



Biology
Higher level
Paper 2

Dec 2019 Block Week
Exam

2 hours 15 minutes

Candidate session number

J	E	R	R	Y	J	I	A	N	G
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Instructions to candidates

- Write your session number in the boxes above.
- Do not open this examination paper until instructed to do so.
- Section A: answer all questions.
- Section B: answer two questions.
- Answers must be written within the answer boxes provided.
- A calculator is required for this paper.
- The maximum mark for this examination paper is **[72 marks]**.

$\frac{59}{72}$ 7

20 pages

2219–6014

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20EP01

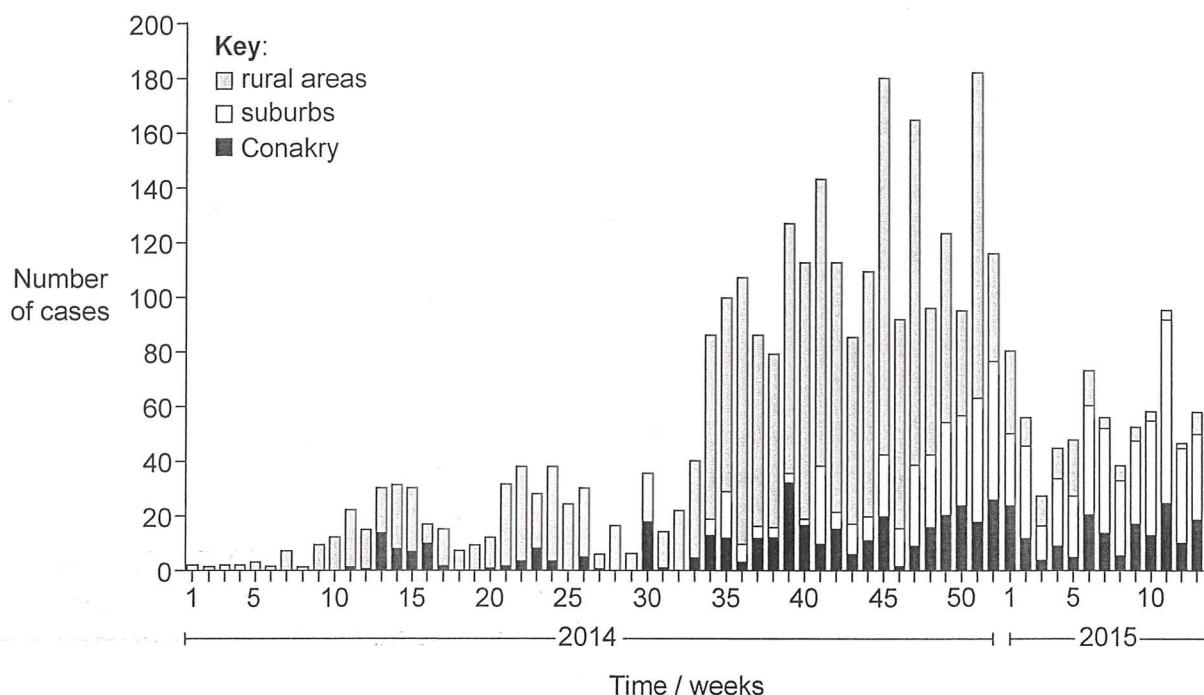


Section A

Answer **all** questions. Answers must be written within the answer boxes provided.

1. Ebola virus disease (EVD) is the disease in humans and other primates that is caused by the Ebola virus. Fruit bats are the reservoir for the virus and are able to spread the disease without being affected. Humans can become infected by contact with fruit bats or with people infected by the virus, their body fluids or equipment used to treat them.

The stacked bar graph shows the epidemiological data for the EVD cases in Conakry, the capital city of Guinea, surrounding suburbs and rural areas in Guinea from the beginning of January 2014 to the end of March 2015.



[Source: Adriana Rico, et al. "Epidemiology of Epidemic Ebola Virus Disease in Conakry and Surrounding Prefectures, Guinea, 2014–2015." *Emerging Infectious Diseases* 22.2 (2016): 178–183. PMC. Web. 23 Mar. 2017.
https://wwwnc.cdc.gov/eid/article/22/2/15-1304_article]

- (a) Identify the week and year in which the first cases were recorded in the suburbs. [1]

Week:	34
Year:	2014

(This question continues on the following page)



(Question 1 continued)

- (b) Based on the graph, compare and contrast the progress of the epidemic in the suburbs and rural areas.

[3]

- No EVD in suburbs present, only EVD spotted in rural area in the first 33 weeks. ✓
- During week 34 to the end of year 2014, EVD in rural area has been peaking compared to what it has in the first 33 weeks; while EVD in suburbs has appeared and ~~has~~ started to rise. ✓
- From week 1 to 15 in year 2015, EVD in suburbs has a general trend of increase, while in rural areas, EVD began to drop to very little amount. ✓ +3

(Question 1 continued)

The table summarizes epidemiological data from Guinea during the Ebola outbreak in 2014. The data are based on figures supplied by Ebola treatment centres. The last column refers to people who died in places other than Ebola treatment centres.

Location		Number of cases			Fatal cases at the Ebola treatment centres 1 %	Fatal cases outside Ebola treatment centres 1 %
		Total	Male	Female		
Capital city	Conakry	553	307	246	40	18
Suburbs	Coyah	236	112	124	47	19
	Forecariah	335	155	180	53	27
	Kindia	108	45	63	60	16

[Source: Adriana Rico, et al. "Epidemiology of Epidemic Ebola Virus Disease in Conakry and Surrounding Prefectures, Guinea, 2014–2015." *Emerging Infectious Diseases* 22.2 (2016): 178–183. PMC. Web. 23 Mar. 2017. https://wwwnc.cdc.gov/eid/article/22/2/15-1304_article]

- (d) Compare and contrast the data for Conakry with the data for the three suburbs.

[2]

- The total number of cases in conakry is higher than any of the three suburbs; in conakry male cases is more than female cases while in all three suburbs, the situation is the other way around; Fatal cases at treatment centres has the percentage higher than fatal cases outside Ebola treatment centres for both Conakry and the three suburbs; Fatal cases percentage of the

✓ +2

at the treatment centre in conakry is lower than any of the three suburbs.

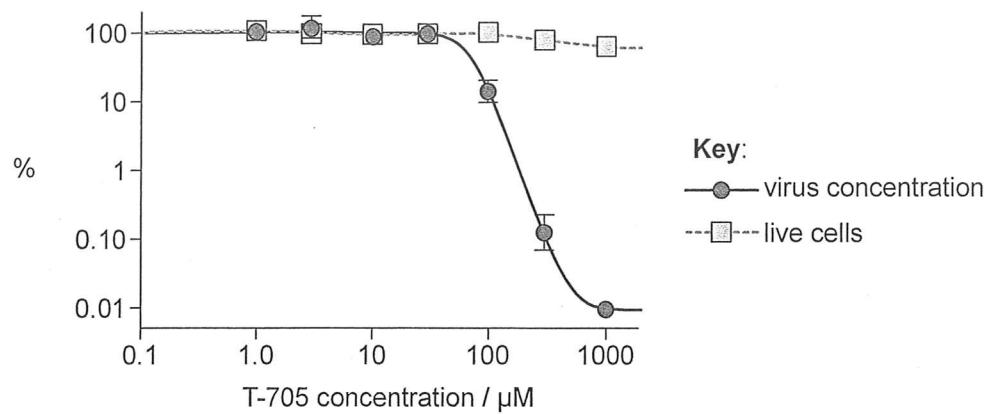
(Question 1 continued)

- (e) Suggest reasons for the high percentage of fatal cases at Ebola treatment centres. [3]

Human can be infected by contacting people with the disease....
 ...their body fluid... and the equipment used to treat them. ✓
 At the treatment centre, the density of people with disease is
 high and exposure to body fluid and polluted equipment is
 likely. Therefore, people is more likely to get the disease at
 Ebola treatment centres and the according percentage of fatal
 cases at the centres is high.

+2

An antiviral drug, T-705, was tested in order to establish whether it has potential to treat EVD. The graph shows the data from an in vitro trial of T-705 on cells that had been infected with Ebola virus five days previously. Virus concentration and live cells are shown as a percentage of the control.



[Source: Oestreich, Lisa & Rieger, Toni & Neumann, Melanie & Bernreuther, Christian & Lehmann, Maria & Krasemann, Susanne & Wurr, Stephanie & Emmerich, Petra & de Lamballerie, Xavier & Ölschläger, Stephan & Günther, Stephan. (2014). Evaluation of Antiviral Efficacy of Ribavirin, Arbidol, and T-705 (Favipiravir) in a Mouse Model for Crimean-Congo Hemorrhagic Fever. *PLoS neglected tropical diseases*. 8. e2804. 10.1371/journal.pntd.0002804.]

- (f) Based on these data, outline the evidence that T-705 has potential to be used as a treatment for EVD. [2]

When T-705 concentration is at 100 μM , there's effect of the drug on the virus. At concentration from 100 μM to 1000 μM , the virus concentration drops tremendously while the influence to live cells is minor and almost negligible. This ensure that the drug kills the virus without doing great harm to living cells.

+2

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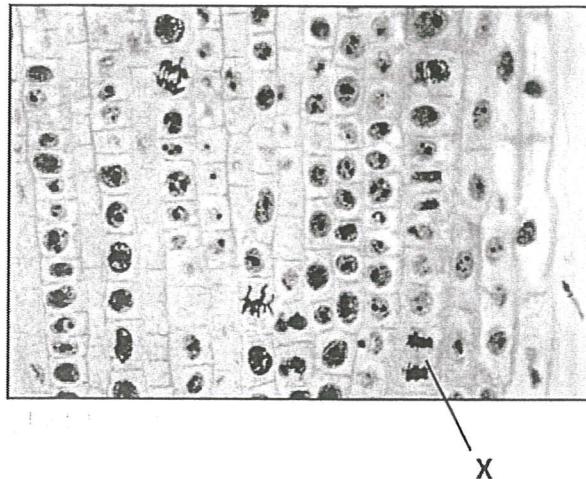


20EP05

Turn over

2. (a) (i) Identify the stage of mitosis labelled X in the image, giving a reason.

[1]



[Source: Copyright 2002, The Trustees of Indiana University]

.. Telophase... Chromosomes are already at different sides of the cells,
.. cytokinesis is about to happen and mitosis has come to an end... ✓ +1

- (ii) Outline what is indicated by the mitotic index of tissue taken from a tumour.

[2]

A tumour ~~cells~~ tissue has cells that are replicating and doing
mitosis at an abnormally high rate. Mitotic index is the
ratio of mitosis cells and total cells so high mitotic index
of the tumor tissue verifies the cancer and indicate the tumour
is active. ✓ +2

- (iii) DNA has regions that do not code for proteins. State two functions of these regions.

[2]

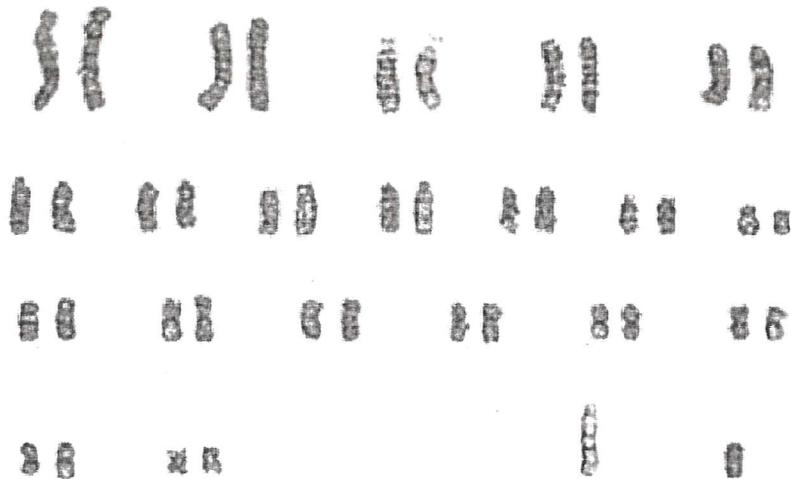
1. Gene regulation. ✓ +2
2. Become structure like telomere or code for other molecules like + RNA.

(This question continues on the following page)



Turn over

3. The karyogram shown is for the African marsh rat (*Dasymys incomtus*). In this species, sex is determined by X and Y chromosomes. Females are XX and males are XY.



[Source: © 2011 Hamanaka *et al*, https://embryology.med.unsw.edu.au/embryology/index.php?title=File:Rat_karyotype.jpg]

- (i) Identify, with a reason, the sex of this individual. [1]

Male. The last two chromosomes are the sex chromosomes. The larger one is X while the shorter one is Y. ✓

- (ii) State the haploid number for this nucleus. [1]

21. ✓

+2

(This question continues on the following page)



20EP08

4. (a) The images show parts of plants belonging to two different phyla.

Plant X



[Source: DanielCD / <https://commons.wikimedia.org/wiki/File:SoriDicksonia.jpg>]

Plant Y



[Source: tbenedict/Pixabay <https://pixabay.com/photos/pine-cones-tree-evergreen-cone-581557/>]

State the phylum of plant X and of plant Y.

[2]

X: ... filicino phyta ✓
Y: ... conifera phyta ✓

+2

- (b) Some plant families, such as the figwort family, have been reclassified on the basis of evidence from cladistics. Explain the methods that have been used recently to reclassify groups of plants.

[3]

Old way of classification have been using comparison of similar structures. However, these structures similarities are not strong evidence of close linkage due to possibilities of analogous and homologous structures. New way of reclassification is taking evidence from genetics, by comparing the similarity of genetic sequence, a more convincing and strong argument can be made in terms of the relationship between different plants. By finding out which plant is more closely related to another, the classification system can be well-modified.

+3

(This question continues on the following page)

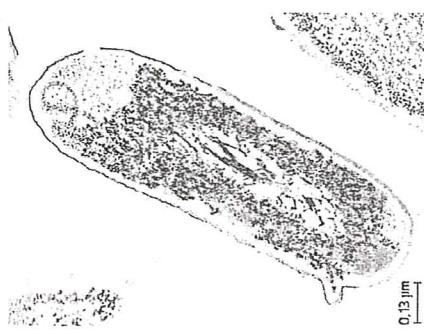


20EP13

Turn over

5. The electron micrographs show a typical prokaryote and a mitochondrion.

Prokaryote



Mitochondrion



[Source: Pradana Aumars, https://commons.wikimedia.org/wiki/Category:Bacteria#/media/File:Bacteria_cell_division.jpg]

[Source: republished with permission of McGraw-Hill Education, from *Harrison's Principles of Internal Medicine*, J L Jameson et al., 16th edition, 2004; permission conveyed through Copyright Clearance Center, Inc]

- (a) Compare and contrast the structure of a typical prokaryotic cell with that of a mitochondrion.

[4]

Mitochondrion has double membrane ; prokaryote has capsule, cell wall, and cell membrane. They both have 70S ribosome to create proteins. There're sometimes pili and flagellas outside the prokaryotic cell while mitochondrion don't have those. There're plasmids and a circular DNA in prokaryotes while in mitochondrion there are a lot of matrix designed for cellular respiration. The size of a prokaryotic cell and mitochondrion is similar.

+4

- (b) Explain how mitochondria could have been formed from free living prokaryotes.

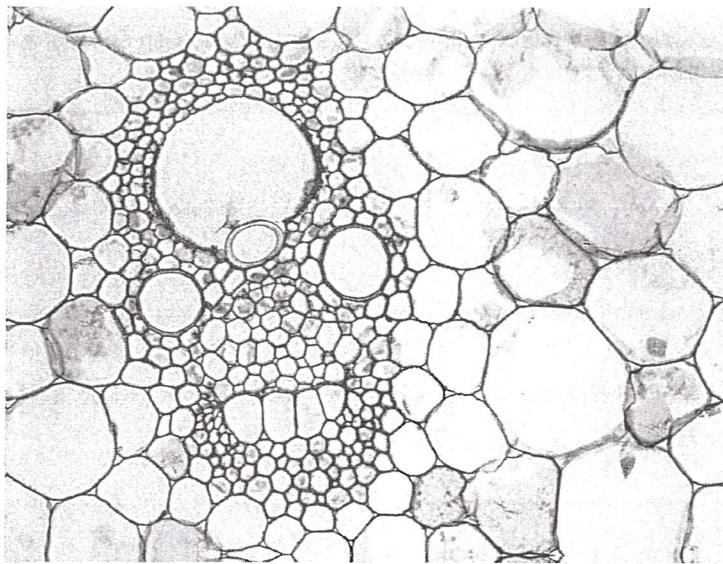
[2]

A bigger cell recognizes the ability of mitochondrion to convert organic molecule to usable energy so it decides to "recruit" the mitochondria. Through endosymbiosis, mitochondria is engulfed by the larger cell and become one of its organelle to assists its proper functioning.

+2



6. The micrograph shows a vascular bundle from the stem of a barley plant.



[Source: Copyright Carolina Biological Supply Company. Used by permission only.]

- (a) Xylem and phloem contain structures that are adapted for transport. Outline the differences between these structures in xylem and phloem.

[2]

Xylem has vessel element and has a polar wall so that
~~water can keep rising through the cohesion-tension theory~~ ✓
Phloem has companion cells and sieve tubes to help translocation
through the pressure-flow hypothesis.

+1

- (b) Explain how the properties of water allow it to move through xylem vessels.

[2]

Water are polar due to the electronegative oxygen in water and
slightly positively charged hydrogens. Therefore, water has
attraction between each other and can easily stick to polar
surfaces due to cohesion and adhesion correspondingly. Xylem
vessels are polar, which forms capillary action and assists
water to move up the vessel. ✓

+2

(This question continues on the following page)



Turn over

- (c) Successful sexual reproduction in flowering plants depends on several essential processes. Outline the role of pollination and seed dispersal.

[2]

Pollination:

Allow pollen grains to land ~~on~~ on stigma which afterwards
allows for fertilization.....

+2

Seed dispersal:

Make sure the offspring is spread out so that they will.....
have enough space and resources to grow up.....

7. (a) State two causes of the decrease of biomass along food chains in terrestrial ecosystems. [2]

- When a plant or a prey is eaten, ~~the~~ 90% of energy is lost through heat and etc, and only part of the biomass is gained....
- Not all biomaterial is eaten ~~by~~ typically only fruit of plants and flesh of prey are eaten. Other parts to rot and breakdown and doesn't pass along the food chain.

+2

(This question continues on the following page)



20EP14

(Question 5 continued)

- (b) The table shows the global carbon budget over two decades; the years 1990 to 1999 and 2000 to 2009.

Carbon	Global carbon budget / $\times 10^{12}$ kg	
	1990 to 1999	2000 to 2009
Atmospheric carbon dioxide	3.0	4.0
Fossil fuel and cement	6.5	8.0
Land use change	1.5	1.0
Carbon storage in land	2.5	2.0
Carbon storage in oceans	2.0	2.5

[Source: © International Baccalaureate Organization 2019]

Using the table, explain causes of the changes in carbon flux over the two decades. [3]

- Carbon emission has increased due to ~~the~~ combustion of fossil fuels
so the carbon budget of CO₂ in atmosphere has increased from 3.0 to 4.0.
- Coal and fossil fuel are in great demand so that they are extracted from the ground. This explains the fossil fuel and cement rising from 6.5 to 8.0 and carbon ~~stop~~ storage in land dropping from 2.5 to 2.0.
- Forests have been transferring to agricultural land by removing trees so land use change drops from 1.5 to 1.0.

+3



Section B

Answer **two** questions. Up to one additional mark is available for the construction of your answers for each question. Answers must be written within the answer boxes provided.

8. (a) Outline the functions of rough endoplasmic reticulum and Golgi apparatus. **2** [3]
- (b) Outline the control of metabolism by end-product inhibition. **2** [5]
- (c) Explain how hydrophobic and hydrophilic properties contribute to the arrangement of molecules in a membrane. **5** [7]
9. (a) Distinguish between the structures of DNA and RNA. **3** [3]
- (b) Mendel found the same pattern of inheritance in all the crosses that he performed. Outline, with examples, different types of inheritance that produce non-Mendelian ratios. **2** [4] **CT22**
- (c) Explain the cause of sickle cell anemia and how this disease affects humans. **6** [8]
10. (a) Outline the roles of helicase and ligase in DNA replication. **2** [4]
- (b) Explain how natural selection can lead to speciation. [7]
- (c) Outline the features of ecosystems that make them sustainable. [4]

Q+L 1

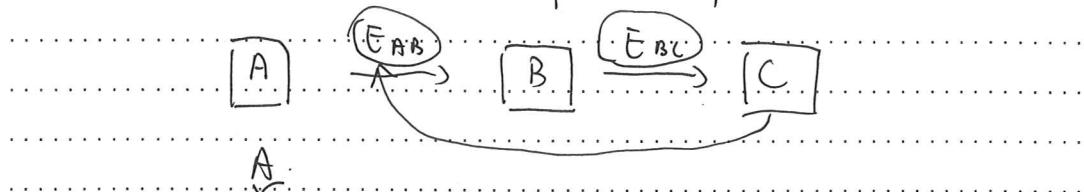
21
32



8. (a) Rough ER and Golgi apparatus are both related to proteins.

Rough ER has ribosomes on it and carry out translation to produce proteins. Then the proteins are sent to Golgi apparatus for processing and packaging for either cell use or export.

(b) Below is the mechanism of end-product inhibition:



A

- Molecule is converted to B through a metabolic reaction

catalyzed by enzyme E_{AB}. Then B is then converted to C through metabolic reaction catalyzed by E_{BC}.

- When there is too much product C produced, it becomes the enzyme inhibitor of E_{AB}, so that the reaction from A to B is happening at a slower rate.

- When the concentration of B drops, the conversion from B to C also drops, resulting in lower concentration of C.

- This way, C has less inhibition effect on E_{AB}, so that the rate of reaction from A to B can be restored.

- This ensures that the level of output of molecule C is within a certain range, thanks to this auto-regulation mechanism brought by end-product inhibition.

(c) Water is polar due to its structure. O has slightly negative charge due to high electronegativity; H has slightly positive charge. The dipole doesn't cancel out. Therefore, when a substance is polar, it can be close to water and

called hydrophilic; while non-polar substance that is not close to water are called hydrophobic.

- Membrane are primarily made up of phospholipid bilayer. In a phospholipid, the phosphate part is polar and hydrophilic, while the lipid part is non-polar and hydrophobic.

- Cell membrane are surrounded by aqueous environment with water. So when phospholipids try to assemble themselves,

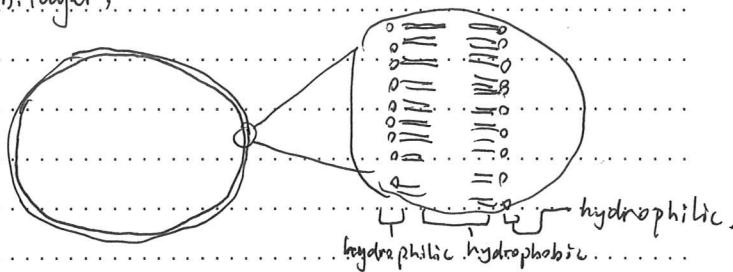
+2

+2

+5



In this kind of environment, they produce the structure of phospholipid bilayer.



where the hydrophilic part lies on the outside and hydrophobic part cuddle around each other on the inside.

- This explains why there are simple diffusion and facilitated diffusion across a membrane.

- when a molecule is polar / hydrophilic, it needs to pass through the membrane through facilitated diffusion via a protein channel. These channels are embedded inside ~~through~~ the membrane to provide pathways for the molecules. For instance, aquaporin allows water to get in and out of the cell; pump for ions allows ions like Na^+ , K^+ to pass through.

- when a molecule is non-polar / hydrophobic, it usually can cross the membrane itself without using facilitation as it won't be blocked by the hydrophobic center of the phospholipid bilayer. Examples are O_2 and CO_2 .



9. (a) DNA is double stranded. It has deoxyribose sugar, phosphate backbone and four nitrogen bases: Adenine - thymine; Cytosine - guanine.

RNA is single stranded. It has ribose sugar, phosphate backbone and four nitrogenous bases: Adenine - uracil; Cytosine - guanine.

+3

(b) non-mendelian traits are linked on a chromosome so that the law of independent assortment isn't satisfied.

Let's say for a pea plant there're two traits we are looking at: shape: dominant: round, recessive: triangle; and color: dominant: blue, recessive: white.

Let's breed with two pea plant with allele

$RrBb \times rrbb$. They have 400 offspring.

$RrBb$ offspring: 184.

$rrbb$ offspring: 176

$Rrbb$ offspring: 22

$rrBb$ offspring: 18

+2

Among them $RrBb$ and $rrbb$ are parental as these are the genotype of the parent generation. $Rrbb$ and $rrBb$ are recombinant.

The recombinant frequency is calculated by recombinant frequency over total frequency: $(18+22)/400 = 10\%$.

This indicates that the two alleles are on one chromosome with 10 units apart whereas the whole chromosome has length of 50 units. This is because, if

The ~~recombinant~~ recombinant the two trait are mendelian.

of the non-mendelian phenotypes $RrBb$, $Rrbb$, $rrBb$, $rrbb$ only occurs when crossing over take place right between the two traits on the chromosome.



$$Rr: \frac{1}{2}, rr: \frac{1}{2}, Bb: \frac{1}{2}, bb: \frac{1}{2}$$

$$RrBb: \frac{1}{2} \times \frac{1}{2} = \frac{1}{4}, Rrbb: \frac{1}{2} \times \frac{1}{2} = \frac{1}{4}$$

$$rrBb: \frac{1}{2} \times \frac{1}{2} = \frac{1}{4}, rrb: \frac{1}{2} \times \frac{1}{2} = \frac{1}{4}$$

$$\text{Then the recombinant frequency would be } (\frac{1}{4} + \frac{1}{4}) / 1 = 50\%.$$

In conclusion, non-mendelian traits are linked and are on one chromosome and are likely to appear together.

Other Mendelian?



- (c) Sickle Cell Anemia (SCA) is caused by substitutional mutation. During translation from RNA to protein, ribosomes makes mistakes. They can skip one RNA nucleotide and shifts the reading of the codon one spot to the right and cause the shifting mutation.
- It is also possible that a RNA nucleotide is transcribed incorrectly so that a different protein is later translated from the different codon form by the substitutional mutation.
 - In the case of SCA, a mistake happens during transcription so that the protein translated becomes non-polar where it should be a polar. When the protein is used to assemble red blood cell, the non-polar property will cause the cell to "sickle" up and not function properly. If people have this disease, their red blood cell will have abnormal shape and have trouble passing through capillaries. They might have great pain after sports when a lot of oxygen are needed in the legs and the red blood cells are stacked in the capillary when they try to send oxygen to the leg.
 - However, the reason why this disease still exists is that there's a "heterozygote advantage". SCA is a heritable disease. It's autosomal recessive, which means homozygous dominant and heterozygotes don't have a disease. It's shown that people with heterozygote genotype for SCA is freed from malaria, which is a pretty good thing... as they don't have SCA and they won't have malaria. They will be consequently better off at places with high risk of getting malaria, like Africa.

+6



20EP17

Turn over

Biology HL – Paper 2 May 2019 (TZ1+TZ2) Answer Key (aka Dec 2019 Block Week exam)

Section A

1 (a) 34 and 2014 (both needed) [1]

1 (b) [3 marks]

- a. start of epidemic/first cases in rural areas
OR
epidemic spread to suburbs later ✓
- b. higher maximum number of cases/greater increase in rural areas
OR
converse for suburbs ✓
- c. increase came earlier in rural areas «than suburbs»
OR
number of cases peaked earlier in rural areas
OR
more cases in rural areas «than suburbs» in 2014 ✓
- d. decrease came earlier in rural areas «than suburbs»
OR
decreasing in rural areas but not in suburbs in 2015/by end of study period
OR
more cases in suburbs than rural areas in 2015 ✓
- e. «large» fluctuations in both ✓

1 (d) [2 marks]

differences:

- a. Conakry has more cases than any of the suburbs
OR
more cases in total in the suburbs than in Conakry ✓
- b. more male cases in Conakry whereas more female cases in suburbs ✓
- c. higher «% of» fatal cases at Ebola treatment centers in suburbs than in Conakry ✓

similarity:

in both Conakry and suburbs «% of» fatal cases in treatment centers is higher than outside ✓

1 (e) [3 marks]

- a. most serious cases are in/are taken to treatment centers
OR
 treatment centers are set up where there are most cases/most serious cases ✓
- b. long time/distance to travel between contracting disease and arrival at treatment center
OR
 travel to treatment center weakens/upsets/harms the patient ✓
- c. Ebola is a virulent disease/Ebola virus mutated «to become virulent»
OR
 little known about Ebola/new disease so treatments not yet developed ✓
- d. no/not enough vaccine/antiviral drug available «in 2014/15»
OR
 antibiotics do not work against viral diseases ✓
- e. secondary infections/Ebola patients infected with other diseases/other Ebola strains
OR
 ineffective hygiene/cleaning/sterilization/use of contaminated equipment/disposal of corpses ✓
- f. small number of staff relative to patients/treatment centers overcrowded/swamped with patients
OR
 insufficient equipment/supplies for large number of patients/with the rapid rise in patients ✓
- g. better reporting at Ebola centers/deaths due to Ebola not reported in rural areas ✓

1 (f) [2 marks]

- a. cells not killed/few cells killed «even at high concentrations» ✓
- b. «T-705» effective/viruses reduced/viruses killed at $100\text{ }\mu\text{M}$
OR
 «T-705» very effective/viruses much reduced/nearly all viruses killed at $1000\text{ }\mu\text{M}$ ✓
- c. virus concentration decreases as T-705 concentration increases ✓
 drug has «high» potential for treatment «at high enough concentration» ✓

2 (a)

telophase because the chromosomes/chromatids have reached the poles
OR
 «late» anaphase as some chromosomes/chromatids are still moving/tails visible ✓

- a. mitotic index is an indication of the ratio/percentage of cells undergoing mitosis/cell division ✓
- b. cancer cells «generally» divide much more than normal «somatic» cells ✓
- c. a high/elevated mitotic index in tumours / possible diagnosis of cancer / measure of how aggressive/fast growing the tumour is ✓

- a. promoters / operators / regulation of gene expression/transcription ✓
- b. telomeres/give protection to the end of chromosomes «during cell division» ✓
- c. genes for tRNA/rRNA production ✓
- d. other valid function for non-coding sequence ✓

3.

i	male because «X and» Y chromosome present OR male because sex chromosomes/last two chromosomes/pair 21 are unpaired/different «from each other»/not homologous ✓
ii	21

4.

X: Filicinophyta ✓
Y: Coniferophyta/Conifera/Gymnosperms ✓
a. «previous» classification used to be based on the appearance/structures of the plant/leaves/flowers/seeds/analogy/phenotype ✓
b. «modern cladistics uses» RNA/DNA nucleotide/base sequencing/amino acid sequencing/homology ✓
c. DNA mutation occurs at a relatively constant rate allowing estimation of when species diverged ✓
d. a shared/common derived characteristic places organisms in the same clade ✓
e. the number of changes in sequences indicates distance from common ancestor OR the fewer the differences «in sequences» means the closer the relationship ✓

5.

differences

- a. prokaryote has cell wall but mitochondrion does not ✓
- b. mitochondrion has double membrane whereas prokaryote has single membrane
OR
«Gram negative» bacteria have cell wall between two membranes whereas mitochondria has intermembrane space between two membranes ✓
- c. mitochondrion has cristae/invaginations of inner membrane but prokaryote does not
OR
prokaryote «may have» flagella/pili/«slime» capsule which mitochondria do not have ✓

similarities

- d. 70S ribosomes in both ✓
- e. DNA in both / loop of DNA in both / naked DNA in both ✓
- f. shape similar/both rod shaped/OWTTE
OR

size of both is similar/both about 3 µm long ✓
both are membrane-bound/OWTTE ✓

- a. endocytosis/engulfing of prokaryote by a larger/another/anaerobic prokaryote/cell ✓
- b. double membrane of the mitochondrion is the result of endocytosis
OR
inner membrane of mitochondrion from engulfed cell and outer from food vacuole ✓
- c. «engulfed prokaryotic cell» was aerobic/respired aerobically/consumed oxygen
OR
«engulfed prokaryotic cell» provided energy/ATP ✓
- d. «engulfed prokaryotic cell» not destroyed/not digested
OR
«endo»symbiotic/mutualistic relationship developed ✓
- e. «engulfed prokaryotic cell» had its own DNA/own «70S» ribosomes ✓

6.

A

- a. plasma membrane in phloem/sieve tubes but not in xylem/vessels
OR
xylem/vessels dead/acellular and phloem/sieve tubes alive ✓
- b. xylem vessels have thicker walls «than phloem» ✓
- c. xylem «vessel» walls are lignified «but phloem walls are not» ✓
- d. phloem vessels have sieve plates «whereas xylem vessels have no cross walls» ✓
- e. xylem/vessels are wider/larger than phloem/sieve tubes ✓
- f. companion cells in phloem «but not in xylem» ✓

6 B

- a. water is polar/a dipole/oxygen slightly negative and hydrogen slightly positive ✓
- b. polarity results in hydrogen bonds/atraction between water molecules ✓
- c. hydrogen bonding/polarity causes cohesion of water «molecules» ✓
- d. cohesion/hydrogen bonding allows water to withstand tension/withstand low pressure/be pulled «upwards»/moved against gravity ✓
- e. cohesion/hydrogen bonding prevents column of water «in xylem» from breaking/column of water is maintained ✓
- f. adhesion of water to xylem/vessel walls «due to hydrogen bonds» ✓

6 C

pollination:

transfer/dispersal/movement of pollen from anther/stamen to stigma

OR

transfer/dispersal/movement of pollen between plants/flowers prior to/allowing fertilization



seed dispersal:

«strategy of» distribution of seeds so that new plants have space/nutrients to develop/avoid competition/colonize new habitats ✓

7 A

- a. «cell» respiration/loss of CO₂/biomass consumed to provide/as a source of energy ✓
- b. loss of energy «as heat» between trophic levels means less energy available for building biomass ✓
- c. waste products «other than CO₂»/loss of urea/feces/egesta ✓
- d. material used/CO₂ released by saprotrophs ✓
- e. undigested/uneaten material «teeth, bones, etc»/detritus buried/not consumed
OR
formation of peat/fossils/limestone ✓

- a. increased CO₂ flux to the atmosphere due to increased burning of fossil fuels by industry/transportation / cement production ✓
- b. «land use change leading to» decreased rate of forest burning
 - OR**
better fire suppression leading to decrease in CO₂ release
 - OR**
example of land use changes that uses less fossil fuel
 - OR**
increase in land covered by forests/plants / forests recovering from historical forestry
 - OR**
any other reasonable explanation of land use change that would lead to decreased rate of carbon flow to atmosphere ✓
- c. carbon storage in land decreased as less photosynthesis due to fewer forests/more construction
 - OR**
release of methane due to «drying of» wetlands/sealing of land with concrete/buildings/roads ✓
- d. carbon storage in ocean increased due to more photosynthesis/algae/greater concentration of CO₂ in the atmosphere
 - OR**
increased diffusion/rate of dissolving of CO₂ into ocean from the atmosphere
 - OR**
limestone/carbonate accumulation «more snails» ✓

SECTION B – EXTENDED RESPONSE

Question		Answers	Notes	Total
8.	a	<p>Outline the functions of rough endoplasmic reticulum and Golgi apparatus.</p> <p>a. <u>ribosomes</u> on RER synthesize/produce polypeptides/proteins ✓ b. proteins from RER for secretion/export/use outside cell/for lysosomes ✓ c. Golgi alters/modifies proteins/example of modification ✓ d. <u>vesicles</u> budded off Golgi transport proteins «to plasma membrane» OR exocytosis/secretion of proteins in <u>vesicles</u> from the Golgi ✓</p>	Accept “for use inside and outside the cell” for mpb.	3 max
8.	b	<p>Outline the control of metabolism by end-product inhibition.</p> <p>a. metabolism is chains/web of <u>enzyme</u>-catalyzed reactions OR metabolic pathway is a chain of <u>enzyme</u>-catalyzed reactions ✓ b. end product/inhibitor is final product of chain/pathway ✓ c. inhibits/binds to/blocks the first enzyme in chain/pathway ✓ d. non-competitive inhibition ✓ e. end-product/inhibitor binds to an allosteric site/site away from the active site ✓ f. changes the shape of the <u>active site</u>/affinity of the <u>active site</u> «for the substrate» ✓ g. prevents intermediates from building up OR prevents formation of excess «end» product/stops production when there is enough OR whole metabolic pathway can be switched off ✓ h. negative feedback ✓ i. binding of the end product/inhibitor is reversible OR pathway restarts if end product/inhibitor detaches/if end product concentration is low ✓ j. isoleucine inhibits/slows «activity of first enzyme in» threonine to isoleucine pathway ✓</p>	<p>Allow mark points shown in clearly annotated diagrams.</p> <p>To gain mpd, mpe and mpf the answer must be in the context of end-product inhibition, not enzyme inhibition generally.</p>	5 max

Question			Answers	Notes	Total
8.	c		<p>Explain how hydrophobic and hydrophilic properties contribute to the arrangement of molecules in a membrane.</p> <p>a. hydrophilic is attracted to/soluble in water and hydrophobic not attracted/insoluble ✓ b. hydrophilic phosphate/head and hydrophobic hydrocarbon/tail in <u>phospholipids</u> ✓ c. <u>phospholipid bilayer</u> in water/in membranes ✓ d. hydrophilic heads «of phospholipids» face outwards/are on surface ✓ e. hydrophobic tails «of phospholipids» face inwards/are inside/are in core ✓ f. cholesterol is «mainly» hydrophobic/amphipathic so is located among phospholipids/in hydrophobic region of membrane ✓ g. some amino acids are hydrophilic and some are hydrophobic ✓ h. hydrophobic «amino acids/regions of» proteins in phospholipid bilayer «core» ✓ i. hydrophilic «amino acids/regions of» proteins are on the membrane surface ✓ j. <u>integral proteins</u> are embedded in membranes due to hydrophobic properties/region OR <u>transmembrane</u> proteins have a hydrophobic middle region and hydrophilic ends ✓ k. <u>peripheral proteins</u> on are on the membrane surface/among phosphate heads due to being «entirely» hydrophilic OR «carbohydrate» part of <u>glycoproteins</u> is hydrophilic so is outside the membrane ✓ l. pore of <u>channel proteins</u> is hydrophilic ✓</p>	<p>Allow mark points shown in clearly annotated diagram.</p> <p>In any part of the answer, accept polar instead of hydrophilic and non-polar or apolar instead of hydrophobic.</p>	
					7 max

(Plus up to [1] for quality: The candidate's answers are clear enough to be understood without re-reading. The candidate has answered the question succinctly with little or no repetition or irrelevant material.)

Question			Answers	Notes	Total																		
9.	a		<table> <thead> <tr> <th></th> <th>DNA</th> <th>RNA</th> </tr> </thead> <tbody> <tr> <td>a.</td> <td>double stranded</td> <td>single stranded ✓</td> </tr> <tr> <td>b.</td> <td>deoxyribose</td> <td>ribose ✓</td> </tr> <tr> <td>c.</td> <td>adenine, guanine, thymine, cytosine</td> <td>adenine, guanine, cytosine, uracil</td> </tr> <tr> <td>OR</td> <td>thymine instead of uracil</td> <td>uracil instead of thymine ✓</td> </tr> <tr> <td>d.</td> <td>«all» helical</td> <td>variety of forms OR mRNA, tRNA and rRNA ✓</td> </tr> </tbody> </table>		DNA	RNA	a.	double stranded	single stranded ✓	b.	deoxyribose	ribose ✓	c.	adenine, guanine, thymine, cytosine	adenine, guanine, cytosine, uracil	OR	thymine instead of uracil	uracil instead of thymine ✓	d.	«all» helical	variety of forms OR mRNA, tRNA and rRNA ✓	<p>A table format is not required but clear distinctions must be apparent.</p> <p>The full names of the bases must be given.</p>	3 max
	DNA	RNA																					
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9.	b	<ul style="list-style-type: none"> a. some traits may involve many genes/be polygenic eg: height, skin colour «correct example required» ✓ b. linked genes/alleles of different genes on same chromosome ✓ c. «small numbers of» recombinant phenotypes due to crossing over «between linked genes» ✓ d. co-dominance of specific alleles/intermediate forms eg: pink flowers «from red and white ones»/blood groups «correct example required» ✓ e. sex-linked effects eg: colour blindness «correct example required» ✓ f. environmental influence on inheritance/epigenetics/methylation ✓ g. any other example of non-Mendelian inheritance with a specific example ✓ 	Accept any verifiable examples of these types of inheritance.	
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4 max

9.	c	<ul style="list-style-type: none"> a. caused by a single nucleotide/base substitution mutation/GAG to GTG ✓ b. «mutation of» a gene of β-globin/a subunit of hemoglobin ✓ c. mRNA copies the mutation of DNA and substitutes an amino acid in hemoglobin «subunit» ✓ d. glutamic acid is substituted by valine ✓ e. sickle cell anemia involves distorted hemoglobin protein/HbS ✓ f. «distorted HbS causes» distortion/sickling/shape change of red blood cells ✓ g. «distorted/sickled red blood cells» block capillaries/blood flow ✓ h. HbS/sickled red blood cells cannot carry enough oxygen «for the body»/leads to fatigue ✓ i. low oxygen concentration seriously affects structure of HbS ✓ j. homozygous «HbS/HbS» state causes severe anemia/death at low oxygen concentrations ✓ k. heterozygous state has less anemia/minor effects/less effect of structure of hemoglobin OR heterozygous state only affected at high altitude/extreme exercise/low levels of oxygen ✓ l. «heterozygous state» provides protection against malaria parasite/selective advantage in malaria areas ✓ 	OWTTE	8 max
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Question		Answers	Notes	Total
10.	a	Outline the roles of helicase and ligase in DNA replication.		

		<p><i>helicase:</i></p> <ul style="list-style-type: none"> a. unwinds/uncorks the DNA «double helix» ✓ b. breaks hydrogen bonds «between bases» ✓ c. separates the «two» strands/unzips the DNA/creates replication fork ✓ <p><i>ligase:</i></p> <ul style="list-style-type: none"> d. seals nicks/forms a continuous «sugar-phosphate» backbone/strand ✓ e. makes sugar-phosphate bonds/covalent bonds between adjacent nucleotides ✓ f. after «RNA» primers are removed/where an «RNA» primer was replaced by DNA ✓ g. «helps to» join Okazaki fragments ✓ 		4 max
10.	b	<p>Explain how natural selection can lead to speciation.</p> <p>a. variation is required for natural selection/evolution/variation in <u>species/populations</u> ✓</p> <p>b. mutation/meiosis/sexual reproduction is a source of variation ✓</p> <p>c. competition/more offspring than the environment can support ✓</p> <p>d. <u>adaptations</u> make individuals suited to their environment/way of life ✓</p> <p>e. survival of better adapted «individuals)/survival of fittest/converse ✓</p> <p>f. inheritance of traits/passing on genes of better adapted «individuals»</p> <p>OR</p> <p>reproduction/more reproduction of better adapted/fittest «individuals» ✓</p> <p>g. speciation is formation of a new species/splitting of a species/one population becoming a separate species ✓</p> <p>h. reproductive isolation of separated populations ✓</p> <p>i. geographic isolation «of populations can lead to speciation» ✓</p> <p>j. temporal/behavioral isolation «of populations can lead to speciation» ✓</p> <p>k. disruptive selection/differences in selection «between populations can lead to speciation» ✓</p> <p>l. gradual divergence of populations due to natural selection/due to differences in environment ✓</p> <p>m. changes in the <u>gene pools</u> «of separated populations»/separation of <u>gene pools</u> ✓</p> <p>n. interbreeding becomes impossible/no fertile offspring «so speciation has happened» ✓</p>		7 max

10.	c	<p>Outline the features of ecosystems that make them sustainable.</p> <p>a. recycling of nutrients/elements/components/materials ✓ b. carbon/nitrogen/another example of recycled nutrient/element ✓ c. decomposers/saprotrophs break down organic matter/release «inorganic» nutrients ✓ d. energy supplied by the sun OR energy cannot be recycled «so ongoing supply is needed» OR energy is lost from ecosystems as heat ✓ e. <u>energy</u> flow along food chains/through food web/through trophic levels ✓ f. photosynthesis/autotrophs make foods/trap energy OR autotrophs supply the food that supports primary consumers ✓ g. <u>oxygen</u> «for aerobic respiration» released by autotrophs/photosynthesis/plants ✓ h. <u>carbon dioxide</u> «for photosynthesis» released by respiration ✓ i. populations limited by food supply/predator-prey/interactions/competition OR populations regulated by negative feedback OR fewer/less of each successive trophic level «along the food chain»/OWTTE ✓ j. supplies of water from rainfall/precipitation/rivers/water cycle ✓</p>	
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4 max

(Plus up to [1] for quality: The candidate's answers are clear enough to be understood without re-reading.
 The candidate has answered the question succinctly with little or no repetition or irrelevant material.)

(Question 7 continued)

Question		Answers	Notes	Total
7.	c	<p>Outline the features of ecosystems that make them sustainable.</p> <p>k. recycling of nutrients/elements/components/materials ✓</p> <p>l. carbon/nitrogen/another example of recycled nutrient/element ✓</p> <p>m. decomposers/saprotrophs break down organic matter/release «inorganic» nutrients ✓</p> <p>n. energy supplied by the sun OR energy cannot be recycled «so ongoing supply is needed» OR energy is lost from ecosystems as heat ✓</p> <p>o. <u>energy</u> flow along food chains/through food web/through trophic levels ✓</p> <p>p. photosynthesis/autotrophs make foods/trap energy OR autotrophs supply the food that supports primary consumers ✓</p> <p>q. <u>oxygen</u> «for aerobic respiration» released by autotrophs/photosynthesis/plants ✓</p> <p>r. <u>carbon dioxide</u> «for photosynthesis» released by respiration ✓</p> <p>s. populations limited by food supply/predator-prey/interactions/competition OR populations regulated by negative feedback OR fewer/less of each successive trophic level «along the food chain»/OWTTE ✓</p> <p>t. supplies of water from rainfall/precipitation/rivers/water cycle ✓</p>		
				4 max

(Plus up to [1] for quality: The candidate's answers are clear enough to be understood without re-reading.
The candidate has answered the question succinctly with little or no repetition or irrelevant material.)