BIOLOGY

PAPER 2B, 2BR 2020 - 2025

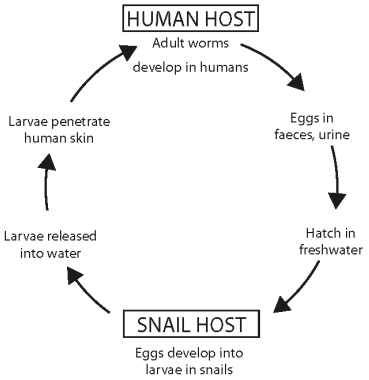
1 – (4BI1/2B_Summer_2020_Q1) – *Structure And Functions In Living Organisms, The Nature And Variety Of Living Organisms*

Read the passage below. Use the information in the passage and your own knowledge to answer the questions that follow.

Schistosomiasis

Schistosomiasis is an infection caused by a parasitic worm called a schistosome. The immature or larvae of the worm live in rivers and lakes in tropical parts of the world.

The diagram shows the life cycle of the schistosome worm.



Some people in tropical parts of the world use water from these rivers and lakes for their daily lives. These people risk infection because the larvae burrow into their skin. The larvae are then transported to other parts of the body where they damage organs such as the kidneys, intestines, lungs and brain. The larvae develop into adult worms.

The adult worms lay eggs in the human body. Some of these eggs are destroyed by the immune system, but most eggs survive. These eggs can get into water if faeces or urine from infected people pass into rivers or lakes. In the water, the eggs develop into small larvae which grow inside freshwater snails. Larvae are released from the snails and infect any person they contact. These larvae develop into adult worms inside the human body.

Doctors diagnose schistosomiasis when they find eggs in the faeces or urine of infected people. Infected people also have blood cells in their urine and antibodies for the pathogen in their blood.

At present, the drug praziquantel is used to kill the worms. A dose of 0.040 g per kg of body mass is usually effective. With no treatment, affected organs can be permanently damaged, leading to death. It is estimated that 240 million people (in the world) have schistosomiasis. Every year 8×10^{-4} per cent of infected people die from the disease.

A vaccine is being developed using a plasmid. The plasmid has DNA inserted that makes a protein found on the body surface of the adult schistosome worm.

In one investigation, a vaccine made using the DNA plasmid was given to a group of infected people. The results showed a mean number of 21.53 worms per person in this group. In the control group, a mean number of 40.53 worms per person was found.

(a) Which process is affected if kidneys are damaged (line 8)?

(1)

- ☒ **A** digestion
- ☒ **B** mutation
- ☒ **C** ultrafiltration
- ☒ **D** vaccination

(b) Suggest three ways to reduce the risk of being infected by schistosomes.

(3)

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(c) Name two different blood cells that would be found in the urine of infected people (line 17).

(2)

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(d) An infected person has a body mass of 120 kg.

What dose of drugs would be effective for this person (lines 19 to 20)?

(1)

- ☒ **A** 0.04 mg
- ☒ **B** 4.8 mg
- ☒ **C** 40 mg
- ☒ **D** 4800 mg

(e) Using the estimated number of people in the world who have schistosomiasis (lines 21 to 22), calculate the number of people who die each year from schistosomiasis.

(2)

number = ...

(f) Which of these is the correct description of a plasmid?

(1)

- ☒ **A** a circle of DNA
- ☒ **B** a circle of mRNA
- ☒ **C** a circle of protein
- ☒ **D** a circle of tRNA

(g) Explain how a vaccine could protect people from schistosomiasis (lines 24 to 25).

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(h) (i) Suggest what is given to the control group (lines 27 to 29).

(1)

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(ii) A scientist claims that the investigation proves the vaccine is effective against schistosomiasis (lines 27 to 29).

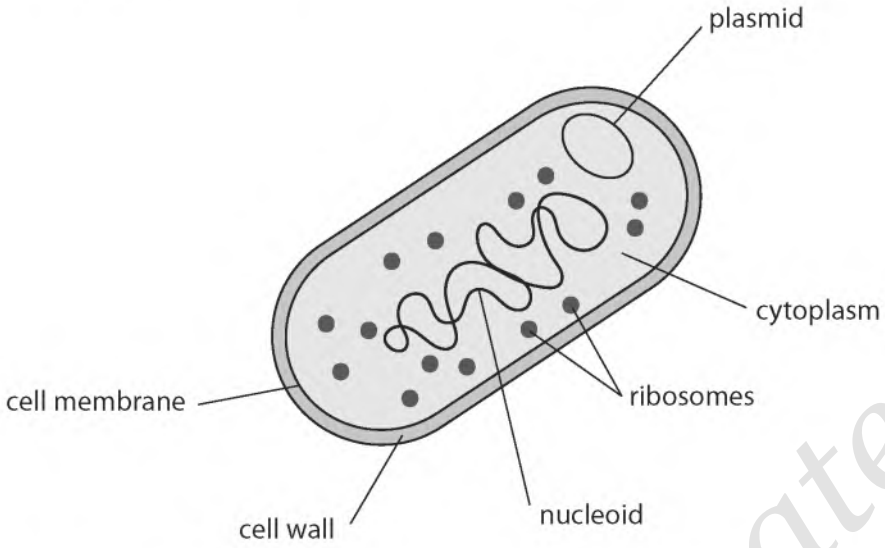
Comment on this claim.

(3)

2 – (4BI1/2B_Summer_2021_Q2) – *The Nature And Variety Of Living Organisms, Structure And Functions In Living Organisms*

P. multocida is a bacterium that causes cholera in chickens.

The diagram shows the bacterium.



(a) Give two structures in this bacterium that are also found in all eukaryotic cells.

(2)

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(b) Scientists investigated the survival of chickens injected with normal *P. multocida* or with weakened *P. multocida*.

The table shows the scientists' results.

Type of injection	Result
normal *P. multocida*	chickens die
weakened *P. multocida*	chickens stay alive

(i) What is a correct conclusion about *P. multocida* from these results?

(1)

- ☒ **A** they are decomposers
- ☒ **B** they are pathogens
- ☒ **C** they are microscopic
- ☒ **D** they are non-living

(ii) The scientists took the living chickens that had been injected with weakened *P. multocida* and then injected them with normal *P. multocida*.

The chickens did not die, as they were now immune.

Explain why these chickens did not die.

(4)

3 – (4BI1/2B_Winter_2022_Q2) – *The Nature And Variety Of Living Organisms*

Food items can often be spoiled if saprotrophic microorganisms such as mould fungi grow on them.

(a) Describe how a saprotrophic fungus such as mould obtains its food.

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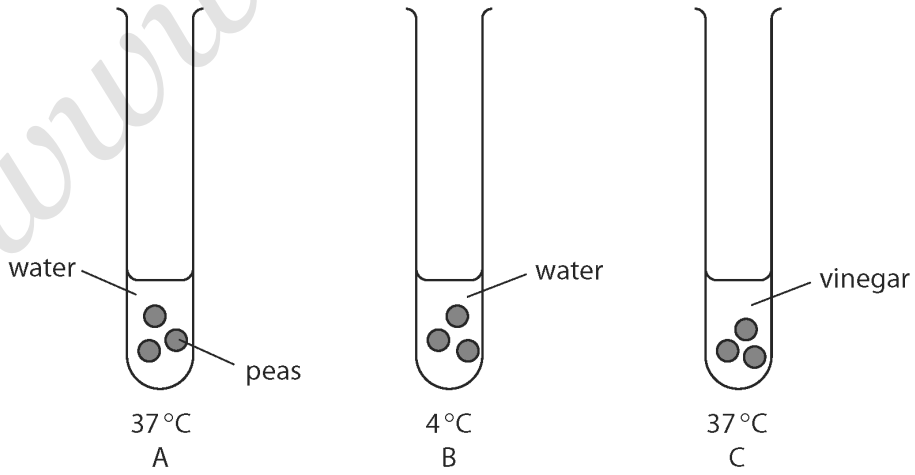
(b) A student uses this method to investigate ways of preventing peas from being spoiled.

- place three peas in each of three test tubes as shown in the diagram
- cover the peas in test tube A with water and keep at 37 °C
- cover the peas in test tube B with water and keep at 4 °C
- cover the peas in test tube C with vinegar, which is a weak acid, and keep at 37 °C
- leave the peas for 24 hours



The student observes the level of cloudiness of the solution to determine how spoiled the peas have become.
The level of cloudiness can be used as a measure of fungal growth.

The table shows the student's results.

Test tube	Conditions peas are kept in	Level of cloudiness
A	water at 37 °C	very cloudy
B	water at 4 °C	slightly cloudy
C	vinegar at 37 °C	no cloudiness

(i) Suggest a problem with using the level of cloudiness of the solution to determine how spoiled the peas have become.

(1)

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(ii) Explain the appearance of the peas in water at 4 °C.

(2)

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(iii) Explain the appearance of the peas in vinegar at 37 °C.

(2)

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4 – (4BI1/2B_Summer_2024_Q1) – *The Nature And Variety Of Living Organisms, Ecology And The Environment, Use Of Biological Resources*

Read the passage below. Use the information in the passage and your own knowledge to answer the questions that follow.

Extinctions

During the evolution of living organisms, most species have become extinct. Evolution by natural selection means that species constantly replace each other. The photograph shows the fossilised jaws of a shark called megalodon. Megalodon was a giant, predatory shark that became extinct 2.6 million years ago.

(Source: © CHRIS HELLIER / SCIENCE PHOTO LIBRARY)

Some scientists think megalodon was replaced by giant, predatory toothed whales. These whales were the ancestors of modern orcas. Any sharks that remained evolved to become smaller. As well as the steady loss of species over time, there have been mass extinction events. Approximately 250 million years ago 90% of all animals and plants became extinct. The cause of this mass extinction is not known, but one theory is that it was due to the eruptions of volcanoes. The volcanoes released sulfur dioxide, carbon dioxide and dust into the atmosphere. This caused populations of producer species to fall, atmospheric carbon dioxide levels to rise, and oxygen levels to fall.

Human activity is now causing another mass extinction. Some scientists estimate that approximately one million animal and plant species are at risk. To prevent species loss, cryozoos are being developed. Cryozoos are storage tanks containing samples of body cells from animals and are kept at a temperature of -170 °C. The cells are put in a salt and sugar solution and then frozen. If a species becomes extinct, the frozen cells can be used to clone new animals. The banteng is an endangered breed of cattle. Banteng body cells have been stored in a cryozoo. These cells have been used with eggs from another species to successfully produce a living banteng.

In the future we may be able to bring back extinct species such as mammoths by making clones using the remains of frozen mammoths. Scientists need to consider the advantages and disadvantages of bringing back extinct animals. Currently, the biodiversity of the world is different from the time when mammoths were alive. Many natural predators of mammoths are now extinct. Mammoths may have helped to keep methane-releasing soil frozen, reducing the release of the methane. Mammoths were also an important part of the nitrogen cycle and increased the nutrient content of low-nutrient Arctic soil.

(a) Megalodon was an animal.

Which of these features does megalodon share with the fungus yeast?

1 nuclei present in cells

2 nervous coordination

3 stores carbohydrate as glycogen

(1)

☒ **A** 1 and 2 only

☒ **B** 1 and 3 only

☒ **C** 2 and 3 only

☒ **D** 1, 2 and 3

(b) Scientists think that the giant, predatory toothed whales that replaced the extinct megalodon consumed the same sources of food.

Explain how the evolution of giant, predatory toothed whales may have caused the extinction of megalodon. (lines 5 to 7)

(3)

(c) (i) Volcanoes release sulfur dioxide into the atmosphere.

Describe the biological consequences of sulfur dioxide release. (lines 10 to 12)

(2)

(ii) The release of large amounts of dust into the atmosphere reduced light intensity.

Explain why this would cause a loss of food chains. (lines 9 to 11)

(3)

(d) (i) Explain why the cells in cryozoos are put in salt and sugar solution rather than pure water. (lines 16 to 18)

(2)

(ii) Describe how scientists could clone a banteng. (lines 18 to 20)

(4)

(e) Explain why releasing cloned mammoths could have negative and positive effects on Arctic biodiversity. (lines 22 to 28)

(3)

ANSWERS

1 – (4BI1/2B_Summer_2020_Q1) – *Structure And Functions In Living Organisms, The Nature And Variety Of Living Organisms*

Question Number	Answer	Mark
(a)	C ultrafiltration *A is incorrect because digestion is not a process in the kidneys* *B is incorrect because mutation is not a process in the kidneys* *D is incorrect because vaccination is not a process in the kidneys*	**1 comp**

Question Number	Answer	Additional guidance	Mark
(b)	An answer that makes reference to three of the following points: • stay out of water / wear waterproof clothes / eq (1) • treat drinking water / boil water (before drinking) / do not drink water / drink bottled water / eq (1) • sanitation / no faeces in water / no urine in water /eq (1) • remove snails /eq (1) • vaccination (1)	**Allow** do not go in infected rivers or lakes / cover skin when in water / avoid contact with affected water / only wash in clean water **Allow** filter water / do not drink river water / lake water **Allow** use sewage treatment system / use toilet with septic tank **Allow** don't touch snails	**3 exp**

Question Number	Answer	Mark
(c)	An answer that makes reference to two of the following points: • red blood cells / rbc (1) • white blood cells / wbc (1) • lymphocytes (1) • phagocytes / macrophages (1)	**2 grad**

Question Number	Answer	Mark
(d)	D 4 800 *A is incorrect because it is the wrong value* *B is incorrect because it is the wrong value* *C is incorrect because it is the wrong value*	**1 comp**

Question Number	Answer	Additional guidance	Mark
(e)	• $8 \times 10^{-4} = 0.0008$ • x 240 million = 192 000 ÷ 100 = 1920 (2)	**Allow** 1 mark for: 19200000 / 1920000 / 192000 / 19200 / 192 / 19.2 / 1.92 / 0.192 / 0.0192 Award full marks for correct numerical answer without working	**2 grad**

Question Number	Answer	Mark
(f)	A a circle of DNA *B is incorrect because it is not RNA* *C is incorrect because it is not a protein* *D is incorrect because it is not RNA*	**1 comp**

Question Number	Answer	Mark
(g)	An explanation that makes reference to three of the following points: • antigen (1) • memory cells / lymphocytes (1) • (secondary) immune response (1) • more antibodies / antibodies made sooner / faster / faster immune response / eq (1)	**3 exp**

Question Number	Answer		Mark
(h)(i)	• (a treatment with) no plasmid / no protein / only water / saline / eq (1)	**Allow** placebo vaccine / a placebo / plasmid with no gene / plasmid with no DNA / different DNA	**1 exp**

Question Number	Answer	Additional Guidance	Mark
(h)(ii)	An answer that makes reference to three of the following points: • reduced numbers / eq (1) • by 19 or by 47% / about 50% • schistosomes / worms, still present in body (1) • no idea of group size / needs to be repeated (1) • no idea of age / sex / health (1)	**Allow** reduces numbers of worms / worms decrease / lower number of worms after vaccine **Allow** more worms in control group **Allow** does not completely get rid of them **Allow** more testing / more people tested	**3 exp**

2 – (4BI1/2B_Summer_2021_Q2) – *The Nature And Variety Of Living Organisms, Structure And Functions In Living Organisms*

Question Number	Answer	Mark
(a)	An answer that makes reference to two of the following points: • cytoplasm (1) • ribosomes (1) • cell membrane (1) • DNA (1)	**2**

Question Number	Answer	Mark
(b)(i)	The only correct answer is B bacteria are pathogens *A is not correct because it is not possible to conclude that the bacteria are decomposers* *C is not correct because it is not possible to conclude that the bacteria are microscopic* *D is not correct because it is not possible to conclude that the bacteria are non-living*	**1**

Question Number	Answer	Mark
(b)(ii)	An answer that makes reference to two of the following points: • vaccination / inoculated (1) • (same) antigens / (same) protein (on bacteria) (1) • secondary immune response (1) • memory cells (1) • (make) large numbers antibodies / (make) antibodies produced fast / soon / eq (1)	**4**

3 – (4BI1/2B_Winter_2022_Q2) – *The Nature And Variety Of Living Organisms*

Question Number	Answer	Additional guidance	Mark
(a)	A description that makes reference to three of the following: • enzymes (1) • (feed on) dead / decaying organisms (1) • for <u>extracellular digestion</u> (1) • absorb the digested food / nutrients (1)	**Accept** named nutrients **Accept** broken down food	**3**

Question Number	Answer	Additional guidance	Mark
(b)(i)	A description that makes reference to one of the following: • judgement of cloudiness is subjective / is qualitative / not quantitative / cloudiness cannot be accurately measured / cannot be repeated by other people / eq (1)	**Accept** cloudiness is judged by eye **Accept** cannot see small differences / it is imprecise **Accept** cannot measure difference in cloudiness	**1**

Question Number	Answer	Additional guidance	Mark
(b)(ii)	An explanation that makes reference to two of: • less kinetic energy / lower collision frequency / not at optimal temperature for enzymes / eq (1) • less fungal growth / less mould / only slight fungal growth (1) • less respiration (1)	**Accept** fewer E-S complexes formed **Accept** microbes / bacteria for fungi **Accept** less decay / less spoilage / less digestion	**2**

Question Number	Answer	Additional guidance	Mark
(b)(iii)	An explanation that makes reference to two of: • enzymes denature (in acid / low pH / vinegar) (1) • active site shape changes / enzymes do not bind with substrate / eq (1) • fungal growth decreases (1)	**Reject** enzymes denature due to **high temperature** **Accept** fungi killed / less spoilage / less decomposition / less respiration **Accept** bacteria / microbes for fungi	**2**

4 – (4BI1/2B_Summer_2024_Q1) – *The Nature And Variety Of Living Organisms, Ecology And The Environment, Use Of Biological Resources*

Question Number	Answer	Additional guidance	Mark
(a)	The only correct answer is B (1 and 3) *A is incorrect as yeast has no nervous system* *C is incorrect as yeast has no nervous system* *D is incorrect as yeast has no nervous system*		**1**

Question Number	Answer	Additional guidance	Mark
(b)	An explanation that makes reference to three of the following: • competition (between megalodon and whales) (1) • whales ate more food / eq (1) • whales better adapted / swam faster / better at feeding / better at hunting / eq (1) • whales survived / eq (1) • whales reproduced more / had more offspring / eq (1)	**Accept** less food left for megalodon / no food / megalodon starve **Accept** megalodon less well adapted **Accept** megalodon did not survive **Accept** megalodon died (out) **Ignore** extinct **Accept** megalodon did not reproduce	**3**

Question Number	Answer	Additional guidance	Mark
(c)(i)	A description that makes reference to two of the following: • acid rain (1) • deforestation / death of trees / death of plants / eq (1) • death of fish / death of animals in lakes / loss of species in lakes or rivers / eq (1)	**Accept** sulphuric acid **Accept** damages plants / trees / eq **Accept** loss of food chains / loss of biodiversity **Accept** harms fish / eq	**2**

Question Number	Answer	Additional guidance	Mark
(c)(ii)	An explanation that makes reference to three of the following: • (less) photosynthesis (1) • so less glucose / sugar / starch / eq (1) • fewer producers / fewer plants / less mass of producers / producers die / plants do not grow as much / eq (1) • less food for consumers / less energy for consumers / eq (1)	**Ignore** cannot produce food for mp2 **Accept** fewer consumers **Accept** fewer herbivores / carnivores **Accept** less food for animals	**3**

Question Number	Answer	Additional guidance	Mark
(d)(i)	An answer that makes reference to two of the following: • prevents <u>osmosis</u> / less <u>osmosis</u> (1) • so water will not enter cells / eq (1) • so cells do not burst / eq (1)	**Accept** osmosis would occur if in water **Accept** water will enter if in (pure) water **Accept** cells burst if in water	**2**

Question Number	Answer	Additional guidance	Mark
(d)(ii)	A description that makes reference to four of the following: • place diploid nucleus into enucleated egg cell / place body cell nucleus into enucleated egg cell / eq (1) • electric shock / eq (1) • mitosis / cell division / eq (1) • place <u>embryo</u> into uterus / womb (1) • of surrogate (mother) (1)	**Accept** <u>fuse</u> body cell with enucleated egg **Accept** empty egg cell for enucleated egg cell **Accept** shock **Reject** meiosis	**4**

Question Number	Answer	Additional guidance	Mark
(e)	A description that makes reference to three of the following: *max two of* • mammoth population increases / over-population occurs / eq (1) • mammoth eats too much food / mammoth eats lots of food / less food for other species / mammoth competes with other species / eq (1) *and max two of* • less global warming / less greenhouse effect / climate change / less ice cap melting / eq (1) • decomposition of faeces / decay of faeces / eq (1) • more amino acid / protein / DNA / chlorophyll, synthesis in plants / producers / eq (1) • (soil nutrients means) more plants / increased plant growth / more producers / eq (1)	**Accept** high mammoth reproduction rate / population not controlled **Accept** overeats prey / animals / prey could go extinct **Accept** less greenhouse gas **Accept** decay of dead mammoths **Accept** better plant growth	**3**