

WESTERN AUSTRALIA

TERTIARY ADMISSIONS EXAMINATION,

1979

BIOLOGY

Please place one  
of your Candidate Identification labels  
in this box

CANDIDATE'S NUMBER:

In figures

In words

TIME ALLOWED FOR THIS PAPER:

Reading time before commencing: Ten minutes.

For working paper: Three hours.

MATERIAL TO BE PROVIDED FOR THIS PAPER:

Question paper comprising 41 pages and 47 questions.

One piece of blank paper for rough work.

INSTRUCTIONS TO CANDIDATES: See page 2 of this question paper.

FOR EXAMINER'S USE ONLY							
Section	Question Number	First Mark	Second Mark	Section	Question Number	First Mark	Second Mark
A	1 - 40			C	46 a		
	41				46 b		
	42				46 c		
B	43				47 a		
	44				47 b		
	45				47 c		
	Sub-total B				Sub-total C		

	First Mark	Second Mark
Final Total		

INSTRUCTIONS TO CANDIDATES ARE CONTINUED ON PAGE 2

## INSTRUCTIONS TO CANDIDATES:

Marks will be allocated as follows: SECTION A - 40 marks  
SECTION B - 36 marks  
SECTION C - 24 marks

Write your number on the front of this question paper.

The answer sheet for Section A is on page 41 which is folded into the back of this paper.

Write your number in the box at the top of page 41 before answering Section A. Attempt ALL questions in this section. Marks are NOT deducted for wrong answers.

When you have completed the Section A answer sheet, fold it back inside the question book. DO NOT tear out this sheet.

Answer Sections B and C in the places provided in the question paper.

You are provided with a piece of blank paper for rough work.

You MUST NOT take this question paper away from the examination room.

SEE PAGE 3

## SECTION A

Suggested time: 60 minutes (40 marks)

Record each answer for questions 1-40 by marking your choice of alternatives on the answer sheet (page 41). For example, if your choice is 3, show it as follows:

1	2	3	4	5
---	---	---	---	---

An error in recording your choice may be cancelled by completely blocking out the error as shown in 5 above.

Give ONE answer to each of questions 1-40. Marks will not be subtracted for wrong answers.

1. *Canis lupus* is the scientific name for the wolf, a member of the Canidae. Canidae would therefore be the name for which of the following levels of classification?

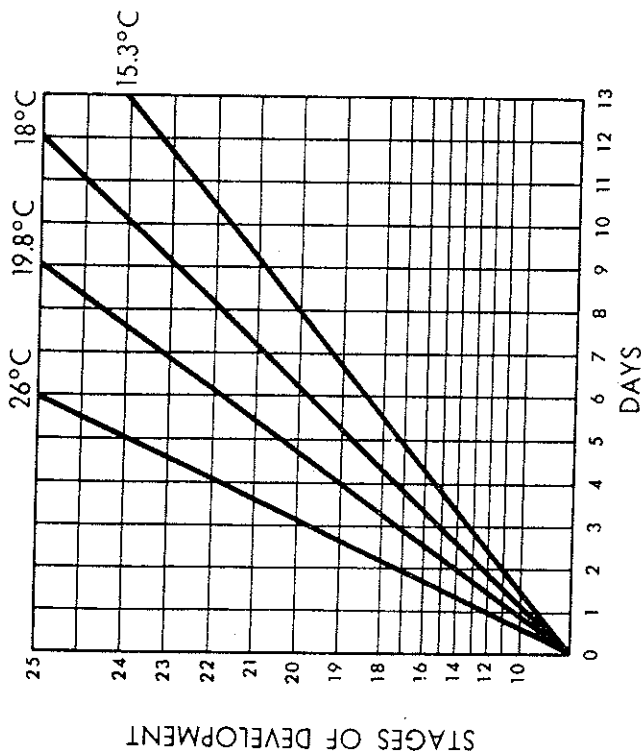
1. Phylum
2. Family
3. Class
4. Species
5. Genus.

2. Compounds within a mature human red blood cell would NOT include

1. chromosomal DNA
2. haemoglobin
3. water
4. ATP.

SEE PAGE 4

Questions 3, 4 and 5 are based on the following graph showing the data collected from an experiment on frog embryology in which four groups of *Rana pipiens* eggs were allowed to develop at four different constant temperatures.



Use the following key to answer questions 3, 4 and 5.

- A. A reasonable conclusion
- B. Statement contrary to data
- C. Insufficient evidence to warrant such a conclusion
- D. Not a conclusion but a restatement of data.

3. Temperatures above 26°C are lethal to developing *Rana pipiens* embryos.

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

SEE PAGE 5

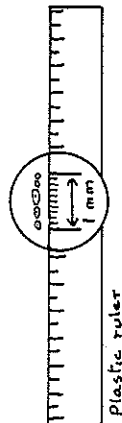
4. Increased temperatures are associated with an increase in the rate of development of *Rana pipiens* embryos.

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

5. The rate of development of *Rana pipiens* embryos varies inversely with the temperature.

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

Questions 6 and 7 refer to the following diagram which shows a clear plastic ruler placed across the field of a microscope. A row of cells can be seen.



6. What is the average length of a cell in millimeters?

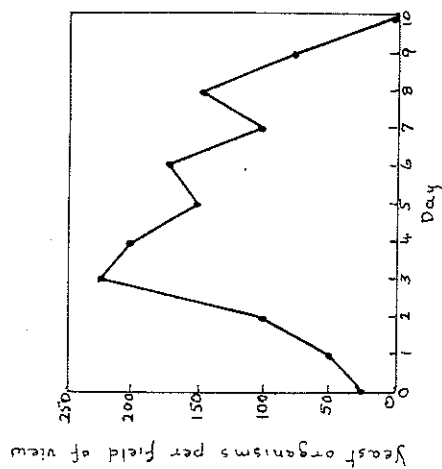
- 1. 1.0mm
- 2. 0.1mm
- 3. 0.2mm
- 4. 0.5mm.

7. What is the average length of a cell in microns?

- 1. 1 micron
- 2. 100 microns
- 3. 200 microns
- 4. 2000 microns.

SEE PAGE 6

Questions 8 and 9 refer to the following graph giving information about daily cell counts made from a culture of yeast incubated at 22°C.



8. Before taking a sample for each count the tube containing the yeast must be shaken vigorously to

1. break off the yeast buds
2. see the individuals
3. obtain an even distribution of yeast
4. concentrate the maximum number of individuals in the pipette.

9. The reason for the decline in population numbers might be

1. a rise in temperature to a lethal level due to the release of energy in the process of anaerobic respiration
2. a rise in toxic wastes and exhaustion of food supply
3. that the natural life span of a yeast cell is 12 days
4. because it had reached its limit of growth.

10. A characteristic which mammals, birds, reptiles, amphibians and fish all have in common is

1. scaly skin
2. a hollow dorsal nerve cord
3. a three-chambered heart
4. a tail.

11. Bacteria were placed in nutrient agar and poured on to a sterile plate. Colonies were found on the plate several days later. What does each colony represent?

1. a population produced by a single bacterium
2. a group of bacteria which collected together during the pouring of the plate
3. a single bacterium
4. a group of viruses
5. fungal hyphae.

12. As a plant community becomes more complex, the animal population associated with it will

1. increase in number
2. remain the same in variety
3. increase in variety
4. decrease in variety.

13. During scientific experiments cultures of cells are always maintained in sterile conditions because

1. bacterial contamination would result in death of the cells
2. contaminants would use some of the nutrients
3. fungal contaminants inhibit bacterial growth
4. contamination introduces an additional variable.

Questions 14 and 15 refer to the following information:

Data were collected on the concentration of certain substances within an algal cell, in sea water and in brackish water. The results are tabulated below in arbitrary units.

Substance	Within the cell	In sea water	In brackish water
Calcium	1.7	12.0	1.7
Magnesium	0.005	57.0	6.5
Sodium	90.0	500.0	60.0
Potassium	480.0 - 500.0	12.0	1.4
Chlorine	500.0 - 600.0	520.0	73.0
Sulphate	0.01	36.0	2.8

14. Which substance enters or leaves the cell in both sea water and brackish water by osmosis?

1. Calcium
2. Chlorine
3. Water
4. Sodium.

15. Which substance is actively transported out of the cell in both sea water and brackish water?

1. Calcium
2. Chlorine
3. Sulphate
4. Water.

16. Stomata open in the morning light because the

1. plant wants to get rid of water
2. plant needs carbon dioxide
3. guard cells are turgid
4. guard cells are not turgid
5. plant only 'breathes' at night.

SEE PAGE 9

17. During photosynthesis

1. oxygen and simple sugar combine to form carbon dioxide and water
2. simple sugar oxidizes and releases energy
3. water and carbon dioxide combine to form fats and proteins
4. water and chlorophyll combine to form simple sugar
5. water and carbon dioxide combine to form simple sugar and oxygen.

18. The term 'selectively permeable' is used to describe which of the following parts or constituents of a typical living cell?

1. Nucleus
2. Cytoplasm
3. Centromere
4. Cell membrane
5. Chromosome.

19. At some point in the life cycle of organisms which reproduce sexually, the diploid number of chromosomes must be reduced to the haploid number because

1. mutations can alter the number of chromosomes in body cells
2. mitosis cannot take place without the occurrence of such a reduction
3. the sperm cell must have the same number of chromosomes as the egg cell
4. all body cells must have the same number of chromosomes
5. the chromosome number would otherwise double in each generation.

20. Which of the following foods needs to be digested?

1. Salt
2. Water
3. Protein
4. Glucose.

SEE PAGE 10

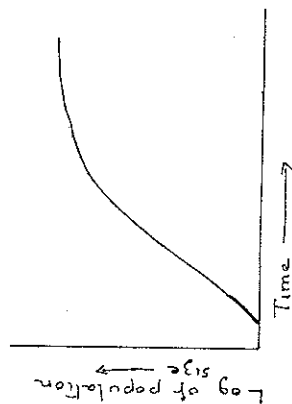
21. Which of the following is the best description of what is meant by basal metabolic rate?
1. The daily calorie output of a person exercising lightly and subsisting on the minimum diet needed to maintain life
  2. The oxidation rate in an active individual going about his daily routine and maintaining normal weight
  3. The ratio of oxygen intake to carbon dioxide output in unspecialised organisms
  4. The oxidation rate which will just maintain the life processes of a person in a state of rest
  5. The amount of heat required to raise the temperature of one kilogram of water through one degree Celsius.
22. The water in a fish tank is maintained at a constant temperature of 22°C and a pH of 6.5. The term pH 6.5 means that the
1. water is maintained at a basic level
  2. hydrogen content of the water is constant
  3. pH is controlled by temperature
  4. water is slightly acidic.
23. In nature a group of similar organisms which can interbreed is called
1. a biotic community
  2. an ecosystem
  3. a species
  4. an environmental unit.
24. Of the factors listed below, which remains most constant in a normal adult human from day to day?
1. Blood concentration of the hormones controlling urine production
  2. Urine output
  3. Fluid intake
  4. Volume of fluid within the cells.

SEE PAGE 11

25. In most cases the biological control of introduced insect pests involves
1. extensive use of insecticides to kill the pests before they can reproduce
  2. the introduction of natural predators from the country of origin of the pest
  3. the rearing and releasing of large numbers of sterile males of the pest species
  4. the collection of pest insects and selection of less harmful mutant strains.
26. Evolution
1. is the cause of variation within natural populations
  2. is the gradual change in the characteristics of a population
  3. causes mutations which are of adaptive value
  4. gives rise to natural selection.
27. Refrigerated food can be kept in edible condition for several weeks because
1. low temperatures kill most bacteria and moulds
  2. access to a refrigerator is difficult for spores
  3. growth of bacteria and fungi is very slow at low temperatures
  4. bacteria and fungi cannot reproduce at low temperatures.
28. The greatest concentration of life in the sea, both in number of individuals per unit volume and in number of species, tends to be in
1. surface waters of the open ocean
  2. the sea bed below the continental shelf
  3. intermediate depths of the ocean
  4. coastal shallows.
29. Body water loss is minimised by birds and reptiles by the conversion of their nitrogenous wastes to an almost insoluble form before passing it from the body. This substance is
1. urea
  2. excreta
  3. ammonia
  4. uric acid
  5. faeces.

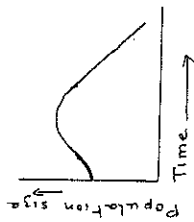
SEE PAGE 12

Questions 30 and 31 are based on the following graph in which the logarithm of the size of a population of mice has been plotted against time.

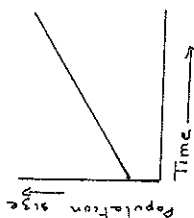


30. Which of the following graphs shows the relationship of the actual population size with time?

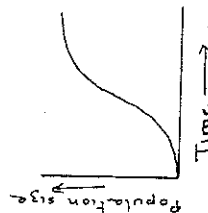
1. Graph A



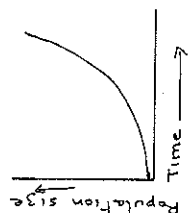
2. Graph B



3. Graph C



4. Graph D



SEE PAGE 13

31. Which of the graphs A-D in question 30 represents the situation in which birth rate is constant, all other determiners of density being zero?

1. Graph A
2. Graph B
3. Graph C
4. Graph D.

32. In which of the following organisms would offspring show the greatest genetic variation from the adult organism?

1. A budding *Hydra*
2. An inbred population of laboratory mice
3. Grey kangaroos in south-west Australia
4. A self-pollinated plant.

33. In which of the following tissues would you expect mitosis to occur most frequently?

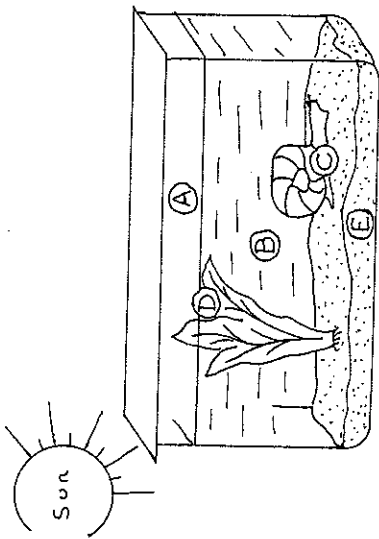
1. Xylem vessels
2. Adult human muscle
3. Epidermal cells of a leaf
4. Plant root tip
5. Insect cuticle.

34. The fact that cockroaches present in the Carboniferous were almost identical to those living today suggests that

1. the climate during Carboniferous times was more humid than it is today
2. cockroaches were so abundant during Carboniferous times that they have continued to exist
3. cockroaches are the ancestors of all other insect types
4. the niche (way of life) occupied by the cockroach has not been filled by a more successful organism.

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Questions 35-38 refer to the chemical and biological relationships which take place inside a sealed aquarium such as the one shown below.



In this aquarium, A represents the air above the water, B is the water, C represents the animal life in the water, D represents the plant life and E is the soil at the bottom.

Assume that the proper balance of plant and animal life has been placed in the aquarium before sealing it.

35. It will be possible for life to continue in the aquarium

1. until the original oxygen supply of the air above the water is used up, but not longer
2. until the original supply of oxygen dissolved in the water has been used up, but not longer
3. at most, not more than two months
4. until the original supply of nitrogen in the soil at the bottom is used up, but not longer
5. indefinitely as long as the sun shines regularly on the aquarium and the temperature stays above freezing.

36. Energy first enters the cycle within the aquarium at

1. A
2. B
3. C
4. D
5. E

SEE PAGE 15

37. The oxygen supply within the aquarium is replenished at

1. A
2. B
3. C
4. D
5. E

38. Most carbon dioxide is released during the day by

1. A
2. B
3. C
4. D
5. E

39. The major reason why unicellular organisms do not grow to more than about 1mm in diameter is

1. they have no hormonal and nervous controls
2. they cannot divide into two cells
3. the surface area to volume ratio increases, thus restricting food requirements
4. diffusion of materials in and out becomes too slow to meet requirements.

40. A farmer starts a colony of rats and a colony of mink. He feeds some of the rats to the mink. He then feeds some of the mink to the remaining rats. By feeding rats to the mink and mink to the rats he claims that he can continue to get mink skins for nothing. Can he?

1. Yes, because the system would be in a steady state
2. Yes, because energy lost in one organism is gained back in the other
3. No, because there is no replenishment of the lost energy
4. No, because this would make both types of organism into second consumers.

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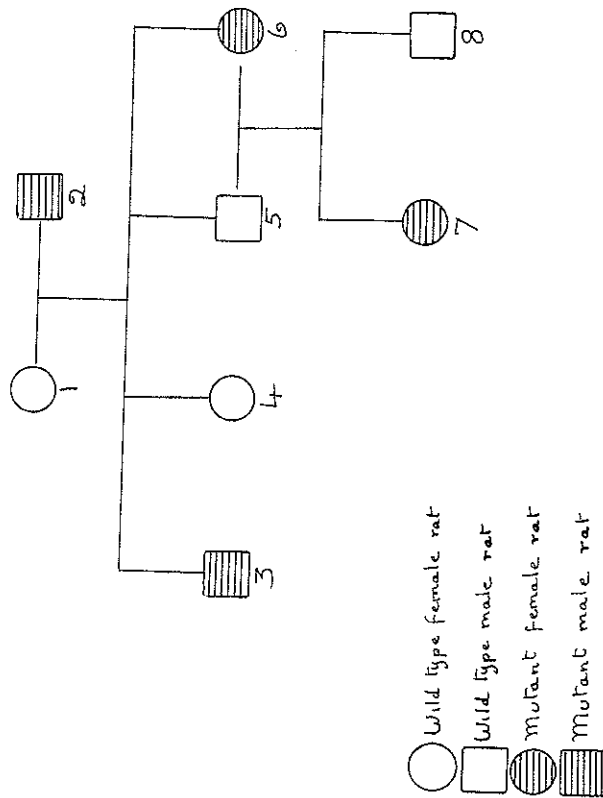


SECTION B

Suggested time: 75 minutes (36 marks)

Attempt ALL questions in this section. Write your answers in the spaces provided.

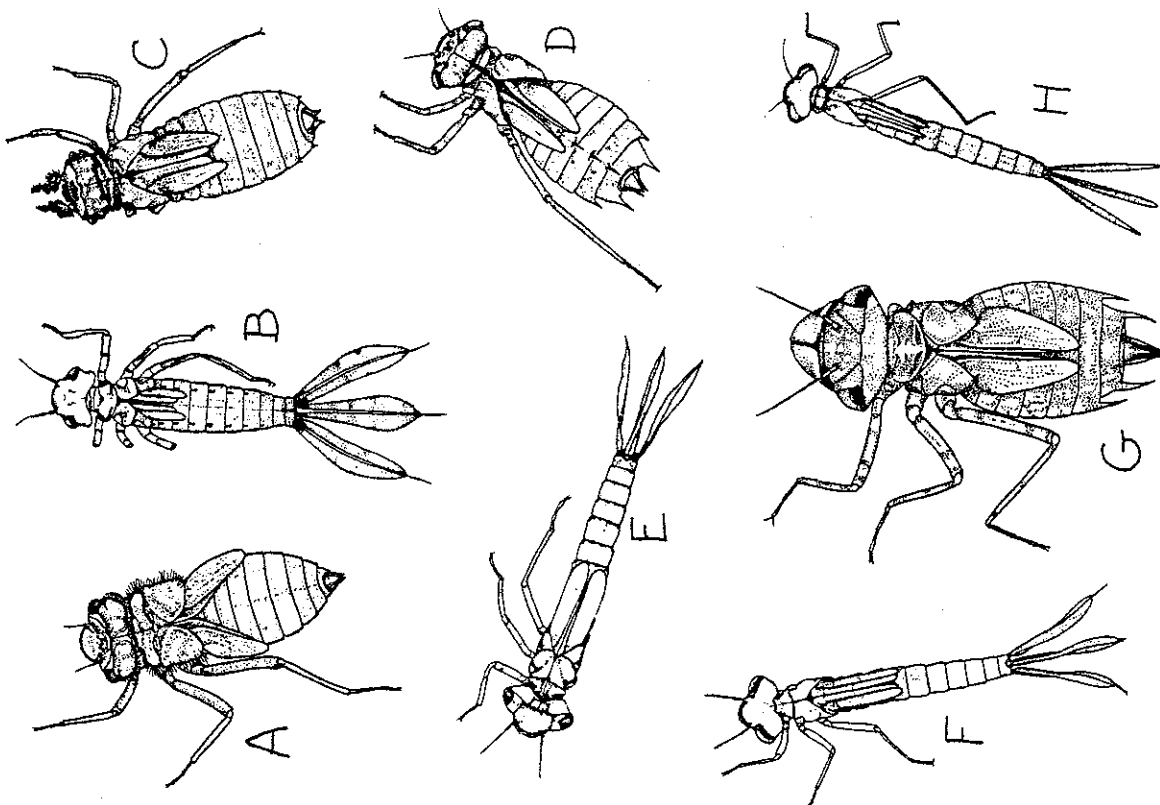
41. (10 marks)



Could the assumption of a sex-linked mutant gene be supported by the above pedigree? Explain.

41. (continued)

42. (7 marks)



(Reproduced with permission by Dr. J. A. L. Watson, CSIRO, Canberra)  
Construct a dichotomous key for the above animals.

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42. (continued)

SEE PAGE 20

43. (7 marks)

A scientist wished to test the hypothesis that wheat will give a farmer a higher yield of grain if given fertilizer brand X rather than fertilizer brand Y. In his experiment he used two containers which were identical in every respect. They were treated as follows:-

<u>Container 1</u>		<u>Container 2</u>	
5 kg loamy soil		5 kg sandy soil	
8 litres of water during the two months		8 litres of water during the two months	
2 g fertilizer X		2 g fertilizer Y	
10 wheat seeds of Type A		10 wheat seeds of Type A	

The scientist found that after two months there was a 15% greater mass of leaves and stems in container 1 than in container 2. He concluded that X was the better fertilizer and that his hypothesis was supported.

- (a) According to the scientist's hypothesis what was the
- experimental variable? \_\_\_\_\_
  - dependent variable? \_\_\_\_\_
- (b) (i) Which of the two variables you listed in (a) was not actually used in the experiment? \_\_\_\_\_
- (ii) Which variable did he use instead? \_\_\_\_\_
- (c) Name the experimental control and explain why it was inadequate. \_\_\_\_\_

- (d) Do you consider that the sample size and the number of replicates used were adequate? Explain. \_\_\_\_\_

- (e) What aspects of the way the experimental variable was applied made his results of little use? \_\_\_\_\_

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44. (7 marks)

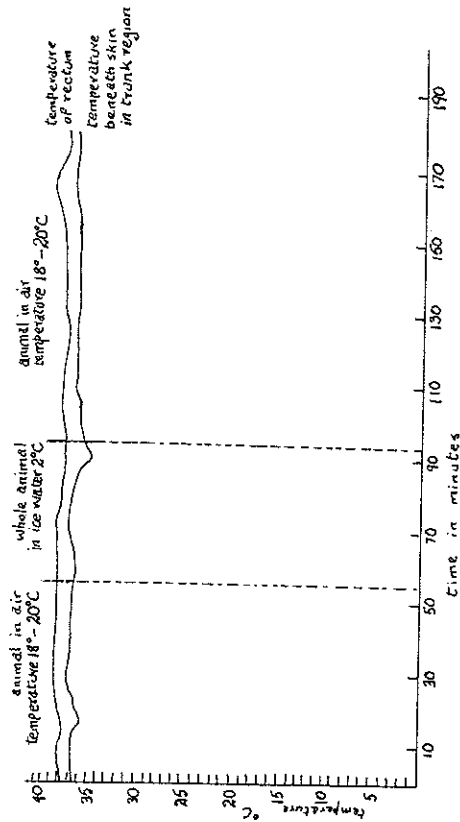


The musk-rat's body is 25-35 cm long. Its flattened tail, which it uses for swimming, is 20-28 cm long, and is either very thinly furred or naked. It is a water rat and is distributed over most of North America. It spends a good deal of the year swimming in ice-cold water at about 20°C. The thick layer of body fur traps air when the animal is swimming and the graphs below show how effective is this fur in controlling body heat loss.

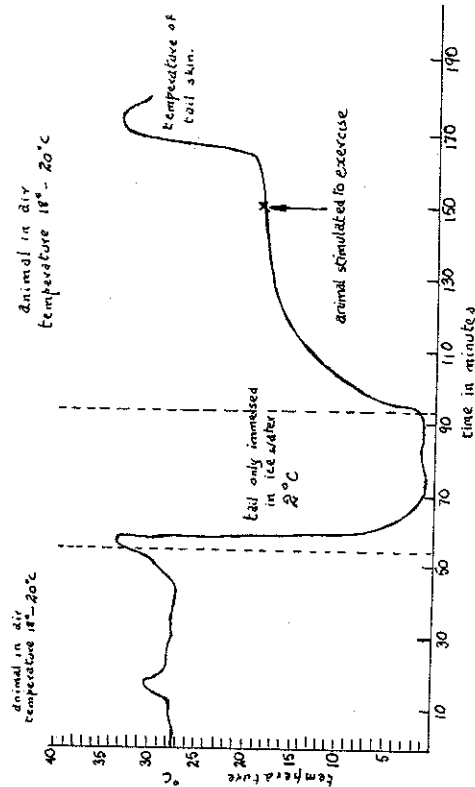
Question 44 is continued on the next page.

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44. (continued)



GRAPH A



GRAPH B

Examine the graphs carefully before answering the questions.

- a) What was the effect of passing from air to ice water and back to air on the rectal temperature and on the temperature beneath the skin in the trunk region?

SEE PAGE 23

44. (continued)

- b) The surface area of the tail forms a considerable part of the total surface area of the animal's body. It has very little or no hair on it. Without reference to the graphs, what effect would you expect this to have on heat loss when the animal is swimming in ice-cold water?

- c) Describe what happened to the tail temperature when the tail was immersed in ice water and for the first 40 minutes after removal from it.

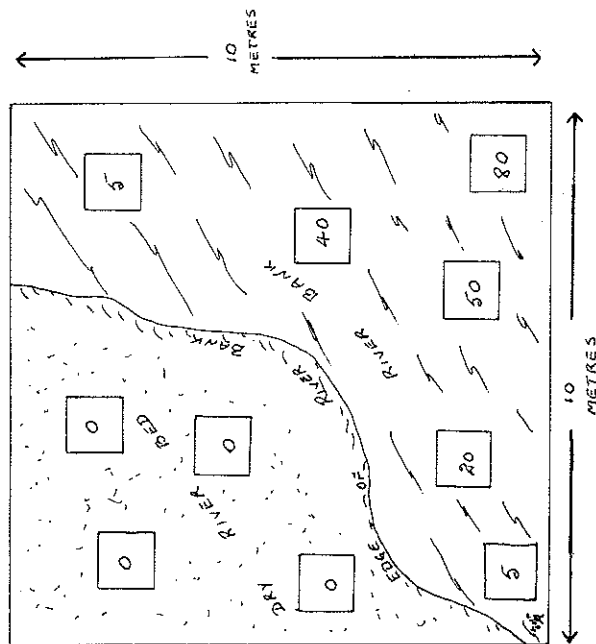
- d) How are the changes in tail temperature described in your answer to c) of great benefit to the animal?

- e) What do the graphs tell you about the possibility of the tail playing a part in heat loss as well as in heat conservation?

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45. (5 marks)

A group of students conducted a field survey of the density and distribution of a small flower, *Helichrysum bracteatum*, known as "everlastings". The students used small quadrats, which were open metal frames 1 square metre in area, as their means of sampling. Below is a diagram showing their results.



Each small square represents the site from where the sample was taken and the number of plants found in that quadrat.

a) What is the estimated population of this plant in the whole area?  
Show your working.

45. (continued)

b) What is the average population density of the plant in the area? Show your working.

c) If you had to conduct the above field sampling, explain how you would distribute the quadrats so that the method would not be biased.

## SECTION C

Suggested time: 45 minutes.

Each question is worth 12 marks. Answer BOTH questions.

Write your answers on the sheets provided at the end of this section.

Where possible support your answers with labelled diagrams.

46. EITHER

- a) Most endemic (native) plants in the hot arid areas of Australia grow quite successfully under extremely harsh conditions. Discuss the different adaptations to this environment found in Australian plants and explain how they enable the plant to continue to carry out photosynthesis, respiration and transpiration under these adverse conditions. In your answer use named plants from high rainfall areas as a basis for comparison.

OR

- b) Draw a diagram (or model) to show a generalised stimulus-response mechanism in a mammal's body. Apply the model to a specific stimulus-response situation in a named mammal, indicating all of the components. Explain how such a model can be helpful in interpreting the operation of homeostatic mechanisms.

OR

- c) Explain how oxygen and glucose are carried in an animal's blood stream and how these molecules pass from the blood to the interior of the cell. Describe the process in which oxygen and glucose molecules are used within the cell.

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47. EITHER

- a) A biologist believed that certain animal and plant species could be used to identify disturbed as against undisturbed environments. He therefore selected two areas, A and B, of the Australian countryside which were of the same size (50 hectares) and originally supported identical plant and animal communities. One area had been left in its natural bush state while the other had been cleared for agricultural use and later abandoned by the farmer. After several years had elapsed, the biologist observed these areas from 1968-1978 and compiled the following species list from his field records covering July-December 1978.

AREA A	No. of Species per hectare	Abundance of individuals within each species	AREA B	No. of Species per hectare	Abundance of individuals within each species
Prominent Plants			Prominent Plants		
Proteaceae			Proteaceae		
Banksias	4	Plentiful	Banksias	4	Plentiful
Hakeas	5	"	Hakeas	4	"
Grevilleas	3	"	Grevilleas	1	Common
Myrtaceae			Myrtaceae		
Honey myrtles	2	"	Honey myrtles	1	"
Eucalypts	2	"	Eucalypts	1	"
Prominent Animals			Prominent Animals		
Invertebrates			Invertebrates		
Spiders	12	"	Spiders	3	Rare
Scorpions	2	Few	Scorpions	2	"
Centipedes	4	"	Centipedes	1	"
Insects	206	Plentiful	Insects	25	Few
Vertebrates			Vertebrates		
Lizards	5	Plentiful	Lizards	1	Rare
Snakes	2	Few	Snakes	0	-
Mammals	3	"	Mammals	1	Rare
Birds			Birds		
Honeyeaters	4	Plentiful	Honeyeaters	2	Few
Predatory	2	"	Predatory	0	-

From his observations he concluded that the two areas were still ecologically different.

After study of the species list do you consider that the best indicators of an undisturbed area would be the dominant plants, the first order consumers or the top carnivores? Discuss the reasons for your answer, taking into consideration such themes as food chains, food webs, pyramid of numbers (biomass) and predator-prey relationships. Illustrate your answer with specific examples from the data table given above.

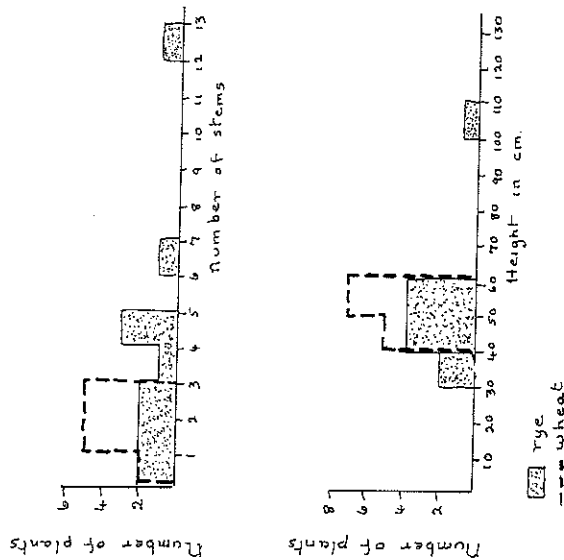
Questions 47(b) and 47(c) are on the next page.

SEE PAGE 28

47. (continued)

OR

b) The results shown below were obtained by growing wheat and rye plants from seed over the same period of time and under similar conditions. Wheat is self-fertilized and hence inbreeding, rye is cross-fertilized and outbreeding. The characteristics studied were height and the number of stems produced.



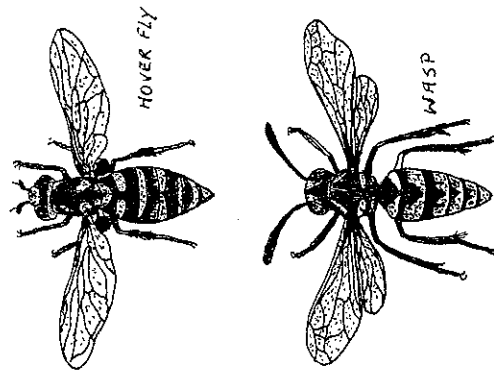
- (i) Which species shows the greatest variation for each character?
- (ii) Explain in genetic terms the reasons for this difference in variation.
- (iii) What other sources of genetic variability are there besides that given in (ii) above?
- (iv) What are the advantages to a species, under natural conditions, of being inbreeding or outbreeding?
- (v) What are the advantages and disadvantages of using inbred and outbred strains as crop plants?
- (vi) About 800 varieties of wheat are maintained at cereal research institutes as a reservoir of genes and gene combinations. The corresponding figure for rye is about 60. Suggest a genetical explanation for this difference.

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47. (continued)

OR

c)



Hover flies can often be seen around plants. They are harmless nectar feeders which lay eggs on plants where aphids are common. Their larvae eat aphids and so their presence is beneficial to the plants.

In appearance many species of hover flies are remarkably similar to certain bees and wasps. The flies possibly gain an advantage through this because they are less likely to be eaten by birds which have learned that bees and wasps may sting. Such a resemblance of the members of one species to those of an unrelated species is known as mimicry.

Explain the processes that could be involved in the evolution of a mimic, e.g. a hover fly, as it comes to resemble more closely its model, e.g. a wasp.

END OF PAPER