National Qualifications 2019

X707/77/02

Biology
Section 1 — Questions

TUESDAY, 30 APRIL

1:00 PM – 3:30 PM

Instructions for the completion of Section 1 are given on *page 02* of your question and answer booklet X707/77/01.

Record your answers on the answer grid on *page 03* of your question and answer booklet.

Before leaving the examination room you must give your question and answer booklet to the Invigilator; if you do not, you may lose all the marks for this paper.

SECTION 1 — 25 marks

Attempt ALL questions

1. Primary cell lines have

A a limited number of cell divisions and are sourced from tumours

B a limited number of cell divisions and are sourced directly from normal animal tissue

C an indefinite number of cell divisions and are sourced from tumours

D an indefinite number of cell divisions and are sourced directly from normal animal tissue.

2. The proteome is larger than the number of genes in the genome of an organism because

A not all genes are expressed as proteins in a particular cell

B post translational modifications generate multiple RNAs from a single gene

C alternative splicing generates multiple RNAs from a single gene

D each mRNA molecule is translated by many ribosomes.

3. A neuron in a squid, running from the brain to the tentacles, is 0·9 m long. A 25 mm length of neuron is depolarised every 0·001 s.

The time taken for an impulse to travel the length of this neuron is

A 0·000028 s

B 0·000036 s

C 0·028 s

D 0·036 s

4. The list shows some events that occur in the cell membrane of a neuron during nerve transmission.

1. Binding of neurotransmitter to neuron
2. Closure of voltage-gated ion channels
3. Opening of ligand-gated ion channels
4. Opening of voltage-gated ion channels

Which events contribute to the depolarisation of the resting potential of a neuron?

A 1 and 2 only
B 2 and 3 only
C 1, 2 and 3 only
D 1, 3 and 4 only

5. Which row in the table describes the expected effects of inhibition of the Na/KATPase?

	Intracellular Na ion concentration	**Intracellular K ion concentration**	**Membrane polarity**
A	increase	decrease	increase
B	decrease	increase	increase
C	increase	decrease	decrease
D	decrease	increase	decrease

6. A decrease in the activity of glucose symport proteins in the cells lining the small intestine could be caused by an increase in the

A glucose concentration inside the small intestine
B sodium ion concentration in the cells
C ATP concentration in the cells
D potassium ion concentration in the cells.

[Turn over

7. The surface area to volume ratio of a cell is an important factor affecting transport into cells.

$$\text{surface area to volume ratio} = \frac{\text{surface area}\,(\mu m^2)}{\text{volume}\,(\mu m^3)}$$

The surface area to volume ratio of an *E. coli* cell is 4·5. A eukaryotic cell has a surface area of 1809 μm^2 and a volume of 7235 μm^3.

Compared to *E. coli*, the surface area to volume ratio of the eukaryotic cell is approximately

A 1·1 times larger

B 1·1 times smaller

C 18 times larger

D 18 times smaller.

8. Alpha helices in proteins are stabilised by

A hydrogen bonds

B ionic bonds

C disulphide bridges

D hydrophobic interactions.

9. Which row in the table describes the effects of an increase in temperature on haemoglobin and oxygen delivery to cells?

	Affinity of haemoglobin for oxygen	**Oxygen delivery to tissue**
A	increase	increase
B	increase	decrease
C	decrease	increase
D	decrease	decrease

10. The lipid bilayers of cell membranes contain a number of different phospholipids, which are present in different proportions and distributed unevenly across the extracellular and intracellular faces of the bilayer.

Figures 1 and 2 show the proportions and distribution of four phospholipids in the cell membrane of human red blood cells.

Figure 1 Proportions of four phospholipids in the cell membrane

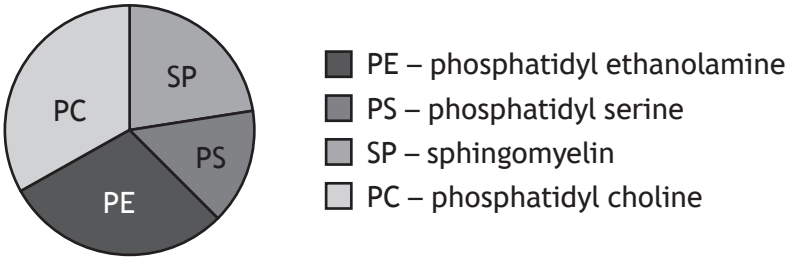
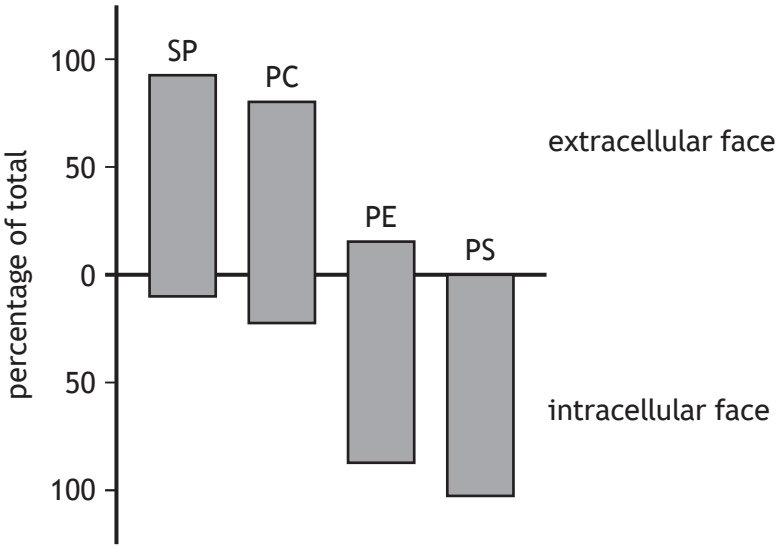


Figure 2 Distribution of the phospholipids in the two faces of the membrane



The key can be used to identify each of the phospholipids.

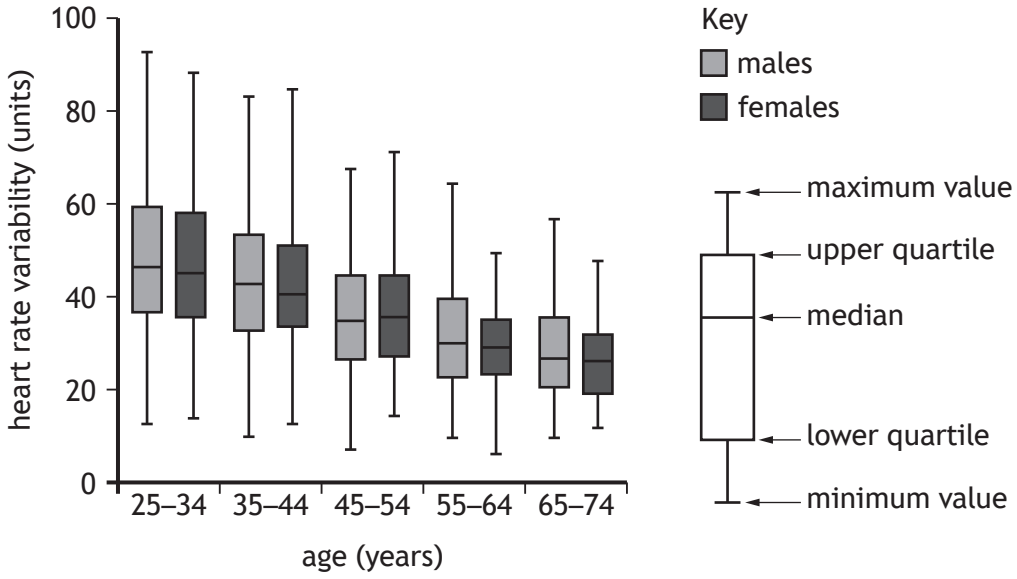
1	more than 25 % of total lipid	go to 2
	less than 25 % of total lipid	go to 3
2	found mainly on the extracellular face	A
	found mainly on the intracellular face	B
3	found mainly on the extracellular face	C
	found mainly on the intracellular face	D

Which letter represents sphingomyelin?

[Turn over

Questions 11 and 12 refer to the following information.

Short-term variations in the time interval between heart beats is termed *heart rate variability* (HRV). HRV is one measure that can be used to assess health. The box plots give information from one study about the influence of age and gender on HRV.



11. From the data shown, which of the statements about HRV is correct?

A There is a trend towards lower HRV in females

B The greatest error in measurements is for ages 25–34

C The mean HRV for females aged 35–44 is lower than 40 units

D Gender-related differences in median values are greater than age-related differences

12. Which row in the table describes features of this study?

	Design of experiment	**Type of data collected**
A	simple	ranked
B	simple	continuous
C	multifactorial	ranked
D	multifactorial	continuous

13. There are approximately 40 species of birds of paradise in New Guinea, on islands nearby, and in areas of mainland Australia. They are thought to have evolved from a crow-like common ancestor that lived 20 million years ago.

The list describes processes that are likely to have contributed to the evolution of the different species.

X The food availability on a certain part of one island favoured the survival of male and female individuals with slender curved bills.

Y On one island with abundant food choices, females choose mates whose head feathers have elongated plumes.

Z Some males and females of a species of crow-like mainland bird were blown by a freak storm to some of the islands.

Which row in the table matches processes of evolution with descriptions from the list?

	Processes of evolution		
	Genetic drift	**Selection**	
		Natural	**Sexual**
A	X	Z	Y
B	Z	X	Y
C	Z	Y	X
D	Y	X	Z

14. Which row in the table indicates factors that can all lead to a high rate of evolution?

	Factor		
	Selection pressure	**Generation time**	**Gene transfer**
A	high	long	asexual reproduction
B	low	short	horizontal
C	low	long	horizontal
D	high	short	sexual reproduction

[Turn over

15. Which of the following adaptations can be explained using the Red Queen hypothesis?

1. Acceleration of cheetahs is related to the speed of the antelope they prey on
2. Migration of insectivorous birds is influenced by the availability of insects
3. Resistance of insect larvae to parasitic wasp infection is a response to these wasps
4. Ornamental head plumes of some male birds are attractive to females

A 1 and 2 only
B 1 and 3 only
C 2 and 3 only
D 3 and 4 only

16. A student used a colorimetric assay to measure the activity of an enzyme in bananas. An extract was prepared from one banana and used five times to measure the enzyme activity. Three absorbance readings were taken for each of the five assays.

The data collected are shown in the table.

	Absorbance reading at 540 nm		
Assay	1	2	3
1	0·55	0·56	0·55
2	0·49	0·48	0·50
3	0·56	0·57	0·57
4	0·62	0·63	0·62
5	0·58	0·58	0·59

The student evaluated the data to be reliable and accurate.

The student's evaluation of the data is

A correct because the data are reliable and accurate
B incorrect because the data are accurate but not reliable
C incorrect because the data are reliable but not necessarily accurate
D incorrect because the data are not reliable and not necessarily accurate.

17. Biological fieldwork can sometimes be more dangerous than laboratory work.

Which of the following would **not** generally be involved in a risk assessment for carrying out fieldwork safely?

A Identify hazards

B Specify control measures

C Assess safety training records of participants

D Consider hazard severity and likelihood of occurring

18. Some populations of a species may evolve to become more r-selected or K-selected depending on the nature of the habitat they occupy.

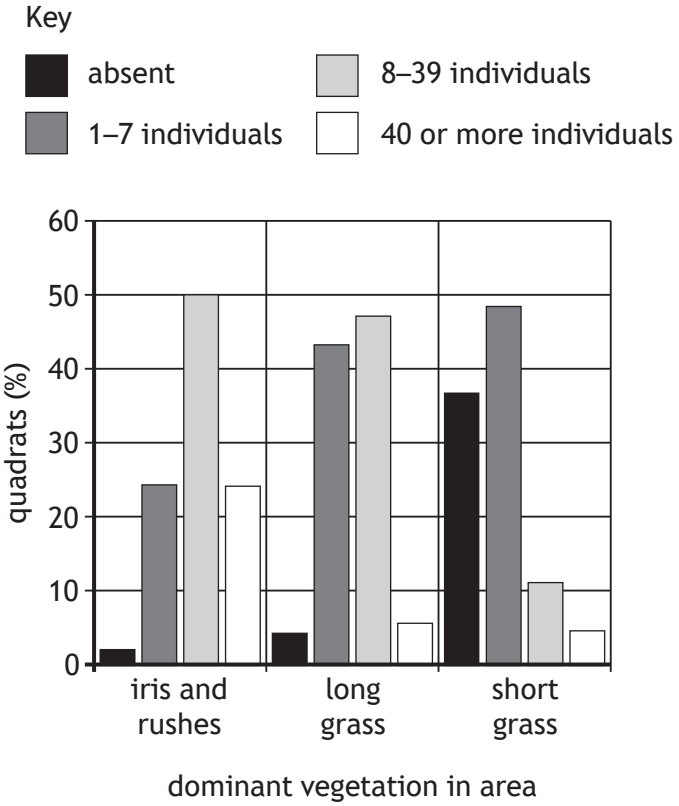
Which row in the table shows changes in the factors likely to be associated with a population becoming more K-selected?

	Environmental stability	**Number of offspring**
A	increase	decrease
B	increase	increase
C	decrease	increase
D	decrease	decrease

[Turn over

19. The population of the snail *Vertigo antivertigo* was investigated at a small site in Wales. Equal numbers of quadrat samples were taken in three areas with different dominant vegetation and the number of individual snails in each was recorded.

The results are shown in the chart.



The information in the chart indicates that this species of snail prefers

A short grass to long grass

B irises and rushes to long grass

C long grass to irises and rushes

D short grass to irises and rushes.

20. Biological fieldwork often requires the estimation of population size for a prey species. One method used is mark and recapture. If the method of marking reduced the camouflage coloration of this species, what effect would this be likely to have on the population estimate obtained?

A Recapture numbers would be increased and population size would be overestimated

B Recapture numbers would be increased and population size would be underestimated

C Recapture numbers would be decreased and population size would be overestimated

D Recapture numbers would be decreased and population size would be underestimated

21. In three-spined stickleback fish, males have a distinctive red underside in the breeding season, which is not present in females. Territorial males were presented with model fish, some of which had their undersides painted red and some of which were left unpainted. Males showed an automatic attack response to only the red-painted models.

This attack response behaviour is triggered by

A sexual dimorphism

B sexual selection

C an honest signal

D a sign stimulus.

22. The list shows three events in meiosis I.

Q Independent assortment

R Recombination of alleles of linked genes

S Pairing of homologous chromosomes

The order in which these events occur is

A S – R – Q

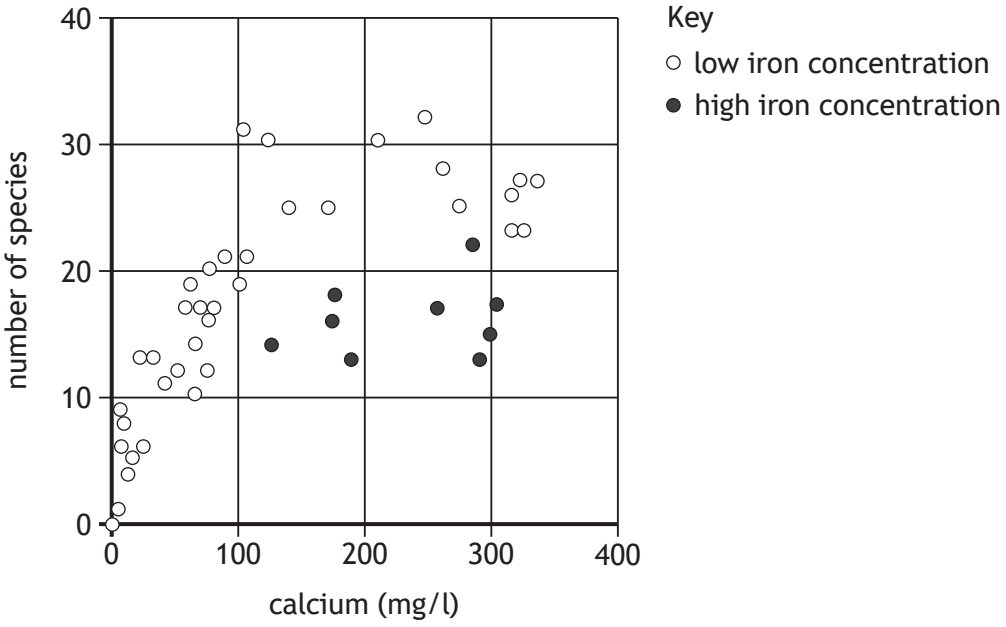
B S – Q – R

C Q – R – S

D Q – S – R.

[Turn over

23. The graph shows species richness of mollusc populations in areas of fenland. The number of species of mollusc was recorded in several areas as well as the calcium concentration in the fenland water. At each site the concentration of iron was also measured.



Which of the following generalisations can be drawn from the graph?

A An increase in calcium from 100 to 400 mg/l increases the species richness

B High iron concentration leads to the highest species richness

C When both calcium and iron concentrations are high the species richness is highest

D An increase in calcium up to 150 mg/l increases species richness

24. New patterns of resistance in *Plasmodium* have increased the challenge experienced in the treatment of malaria.

Which of the following strategies is **least** likely to reduce the challenges in the treatment and control of malaria?

A Improved sanitation

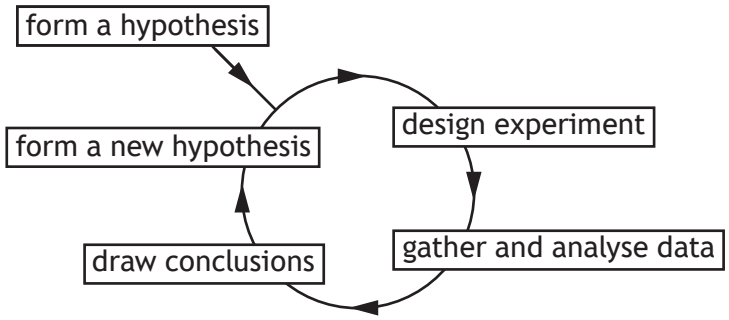
B Development of new culture methods for *Plasmodium*

C Coordinated vector control

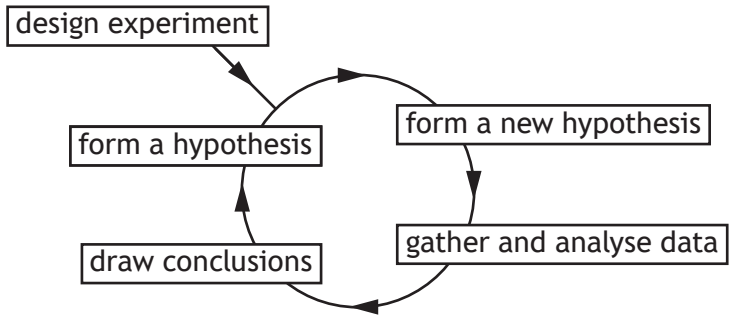
D Building of new low-density housing in malarial areas

25. Which diagram shows the sequence of events in the scientific cycle?

A



B



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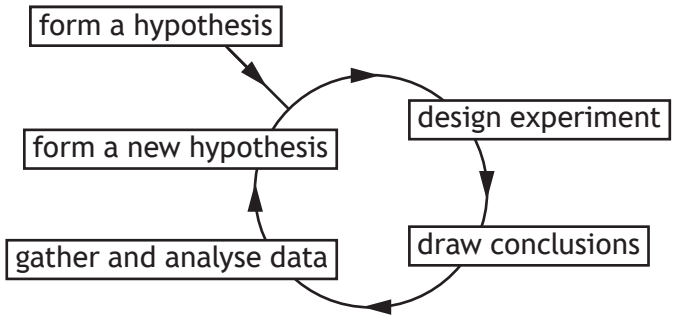

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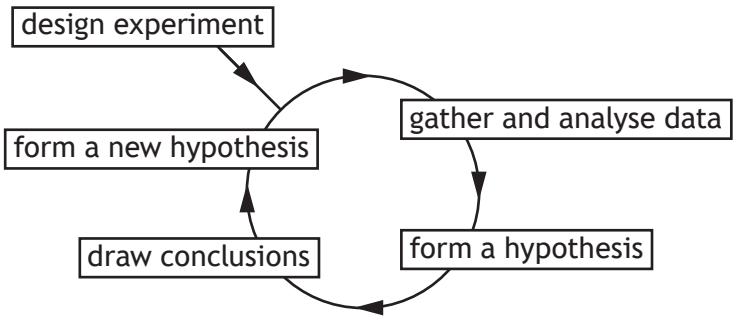

[END OF SECTION 1. NOW ATTEMPT THE QUESTIONS IN SECTION 2 OF YOUR QUESTION AND ANSWER BOOKLET.]

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