Structure of this paper

Section		Number of questions available	Number of questions to be attempted	Suggested working time	Marks available
A	Multiple choice	1-30	All	40	60 (30%)
B	Short answers	31-35	All	90	100 (50%)
C	Extended answers	36*	Two parts	50	40 (20%)
		37*	Two parts		
				Total marks	200

*Questions 36 and 37 each consist of four optional parts, of which **two** should be attempted in each question.

Instructions to candidates

1. The rules for the conduct of Tertiary Entrance Examinations are detailed in the booklet *TEE Handbook.* Sitting this examination implies that you agree to abide by these rules.

2. Answer the questions according to the following instructions:

   Section A Answer **all** questions, using a 2B, B or HB pencil, on the separate Multiple Choice Answer Sheet. Do **not** use a ball point or ink pen.

   Section B Write your answers in the spaces provided in this Question/Answer Booklet. A blue or black ball point or ink pen should be used.

   Spare answer pages may be found at the end of this booklet. If you need to use them, indicate in the original answer space where the answer is continued (i.e. give the page number).

   The space provided for each question is an indication of the length of answer required.

   Section C Write your answers in the Standard Answer Book. Use a blue or black pen (not pencil) for this section. Do not copy the questions when answering; merely write the number of the question in the margin.

3. At the end of the examination your Question/Answer Booklet should be attached to the **front** of the Standard Answer Book(s) with the paper binder provided.

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SECTION A **(60 marks)** Suggested time: 40 minutes

Record an answer for Questions 1-30 by marking your choice of alternative on the separate Multiple Choice Answer Sheet using a 2B, B or HB pencil. Each question is worth two marks. Marks are not deducted for wrong answers.

If you want to change an answer, rub out your first answer and mark the new choice. The Multiple Choice Answer Sheet for Section A will be collected separately by the Supervisor.

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1. DNA is known to be the substance within cells that carries all the genetic information about the organism. Which of the following statements about DNA best describes the manner in which this information is stored?

   (a) A molecule of DNA contains thousands of repeated units which are paired opposite each other in a double-stranded structure.
   (b) Nitrogenous bases in DNA occur in complementary pairs on opposite strands.
   (c) There are four different nitrogenous bases in DNA, giving rise to 64 different possible DNA molecules.
   (d) There is a large number of possible sequences of nitrogenous bases along a DNA strand.

2. Most educational and research centres in the world now have strict controls over the use of animals for scientific purposes. What is the main reason for this?

   (a) Most research has already been done so there is no need to repeat it.
   (b) Modern research methods are more cruel than those used in the past.
   (c) Modern society has higher ethical standards in respect of animal rights.
   (d) Computers can now be used to simulate animal experiments.

3. Haemophilia is a blood disorder in humans which is inherited as a sex-linked recessive gene. Which ONE of the following statements is false?

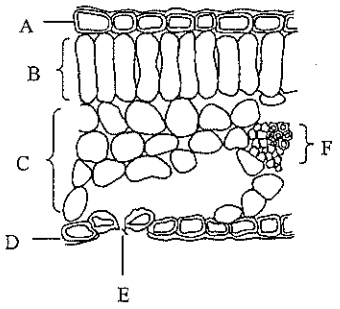
   (a) The daughters of all affected women will either be carriers or affected.
   (b) The sons of all affected men will be carriers.
   (c) The daughters of all affected men will either be carriers or affected.
   (d) The fathers of affected women must be affected.

SEE NEXT PAGE

4. An interesting group of succulent plants called the "ice plants" have enzymes that allow the leaf cells to absorb CO_2 during the night. During the daytime, the absorbed CO_2 is made available for photosynthesis. Which of the following is the most likely reason for this adaptation?

(a) CO_2 concentrations are low in the air where these plants are found.
(b) Leaves of these plants lack stomata, so they find it difficult to absorb enough CO_2 during the day.
(c) If light levels are too low during the day, moonlight can be used for photosynthesis.
(d) This allows stomata to be closed during the day to prevent dehydration in hot weather.

The next three questions refer to the diagram below, showing a transverse section of a plant leaf.



5. In which regions of the leaf does most photosynthesis take place?

(a) A and B
(b) B and C
(c) A and D
(d) C and F

6. During the day, there is a net loss of certain gases from the leaf through structure E. Which gases are they?

(a) Oxygen and carbon dioxide
(b) Carbon dioxide and water
(c) Nitrogen and carbon dioxide
(d) Oxygen and water

7. Which ONE of the following statements concerning structure E is correct?

(a) The gap closes in response to both low light levels and dehydration of the plant, resulting in lower rates of photosynthesis in the leaf.
(b) The gap opens in response to low light levels in order to release the excess CO_2 produced in cellular respiration.
(c) Opening and closing of the gap is regulated entirely by the requirements of the leaf cells for CO_2 for photosynthesis.
(d) Opening and closing of the gap has an effect on water loss from the leaf but not on the rate of photosynthesis.

8. A student breeds fruit-flies with red eyes for 20 generations. Suddenly, in the 21st generation, she discovers three white-eyed flies in the culture. Which of the following statements is the most likely explanation of the observation?

(a) The flies have adapted to the pale food in the culture jars.
(b) A mutation has occurred.
(c) The white-eyed gene has reappeared after skipping generations.
(d) At least two genes are responsible for eye colour in fruit flies.

9. Which of the following would be **least** effective in causing reproductive isolation between two populations of the same species?

(a) The populations are of different sizes.
(b) The populations breed at different times of the year.
(c) The sperm and ova of the two populations are incompatible.
(d) The populations show different courtship behaviour.

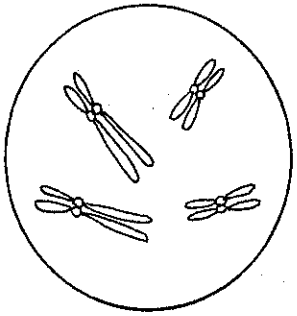
10. Which ONE of the following is an example of evolutionary change in a mouse population?

(a) Half the mice are drowned in a flood.
(b) A mutation for spotted fur occurs.
(c) After a very cold winter, only those mice with thicker fur survived.
(d) A drought causes a food shortage for the mouse population.

11. Which of the following is **least** likely to be a significant avenue of water loss in terrestrial animals?

(a) Water loss from respiratory surfaces
(b) Evaporation from the skin
(c) Osmotic loss across the body surface
(d) Excretion of nitrogenous wastes

The next two questions refer to the diagram below, showing a cell in the early stages of mitosis.

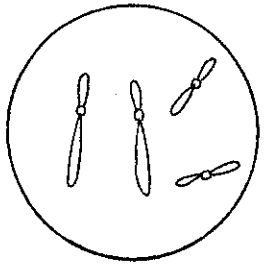


12. What is the diploid number of chromosomes in this species?

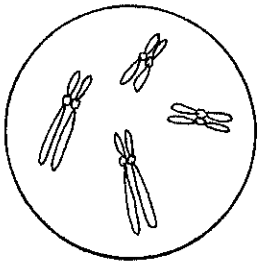
(a) 2
(b) 4
(c) 8
(d) 16

13. Which ONE of the following diagrams correctly represents the outcome of a mitotic division in cells of this species?

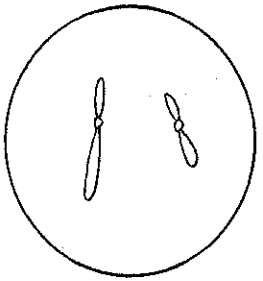
(a)



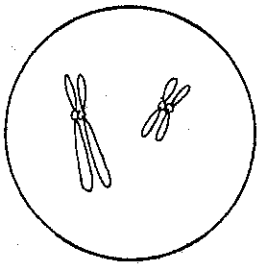
(b)



(c)

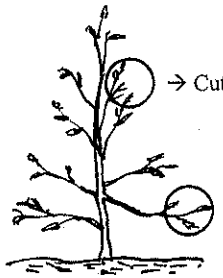


(d)



Questions 14 to 17 refer to the following information.

Most flowering plants can be reproduced asexually from cuttings. A study was conducted to compare cuttings made from upper, vertical stems of the parent plant with cuttings made from lower, horizontal stems of the same plant.



Observations were made on the plants that grew from these cuttings and these are summarized below.

Cutting Type	Survival Rate (%)	Average Plant Height (cm)	Average Plant Width (cm)
Upper, Vertical	68	18	6
Lower, Horizontal	65	7	14

14. What is the dependent variable in this experiment?

(a) The species of plant used
(b) The part of the plant from which cuttings were taken
(c) The shape of the plants that grew from the cutting
(d) The growth rate of the cuttings

15. Choose the most valid inference to be made from these results.

(a) Plants grown from upper cuttings are healthier than those grown from lower cuttings.
(b) Mutations occur more commonly in the lower stems.
(c) Cuttings taken from different parts of a single plant are genetically different.
(d) Cuttings taken from different parts of a single plant show different growth patterns.

16. It was later found that a certain chemical, when sprayed on all the plants, resulted in them growing equally tall. What type of chemical was this most likely to have been?

(a) An auxin
(b) An enzyme
(c) A mineral nutrient
(d) A carbohydrate

17. After the investigation the researcher made the following statement. "All plants possess a mechanism that controls the growth of various parts of the shoot system."

This statement is an example of which of the following?

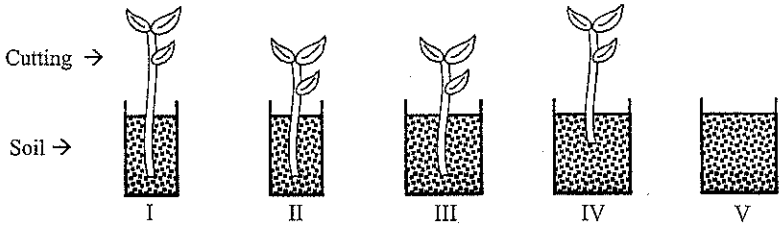
(a) A generalization
(b) A conclusion
(c) A theory
(d) A hypothesis

18. A flowering plant has a haploid chromosome number of 8. Which of the following statements about the plant is true?

(a) Its root cells contain 4 chromosomes
(b) Its egg cells contain 16 chromosomes
(c) Its leaf cells contain 32 chromosomes
(d) Its pollen cells contain 8 chromosomes

Questions 19 and 20 refer to the following information.

Five pots were set up with plant cuttings in soil mix. (Note: All diagrams are drawn to the same scale.)



19. Which two of the following pots would be most useful to test the hypothesis that "the deeper a cutting is planted the more likely it is going to grow into a new plant"?

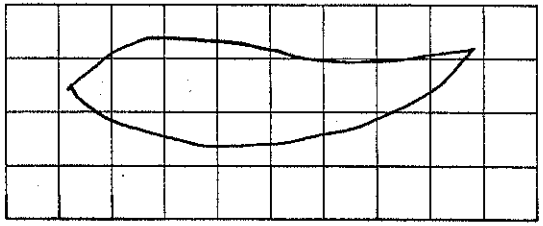
(a) Pots I and II
(b) Pots III and V
(c) Pots I and III
(d) Pots III and IV

20. Which of the following changes to the procedure used would be **least** likely to improve the reliability of the above investigation?

(a) Use the same species of plant in all five set-ups.
(b) Make several of each of the five types of set-up.
(c) Water the pots more often to promote growth.
(d) Repeat the experiment several times.

Questions 21 and 22 refer to the following information.

The diagram below shows a tracing of the outline of a eucalypt leaf on centimetre graph paper.



21. Which of the following would be the best estimate of the total surface area of the leaf?

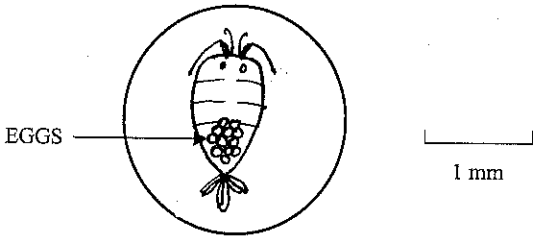
(a) 29 cm^2
(b) 15 cm^2
(c) 20 cm^2
(d) 10 cm^2

22. To measure the amount of water in this leaf which of the following procedures would be most useful?

(a) Measure the leaf's thickness and use this to calculate the volume of the leaf.
(b) Place the leaf in water overnight and measure how much it gains.
(c) Weigh the leaf, dry it in an oven overnight, then measure the weight lost in the drying process.
(d) Measure the weight lost over a one hour period and divide this into the total weight of the leaf.

Questions 23 and 24 refer to the following information.

The following diagram represents the view of a slide seen through a monocular microscope using a 5x ocular lens and a 8x objective lens. The scale on the right has been drawn to the same magnification.



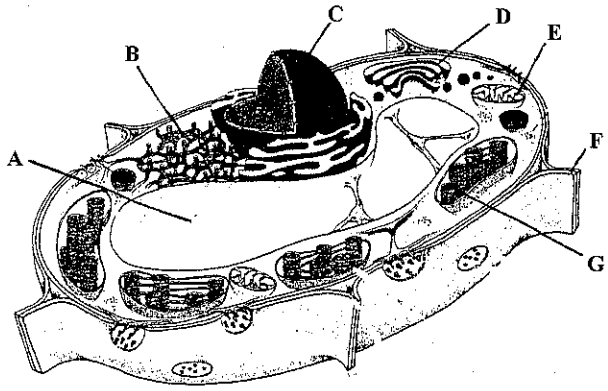
23. What is the best estimate of the length of one of the eggs seen in the body of the animal shown on the slide?

(a) 100 μm
(b) 10 μm
(c) 40 μm
(d) 400 μm

24. To observe the eggs in more detail the biologist changed both lenses to make the eggs appear 10 times larger still. Which combination of lenses would achieve this?

(a) A 10x ocular and a 10x objective
(b) A 10x ocular and a 40x objective
(c) A 15x ocular and a 25x objective
(d) A 15x ocular and a 40x objective

Questions 25, 26 and 27 refer to the following diagram of a plant cell.



25. Which of the labelled structures would be most likely found in an animal cell?

(a) A and B
(b) B and E
(c) C and G
(d) D and F

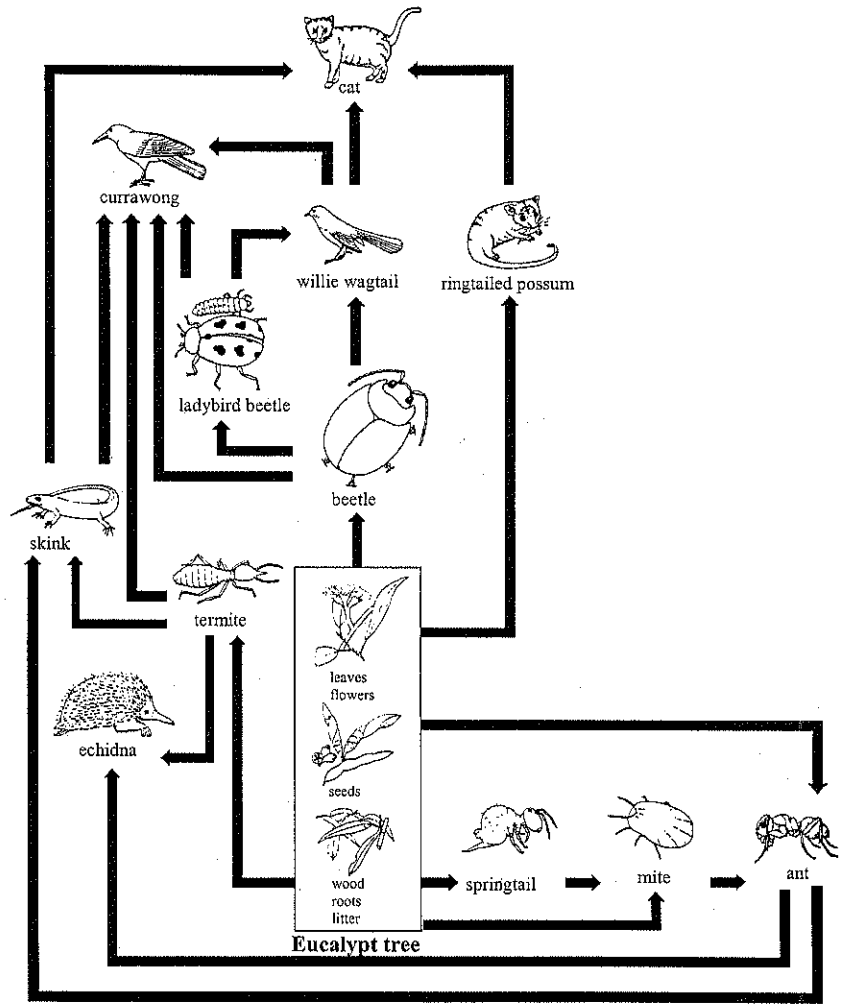
26. It is not known whether this cell has been taken from the root or from the shoot of the plant. Which structure would be most helpful in deciding this question?

(a) A
(b) D
(c) E
(d) G

27. Which of the following is **not** an important function of structure F in plants?

(a) It controls the movement of substances into and out of the cell.
(b) It prevents the cell from rupturing following the uptake of water.
(c) It provides structural rigidity to the plant as a whole.
(d) It assists in water movement from the roots to the shoot.

Questions 28, 29 and 30 refer to the following food web occurring in a woodland community in eastern Australia.



28. Which of the following animal species from the food web would have the lowest biomass in the community?

(a) Cat
(b) Mite
(c) Echidna
(d) Skink

29. Which of these organisms from the community is autotrophic?

(a) Mite
(b) Termite
(c) Currawong
(d) Eucalypt tree

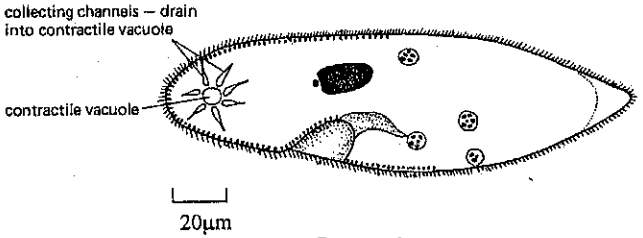
30. It is intended to introduce koalas to this community. They feed exclusively on eucalypt leaves. Which ONE of the following is a likely consequence of such an introduction?

(a) Numbers of currawongs would increase because they don't eat eucalypt leaves.
(b) Echidnas would eat more ants because there would be fewer termites.
(c) The total biomass of the community would be unaffected by the introduction of the koala.
(d) The introduction of the koalas would fail because ringtail possums are already established.

SECTION B (100 marks) (Suggested time: 90 minutes)

Attempt all questions in this section. Write answers in the spaces provided. Use black or blue ink or ball point pen.

31. *Paramecium* is a single-celled freshwater animal whose cytoplasm contains a structure known as a contractile vacuole. Over a period of time, the vacuole fills with pure water from the cytoplasm and then contracts, expelling the water from the cell.



Paramecium

In a study of contractile vacuole function, a biologist observed the frequency of vacuole contractions in a *Paramecium* bathed in salt solutions of various concentrations, and obtained the results below:

Concentration of NaCl (M)	Number of contractions per minute
0.00	6.5
0.01	6.2
0.02	6.0
0.03	5.7
0.04	5.5
0.05	4.9
0.10	4.4
0.15	3.9
0.20	1.2

(a) (i) By what means does water enter the cytoplasm of the *Paramecium*?

(ii) By what means does water enter the contractile vacuoles?

(iii) Single-celled animals living in the ocean do not possess contractile vacuoles. Explain why.

(4 marks)

(b) Explain why the frequency of contractions decreases as salt concentration increases.

(4 marks)

(c) The biologist found that the rate of contraction of the vacuole at any particular salt concentration could be decreased by reducing the concentration of dissolved oxygen in the water. Explain this finding.

(4 marks)

(d) In a further series of experiments, the biologist maintained a *Paramecium* in a bathing medium of constant salt concentration and oxygen content and varied the temperature of the medium. His results are shown below.

Temperature (^{O}C)	Number of contractions per minute
5	2.2
10	4.6
15	5.5
20	5.7
25	4.1
30	1.9

Suggest an explanation for these results.

(4 marks)

(e) List **two** other factors that would be likely to have an effect on the frequency of vacuole contractions in *Paramecium* and in each case explain the effect.

(4 marks)

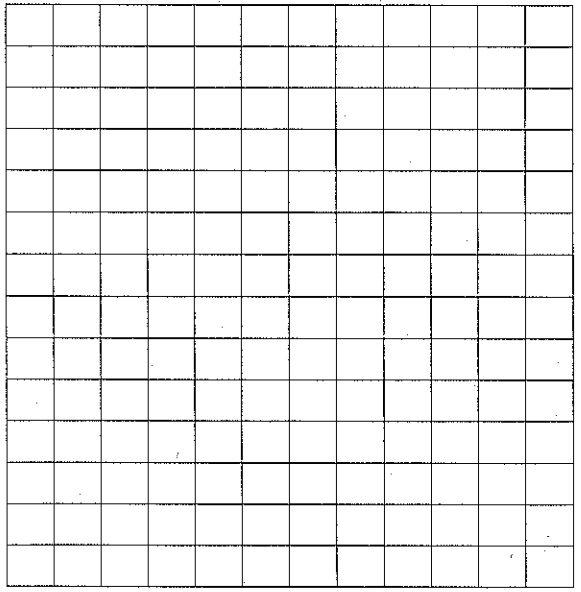
32. All reptiles are ectothermic. A biologist measured the body temperature of two different reptiles, a lizard and a turtle in a range of air temperatures over a 24 hour period. The results of the investigation are summarized in the table below.

	Temperature °C		
Time	Air	Lizard	Turtle
6 am	22	27	21
12 noon	34	30	32
6 pm	27	29	26
12 midnight	19	26	20
6 am	21	26	21

(a) Graph all these data on the single grid provided.

(4 marks)

(If you wish to have a second attempt at this item, the grid is repeated at the end of the examination booklet. Indicate clearly on this page if you have used the second grid and cancel the working on the grid on this page).



(b) For this investigation give the following.

(i) A hypothesis this investigation may be testing.

(ii) The dependent variable(s).

The independent variable(s)

(4 marks)

(c) Name **four** variables that would have to be controlled for the investigation to be reliable.

(4 marks)

(d) Describe what the graph tells us about the temperature regulating abilities of the two reptiles used in the investigation.

(4 marks)

(e) Which of the following predictions based on the above data would be more reliable:

The body temperature of the turtle at 30°C air temperature will be 30°C
or
The body temperature of the lizard at 14°C air temperature will be 26°C

Explain your answer.

(4 marks)

33. One of the biggest threats to urban and agricultural bushland areas is invasion by introduced plants, particularly grasses. This can be seen in comparable transect sketches made at different locations in a jarrah forest in South Western Australia.

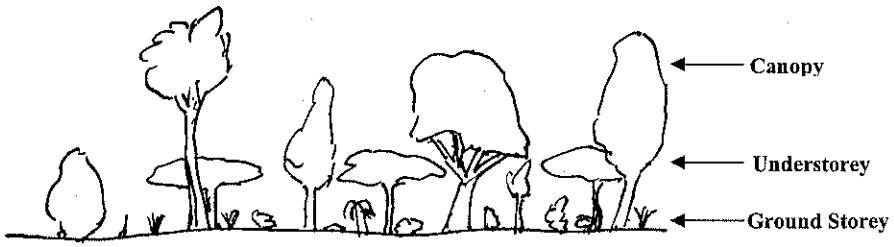


Figure 1 Location: 10 km from nearest farm, town or roadway.

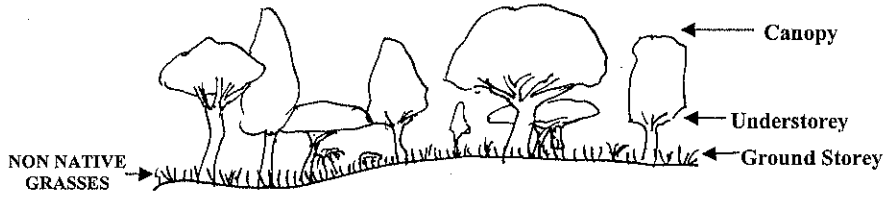


Figure 2 Location: adjacent to farming property and roadway.

(a) Name **four** ways that humans may have introduced non-native plants to bushland areas.

(4 marks)

(b) One of the most obvious ways that introduced grasses would affect native species is by competition. Name **four** things that the grasses and native plants would compete for.

(4 marks)

(c) The transect diagrams show three layers in the forest, the canopy, the understorey and the ground storey. Predict which layer would be most severely affected by competition from introduced grasses and give **two** reasons why.

(4 marks)

(d) Fire is a regular event in natural bushland. Significant grass cover in these areas can change the intensity of the fire and cause great long-term damage to the ecosystem.

(i) Describe one way in which fire can be beneficial to natural Australian bushland ecosystems.

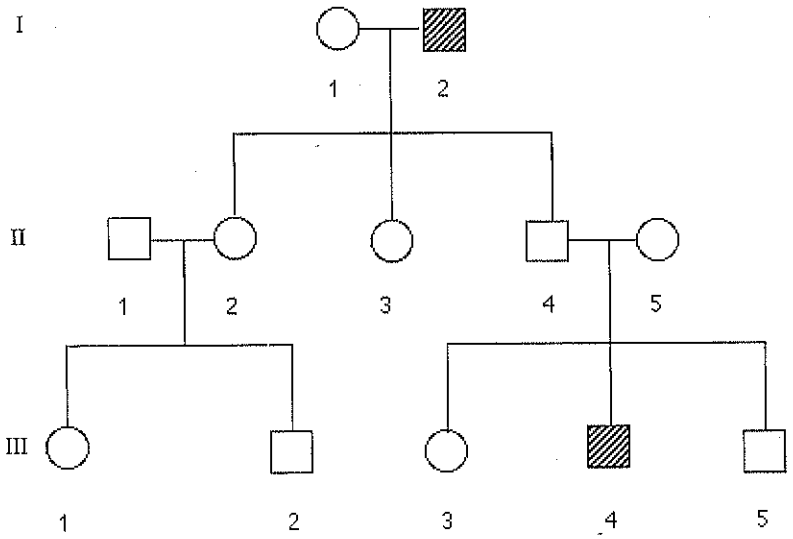
(ii) Describe one way in which a fire in a heavily grass infested area might be harmful to the ecosystem.

(4 marks)

(e) For some introduced species biological control has been used. Name one example of biological control used in Australia and state **three** important conditions that must be met in any biological control programme.

(4 marks)

34. The pedigree below shows the inheritance of a skin condition in cattle that is rare but not serious. It is inherited as an autosomal recessive. Individuals possessing the trait are shaded. Using the symbols D for the normal allele and d for the disease allele, answer the questions shown below, showing full working.



(a) Indicate whether the following statements are true or false and give a reason for your answer.

(i) Individual I 2 must have had one parent with the condition.

(ii) Individual III 3 has a 1 in 4 chance of being a carrier of the disease.

(4 marks)

(b) What is the probability that each of the following individuals is heterozygous for the characteristic? Show your working in each case.

(i) II 3

(ii) II 5

(4 marks)

(c) A breeder is keen to know if III 5 is a carrier for the characteristic. Explain how this could be determined, showing your working.

(4 marks)

(d) Individual II 2 is crossed with individual II 4.

(i) What is the probability that their first calf will be a normal-skinned male? Show your working.

SEE NEXT PAGE

(ii) What is the probability that their first calf will be a diseased female? Show your working.

(4 marks)

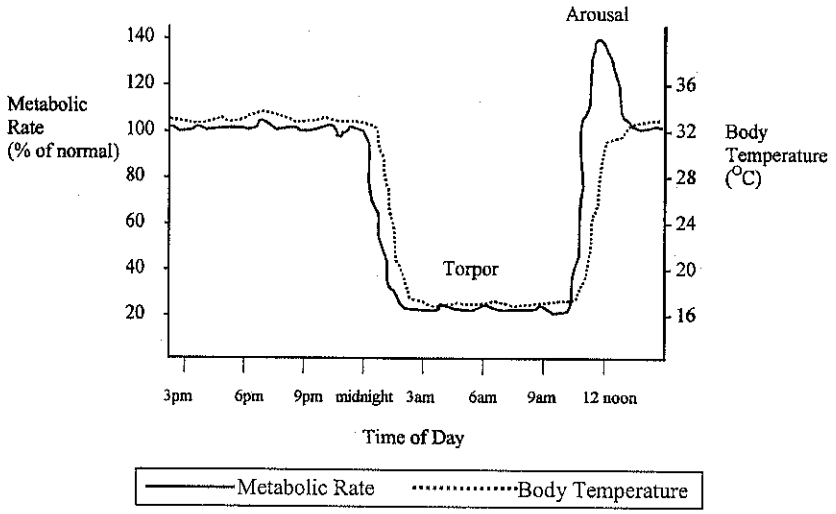
(e) A biology student who was unaware of the mode of inheritance of the skin disease examined the pedigree and concluded that the disease was inherited as a sex-linked recessive gene. On the basis of the pedigree alone, could this conclusion be correct? Explain your answer with full working.

(4 marks)

SEE NEXT PAGE

35. The fat-tailed dunnart is a mouse-sized carnivorous mammal that inhabits large areas of inland Australia. It has been discovered that, during winter, this animal undergoes daily **torpor**, a type of hibernation, during which the animal's metabolic rate and body temperature drop to very low levels for a number of hours.

The graph below shows the animal's metabolic rate and body temperature when kept at an air temperature of 9.0°C over a 24-hour period. At the end of the period of torpor is a brief period of arousal, following which the metabolic rate and body temperature return to normal.



(a) Give one advantage and one disadvantage of daily torpor as an adaptation to a cold environment.

Advantage

Disadvantage

(4 marks)

(b) Torpor and hibernation occur mainly in small birds and small mammals. Explain why larger birds and mammals are less likely to need this kind of strategy.

(4 marks)

(c) (i) Define the term **endothermic**.

(ii) Use evidence from the information provided above to explain why the dunnart is considered endothermic even during torpor.

(4 marks)

(d) During arousal, the dunnart's metabolic rate increases above normal levels. In terms of the stimulus – response – feedback model of temperature regulation, explain why its body temperature does not rise above normal levels.

(4 marks)

(e) Describe **two** other adaptations you might expect to find in the dunnart in response to low environmental temperatures.

(4 marks)

SECTION C **(40 marks)** Suggested time: 50 minutes

ANSWER SECTION C IN THE STANDARD ANSWER BOOK

Question 36 mainly tests your **knowledge** of syllabus content. Question 37 mainly tests **how you apply** your understanding of biological principles. There are four parts to each question. You must answer **two** parts from 36 and **two** parts from 37. Each part carries ten (10) marks.

Answers may be presented in different ways provided they communicate your ideas effectively. You may choose to:

- present a clearly labelled diagram;
- write notes beside a clear diagram;
- write lists of points, with sentences which link them;
- write concisely worded sentences;
- use some other appropriate way to present ideas.

Marks may be deducted for answers which are poorly presented or difficult to read. Use black or blue pen or ball point for written answers and pencil for diagrams.

Question 36

Answer any two questions from 36(a) to 36(d). (10 marks for each)

36(a) Name the principal nitrogenous waste product of each of the following animals:

Freshwater fish
Galah
Kangaroo

Relate the properties of the nitrogenous waste product to the environment of each animal.

36(b) Explain what is meant by the term biomass pyramid and use it to explain the flow of energy in an ecosystem.

36(c) Approximately 99% of all species that have ever existed are extinct, yet the diversity of life on earth has increased over time. What evidence indicates that the increase in the diversity of life on earth over time is the result of biological evolution?

36(d) Most genes in the body carry information about the structure of enzymes, highlighting the importance of enzymes to cellular function.

Describe the functions of enzymes in cells and explain why enzymes are so specific in their action.

Question 37

Answer any two questions from 37(a) to 37(d). (10 marks for each)

37(a) Over the next few decades several missions by spacecraft will look for evidence of life elsewhere in the solar system. Two places that will be explored by spacecraft landers are the planet Mars and Europa, a satellite of the planet Jupiter.

Mars is known to have a thin atmosphere of carbon dioxide and nitrogen. Although water vapour is present in the atmosphere and water ice is present in polar regions, there are no oceans, rivers or lakes. Temperatures on Mars vary from –128°C at the poles in winter to 37°C at the equator in summer. Scientists believe liquid water may be found somewhere beneath the surface of the planet.

Europa is much further from the sun. It has no atmosphere and its surface is covered mostly by ice several kilometres thick. There is good evidence that oceans of liquid water lie beneath the ice. The average surface temperature of Europa is – 180°C but it is thought that the oceans underneath are warmed by tidal forces and may have temperatures similar to those on Earth.

What particular difficulties would be faced by Earth-like organisms living on

(i) Mars, and
(ii) Europa?

In terms of the requirements of living organisms, explain why the conditions on Mars and Europa may be too hostile for life forms as we know them on Earth.

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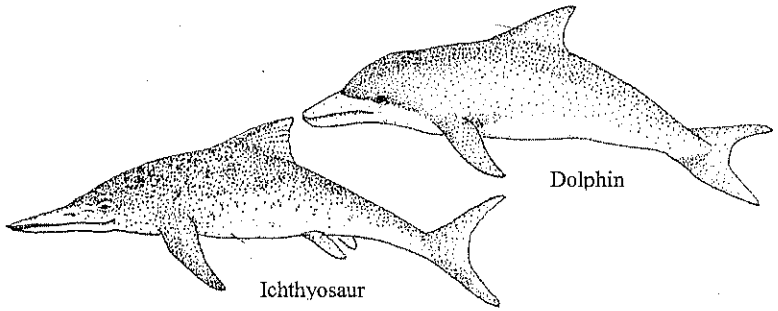
37(b) Ichthyosaurs are extinct marine animals that appear remarkably similar to a modern marine animal, the dolphin. However, ichthyosaurs were reptiles, related to snakes and lizards while dolphins are mammals related to dogs, cats and humans. Explain how two animals from such very different groups could have evolved to look so similar.



37(c) Australian governments are promoting and funding extensive reafforestation programmes (tree planting and re-establishment of vegetation). Describe some features such programmes should possess and explain the reason why reafforestation is important.

37(d) It is now known that the first cells appeared on Earth at least 3.5 billion years ago, only a few hundred million years after the Earth itself formed in the primitive solar system. The earliest forms of life were called 'protobionts' and fed on organic molecules existing in limited supply in the oceans.

Using your knowledge of the processes of photosynthesis, respiration and energy transfer in living systems, explain why it became necessary for the evolution of autotrophic cells before the earliest ecosystems could develop.

END OF PAPER

Check that you have written your Student Number on the front cover of this booklet

and on the Standard Answer Book(s).