

Structure of this paper

Section	Number of questions available	Number of questions to be attempted	Suggested working time (minutes)	Marks available
A Multiple choice	30	30	40	60 (30%)
B Short answers	5	5	90	100 (50%)
C Extended answers	2	2*	50	40 (20%)
Total marks				200 (100%)

* Each question in Section C consists of four optional parts, of which **two** should be attempted.

Instructions to candidates

- 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.
- 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. Do not answer this section in a Standard Answer Book. A blue or black ball point or ink pen should be used.

A blank answer page may be found at the end of this booklet. If you need to use it, indicate in the original answer space where the answer is continued (i.e. write "continued on page 31").

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. Do not answer this section in this Question/Answer Booklet. 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.

- 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 answer sheet for Section A will be collected separately by the Supervisor.

- Which of the following is an inference?
 - Commercial timber produced from older trees is denser than timber from young trees of the same species.
 - The outer layer of sapwood of a tree is often a different colour from the inside of the trunk.
 - Areas of forest that currently produce the best timber will remain the best areas for future timber production.
 - The timber of some species of tree is unsuitable for commercial use.
- A bird in a cold environment can reduce heat loss by which of the following processes?
 - Panting
 - Flying vigorously
 - Increasing its metabolic rate
 - Erecting its feathers
- You have a freshwater aquarium at home and have just purchased a new fish. To your dismay, the fish dies within a day of placing it in your tank. You later discover that it was a marine fish. Select the best explanation of the fish's death.
 - The fish gained too many salts by active transport across its gills.
 - The fish produced too much urine.
 - The fish gained too much water through its body surface.
 - The fish drank too much fresh water.

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4. Eastern coral snakes are brightly coloured, with red, yellow and black rings along their bodies. The snakes are poisonous and their bite kills many animals quickly. Predators rarely attack these snakes and those that do are usually killed. Which of the following is the most likely explanation of why the snakes are rarely attacked?

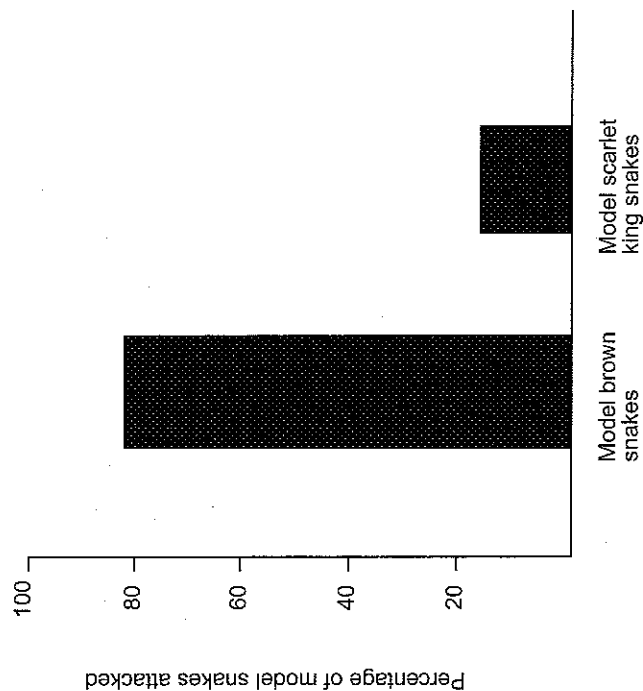
- (a) Only predators that avoid the snakes survive to breed.
- (b) Predators are bitten and learn to avoid the snakes.
- (c) The colourings camouflage the snakes.
- (d) The predators that survive the snake's bite pass on resistance to their offspring.

5. A non-poisonous snake called the scarlet king snake lives in the same habitat as the eastern coral snake. The two species have similar colours. A biologist reasoned that predators would not attack scarlet king snakes because they looked so much like the dangerous eastern coral snakes. Which of the following best defines this suggestion?

- (a) It is an observation.
- (b) It is an hypothesis.
- (c) It is a theory.
- (d) It is a conclusion.

Questions 6 and 7 relate to the following extra information.

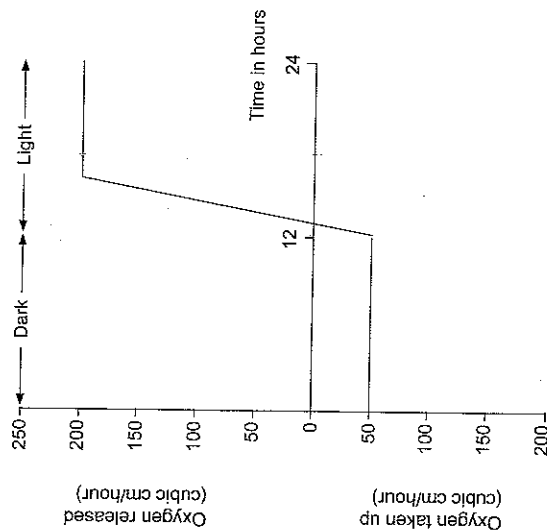
Biologists reasoned that if this suggestion was correct, then model snakes made from plastic and coloured like scarlet king snakes would not be attacked if they were placed in the habitat where eastern coral snakes occurred. However, model snakes that were identical in size and shape but were coloured brown should be attacked. The results of an experiment testing this reasoning are shown below.



6. What was the control in this experiment?
- (a) The real scarlet king snakes.
 - (b) The snakes that were not attacked.
 - (c) The eastern coral snakes in the habitat.
 - (d) The model brown snakes.
7. What was the dependent variable in the experiment?
- (a) The colour of the model snakes.
 - (b) The percentage of snakes attacked.
 - (c) The presence of eastern coral snakes.
 - (d) The number of model snakes used in the experiment.

Questions 8 and 9 relate to the following information.

Data were obtained relating to the rates of oxygen release and uptake in plants. The plants were placed for 12 hours in the dark followed by 12 hours in the light. Temperature was constant throughout the experiment. The results are shown in the graph.



8. Which one of the following is the most accurate estimate of the total volume of oxygen used by the plants for respiration during the 24 hours of the experiment?

(a) 50 cubic cm
(b) 600 cubic cm
(c) 1200 cubic cm
(d) 1800 cubic cm

9. What is the overall rate of oxygen production (cubic cm/hour) from photosynthesis at 20 hours?

(a) 250 cubic cm/hour
(b) 200 cubic cm/hour
(c) 150 cubic cm/hour
(d) 50 cubic cm/hour

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10. Joe and Bob are identical twin brothers. Joe married Sarah and Bob married Sarah's identical twin sister Maria. If both couples have a baby, which of these statements will be true?

(a) The babies will be genetically different because of the high probability of random mutation.
(b) The babies will be genetically different because of random segregation of chromosomes during meiosis.
(c) The babies will be genetically identical because both sets of parents are genetically identical.
(d) The babies will be genetically identical because they have come from identical gene pools.

11. The open ocean can be divided into an upper zone where primary productivity occurs and a lower zone where it does not. What is largely responsible for the difference?

(a) The upper zone is sufficiently warm for photosynthesis.
(b) The upper zone has sufficient light for photosynthesis.
(c) The lower zone has a high density of consumers that eat all the producers.
(d) The lower zone lacks producers and therefore nothing can live there.

12. What do mitosis and the second division of meiosis have in common?

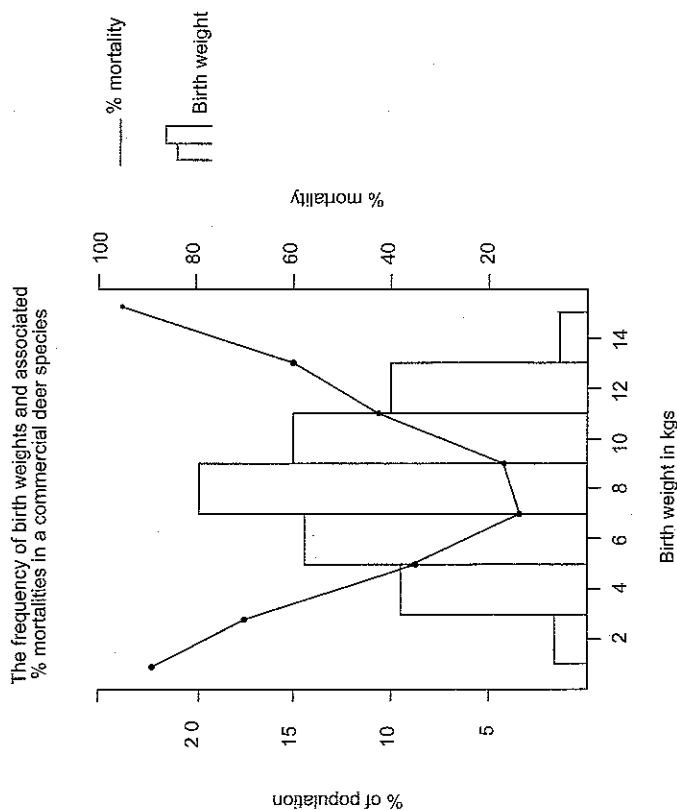
(a) Genetically identical chromatids pass to each pole.
(b) At some point both chromosomes of an homologous pair lie side by side.
(c) The chromatids separate.
(d) The chromosome number is reduced to haploid.

13. Red/green colour deficiency (colour blindness) in humans is determined by a sex-linked recessive allele carried on the X chromosome. A man with normal vision marries a woman with normal vision. They have a 'colour blind' son. All of his grandparents have normal vision. From which of his grandparents did the son inherit the allele for 'colour blindness'?

(a) Father's mother (paternal grandmother)
(b) Father's father (paternal grandfather)
(c) Mother's father (maternal grandfather)
(d) Mother's mother (maternal grandmother)

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Question 14 refers to the following information. The histogram represents the percentages of newborn young of a commercial deer species falling into various birth weight categories. The weights are shown on the horizontal axis and the percentage of the population in each weight category on the left-hand vertical axis. The line graph represents the percentage mortality within three days of birth in each of the weight categories. The percentage mortalities are shown on the right-hand vertical axis.



14. Which of the following statements is best supported by the graph?

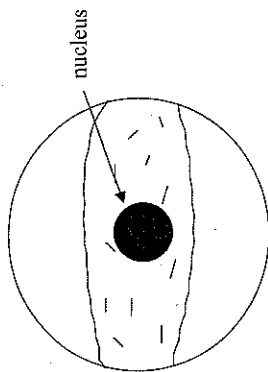
- (a) Birth weight depends on mortality.
- (b) Lighter new-borns are more likely to survive.
- (c) A newborn with a birth weight of 5.5kg is more likely to survive than one with a birth weight of 11.5kg.
- (d) Birth weight is the cause of mortality in newborns in this species.

15. Which of the following statements about water balance in mammals is INCORRECT?

- (a) All mammals obtain water from aerobic respiration.
- (b) All mammals obtain water from drinking.
- (c) All mammals lose water through evaporation.
- (d) All mammals lose water through urine.

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Questions 16 and 17 apply to the following diagram that shows part of an animal cell viewed under a microscope using a 10x ocular lens and a 40x objective lens.



16. The nucleus was measured to be 20µm in diameter. What was the field diameter for the diagram above?

- (a) 10µm
- (b) 50µm
- (c) 100µm
- (d) 200µm

17. Without changing anything else, the observer changed the revolving nosepiece of the microscope to a different magnification. This allowed the image of the entire cell to just fall within the field of view. The cell was then measured to be 200µm long. What was the magnification of the second objective used?

- (a) 5x
- (b) 10x
- (c) 20x
- (d) 80x

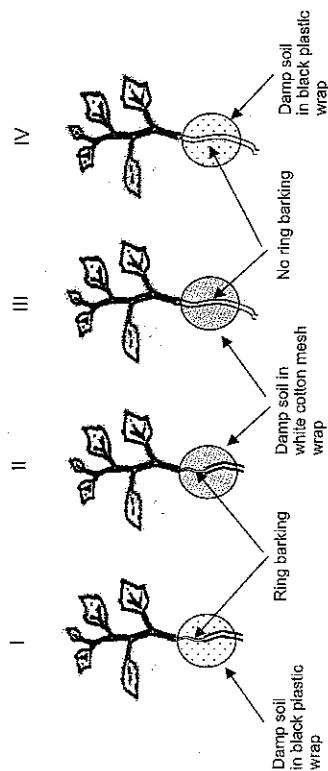
18. A common English dictionary defines biology as 'the study of living things'. To a biologist this definition is inadequate. What is the best reason for this?

- (a) Biologists also study many dead specimens.
- (b) Biologists also study the non-living environment.
- (c) Biologists also study the chemistry of living things.
- (d) Biologists also study non-living fossils.

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Questions 19 and 20 apply to the following diagram and information.

Aerial layering is a technique used in horticulture to reproduce plants asexually. A suitable shoot of a plant is partially wrapped in a soil medium in an effort to promote root formation. When this root formation occurs, the shoot is cut from the plant and carefully planted in a pot. A reference source claims that ring-barking the shoot (removing a section of its phloem right around the stem) will help roots form. A student set up four shoots as shown below.



19. Which of the pairs of shoots listed below would best test the claim that ring-barking the shoot will enhance root formation?

- (a) I and IV
- (b) I and II
- (c) II and IV
- (d) III and IV

20. What is the dependent variable in this investigation?

- (a) The temperature of the soil
- (b) The amount of water in the soil
- (c) Leaf formation
- (d) Root formation

21. Select the best explanation of how some bacteria are metabolically active in hot springs.
- (a) At high temperatures enzymes are not needed to catalyse chemical reactions.
 - (b) Their enzymes have high optimal temperatures.
 - (c) Their enzymes are insensitive to temperature.
 - (d) They use molecules other than proteins to catalyse chemical reactions.
22. A fishpond contained roughly equal numbers of orange goldfish and white goldfish. To investigate how the fish colours were inherited, the owner put 20 white fish in a separate pond and allowed them to breed. Which of the following results would indicate that white colour is inherited as a recessive, autosomal allele?
- (a) Approximately 75% the offspring are white.
 - (b) Approximately 25% of the offspring are white.
 - (c) All of the offspring are orange but they will produce some white offspring when they mature and breed.
 - (d) All the offspring are white.
23. Some scientists are concerned that the effects of greenhouse gases may be worse than we think. Which of the following would help to reduce or mask the measurable effects of greenhouse gases?
- (a) Smog and haze in the atmosphere reduce the amount of solar radiation reaching the Earth's surface.
 - (b) The clearing and burning of forests adds more carbon dioxide to the atmosphere.
 - (c) Birth rates of humans are falling in most countries.
 - (d) Use of renewable energy sources is increasing.

Questions 24–26 relate to the following information.

A zookeeper is rearing four different carnivores that share the same meat diet. Information on the body weight and individual energy expenditure of each carnivore is shown in the table below. The zookeeper has enough food available to support 10 individuals of Carnivore 1 for one year.

Carnivore	Body weight (kg)	Individual energy expenditure (kJ/year)	Energy expenditure per unit mass (kJ/kg/day)
1	60	3,400,000	155
2	45	700,000	42
3	4	1,400,000	960
4	0.025	17,000	1,860

24. Approximately how many individuals of Carnivore 4 could be kept for a year on the same amount of food?

- (a) 20,000
- (b) 2,000
- (c) 200
- (d) 20

25. What is the main reason why Carnivore 4 has the highest energy expenditure per unit mass (kJ/kg/day)?

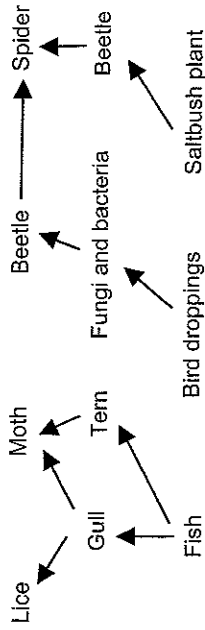
- (a) Small animals have a high surface area to volume ratio.
- (b) Small animals have less efficient cell metabolism.
- (c) Small animals move further in relation to size when feeding.
- (d) Small animals are all endothermic.

26. Which carnivore is most likely to be ectothermic?

- (a) Carnivore 1
- (b) Carnivore 2
- (c) Carnivore 3
- (d) Carnivore 4

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Question 27 relates to the following diagram showing parts of a food web for a community living on or near an island off the coast of Western Australia.



27. Which of the following statements about this community is true?

- (a) The biomass of the spider species is less than the total biomass of the two beetle species.
- (b) The seabirds are producers in this community.
- (c) Saltbush plants provide the total solar energy input for the community.
- (d) Lice are first-order consumers.

28. Which of the following statements is true of natural ecosystems?

- (a) Energy recycles through natural ecosystems.
- (b) Nutrients flow through natural ecosystems.
- (c) Natural ecosystems include living and non-living components.
- (d) There is no heat energy loss from natural ecosystems.

29. Records kept for hundreds of years show that for every 100 human females born there are 101 males born. This difference is very small but it is considered to be significant and reliable. Which of the following contributes to the reliability of the finding?

- (a) The sample size of the investigation is very large.
- (b) It is easy to sample the human population.
- (c) Humans occur on most land areas of the world.
- (d) Investigations done on humans are more reliable than those done on other species.

30. Use your understanding of food pyramids and biomass in balanced natural ecosystems to select the correct statement from the following.

- (a) Because producers have the highest biomass it is unlikely that any individual plant species will be rare.
- (b) Third order consumers will always be fewer in numbers than second order consumers.
- (c) The higher the trophic level of a species the smaller the organism.
- (d) The number of organisms of a particular species depends on many factors, not just its position in the food web.

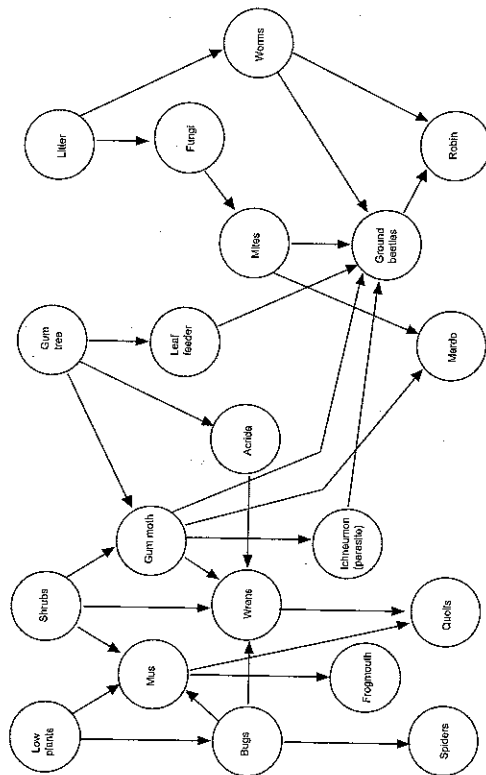
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SECTION B (100 marks)

Attempt all questions in this section. Write answers in the spaces provided. Use black or blue ink or ball point pen. Do not continue or rewrite any Section B answers in the separate Section C answer booklet.

Suggested time: 90 minutes

31. The following diagram shows a food web occurring in a eucalypt woodland in Australia.



(a) Is *Acrida* a plant or an animal? Using information from the food web, explain your answer.

(4 marks)

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(b) Which species, robin or ground beetles, will have the greatest biomass? Explain your answer by reference to the food web.

(4 marks)

(c) Indicate whether each of the following statements about the food web is **TRUE** or **FALSE**. Give a reason for each answer.

(i) Energy is constantly lost from the food web.

(ii) Some of the biomass in the ground beetles may eventually be found in the bodies of spiders.

(4 marks)

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- (d) In some links in the food web, dozens, even hundreds, of species are grouped as one (e.g. mites). Give two reasons why this has been done.

(4 marks)

- (e) The gum trees in the community were sprayed with insecticide to reduce damage caused by gum moths. The insecticide is not harmful to vertebrate animals at the rate it was sprayed. There were no immediate impacts on other species, but after three months the frogmouths and quolls began to die. What might be causing their deaths?

(4 marks)

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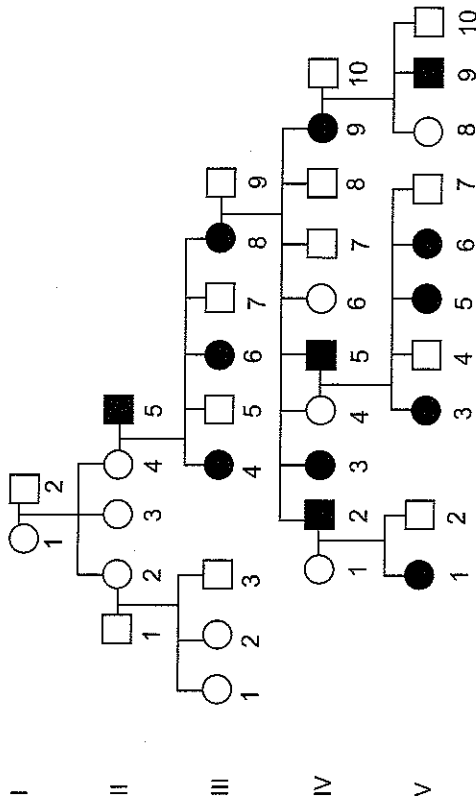
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32. Most examples of sex-linked characteristics on the X chromosome used in textbooks are recessive. However, sex-linked characteristics on the X chromosome can also be dominant. The pedigree below shows the pattern of inheritance of an extremely rare coat colour in a small African rodent being promoted as a pet. It is inherited as a sex-linked dominant condition on the X chromosome.

Using the symbols 'A' for the dominant allele and 'a' for the recessive allele, answer the questions below.



- (a) Indicate the possible genotype(s) of the following individuals. Remember to use the symbols 'A' for the dominant allele and 'a' for the recessive allele.

I 1 _____

III 5 _____

III 8 _____

IV 5 _____

(4 marks)

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- (b) A breeder crosses V1 and V9 and their first offspring is an affected male. What is the probability that their second offspring will also be an affected male? Show your working.

(4 marks)

- (c) Breeders are keen to develop a pure-breeding line of rodents with this characteristic. Are they likely to succeed? Explain your answer.

(4 marks)

- (d) An astute breeder concluded correctly that the pedigree could also be explained if the characteristic was inherited by an autosomal recessive gene. Suggest a cross that could be set up using animals from the pedigree to show conclusively whether or not the characteristic is inherited by an autosomal recessive gene or a sex-linked dominant gene. Show your working.

(4 marks)

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- (e) It is difficult to tell males from females in the newborn young of this species. It would be advantageous to breed from parents whose genotypes produce male offspring of one colour and female offspring of another colour. What genotypes should the parents be to achieve this? Show your working.

(4 marks)

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33. Trays of 100 seedlings of a species of *Eucalyptus* (gum tree) were watered with various concentrations of salt water. The percentages of the seedlings that survived in each tray are recorded in the table below.

Tray Number	Concentration of Salt (g NaCl /L)	Percentage of Seedlings Surviving (%)
1	0	96
2	5	91
3	10	45
4	15	25
5	20	2
6	25	0

- (a) For this experiment, name the following:

- (i) The dependent variable _____
(ii) The independent variable _____
(iii) What is the control for this experiment? Give a reason for your answer.

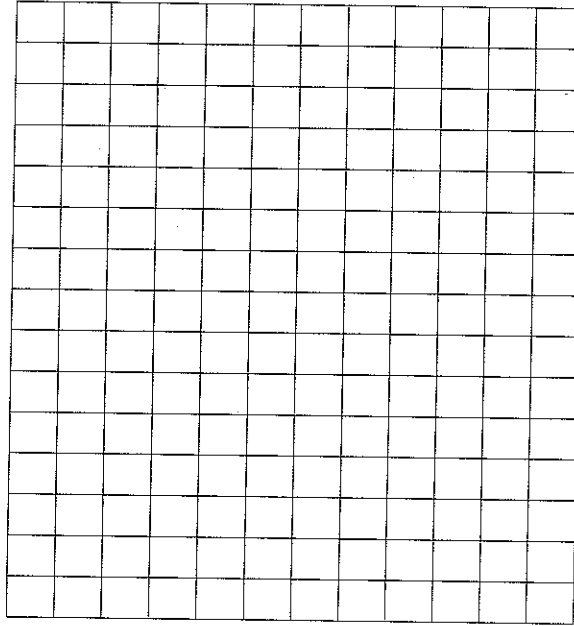
- (b) Name four variables that the biologist would need to control in this experiment.

(4 marks)

The surviving seedlings from Tray 5 were grown to maturity and allowed to produce seeds. In another experiment, seedlings from these seeds were treated in exactly the same way as in the original experiment. The results are recorded below.

Tray Number	Concentration of Salt (g NaCl /L)	Percentage of Seedlings Surviving (%)
1	0	94
2	5	88
3	10	45
4	15	35
5	20	25
6	25	12

- (c) Plot a graph of both sets of data for the two experiments on the grid provided below. (If you wish to have a second attempt at this item, the grid is repeated at the end of this examination booklet. Indicate clearly on this page if you have used the second grid and cancel the working on the grid on this page).



(4 marks)

- (d) State a likely hypothesis for this whole investigation.

(4 marks)

- (e) (i) Compare and explain the survival rates of seedlings in Trays 1 and 2 in the first and second stages of this investigation.

- (ii) Compare and explain the survival rates of seedlings in Trays 5 and 6 in the first and second stages of this investigation.

(4 marks)

34. Scientists have recently discovered that people who spend more time in 'deep sleep' at night have a different allele of the gene for the production of the enzyme adenosine deaminase. They have called this allele the 'slumber gene'. Adenosine builds up in the brain during the day as a product of the breakdown of ATP, ADP and other molecules involved in providing energy for cellular processes. During deep sleep, adenosine in the brain is broken down by adenosine deaminase. The enzyme produced by the slumber gene is less efficient than the normal enzyme and occurs in about 10% of the general population.

- (a) Provide an hypothesis to explain the variation in deep sleep amongst individuals that incorporates the function of adenosine deaminase.

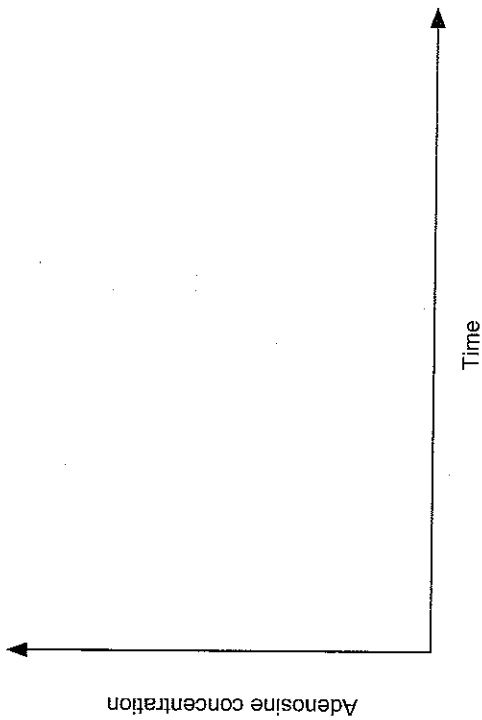
(4 marks)

- (b) (i) Give two characteristics of all enzymes.

- (ii) In the case of the 'slumber gene', what is meant by the efficiency of enzyme action?

(4 marks)

- (c) This part of the question refers to the axes below.



- (i) From the information provided on the efficiency of the two enzymes, sketch the relationship between adenosine concentration and time for each enzyme. Include a key (legend).
- (ii) Name one assumption that must be made for the comparison to be valid.

(4 marks)

- (d) (i) In terms of DNA structure, explain what is meant by different alleles of a gene.

- (ii) How could the enzymes produced by two different alleles of the same gene be different in efficiency?

(4 marks)

- (e) Adenosine deaminase removes a breakdown product of ATP.

- (i) Name two specific cellular processes requiring ATP.

- (ii) Predict, with an explanation, how deep sleep time might be affected the night after a person has studied 12 hours for an examination.

(4 marks)

35. Small endotherms living in extremely cold or hot environments tend to spend a considerable amount of time in burrows or nests. During this time their body temperature is very similar to burrow temperature and their heart rate and rate of activity fall. This state is called torpor.

(a) (i) Give a definition of endothermy.

(ii) Name an adaptation for minimising heat loss in endothermic animals other than living in burrows and explain how it works.

(4 marks)

(b) (i) Explain one advantage of endothermy in a cold environment.

(ii) Explain one advantage of ectothermy in a hot environment.

(4 marks)

(c) (i) Explain one advantage of torpor in a cold environment.

(ii) Explain one advantage of torpor in a hot environment.

(4 marks)

(d) (i) Give one reason why the concept of torpor is not applied to reptiles.

(ii) Give two reasons why large endotherms do not enter torpor.

(4 marks)

(e) Explain two disadvantages of using torpor as a strategy in extreme temperature environments.

(4 marks)

ANSWER SECTION C IN THE STANDARD ANSWER BOOK

SECTION C consists of two questions, 36 and 37. There are four parts to each question. You must answer **two** parts from Question 36 and **two** parts from Question 37. Each part carries ten (10) marks.

Question 36 mainly tests your **knowledge** of syllabus content. Question 37 mainly tests **how** you **apply** your understanding of biological principles.

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 that are poorly presented or difficult to read. Use black or blue pen or ballpoint 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) Describe the structure and function of the plasma membrane. Compare and contrast passive transport and active transport by which substances move across the plasma membrane.
- 36(b) Describe the stimulus-response-negative feedback model, using a named, non-human example.
- 36(c) Contrast the effects of sexual and asexual reproduction on heritable variation in species and relate these effects to survival in both changing and stable environments.
- 36(d) What direct and indirect effects might increasing human populations have on natural ecosystems? In what ways can these effects be lessened?

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Question 37

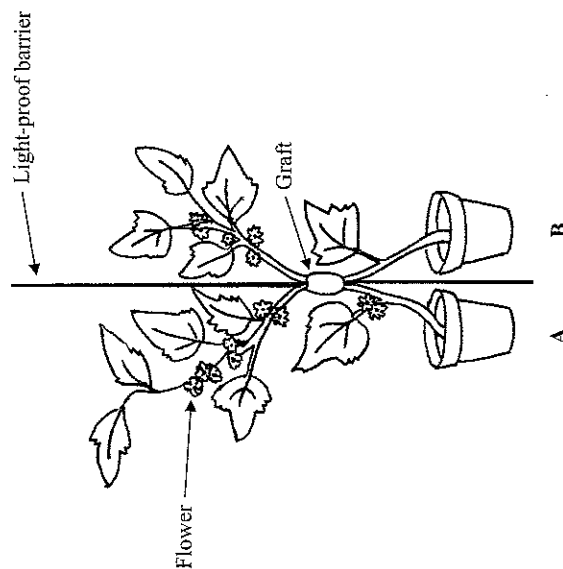
Answer any two questions from 37(a) to 37(d). (10 marks for each)

- 37(a) Photosynthesis is not the only form of primary production. Some single-celled organisms produce organic molecules from carbon dioxide using energy stored in molecules such as hydrogen sulphide (H_2S). This is called chemosynthesis. A word equation for chemosynthesis is:

Carbon dioxide + water + oxygen + hydrogen sulphide \rightarrow organic compounds + sulphuric acid

Compare and contrast chemosynthesis and photosynthesis, focusing on (i) the raw materials, (ii) the source of energy transferred to carbon products, and (iii) the ecological implications of the two forms of production of organic molecules from carbon dioxide.

- 37(b) Cocklespurs are short day plants. This means that they develop flowers when the daily hours of sunlight are short (as occurs in winter). The diagram below shows two cocklespur plants (A and B) that are connected by a graft. The graft joins the transport systems of both plants. Apart from the graft, both plants are totally separated by a light-proof barrier. Plant A was exposed to short day lengths to encourage flowering while Plant B was exposed to long day lengths, which should discourage flowering. Shortly afterwards both plants flowered.



- (i) Explain why both plants flowered.
- (ii) How could this knowledge be applied in a commercial flower farm?

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37(c) Myxomatosis is a viral disease of rabbits that is transmitted by the bites of mosquitoes or rabbit fleas. It was introduced into Australia in 1950 to control introduced rabbits and within two years reduced the rabbit population from 600 million to 100 million. However, genetic resistance in some rabbits was noticed soon afterwards and there is evidence that the virus also became less deadly compared to the original strain released. From your understanding of natural selection, explain:

- (i) How did the rabbit population become resistant?
- (ii) How did the virus become less deadly?

37(d) Conservation of biodiversity in our ecosystems is a very high priority for biologists and governments around the world. However, not all organisms enjoy the same level of protection. Poison baits for rats and mice are sold in every supermarket but the community is horrified when whales are killed.

Use named examples to illustrate the biological factors that should be considered when deciding the level of protection that should be given to various species.

Use the grid below to answer question 35(a) if you have cancelled your first attempt.

A full-page sheet of white graph paper featuring a uniform grid of thin black lines. The grid consists of 20 columns and 20 rows, creating a total of 400 small squares. The lines are evenly spaced and extend across the entire page, leaving a small margin at the top and bottom.

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).