinations Higher 1

CANDIDATE NAME	CT GROUP	17S7

BIOLOGY

Paper 2 Structured and Free-response Questions

27 August 2018

8876/02

2 hours

No additional materials are required.

INSTRUCTIONS TO CANDIDATES

Write your **name** and **CT group** in the spaces provided at the top of this cover page.

SECTION A

This section contains **six** questions. Answer **ALL** questions in the spaces provided on the Question Paper.

SECTION B

This section contains **two** questions. Answer any **one** question in the spaces provided on the Question Paper.

Your answers must be in continuous prose, where appropriate.

A NIL RETURN is required for questions not answered.

INFORMATION FOR CANDIDATES

The use of an approved scientific calculator is expected, where appropriate.

You may lose marks if you do not show your working or if you do not use appropriate units.

The number of marks is given in brackets [] at the end of each question or part question.

You are reminded of the need for good English and clear presentation in your answers.

For Examiners' Use			
1	/ 8		
2	/ 8		
3	/ 9		
4	/ 8		
5	/7		
6	/ 5		
7/8	/ 15		
Final Mark	/ 60		

This document consists of **20** pages.

Section A

Answer **all** the questions in this section.

QUESTION 1

Fig. 1.1 shows a goblet cell from the colon of a rat, which can be found scattered among the epithelial cells that line the intestinal tract. The goblet cell produces mucus that is subsequently packaged into mucigen granules before being secreted out of the cell.



Fig. 1.1

(b) Explain how organelles **A** and **B** are adapted to allow the goblet cell to secrete mucus out of the cell.

[4]

(c) In 1967, Lynn Margulis proposed the theory of endosymbiosis, which states that mitochondria and chloroplasts of eukaryotes evolved from ancient prokaryotes. It proposed that these ancient prokaryotes were engulfed by other bacterial cells and both benefitted from the relationship – this has led to the evolution of eukaryotic cells.

Describe how the similarities between mitochondria and prokaryotic cells support the theory of endosymbiosis.

[2]

[Total: 8]

QUESTION 2

Fig. 2.1 is a diagram representing the transport of glucose from the intestinal lumen to the extracellular fluid across an intestinal epithelial cell. Three proteins are labelled **P**, **Q** and **R**.



Fig. 2.1

(a) Describe what is meant by *facilitated diffusion*.

	[1]	1
	r.,	1

(b) Identify which transport protein, **P**, **Q** or **R**, is involved in facilitated diffusion.

[1]

(c) Explain how glucose is transported from the intestinal lumen to the extracellular fluid.

[4]

- (d) Suggest why **R** is necessary in facilitating the transport of glucose across the epithelial cell in Fig. 2.1.
 - [2] [Total: 8]

QUESTION 3

Fig. 3.1 shows the gene expression of a ribosomal protein, rS2.



Fig. 3.1

(a) Describe the main structural features of a ribosome.

_____[2]

(b) State the role of the *r*S2 promoter.

[1]

(c) List three ways by which process **X** differs from process **Y**.

[3]

(d) Suggest how a mature ribosome is assembled upon the completion of process Y.

[3]

[Total: 9]

QUESTION 4

In his book *On the Origin of Species* (1859), Charles Darwin wrote about the high degree of variation among domesticated plants and animals, and their differences from their wild ancestors. One of the animals Darwin studied in depth was the domestic rock pigeon. Pigeon breeding was an ancient pastime, which Darwin himself partook in.

- In birds, the sex chromosomes are referred to as Z and W, rather than X and Y as in mammals.
- The W chromosome has no genes that affect plumage colour.
- The heterogametic sex is the female, not the male.
- Thus the male has two Z chromosomes (ZZ) and the female has one Z and one W chromosome (ZW).

Plumage colour in pigeons is sex-linked, and controlled by three alleles. Ash-red allele (A) is dominant to blue (B), which is dominant to brown (N).

(a) State and explain the meaning of the term sex linkage in this context.

[2]

When an ash-red male was bred with an ash-red female, the majority of the offspring were ash-red, but some of the females were blue. Table 4.1 shows the results of the cross.

Table 4.1				
phenotype	number of offspring			
ash-red male	7			
ash-red female	3			
blue female	4			

(b)(i) Identify the parental genotypes in this cross.

[2]

ash-red female parent

ash-red male parent

[3]

(iii) State the expected phenotypic ratio for the offspring of this cross.

[1]

[Total: 8]

⁽ii) Using suitable symbols, draw a genetic diagram to explain the results shown in Table 4.1.

QUESTION 5

Bats are perhaps the most unusual and specialized of all mammals. Together with birds, they are the only extant vertebrates that are capable of powered flight. Bats live in hollow trees, caves and have limited flying range. They have mastered the night skies largely by using echolocation to perceive their surroundings and find their prey in the dark.

(a) Suggest how the ability to use echolocation may have evolved from an ancestor that did not have that ability.



Table 5.1 shows data for both species.

Table 5.1						
species	mean body mass (g)	mean wingspan (m)	range of echolocation call (kHz)	colour		
P. pipistrellus	5.5	0.22	42–47	medium to dark brown		
P. pygmaeus	5.5	0.21	52–60	medium to dark brown		

(b)(i) Name the genus to which the *Pipistrellus pygmaeus* belongs.

[1]

(ii) Using the data in Table 5.1, suggest why pipistrelles were originally classified as one species.

·······
-
[2]

[Total: 7]

QUESTION 6

Flooding is a severe threat for survival of terrestrial plants, mainly because it severely impedes the gas diffusion rate. Rice (*Oryza sativa*) is the only cereal that can be cultivated in the frequently flooded rivers.

An investigation was carried out into the effect of flooding on the growth of the submerged stems of rice plants. Young rice plants were grown in a container in which the level of water was increased in 10 cm steps, over a period of seven days. The mean length of the submerged internodes (lengths of stem between two leaves) and the concentration of ethylene in the rice stems was measured each day. As a control, rice plants were grown in identical conditions but the water level was kept constant throughout the seven days. The results are shown in Fig. 5.1.



Fig. 6.1

(a) Describe the effects of increasing water level on the mean length of the submerged internodes and mean concentration of ethylene in rice stems.

(b) Suggest an advantage to the rice plants of the effect that you have described in (a).

	[1]	
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[Total: 5]

--- END OF SECTION A ---

Section B

Answer one question in this section.

Write your answers on the lined paper provided at the end of this Question Paper.

Your answers should be illustrated by large, clearly labelled diagrams, where appropriate.

Your answers must be in continuous prose, where appropriate.

Your answers must be set out in sections (a) and (b) as indicated in the question.

QUESTION 7

(a)	Outline the roles of hydrogen bonds in biomolecules.	[6]
(b)	Discuss the suggestion that all living organisms on Earth depend on phosphate.	[9]
QUES	TION 8	[Total: 15]
(a)	Outline the role of membranes at the surface of and within the cell.	[6]

(b) The cell theory is based on a number of principles.

Discuss the extent, in humans, to which these principles can be accounted for by mitosis and the different types of stem cells.

You should consider both individual human and populations of humans from one generation to the next. [9]

[Total: 15]









--- END OF SECTION B ---

--- END OF PAPER---

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