



National
Qualifications
2025

X807/77/02

Biology
Section 1 — Questions

TUESDAY, 27 MAY

9:00 AM – 12:00 NOON

Instructions for the completion of Section 1 are given on *page 02* of your question and answer booklet X807/77/01.

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.



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SECTION 1 — 20 marks

Attempt ALL questions

1. Which of the following is least likely to provide appropriate scientific verification of research findings?

- A Publication in an academic journal
- B Discussion in a university seminar
- C Description in a conference lecture
- D Promotion on a website

2. Which row in the table describes features of the rough endoplasmic reticulum?

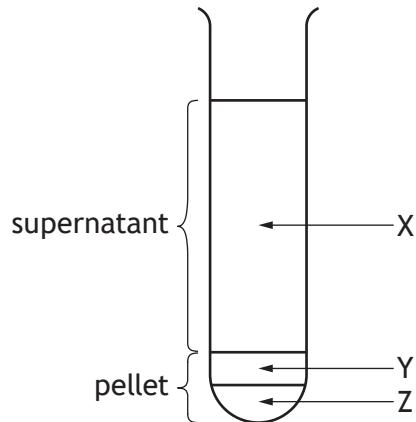
	Ribosomes present	Site of lipid synthesis	Site of transmembrane protein synthesis	Site of cytosolic protein synthesis
A	yes	no	yes	yes
B	yes	yes	yes	no
C	yes	no	yes	no
D	no	yes	no	no

3. The table shows some properties of six proteins.

Protein	Isoelectric point (pH)	Molecular mass (kilodaltons)
1	9.2	296
2	8.5	139
3	5.6	98
4	8.5	45
5	10.1	27
6	7.5	25

A pH 8.5 buffer was added to an extract containing a mixture of the six proteins.

The extract was then centrifuged and the resulting supernatant and pellet are shown in the diagram.

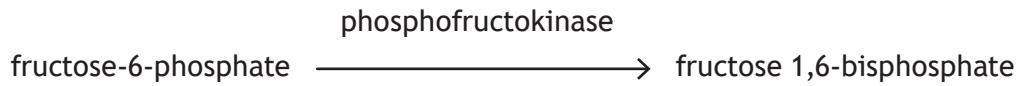


Which row in the table shows the position of the six proteins in the test tube?

	Protein 1	Protein 2	Protein 3	Protein 4	Protein 5	Protein 6
A	Z	Y	X	X	X	X
B	X	X	X	X	Y	Z
C	X	Z	X	Y	X	X
D	X	Y	X	Z	X	X

[Turn over

4. Phosphofructokinase is an enzyme that catalyses the reaction shown.



Phosphofructokinase can be inhibited allosterically by high levels of ATP within the cell.

Which statement describes the regulation of this enzyme?

- A ATP acts as a positive modulator, increasing affinity for fructose-6-phosphate, and fructose 1,6-bisphosphate concentration falls.
 - B ATP acts as a negative modulator, decreasing affinity for fructose 1,6-bisphosphate, and fructose-6-phosphate concentration falls.
 - C ATP acts as a negative modulator, decreasing affinity for fructose-6-phosphate, and fructose 1,6-bisphosphate concentration falls.
 - D ATP acts as a positive modulator, increasing affinity for fructose 1,6-bisphosphate, and fructose-6-phosphate concentration falls.
5. The statements outline stages in signal amplification following the absorption of a single photon of light by rhodopsin.
- Photoexcited rhodopsin activates molecule R.
 - Activated molecule R activates molecule S.
 - Active molecule S breaks down molecule T.
 - Reduction in concentration of molecule T affects the ion channels in the membrane of rod cells.

Which row in the table identifies molecule R, molecule S, and molecule T?

	Molecule R	Molecule S	Molecule T
A	cyclic GMP	phosphodiesterase	transducin
B	cyclic GMP	transducin	phosphodiesterase
C	transducin	cyclic GMP	phosphodiesterase
D	transducin	phosphodiesterase	cyclic GMP

6. Acetylcholine (ACh) is a neurotransmitter found in many living organisms.

In humans, 40 000 molecules of ACh are released per synapse event. Of these released molecules, 80% do not bind to ACh receptors.

The density of ACh receptors at the synapse is 20 000 per μm^2 .

Calculate the area of the synapse, assuming one release event is sufficient to bind to all receptors at a synapse.

- A $0.4 \mu\text{m}^2$
- B $1.6 \mu\text{m}^2$
- C $2.5 \mu\text{m}^2$
- D $4.0 \mu\text{m}^2$

7. Which row in the table identifies intracellular and extracellular events that trigger apoptosis?

	Intracellular	Extracellular
A	absence of growth factors	DNA damage
B	death signal molecules from lymphocytes	absence of growth factors
C	DNA damage	death signal molecules from lymphocytes
D	presence of growth factors	death signal molecules from lymphocytes

8. Which of the following statements about retinoblastoma protein (Rb) is correct?

- A The normal version of the gene acts as an oncogene.
- B It is inhibited when phosphorylated by G1 cyclin-Cdk.
- C It stimulates the transcription of genes that code for proteins needed in G1 phase.
- D It stimulates the transcription of genes that code for proteins needed in S phase.

[Turn over

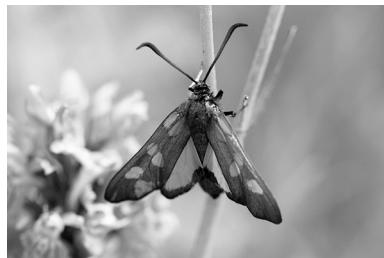
9. A study was designed to investigate the impact of tapeworm parasites on the sensitivity of host brine shrimp to arsenic pollution in a Spanish estuary.

Which of the following plans would best allow comparison of the response of infected and uninfected individuals and achieve the aims of the study?

- A Use a range of arsenic concentrations and a number of populations of brine shrimp, each with low genetic variation and similar ages.
- B Use a range of arsenic concentrations and one population of brine shrimp, each with high genetic variation and similar ages.
- C Use a single arsenic concentration and a number of populations of brine shrimp, each with low genetic variation and different ages.
- D Use a single arsenic concentration and one population of brine shrimp, each with high genetic variation and different ages.

10. A project was designed to investigate the distribution and morphology of red-spotted burnet moths. These moths are glossy black, with five or six red spots on each forewing.

Amateur moth enthusiasts were asked to photograph these moths and record their location and some physical characteristics for analysis.



Two of the characteristics recorded were:

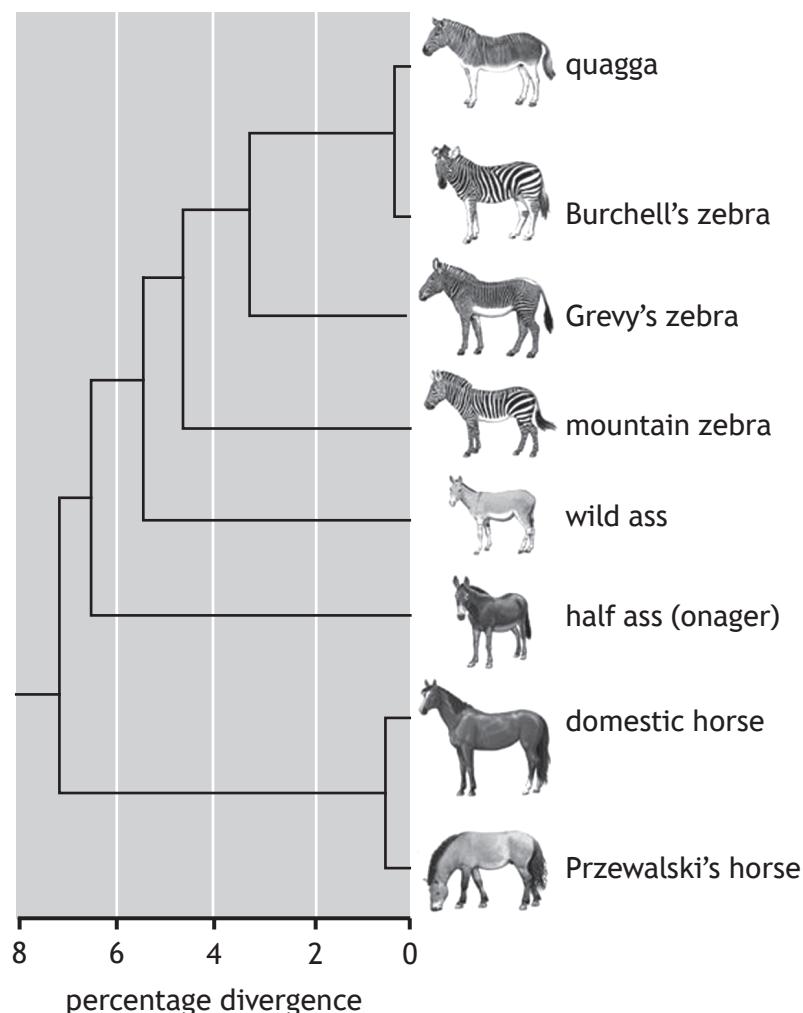
- red wing area: a score of one was given to moths with only a small area of red on the wings, a score of two where around half of the wing area was red and a score of three where the majority of the wing area was red
- the number of red spots on each forewing.

Which row in the table describes the types of data that were collected?

	Red wing area	Number of red spots
A	qualitative	quantitative, discrete
B	ranked	quantitative, discrete
C	qualitative	quantitative, continuous
D	ranked	quantitative, continuous

11. Phylogenetic trees show the evolutionary relationships amongst a group of organisms.

The diagram shows a phylogenetic tree for members of the Equidae family.



Using the information given, which of the following statements is true?

- A Horses are more closely related to asses than they are to zebras.
- B Quagga and Burchell's zebras do not share a common ancestor with Grevy's and mountain zebras.
- C Horses are as closely related to zebras as they are to asses.
- D The half ass is more closely related to horses than the wild ass.

[Turn over

12. Which of the following is **not** assumed when the mark and recapture technique is used?

- A All animals have an equal chance of recapture.
- B No animals are predated before recapture.
- C No immigration or emigration occurs.
- D Marked animals mix randomly after release.

13. Which of the following statements about animal species that use external fertilisation is correct?

- A External fertilisation never involves courtship rituals.
- B Female choice is never a feature of external fertilisation.
- C External fertilisation requires the direct transfer of gametes.
- D Offspring produced by external fertilisation generally have lower survival rates.

14. Female killer whales (*Orcinus orca*) have the longest post-reproductive lifespan of any non-human animal. Offspring of both sexes remain in the maternal group.

Researchers used data from photographic censuses of killer whale populations recorded over many years to study the consequence of a mother's death on offspring survival.

The results are shown in the table.

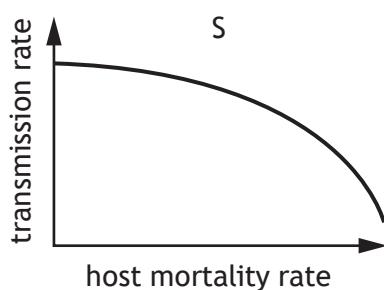
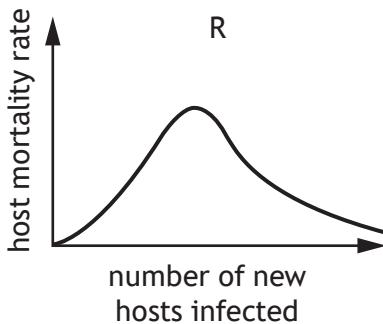
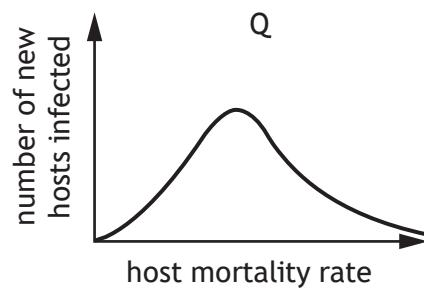
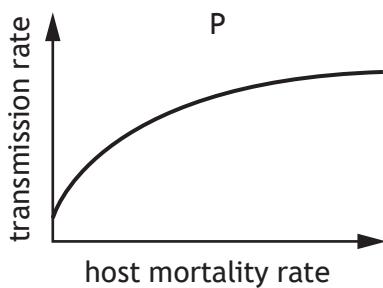
	Probability of surviving to 40 years of age	
	Male offspring	Female offspring
Mother alive	0.49	0.65
Mother dies when offspring 15 years of age	0.31	0.65
Mother dies when offspring 30 years of age	0.22	0.55

Compared to a mother who dies when her male offspring is 30 years old, a surviving mother increases her male offspring's probability of reaching the age of 40 by

- A 18%
- B 55%
- C 82%
- D 123%.

15. One evolutionary theory proposes that an intermediate level of virulence maximises the fitness of a parasite (number of new hosts infected) as a result of a trade-off between virulence and transmission. The theory assumes that an increase in virulence, measured by host mortality rate, slows down the increase in the rate of transmission.

Which pair of the following graphs represents this trade-off theory?



- A P and Q
- B P and R
- C Q and S
- D R and S

[Turn over

16. The cheetah is a large cat native to Africa and central Iran.



The level of genetic variation in cheetahs is between 0.1% and 4% of that in an average living species.

The decrease in genetic variation was caused by two events in the evolutionary history of the species.

Event 1

100 000 years ago, cheetahs rapidly expanded their range into Asia, Europe, and Africa. This expansion meant that cheetahs were dispersed over a very large area. This restricted the ability to exchange alleles between members of the population.

Event 2

12 000 years ago, an extinction event occurred that caused the cheetahs in Europe to go extinct. This meant that the remaining populations could only be found in Africa and Asia. This event prevented any gene flow between populations.

Use the information to identify the correct terms describing events 1 and 2 and changes in allele frequency.

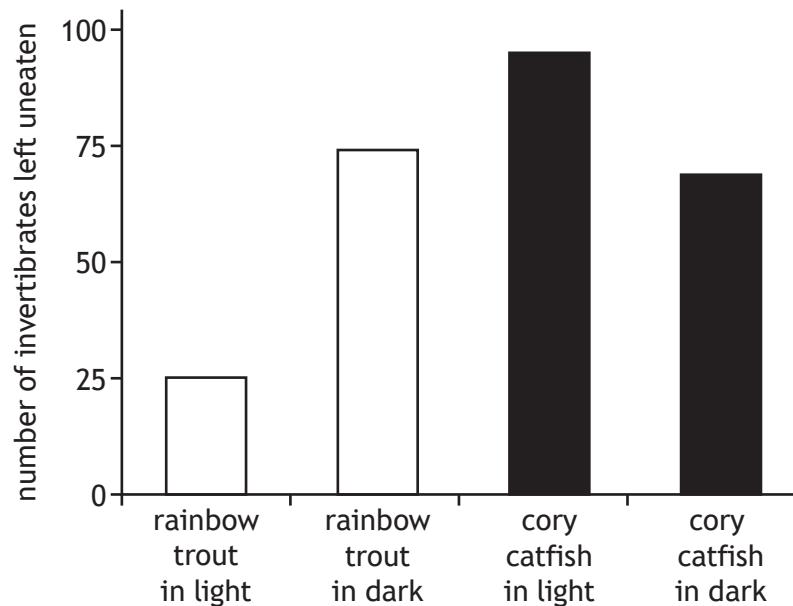
	Event 1	Event 2	Changes in allele frequency
A	founder effect	bottleneck effect	random
B	founder effect	bottleneck effect	non-random
C	bottleneck effect	founder effect	random
D	bottleneck effect	founder effect	non-random

17. Which of the following examples of immune evasion relates to specific cellular defence?

- A *Xenos vesparum*, an endoparasite of paper wasps, can reduce the level of phagocytosis carried out by its host.
- B *Trypanosoma brucei*, a protozoan parasite that causes sleeping sickness, periodically replaces cell surface glycoproteins that act as antigens.
- C Hookworm parasites promote the expression of anti-inflammatory molecules in the human gut.
- D Some herpesviruses can alter the activity of natural killer cells.

18. Cory catfish and rainbow trout are both species of fish that are found in rivers and streams and feed on invertebrates. In a laboratory experiment to investigate their feeding strategies, four aquaria were set up. Each aquarium contained 100 invertebrate larvae and was either placed in a brightly lit area or a dark cupboard. One fish was introduced to each aquarium and left to feed for 30 minutes. The fish was removed and the uneaten invertebrates counted and recorded.

The results are shown in the bar chart.



Which of the following conclusions is consistent with the data shown?

- A Cory catfish are visual predators but have less predation impact on the prey than rainbow trout.
- B Cory catfish are visual predators and have a greater predation impact on the prey than rainbow trout.
- C Rainbow trout are visual predators and have a greater predation impact on the prey than cory catfish.
- D Rainbow trout are visual predators but have less predation impact on the prey than cory catfish.

[Turn over

19. Green sturgeon, *Acipenser medirostris*, are fish that can grow to be over 2 m long with a mass of 160 kg. Females can live to be 50 years old and begin spawning at around 16 years. They then spawn every 4–5 years, producing thousands of eggs per spawn. Compared to other sturgeon species, the number of eggs produced is relatively low due to their large egg-size.

From the information given, which is the best description of the green sturgeon's reproductive strategy?

- A r-selected only
- B K-selected only
- C Mainly r-selected, but with features of K-selection
- D Mainly K-selected, but with features of r-selection

20. The fundamental niche of a species is one that it occupies in

- A the absence of any intraspecific competition
- B the absence of any interspecific competition
- C response to interspecific competition
- D response to intraspecific competition.

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

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