

WESTERN AUSTRALIA

TERTIARY ADMISSIONS EXAMINATION

1982

BIOLOGY

Please place one
of your Candidate Identification labels
in this box

CANDIDATE'S NUMBER:

In figures

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In words

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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 36 pages and 48 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	47 a		
	41				47 b		
	42				47 c		
	43				48 a		
	44				48 b		
B	45				48 c		
	46				Sub-total C		
	Sub-total B						

	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 36 which is folded into the back of this paper.

Write your number in the box at the top of page 36 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 36). For example, if your choice is 3, show it as follows:

1	2			5
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An error in recording your choice may be cancelled by completely blocking out the error as shown in 4 above.

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

1. A self-contained spacecraft can be considered as _____

1. an organ system
2. a population
3. a community
4. an ecosystem

2. Karri seedlings germinate in large numbers after a bushfire, following the fall of seed from burnt trees, but only a few survive to full growth. Which of the following is the most likely reason for the above observations?

1. Browsing animals eat most of the seedlings at an early age
2. Animals eat most of the seeds
3. Karri seedlings need a certain minimum level of light to germinate
4. Karri seedlings only grow in burnt areas

3. The haemoglobin molecule combines more easily with carbon monoxide than with oxygen. People often die of carbon monoxide poisoning because the

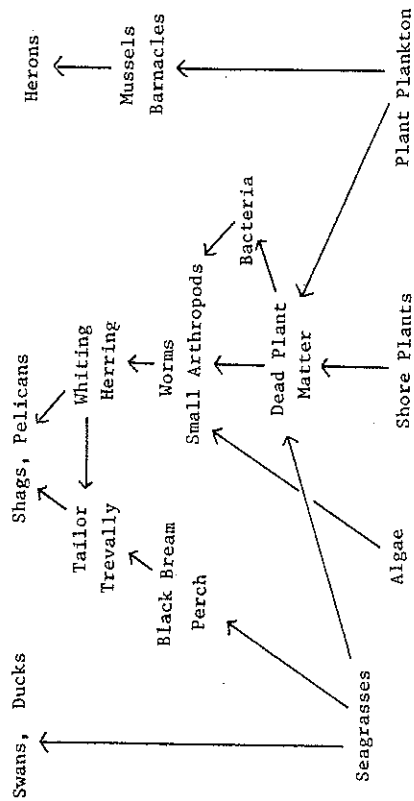
1. oxygen carrying capacity of the blood is decreased
2. oxygen carrying capacity of the blood is increased
3. CO₂ carrying capacity of the blood is decreased
4. CO₂ carrying capacity of the blood is increased

SEE PAGE 4

•

Questions 4-8 are based on the following information.

The relationships of certain living things in the Blackwood River estuary are shown below.



4. The best examples of first order consumers would be

1. tailor and trevally
2. bacteria
3. swans and barnacles
4. small arthropods

5. Investigation has shown that about 40% of the energy consumed in this ecosystem is obtained from green plants. Which of the following sources initially supplies the rest of the energy consumed?

- 1) Nutrients in the mud.
- 2) Dead plant matter.
- 3) Dead animal matter.
- 4) Minerals in the sea water.

6. The diagram is an example of

1. an energy cycle
2. a food web
3. a community profile
4. an ecosystem

SEE PAGE 5

7. If silt in the water prevented the growth of sea grasses and algae, it is expected that

1. the swans would eat other food
2. the population of bacteria would decrease
3. the heron population would not be affected
4. there would be more plant matter for the decay organisms

8. Which of the following statements is NOT true?

1. The arrows in the diagram represent energy flow
2. The number of producer organisms affects the number of pelicans
3. The energy which the herons use is derived originally from sunlight
4. Only worms and small arthropods are first order consumers

9. Although the heart beats intermittently, the blood pressure in the arteries does not drop to zero between successive heart beats and the blood is kept in continuous motion. Which one of the following best helps to explain these observations?

1. The left and right ventricles contract alternately
2. The atria and ventricles contract alternately
3. The blood expands and contracts with the pressure changes produced by the periodic contractions
4. The walls of the arteries are elastic

10. When chromosomes first appear during mitosis, each seems to be double. Just after mitosis is completed, each chromosome in the new daughter cell is single. Using this information one could predict that chromosome duplication occurs

1. just after the nuclear membrane disappears
2. at some time before mitosis begins
3. when chromosomes move to the poles of the spindle in late mitosis
4. during metaphase

SEE PAGE 6

Questions 11-13 are based on the following information.

Radioactively "labelled" amino acids are injected into the blood stream of a rat and are carried around the body to be used by active cells. If cells are killed at various times after the injection, the fate of these amino acids can be determined.

11. It is expected that radioactively labelled compounds would be found first in cells which are

1. forming urea
2. forming lipids
3. forming proteins
4. storing carbohydrates

12. In which of the following regions of the cell would you find a high level of radioactive compounds?

1. Nucleus
2. Ribosomes
3. Cell membrane
4. Mitochondria

13. Which of the following is a necessary assumption in these experiments?

1. Rats are better able to withstand doses of radioactivity than other animals
2. Radioactive amino acids will remain separated from similar natural substances
3. Rats will treat radioactive amino acids in the same way as they treat natural amino acids
4. Plants will react to "labelled" amino acids exactly as animals do

14. One important result of meiosis is that it

1. revitalises the organism
2. doubles the chromosomes between generations
3. produces a fertilized egg
4. maintains the species chromosome number

SEE PAGE 7

Questions 15-17 are based on the following information.

Suppose that you returned from a biological excursion with animals having the following characteristics:

- | | |
|----------|-----------------------------|
| animal A | hair, backbone, claws |
| animal B | feathers, backbone, claws |
| animal C | hair, backbone, no claws |
| animal D | scales, backbone, claws |
| animal E | shell, muscular foot, gills |

15. Animals A to D belong to the group of animals called

1. echinoderms
2. invertebrates
3. vertebrates
4. mammals

16. Animal E is most likely to be

1. a mollusc
2. an annelid
3. an echinoderm
4. a rock lobster

17. The two most closely related animals are

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

18. Most flowers produce both pollen and ovules. In sunflowers the anthers ripen first to produce pollen and only later, when the pollen has gone, do the stigmas open to receive pollen brought to them. This ensures that

1. the bees only collect pollen from ripe flowers
2. the pollen produced by one flower does not land on its own stigma
3. every flower is sure to be pollinated
4. only sunflower pollen is brought to the flower by the bees

SEE PAGE 8

Questions 19-21 are based on the following data.

Minced egg white, a protein, was placed in seven test tubes each containing 10 ml of water. The tubes were then treated as shown in the table and left for 12 hours. The amount of peptide (protein fragments) in each tube was then estimated.

Tube	Treatment	Peptides produced	Visible Effect
A	Added pepsinogen	No	No change
B	Pepsinogen & acid	Large amounts	Clear
C	Nothing	No	No change
D	Acid	Trace	No change
E	Pepsinogen (boiled) and acid	No	No change
F	Pepsinogen & base	No	No change
G	Base	No	No change

19. Which tube is the control for the entire experiment?

1. A
2. C
3. D
4. G

20. Which tubes show that the pH of the medium is important to the activity of pepsinogen?

1. B and F
2. D and G
3. B and C
4. E and G

21. Which tubes show that the properties of pepsinogen can be destroyed?

1. C and E
2. A and B
3. F and G
4. B and E

22. Which one of the following is a possible reason for a farmer growing a legume crop such as lucerne?

1. To add nitrates to the soil
2. To add superphosphates to the soil
3. To add trace elements to the soil
4. 1, 2 and 3 are all possible reasons

23. If a party of explorers finds a pond community in a completely dark cave, they can be sure that

1. photosynthesis occurs somewhere in the cave
2. some animals frequently move in and out of the cave
3. food is coming in from the outside by some means
4. there are more producers than consumers in the cave

24. Which of these organisms use carbon dioxide from their surroundings as well as adding carbon dioxide to their surroundings?

1. Decay bacteria
2. Sponges
3. Brown algae
4. Sea anemones

25. The air in a soil is important because from it plants obtain

1. their supply of phosphorus
2. carbon dioxide necessary for photosynthesis
3. nitrogen necessary for plant growth
4. oxygen necessary for root respiration

26. A biologist diluted blood with water on a glass slide and observed it through a microscope. The cells seemed to burst. This is probably because he

1. used distilled water
2. used very salty water
3. added water too rapidly
4. used dead cells

27. Crinia is a small frog found in swamps which dry up in summer. Two collections of Crinia were made, one from Western Australia and the other from south eastern Australia. Although the frogs were very similar in appearance, it was suggested that these two samples belonged to two different species. The best way to test this suggestion is to

1. study more frogs from the same areas
2. transfer Western Australian frogs to the eastern states and determine whether they grow and reproduce there
3. determine the degree of similarity between the tadpoles of the two populations
4. allow the frogs to interbreed and see if the offspring are fertile

28. A man is surface-sterilized and placed in a lighted, germ-free capsule with a tank containing only green algae (Chlamydomonas sp.) and sterile water. The man's wastes are placed in the tank and he drinks only filtered water from the tank and eats only compressed algae. The man is not likely to survive. Why?

1. He contracts disease from the contaminated water
2. The algae are unable to use the nitrogen in the air or in the man's wastes
3. The algae supply only carbohydrates
4. Man cannot live without a wide variety of organisms around him

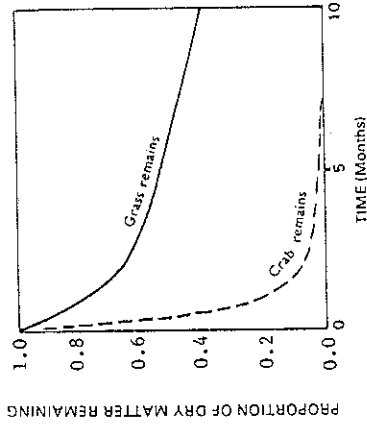
29. Veins which have been overstretched for long periods of time become larger in diameter. However, the valves in the veins do not increase in size, therefore

1. the valves will no longer block reverse flow in the enlarged veins
2. the valves use twice the energy in actively transporting blood in the enlarged veins
3. we could expect a decrease in the venous blood pressure
4. the weight of the blood flattens the valves to such an extent that they collapse, making it easier for blood to return to the heart by muscle action

SEE PAGE 11

Questions 30 and 31 are based on the following information.

In experiments conducted on an American coastal marsh, scientists enclosed animal remains (dead crabs) and plant remains (grass) in plastic mesh bags and buried them in the mud where they were exposed to the activities of organisms. The scientists then compared the rates at which the dead plant and animal material were consumed (see graph below).



30. The best reason for the grass decomposing more slowly than the crab is that

1. the grass contained more water than the crabs
2. the grass contained an organic material which was not found in crabs
3. decay bacteria were able to decompose crabs but not grass
4. fungi were able to decompose crabs but not grass

31. The best reason why plastic mesh bags were used was that

1. plastic mesh decomposes very little and so the solid would be easily retained
2. plastic does not get wet and therefore dry weight could easily be determined
3. plastic mesh is easily recoverable from a swamp
4. plastic mesh would prevent water and inorganic salts escaping

SEE PAGE 12

Questions 32-34 are based on the following information.

Cassytha plants have thin green stems which twine around the stems of other plants to which they are attached by means of modified roots. These roots penetrate the vascular tissue of the supporting plant. Cassytha leaves are minute in size.

32. Cassytha is regarded as a parasite because it
1. grows on another plant
 2. has minute leaves
 3. absorbs nutrients from another plant
 4. is not rooted in the ground
33. The structure and appearance of Cassytha indicate that it probably
1. carries out no photosynthesis
 2. is not completely parasitic
 3. derives all of its food from the supporting plant
 4. is a non-vascular plant
34. Cassytha is considered to be a "well-adapted parasite". This suggests that it
1. rarely kills its supporting plant
 2. is smaller than its supporting plant
 3. only parasitizes plants that it can kill quickly
 4. produces many more seeds than non-parasite relatives

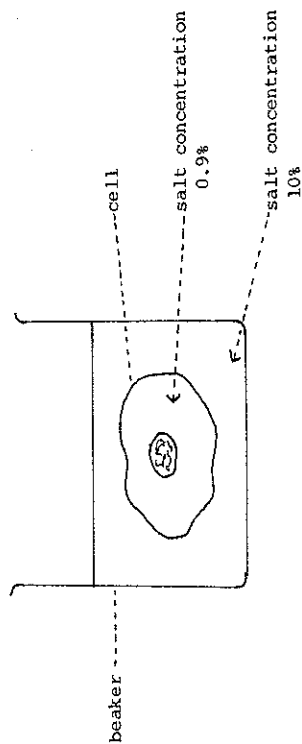
35. Some species of organisms produce large numbers of offspring during their lives, eg. rock lobsters may produce 2 million young. Others produce relatively few, such as the cockatoo which may produce only 40 young. These differences are related to the

1. size of the organism
2. place in which the organism lives
3. dangers to which the young organism is exposed
4. amount of food available to the young after hatching

SEE PAGE 13

36. An increase in the rate of urine production occurs following the drinking of a large volume of water, but in most humans the increase cannot be detected until 30 minutes have elapsed. The best explanation for the delay is that

1. the drinking of water stimulates nerves, but the kidney is such a distance from the central nervous system that the extra volume is not detected for about 30 minutes
2. the increased water intake enters the circulation, but the blood does not circulate through the renal artery to the kidney for about 30 minutes
3. water is not absorbed from the digestive tract immediately and appreciable amounts get into the bloodstream only after about 30 minutes
4. the increased rate of water excretion depends on an increase of ADH, the concentration of which changes relatively slowly



The concentration of water is

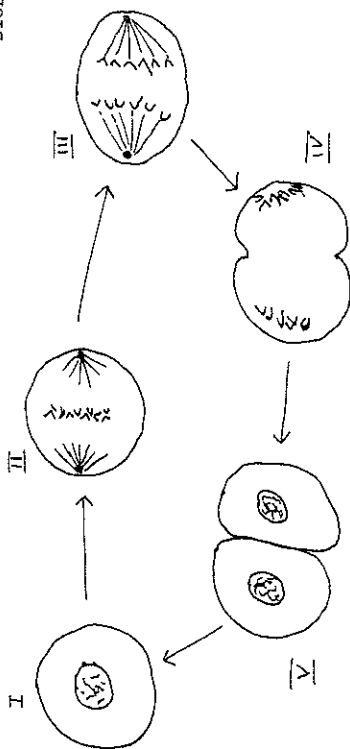
1. greater inside the cell than outside
2. greater in the immediate environment than in the cell
3. equal inside and outside the cell
4. not important to the size of the cell

38. Which of the following is the major function of receptors?

1. They control the automatic functions of the body
2. They produce responses after stimuli have been received
3. Their major function is to coordinate stimulus and response
4. They give organisms a sensitivity to their environment

SEE PAGE 14

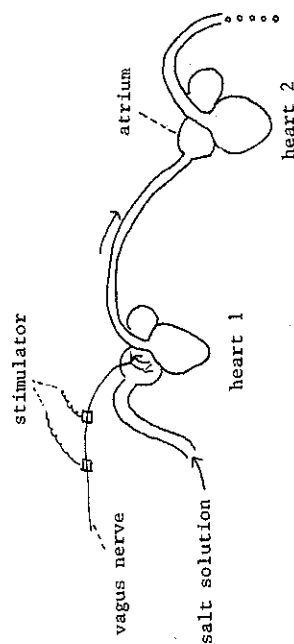
14.



39. Could the above figure represent division in bacteria, and why?

1. Yes, because the process in bacteria is identical to that in other organisms
2. Yes, because bacteria have DNA, nuclei and cell walls
3. No, because bacteria do not have DNA or cell walls
4. No, because bacteria do not have definite nuclei or nucleoli

40. The diagram shows an experiment in which two frog hearts were connected in such a way that a salt solution, after passing through the first, was led into the right atrium of the second. The vagus nerve of the first heart was stimulated and the rate of heart beat slowed down. It was seen that the second heart's beat also slowed down.



The best explanation for this observation is that

1. the vagus nerve is the part of the nervous system which inhibits heart beat
2. a stimulating hormone was present in the salt solution in heart 2
3. an inhibiting hormone was secreted in heart 1
4. the nerve impulse was transmitted in the salt solution to the second heart

SEE PAGE 15

15.

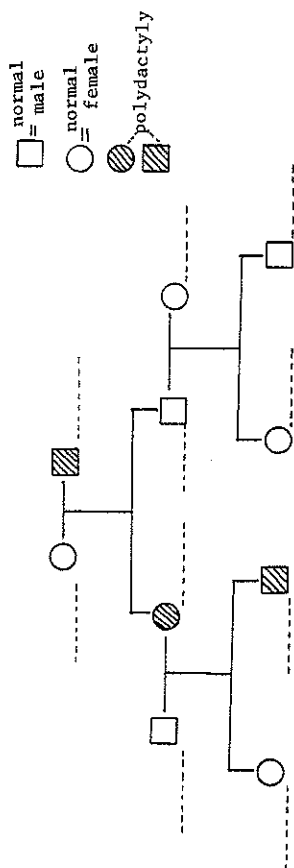
SECTION B

Suggested time: 75 minutes (36 marks)

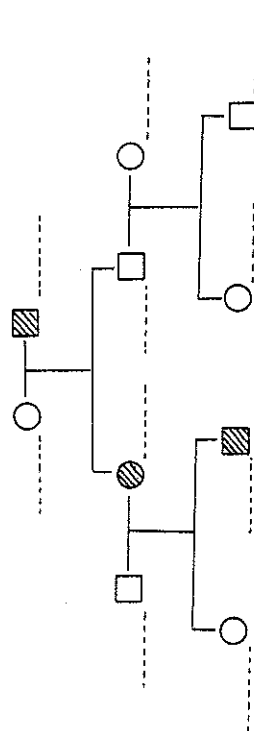
Attempt all questions in this section. Write your answers in the space provided.
41. (7 marks)

Polydactyly (the occurrence of extra fingers) is a rare genetic character in human beings. The pedigree, drawn twice below, is of a human family in which this character appeared. It has been suggested that polydactyly may be due either to a recessive or to a dominant gene not located on the sex chromosomes.

(a) For each individual in the pedigree below write in the genotype which should be found if polydactyly was due to a recessive gene.



(b) In the following pedigree fill in the genotypes for the possibility of a dominant gene as the cause of polydactyly.



(c) Which explanation is the more likely? Give reasons for your answer

SEE PAGE 16

42. (continued)

a) What hypothesis could be under test?

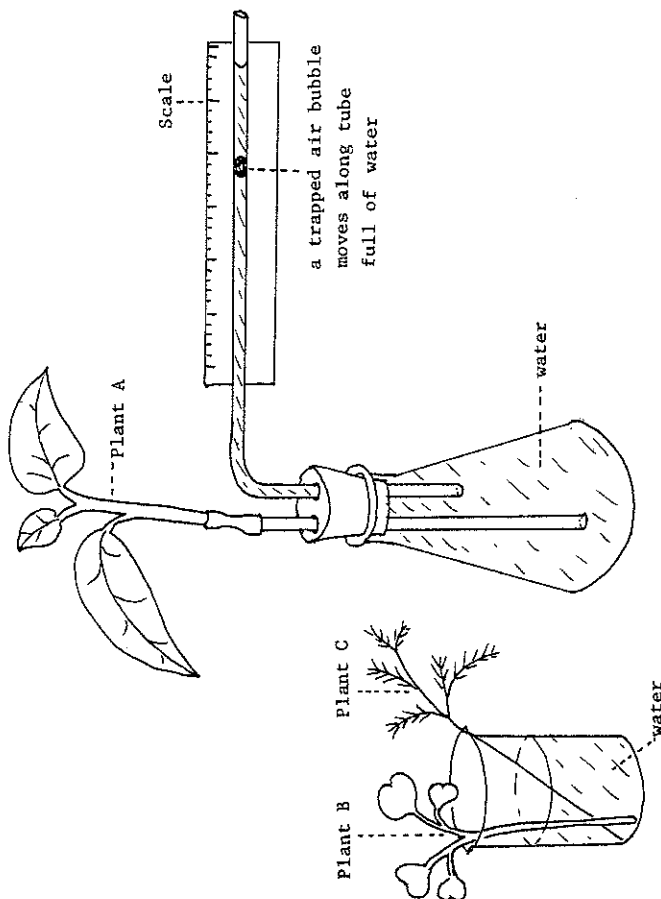
b) Name two variables that would have to be controlled. Explain your answer.

c) What measurements would you record?

d) Name two possible sources of error in the experiment.

SEE PAGE 18

42. (7 marks)



If you and a friend walked into your biology laboratory and saw the materials drawn above being used in an experiment, what answers would you give to the following questions posed by your friend?

SEE PAGE 17

43. (continued)

Blair found that there were two colours of mice, a darkish brown and a much paler gray. The frequencies of the two colours varied in different populations as shown in the table below.

Collecting station	Soil colour	Calculated % frequencies	
		Brown	Gray
Salinas (A)	Pinkish gray	80.0	20.0
Tularosa (B)	Dark red	81.5	18.5
Alamogordo (C)	Pinkish gray	44.9	55.1
Lone Butte (D)	Pinkish gray	63.2	36.8
White Sands (E)	Creamy white	46.2	53.8

a) Give a possible explanation for differences in the coat colour frequencies in the population at Tularosa and Alamogordo.

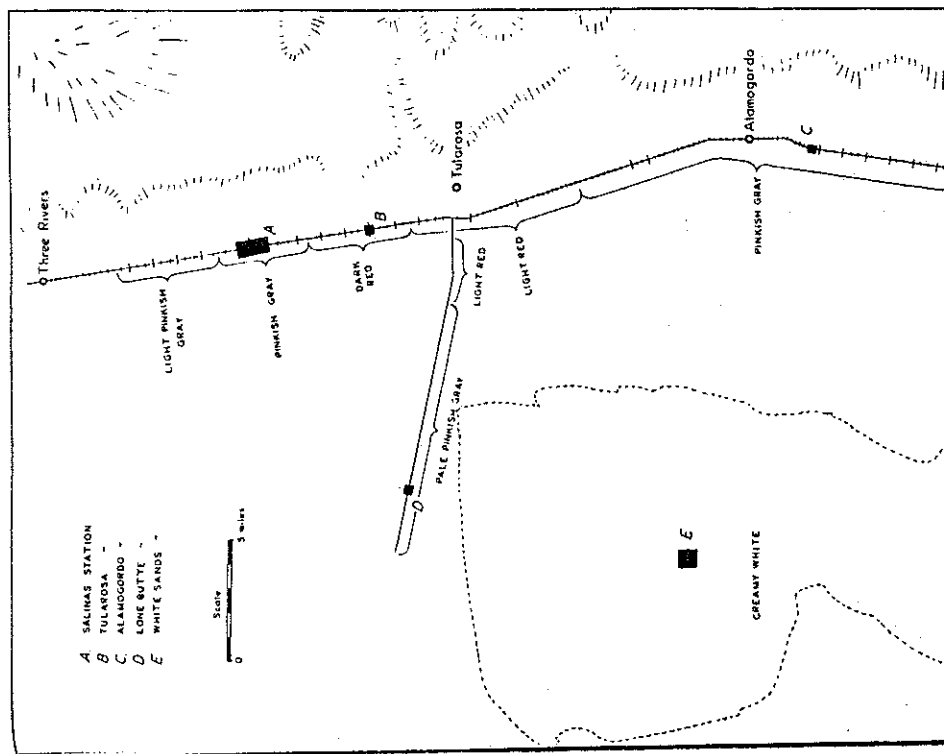
b) Consider the map showing the locations of ALL the groups and suggest an explanation for the difference in coat colour frequencies among the populations which live on pinkish gray soil.

c) List FOUR other items of information you should seek in order to support your suggested explanations in the answer to b).

SEE PAGE 20

43. (6 marks)

Working in New Mexico, Frank Blair studied the coat colours in five closely adjacent populations of a single species of deer mouse (*Peromyscus*). The mice tended to remain within a relatively small home territory in grassy drains and channels beside the railway line and in open semi-desert and desert country nearby. They were also found in two other areas separated from the railway line by unfavourable countryside as shown in the map below in which black rectangles labelled A-E represent the collecting stations. Soil colours are indicated appropriately.



SEE PAGE 19

44. (5 marks)

One way of determining the metabolic rate of an animal is to measure the amount of O_2 used over a period of time. Larger animals will use more O_2 than smaller ones, so the results are usually expressed as the volume of O_2 consumed per unit of body mass. (O_2 is oxygen).

Table I shows some mammalian metabolic rates.

TABLE I

	Body mass (kg)	O_2 consumption per hour (cubic millimetres per gram)
Mouse	0.025	1580
Rat	0.226	872
Rabbit	2.200	466
Dog	11.7	318
Man	70.0	202
Horse	700.0	106
Elephant	3800.0	67

a) Describe the relationship between mass and metabolic rate for the animals in this list.

b) Suggest one reason, related to heat loss, to account for the fact that small mammals have a high metabolic rate.

SEE PAGE 21

44. (continued)

Table II shows the daily intake and expenditure of energy for some mammals.

TABLE II

	Intake (kilojoules)	Metabolic rate (expenditure) (kilojoules/kg)	Metabolic rate (expenditure) (kilojoules/square m)
Mouse	167	887	4957
Dog	3200	218	4350
Man	8800	134	4360
Pig	10500	80	4495
Horse	21000	46	3976

c) How does Table II support the view that heat loss and surface area are related?

d) A reptile with a mass of about 1 kg has a metabolic rate of only 9.2 kilojoules per kilogram per day. Relating your answer to body temperature, say why you think the reptile's metabolic rate is so low.

e) The data given above suggest that there is a theoretical minimum size for mammals. Explain why.

SEE PAGE 22

45. (6 marks)

The following paper is a report of research on the ethology (behaviour) of new born mice carried out by Dr D Csermely and published in the Italian Scientific Journal *Monitore zoologico italiano* in 1981. The terms 'sire' and 'dam' are used here to indicate the male and female parent respectively.

" PATERNAL INFLUENCES ON LOCOMOTOR ACTIVITY
OF THE NEWBORN MOUSE

D Csermely

Istituto di Zoologia dell'Università de Parma

In many rodent species parent presence interacts both directly and indirectly with physiological and ethological development of the offspring (Dudley, 1974; Elwood, 1975). The female mouse, shortly after giving birth, produces a chemical signal together with urine, which reduces the motility of 6 days old mice (Cowley & Wise, 1970). Based on the view that the male mouse actively cares for the litter (Priestnall & Young, 1978; Csermely & Mainardi, 1981) and strongly affects the offspring's general behaviour (Dudley, 1962, 1963) my research attempted to investigate the significance of paternal presence on offspring behaviour, particularly locomotor activity.

In my experiments I used a test described by Henderson (1978), putting 4 days old mice, one at a time, on a sheet of paper with numbered squares of 2.5 cm per side, and observing how many squares they entered during 1 minute.

The offspring grown with sire presence (Category A) showed less activity than those grown with two females (Category B) or with the dam alone (Category C). No significant difference was found between categories B and C. Litter size or test order did not affect locomotor activity.

In a second experiment sire presence was substituted by adult male urine added near the nest. The general results were similar to the previous ones. Analysis of variance showed that the observed differences between categories were due to the treatment. The activity of mice grown with the mother near male urine (Category A1) was less than that of mice grown with the dam alone (Category C). Category B, where the pups were with two females and male urine, was midway between the others.

It is clear from these experiments that the sire tends to reduce the offspring locomotor activity. His presence is signalled by emission with the urine of a chemical substance, acting as a pheromone and with stronger effects than the female one. The adaptive value of this mechanism is to increase group cohesion by preventing the offspring from moving out of the nest. "

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SEE PAGE 23

45. (continued)

a) What was the hypothesis that Dr Csermely was investigating?

b) Was his research merely a repetition of another investigation, or did he study a new idea? Explain.

c) Do his results support the hypothesis he was testing? Explain.

d) Suggest two reasons why reports such as this one can influence the growth of scientific knowledge.

SEE PAGE 24

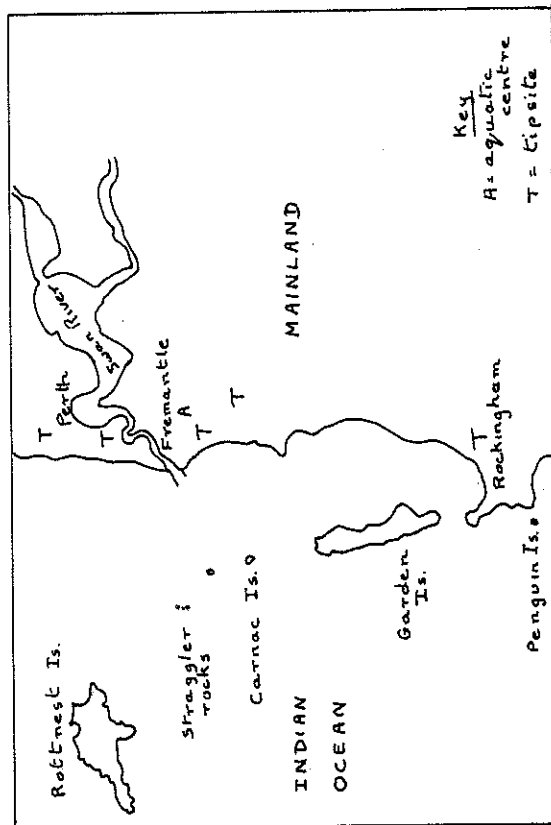
46. (5 marks)

Salmonella bacteria were recognised as the cause of human enteric fever less than a hundred years ago. In Western Australia 260 varieties of Salmonella have been identified in man and other animals but only 130 of these have been directly implicated in cases of human infections. In the Perth metropolitan area, 10 Salmonella varieties account for 82% of all infections.

The silver gull (Larus novae-hollandiae) is the common gull of the Australian coastline and is known to carry Salmonella. This gull is an omnivorous scavenger feeding on a wide variety of natural foods on island shores and readily exploiting supplementary food sources provided by urban environments. Near Perth, nesting populations occur on Rottnest, Carnac, Garden and Penguin Islands. The birds forage throughout the metropolitan area and as far as Midland. It is estimated that there are approximately 5000 birds on Carnac Island, about 2-3000 on Rottnest and a further 12-15000 foraging in the metropolitan area.

Birds are tested for Salmonella by investigation of their droppings for varieties of the bacterium.

MAP SHOWING BREEDING AND FEEDING SITES OF THE SILVER GULL



SEE PAGE 25

46. (continued)

Table showing the number of gull droppings infested with Salmonella varieties at three locations.

Variety	Tipsites	Carnac Island	Rottnest Island
S. adelaide (A)	9	1	7
S. anatum (B)	11	-	2
S. derby (C)	32	14	-
S. give (D)	21	-	-
S. muenchen (E)	7	-	4
S. newport (F)	11	-	-
S. typhimurium (G)	25	2	6
No. of samples tested	388	84	84
No. of infected droppings	116	17	19

a) Which of the varieties occurring on tipsites are also found on
i) Carnac Island, and ii) Rottnest Island?

b) Considering the data in the above table, how likely is it that Rottnest and Carnac Island gulls exploit different food sources? Explain.

c) Name two factors which might influence where the gulls feed.

d) Gulls' eggs and young chicks on Carnac are preyed upon by the King Skink and the Tiger Snake. Which variety of Salmonella would you expect to be most common in these reptiles? Explain.

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SECTION C

Suggested time; 45 minutes

There are three alternatives to each question. Choose ONE alternative from each question.

Each question is worth 12 marks. Answer both questions in essay form.

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

Where possible, support your answers with labelled diagrams.

47. EITHER

- (a) "Within an ecosystem, energy from the sun is incorporated into the community, transferred from one organism to another and gradually lost. On the other hand, matter tends to be continually cycled through the community."

Explain what this statement means, giving examples where possible to support your answer.

OR

- (b) Give an example (real or imaginary) of the way in which a change in (i) the resources available and (ii) weather conditions can increase or decrease the population size of an organism.

Do these changes influence other populations or any features of the physical environment? If so, how? If not, why not?

OR

- (c) Sheep are successfully farmed in arid areas of Australia where day temperatures are high but the nights may be very cold.

Explain how a sheep is able to control its body temperature under such extreme conditions. (It should be noted that sheep have a limited capacity to sweat).

SEE PAGE 27

48. EITHER

- (a) Avocado trees do not grow wild in the southwest of Western Australia. Possible reasons for this are that

- (i) the climate is unsuitable
- (ii) the soil is unsuitable
- (iii) the avocado cannot compete successfully with trees that do grow in Western Australia.

Describe experiments you could conduct to determine which of these reasons are justified explanations for the absence of avocado trees.

OR

- (b) Design a hypothetical multicellular plant or animal which would be adapted to live in a shallow sea bay which is not more than 20 metres deep and has a sandy bottom.

Select 4 structural features and show how these are specifically constructed to assist the survival of the organism.

OR

- (c) Forestry Department research officers in Western Australia have found that many shrubs in the southwest forests germinate most successfully after a hot bushfire which has killed the seeds of competing grasses. In particular, several species of pea flowers and wattles grow to form dense thickets 5-10 years after a fire which was hot enough to crack the hard seed coats. Within these thickets several species of marsupials, such as the tamar wallaby, the numbat, the woylie and the bandicoot, find the cover and the food which are not available in more open bushland.

- (i) What are the chief risks to human society from permitting or promoting hot fires in our forests?

- (ii) Although many escape, some animals are killed during a fire and others die soon afterwards due to lack of food. Do the populations of the different species suffer a long-term gain or loss from the effects of the fire? Explain.

- (iii) How could human beings so manage fires as to effect the survival and possible increase in numbers of these rare mammals without detriment to other users and uses of the forest?

END OF PAPER