



National  
Qualifications

**X807/77/02**

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

Duration — 3 hours

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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.



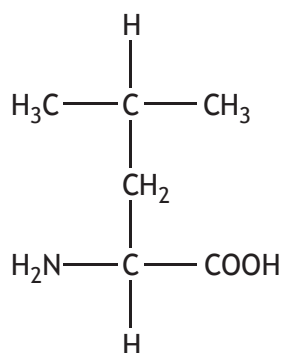
SECTION 1 — 20 marks

Attempt ALL questions

1. Which row in the table describes features of a positive modulator binding to an enzyme?

|   | Binding         | Affinity for substrate |
|---|-----------------|------------------------|
| A | allosteric site | increases              |
| B | active site     | increases              |
| C | allosteric site | decreases              |
| D | active site     | decreases              |

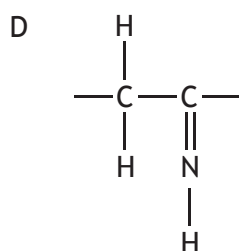
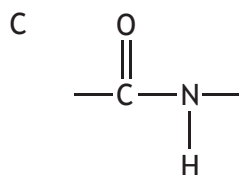
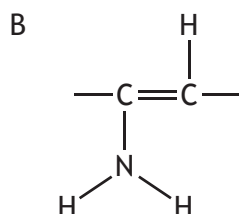
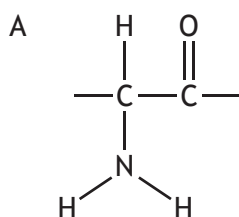
2. The diagram shows the structure of the amino acid leucine.



To which class of amino acids does leucine belong?

- A Polar
- B Hydrophobic
- C Acidic
- D Basic

3. Which of the following diagrams illustrates a peptide bond?

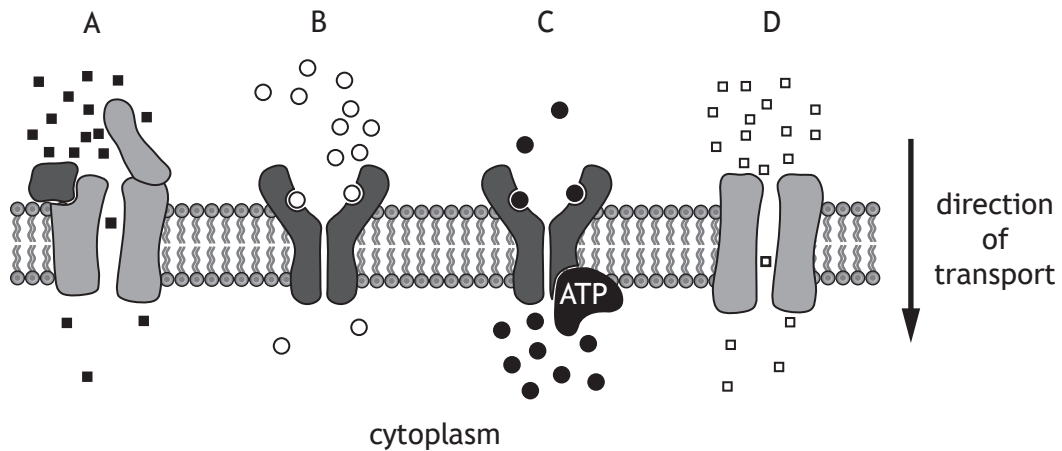


4. Which of the following is an advantage of an *in vitro* experiment?

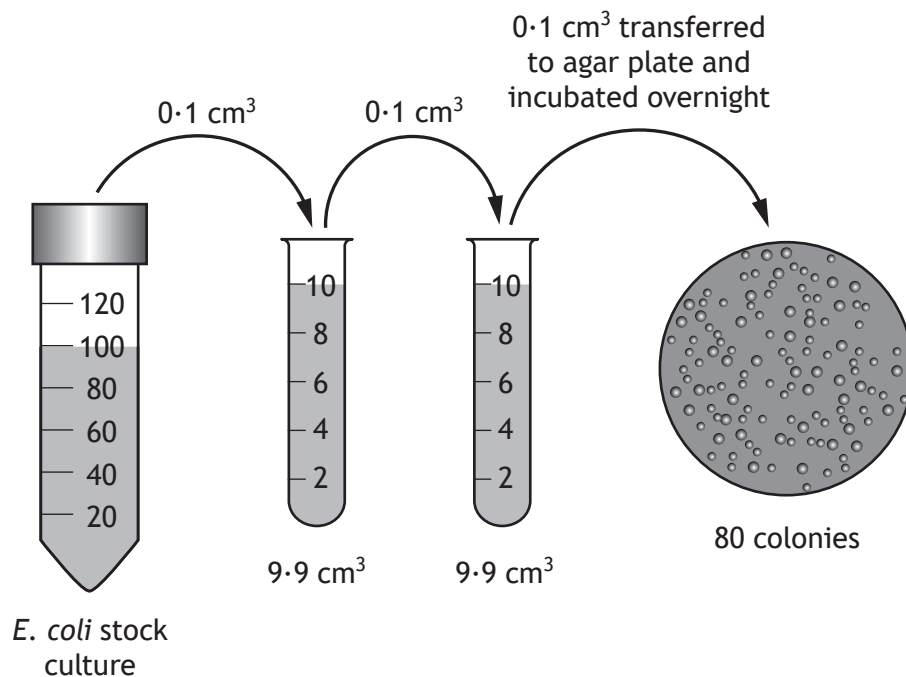
- A The environment is closely controlled
- B The effect on whole organisms can be monitored
- C The organism is in its natural surroundings
- D The environment is affected by confounding variables

[Turn over

5. The diagram shows the transport of four substances into a cell.  
Which substance is transported by facilitated diffusion via a transporter protein?



6. The figure shows how a biologist used serial dilution followed by plating to estimate the number of cells in a 100 cm<sup>3</sup> stock culture of *E. coli*.



How many *E. coli* cells were present in the original stock culture?

- A  $8.0 \times 10^4$
- B  $8.0 \times 10^6$
- C  $8.0 \times 10^7$
- D  $8.0 \times 10^8$

7. The statements describe the sequence of events that follows the absorption of a photon of light by rhodopsin in the rod cell of a mammal.

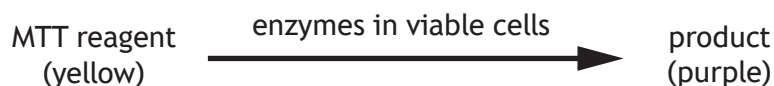
1. Cyclic GMP is hydrolysed
2. Ion channels in the membrane of the rod cell close
3. The G-protein transducin is activated
4. The enzyme phosphodiesterase is activated

The order in which these events occur is

- A 1, 3, 4, 2  
B 3, 4, 1, 2  
C 4, 3, 2, 1  
D 3, 1, 2, 4.

8. The toxicity of potential new drugs can be assessed by measuring the viability of mammalian cells cultured in the presence of the drug.

Cell viability can be measured using an MTT assay, which involves a colour change as shown.



The intensity of colour of the purple product can be measured using a colorimeter and used to calculate the percentage of viable cells.

An MTT assay was used in an experiment to test cell viability in the presence of a drug.

Four culture dishes, each containing mammalian cells in growth media, were set up.

MTT and the drug were added to the dishes as indicated in the table.

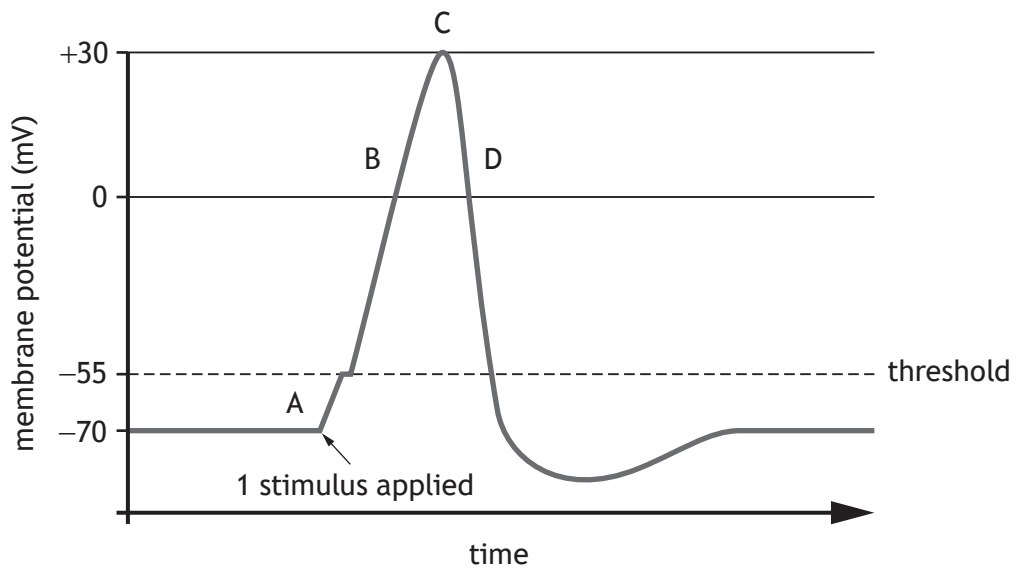
Which dish would act as a positive control for the MTT assay?

| Dish | Drug present | MTT present |
|------|--------------|-------------|
| A    | ✓            | X           |
| B    | X            | ✓           |
| C    | ✓            | ✓           |
| D    | X            | X           |

[Turn over

9. The diagram shows the changes in membrane potential during the transmission of a nerve impulse.

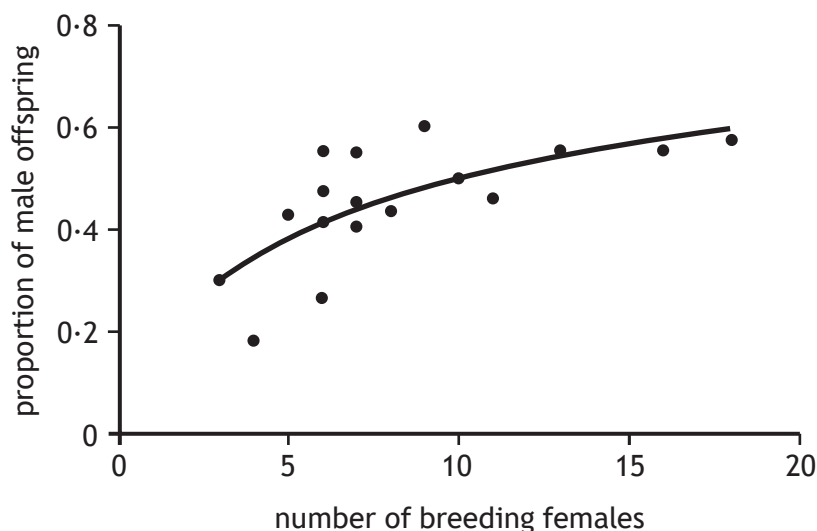
Which letter represents the time when the voltage-gated potassium ion channels are open?



10. Which row in the table identifies the mechanism of apoptosis induced as a result of p53 activation?

|   | Origin of cell death signal |          | Trigger for cell death         |            |
|---|-----------------------------|----------|--------------------------------|------------|
|   | External                    | Internal | Natural killer cell attachment | DNA damage |
| A | ✓                           |          | ✓                              |            |
| B |                             | ✓        |                                | ✓          |
| C |                             | ✓        | ✓                              |            |
| D | ✓                           |          |                                | ✓          |

11. The scatterplot shows how the proportion of male offspring produced each year may depend on the number of breeding females present in a population of small mammals in a given area.



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

- A The sex ratio in litters will not be affected by the density of breeding females
  - B When breeding female density is low, producing male offspring will increase fitness
  - C When breeding female density is high, the proportion of male offspring will be reduced
  - D Only at intermediate density of breeding females will the sex ratio be in line with the expected ratio if female breeding density had no effect
12. The allele (T) for the ability to taste the bitter chemical phenylthiocarbamide (PTC), is dominant over the allele (t) for the inability to taste the chemical.
- 400 biology students were tested and 64 were found to be non-tasters.
- The percentage of heterozygous students is

- A 16%
- B 27%
- C 32%
- D 48%

[Turn over

13. The problem solving capability of squirrels was investigated. The time taken to solve a food extraction problem was measured for a sample of grey squirrels and a sample of red squirrels. Mean values were calculated and compared for the two species.

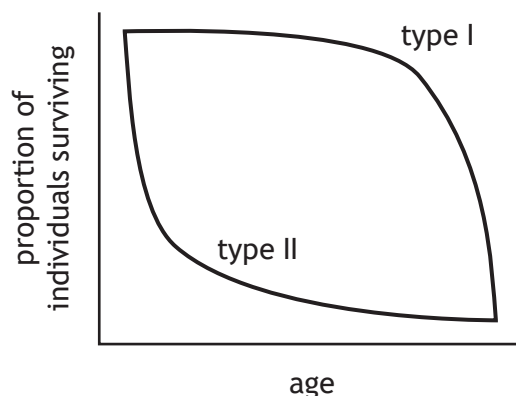
Which row in the table represents the variables involved in this investigation?

|   | Independent variable | Dependent variable |
|---|----------------------|--------------------|
| A | continuous           | continuous         |
| B | continuous           | discrete           |
| C | discrete             | continuous         |
| D | discrete             | discrete           |

14. In animal behaviour studies, which of the following units could be used in measurements of latency?

- A Metres
- B Metres per second
- C Seconds
- D Seconds per metre

15. The survivorship curves show the probability of individuals in two types of species living to different ages.



Which row in the table shows the likely survivorship and environment of a K-selected species?

|   | Survivorship | Environment |
|---|--------------|-------------|
| A | type I       | stable      |
| B | type I       | unstable    |
| C | type II      | stable      |
| D | type II      | unstable    |



16. The red-necked phalarope, *Phalaropus lobatus*, is a rare wading bird that breeds in parts of the British Isles during summer.

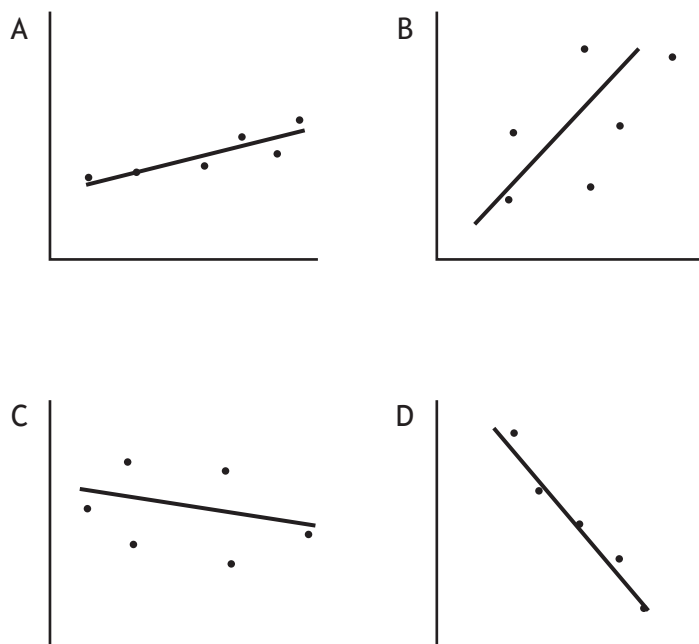
The females are larger than males and are more brightly coloured. When breeding, the females compete for males and take the lead in courtship. When egg-laying is complete, the female may search for another male. Male birds incubate the eggs and carry out all other parental tasks but each male breeds with only one female in a breeding season.

Which of the following are features of the red-necked phalarope's reproductive behaviour?

- A Polygamy and polygyny
  - B Polygamy and polyandry
  - C Monogamy and polygyny
  - D Monogamy and polyandry
17. Aggressive ants that live in the hollow thorns of tropical *Acacia* trees feed on the nectar and lipid-rich bodies that the tree produces.

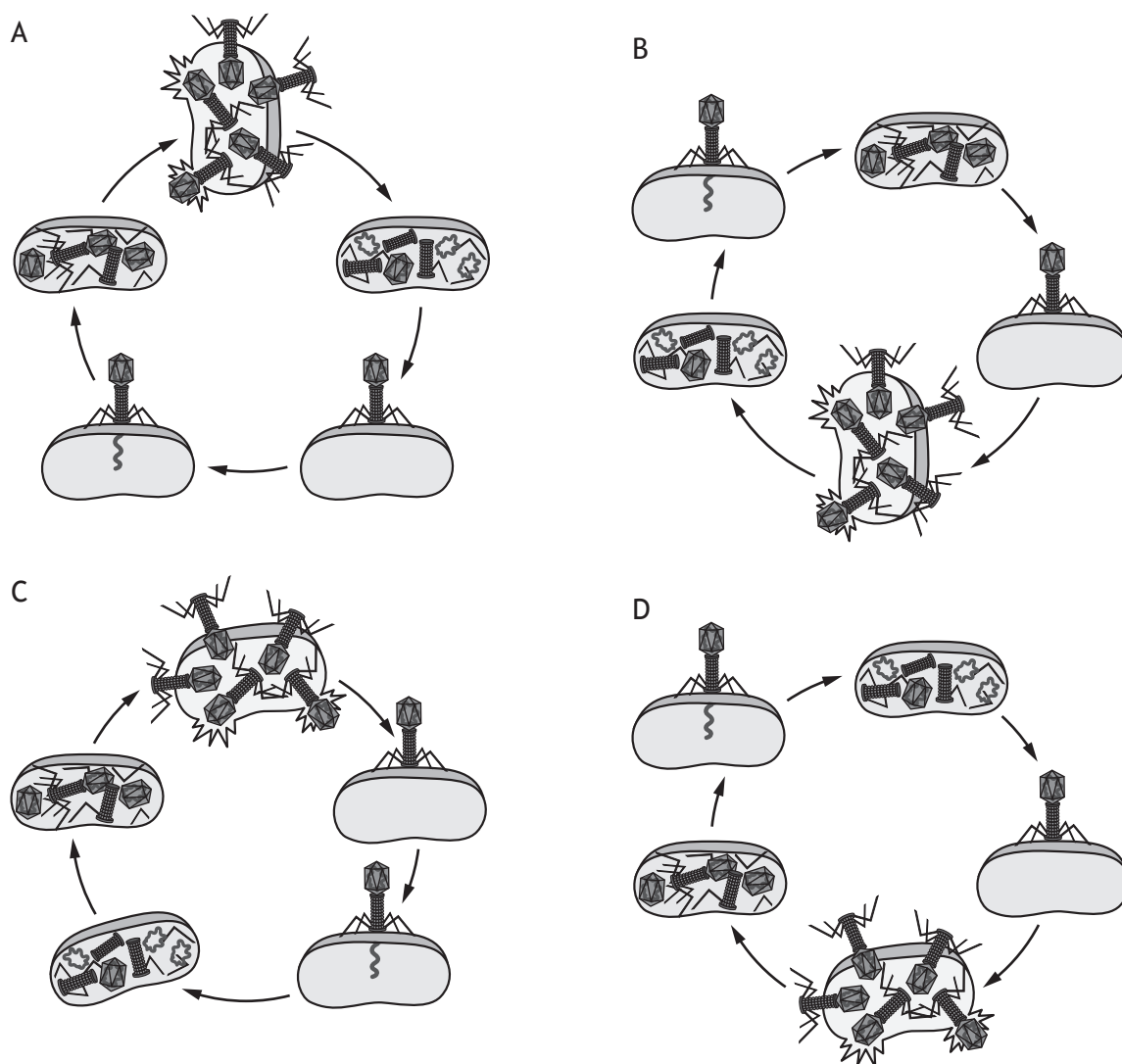
Which of the following experiments best tests the hypothesis that these ants defend the plant by killing or chasing away leaf-feeding insects?

- A Remove leaf-feeding insects and measure subsequent ant density
  - B Remove lipid-rich bodies and measure subsequent ant density
  - C Remove leaf-feeding insects and measure subsequent plant growth
  - D Remove ants and measure subsequent leaf damage
18. Which graph shows a strong, positive correlation?



[Turn over for next question]

19. Which sequence represents the order of stages in the life cycle of a virus?



20. Herd immunity threshold is the

- A density of infected hosts required for the occurrence of an epidemic
- B density of resistant hosts in the population required to prevent an epidemic
- C density of resistant parasites in the host population required to cause an epidemic
- D density of parasites within individual hosts of the population required for an epidemic.

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