



National  
Qualifications  
2016

**X707/76/02**

**Biology**  
**Section 1 — Questions**

MONDAY, 9 MAY  
9:00 AM – 11:30 AM

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Instructions for the completion of Section 1 are given on *Page 02* of your question and answer booklet X707/76/01.

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.

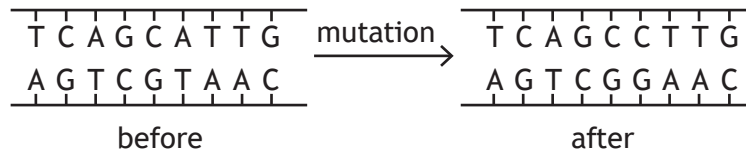


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SECTION 1 — 20 marks

Attempt ALL questions

1. The diagram below shows part of a DNA molecule before and after a mutation.

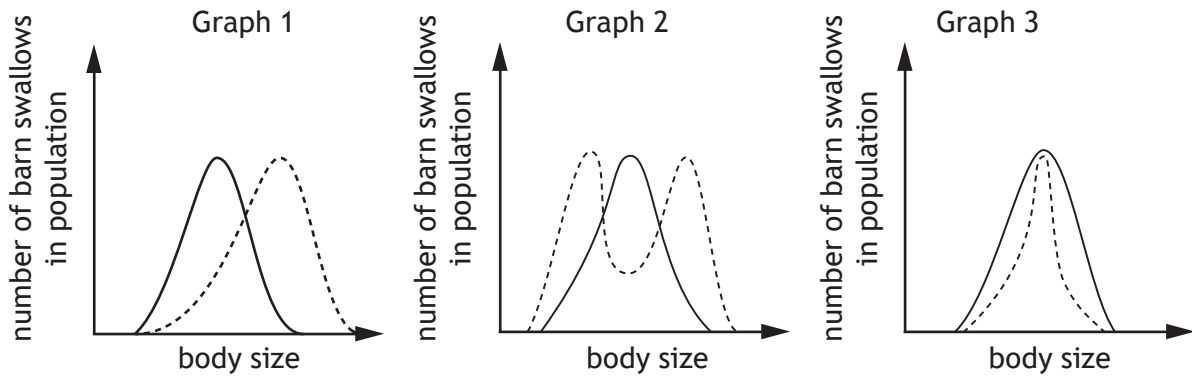


The type of mutation shown is

- A deletion
  - B substitution
  - C insertion
  - D inversion.
2. Which of the following are required in a polymerase chain reaction (PCR)?
- A DNA polymerase, template strand and primers
  - B RNA polymerase, template strand and primers
  - C DNA polymerase, template strand and ligase
  - D RNA polymerase, ligase and primers
3. Each cycle of a polymerase chain reaction (PCR) takes 5 minutes.
- If there are 1000 DNA fragments at the start of the reaction, how long will it take for the number of fragments produced by the reaction to be greater than 1 million?
- A 15 minutes
  - B 35 minutes
  - C 50 minutes
  - D 55 minutes

4. The graphs below show possible changes in the body size of a population of barn swallows, *Hirundo rusticana*, in response to a selection pressure.

——— original population  
 ..... population after selection

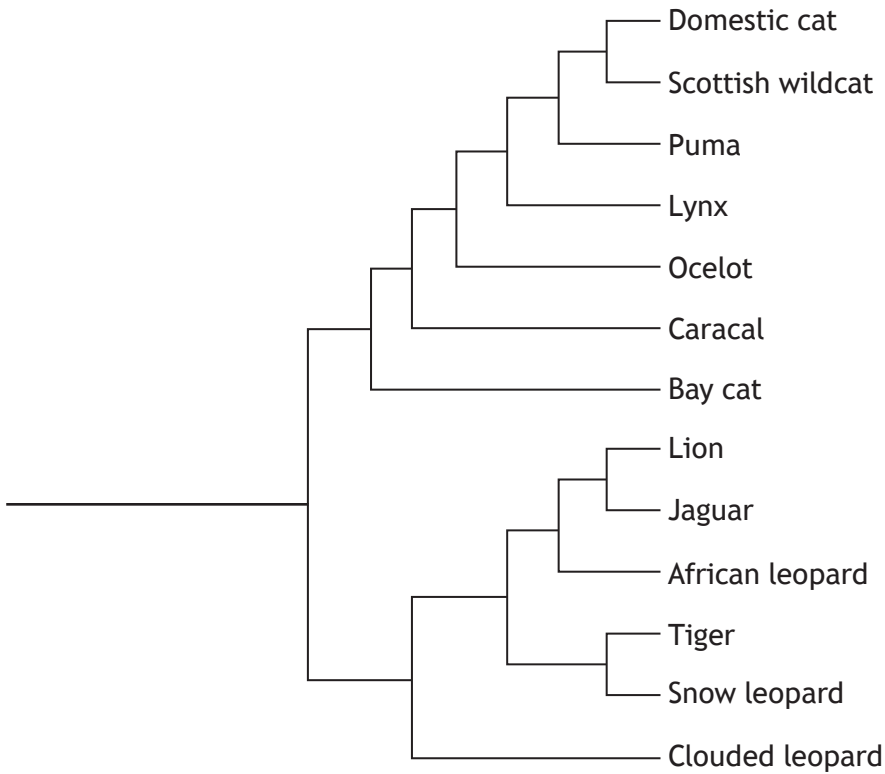


Which row in the table below matches each graph with the type of selection taking place?

	Graph		
	1	2	3
A	disruptive	directional	stabilising
B	directional	disruptive	stabilising
C	stabilising	disruptive	directional
D	directional	stabilising	disruptive

[Turn over

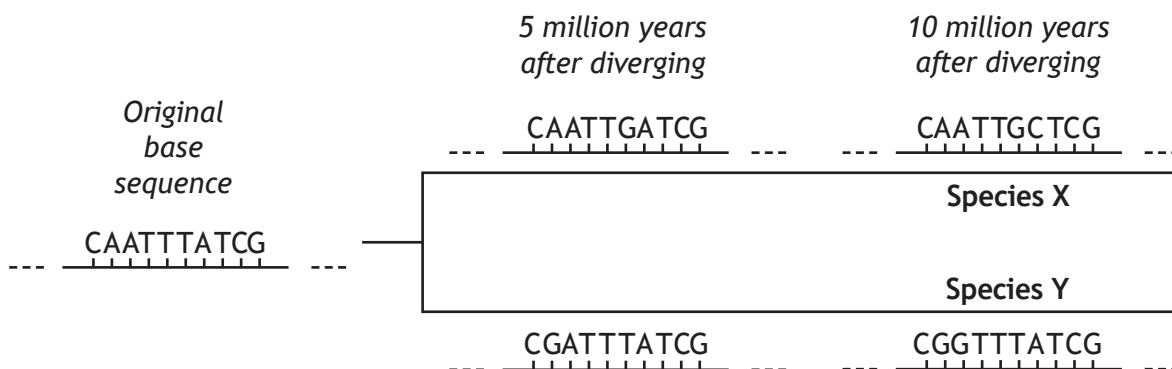
5. The diagram below represents a phylogenetic tree showing the evolutionary relatedness of several species of cat.



With how many species does the African leopard share a common ancestor in this phylogenetic tree?

- A 2 only
- B 5 only
- C 12 only
- D 13

6. Over millions of years of evolution, mutations occur at a broadly constant rate within a gene. This allows genes to be used as molecular clocks. The diagram below shows how the base sequence in part of a gene changed as two evolutionary lineages diverged from an original base sequence. The base sequence in the gene has changed at a rate of 1 base per 5 million years as shown.



Assuming this rate of mutation continued, by how many bases would this part of the gene differ in Species X compared with Species Y 20 million years after diverging from the original base sequence?

- A 4  
 B 8  
 C 16  
 D 20
7. In metabolic pathways, the rates of reaction can be affected by the presence of enzyme inhibitors.

Which row in the table below is correct?

	<i>Type of inhibition</i>	<i>Inhibitor binds to active site</i>	<i>Effect of increasing substrate concentration on inhibition</i>
A	competitive	yes	reversed
B	non competitive	yes	unaffected
C	competitive	no	unaffected
D	non competitive	no	reversed

8. Which row in the table below identifies the number of heart chambers and the type of circulatory system in amphibians?

	<i>Number of heart chambers</i>	<i>Type of circulatory system</i>
A	3	incomplete double
B	4	incomplete double
C	3	complete double
D	4	complete double

9. During unexpected periods of drought the South American lungfish, *Lepidosiren paradoxa*, survives by burying into mud.

This type of behaviour is known as

- A predictive dormancy
- B daily torpor
- C aestivation
- D hibernation.

10. An experiment was set up to investigate the effect of different respiratory substrates on the rate of respiration in yeast. Methylene blue can be used to measure the rate of respiration as it changes from dark blue to colourless when it accepts hydrogen ions. Four test tubes were set up, each containing yeast, methylene blue and one of the respiratory substrates.

The table below shows the results of this investigation.

<i>Test tube number</i>	<i>Respiratory substrate</i>	<i>Appearance of the methylene blue after 20 minutes</i>
1	starch	dark blue
2	sucrose	light blue
3	lactose	dark blue
4	glucose	colourless

Which of the following conclusions is correct?

The rate of respiration is

- A higher with starch than with glucose
- B lower with sucrose than with lactose
- C higher with glucose than with lactose
- D lower with glucose than with sucrose.

11. Stages of aerobic respiration are shown below.

- 1 Glycolysis
- 2 Citric acid cycle
- 3 Electron transfer chain

Which stage(s) involve(s) **both** phosphorylation of intermediates and generation of ATP?

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

12. Which row in the table below identifies a stage of aerobic respiration, its site and an event which occurs during that stage?

	<i>Stage</i>	<i>Site</i>	<i>Event</i>
A	electron transfer chain	inner mitochondrial membrane	carbon dioxide is released
B	electron transfer chain	matrix of mitochondrion	hydrogen ions combine with oxygen
C	citric acid cycle	inner mitochondrial membrane	hydrogen ions combine with oxygen
D	citric acid cycle	matrix of mitochondrion	carbon dioxide is released

13. A field trial was set up to investigate the effect of phosphate fertiliser on the yield of the potato cultivar Maris Piper. Potatoes were planted in 5 plots, each of which received a different level of phosphate fertiliser. When they were harvested the yield from each plot was recorded.

A list of suggested improvements to this field trial is shown below.

- 1 Apply equal volumes of water to each plot.
- 2 Grow the same number of potato plants in each plot.
- 3 Use 10 plots at each phosphate fertiliser level.
- 4 Plant different potato cultivars in each plot.

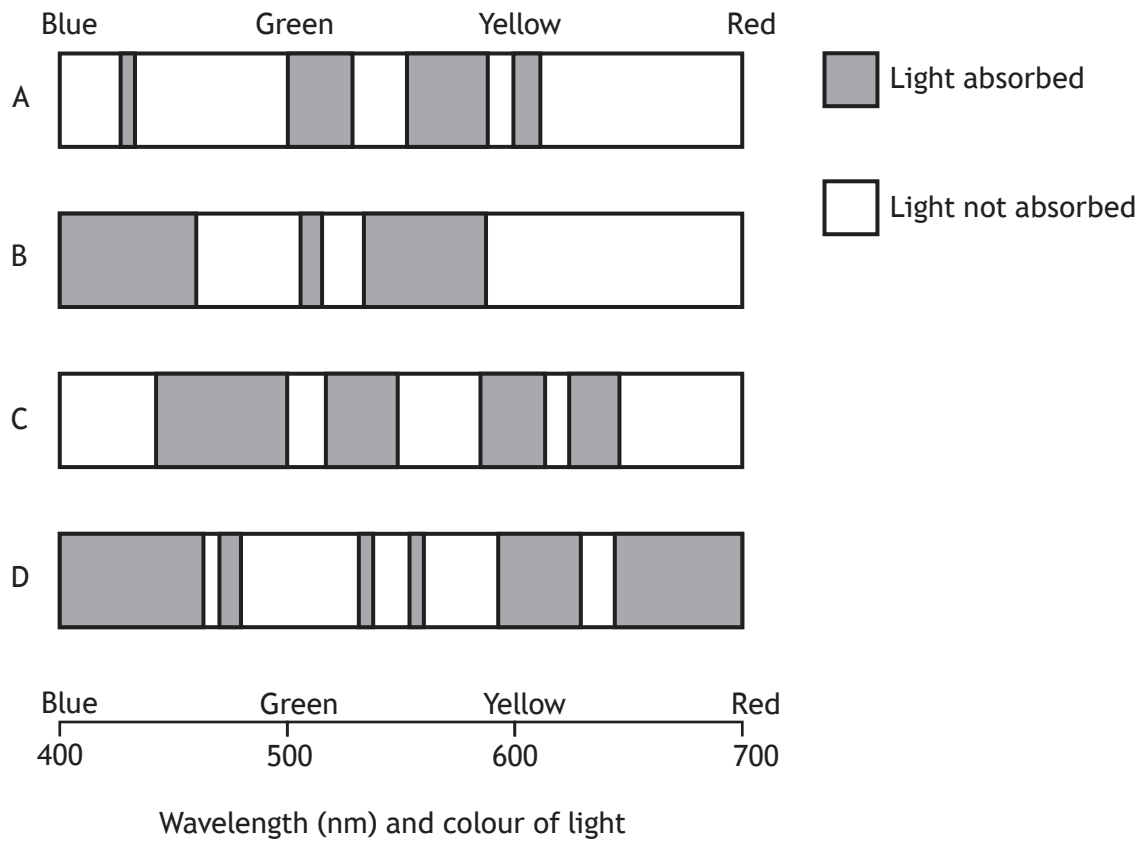
Which of the suggestions would improve the validity of the results?

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

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14. Which compound combines with hydrogen during carbon fixation (Calvin cycle)?
- A Ribulose biphosphate
  - B NADP
  - C Oxygen
  - D 3-phosphoglycerate
15. The following absorption spectra were obtained by testing four different plant extracts.

Which extract contains chlorophyll?



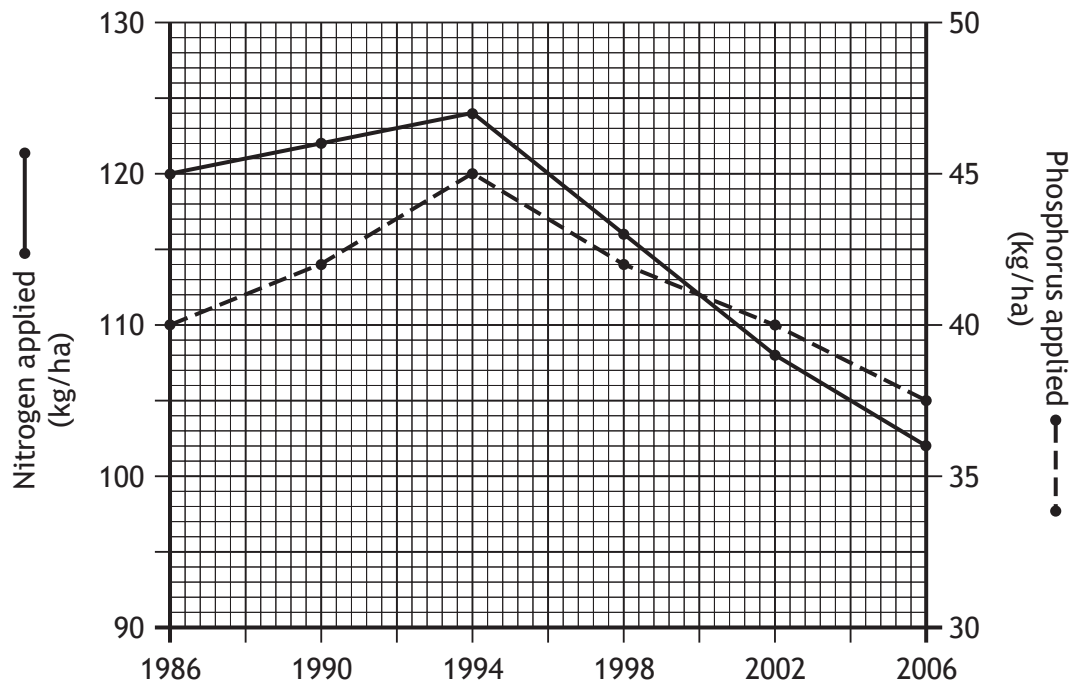
16. The table below shows the biological and economic yields of four different crops.

<i>Crop</i>	<i>Biological yield</i> (tonnes of dry mass/hectare)	<i>Economic yield</i> (tonnes of dry mass/hectare)
pea	10	2
rice	15	10
wheat	30	8
potato	30	10

The crop with the highest harvest index is

- A pea
- B rice
- C wheat
- D potato.

17. The graph below shows the levels of nitrogen and phosphorus applied to crops in an area of Scotland between 1986 and 2006.



In which year was there the smallest difference between the levels of nitrogen and phosphorus applied?

- A 1998
- B 2000
- C 2002
- D 2006

18. Which of the following are features of naturally inbreeding crop plants?
- 1 Susceptible to inbreeding depression
  - 2 Deleterious alleles eliminated by natural selection
  - 3 Self-pollinating
- A 1 and 2 only  
B 1 and 3 only  
C 2 and 3 only  
D 1, 2 and 3
19. On returning to their roost after feeding, vampire bats may regurgitate blood to feed an unrelated individual in the same social group.  
This is an example of
- A mutualism  
B altruism  
C social hierarchy  
D kin selection.
20. The statements below refer to behaviour sometimes displayed by lions kept in captivity.
- 1 Repetitive chewing on cage bars
  - 2 Excessive licking of body
  - 3 Continually pacing backwards and forward
- Which are examples of stereotypy?
- A 1 only  
B 1 and 2 only  
C 2 and 3 only  
D 1, 2 and 3

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

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