

SECTION 1

Total Marks (75)

PART A. (15 Marks)

Use the multiple choice answer sheet.

Junior Essay Trial
BIOLOGY 2001

1. Arteries are able to withstand high blood pressure because

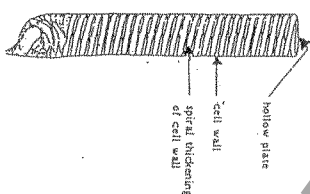
- they have a higher surface area to volume ratio than veins
- they are connected to capillaries which deliver blood to the tissues
- they have valves to force the blood under high pressure
- they have a thicker elastic fibre/smooth muscle layer than veins

2. In order to maintain a normal body temperature of 37°C in cold conditions

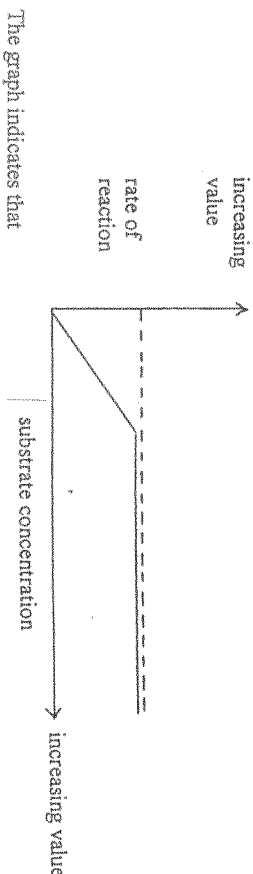
- hypothalamus heat promoting centre shuts off
- skin blood vessels dilate
- skeletal muscles are activated and shivering occurs
- sweat glands are activated

3. The accompanying diagram represents a longitudinal section of a plant cell. The principal function of this cell is

- to produce sugars by photosynthesis
- to transport water
- to allow atmospheric carbon dioxide into the leaf
- to transport sugars



4. The following graph shows the effect that the concentration of substrates has on the rate of an enzyme-mediated reaction



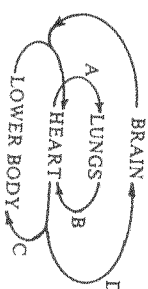
The graph indicates that

- the higher the concentration of the substrate, the greater the rate of reaction
- the rate of the reaction is unaffected by the substrate concentration
- above a certain concentration, increased levels of substrate have no effect on the rate of reaction
- above a certain concentration, the rate of reaction is decreased by increased levels of substrate

5. Several medical conditions result in low aldosterone levels. Lack of aldosterone could result in

- high sodium levels and low potassium levels in the blood
- low sodium levels and high potassium levels in the blood
- higher levels of carbon dioxide in the blood
- higher blood volume and blood pressure

6. The following diagram represents the circulation of blood in the human body.



A blood sample taken from which point would reveal blood richest in carbon dioxide?

- A
- B
- C
- D

7. Part of a DNA molecule, which is 48 base pairs long, would code for a section of protein -

- 12 amino acids long
- 16 amino acids long
- 24 amino acids long
- 48 amino acids long

8. To explain his results, Mendel assumed that the pairs of "factors" from each parent had to separate at some time in the life cycle. With our current knowledge that genes are located in chromosomes, we now know that this segregation of chromosomes occurs during -

- pollination
- fertilization
- gamete formation
- mitosis

9. The study of fossils provides information which helps us to -

- show how individual organisms change over time
- explain the mechanism of natural selection
- trace the ancestry of certain organisms
- demonstrate the origin of life

10. In humans, the gene for normal skin pigmentation (N) is dominant over the gene for albinism (n).

An albino woman whose father is albino, and whose mother has normal skin pigmentation, marries a man who is not an albino even though his father is.

They have a daughter who has normal skin pigmentation.

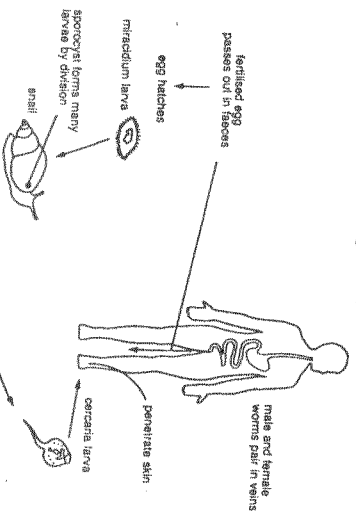
The genotype of the woman, man and their daughter respectively would be

- a) nn Nn Nn
b) NN nn nn
c) Nn NN Nn
d) nn NN NN

11. A doctor had diagnosed that a patient is suffering a disease caused by a viral infection. The doctor based her diagnosis on an examination of the pathogen. Which one of the following sets of features indicates a virus:

	Nucleus	Cell Wall	Cell Membrane	Range is Size (µm)
a	✓	✓	✓	3 - 10
b		✓	✓	0.5 - 5.0
c			✓	0.01 - 0.3
d	✓		✓	2 - 1000

12. This question refers to the following life cycle of *Schistosoma mansoni*.

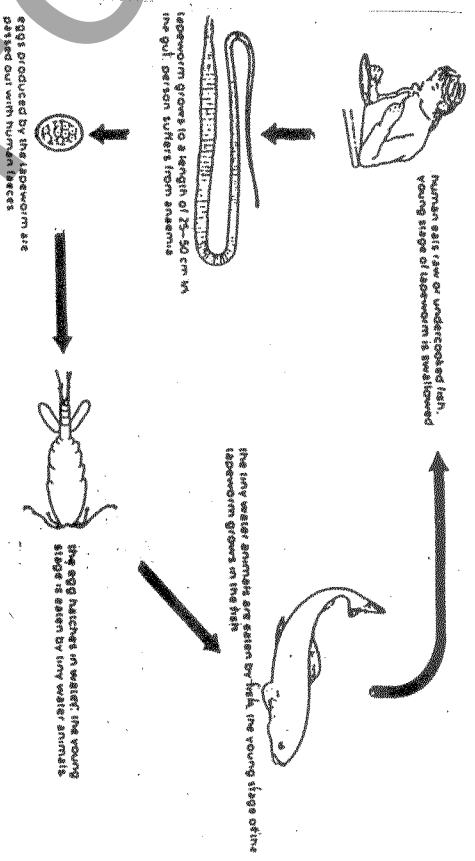


- The vector for the disease schistosomiasis is the
- a) human
b) cercaria larva
c) miracidium larva
d) snail

13. On a visit to the doctor a student was told to gargle saltwater for 30 seconds twice a day in order to fight a suspected throat infection. The biological reasoning for such treatment is

- a) the salt ions will poison all cells in the throat
b) gargling increases the temperature of the throat region thereby denaturing the enzymes of the bacteria cells
c) due to osmosis the bacterial cells will 'dehydrate' and thus die
d) due to osmosis the bacterial cells will swell with water, burst open and thus die

14. Illustrated below is the life cycle of the fish tapeworm.



The best way to control the spread of this disease is to:

- a) give all humans de-worming tablets
b) put antibiotics into the water where the fish live
c) kill the mosquito vectors
d) thoroughly cook the fish before eating

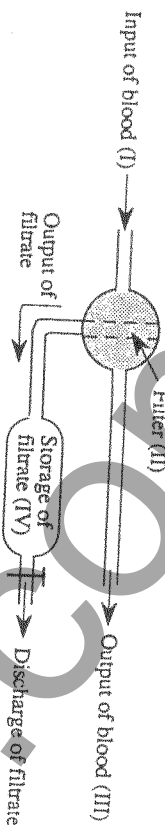
15. A protein molecule that causes disease is called a

- a) protozoan
b) fungus
c) virus
d) prion

PART B (60 Marks)

Attempt questions 16 – 29 in the Answer Booklet.

16. (5 Marks) Marks
The functions of the mammalian excretory system can be represented as shown in the diagram.



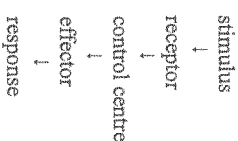
- (a) (i) Name the organ indicated by shading. 1
(ii) State the other function, besides filtering, that is performed by the organ indicated by shading? 1
(iii) Name TWO substances present in the blood in both I and III. 1
(iv) Name TWO substances present in both the blood in I and the filtrate IV. 1
- (b) Explain how the organ indicated by shading contribute towards homeostasis in the mammal? 1

17. (6 Marks)
Transport of substances to cells and removal of waste products from cells are essential processes in the tissues of mammals and of flowering plants.

- (a) (i) Name two substances transported to the cells of a mammal. 1
(ii) Name two waste products transported away from the cells of a mammal. 1
- (b) State one way in which the transport systems of mammals and of flowering plants are similar. 1
- (c) Tabulate two differences between transport in mammals and in flowering plants. 2
- (d) Describe one way in which transport in a mammal helps to maintain homeostasis. 1
18. (4 Marks)

For a named species that has been genetically altered, evaluate the potential impact of the use of genetic engineering on the diversity of this species.

19. (6 Marks) Marks
The stimulus – response pathway illustrates the way in which animals respond to changes in their internal or external environment



- a) If the stimulus is “lowered CO₂ levels in the blood”, describe the receptor, control centre, effector & response in a similar diagram on your answer sheet. Indicate clearly which part of your example corresponds to each word in the model. 4

- b) Explain the meaning of negative feedback, using the example in part (a). 2

20. (6 marks)
Mendel observed the inheritance of seven characteristics in his experiments with peas: rounded or wrinkled seeds; yellow or green pods; coloured or white flowers, green or yellow seed coats; inflated or constricted pods; axial or terminal flowers and long or short stems.

- a) Peas have a chromosome number of $2N = 14$. It could be assumed that each of these alleles (gene pairs) was carried on a separate chromosome to the others. Explain. 2
- b) If some alleles were linked on one chromosome would it have made any difference to Mendel’s results / conclusions? Explain. 2
- c) Describe the aspects of the experimental techniques used by Mendel that led to his success. 2

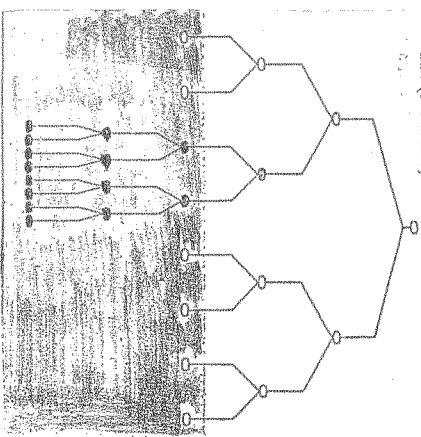
20. The Australian echidna (*Tachyglossus aculeatus*) possesses spines for protection from predators. (9 Marks)

Marks



- Explain how Darwin would have explained the evolution of the echidna's spines from normal mammal hair? 3
- The hedgehog and echidna have both undergone adaptive radiation to both have spines but have different methods of reproduction. What type of evolution has this adaptive radiation led to? Explain giving another example. 3
- Using a named example discuss how advances in technology have changed scientific thinking about evolutionary relationships. 3

22. (3 Marks)



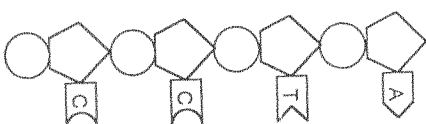
I
IN A NORMAL ENVIRONMENT
the common strain of the bacterium *Escherichia coli* (white bacteria) multiply. A mutant strain resistant to the antibiotic streptomycin (black bacteria) remains rare.

II
IN A CHANGED ENVIRONMENT where
streptomycin is present (grey area).

- Explain why the mutant strain in I remain rare? 1
- Describe what happens after streptomycin is added in II. 1
- Results such as these are a modern example used to support one theory of evolution. Name this theory. 1

23. (2 Marks)
The diagram shows a portion of a single strand of DNA molecule.

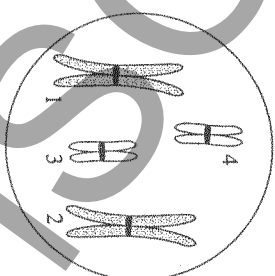
Marks



- Draw the other strand which complements DNA consisting of a series of nucleotides. Name the three subunits of a nucleotide and mark them on your diagram. 2

24. (2 marks)

The diagram shows a parent cell with four chromosomes at an early stage of meiosis.



- Draw an example of a cell that could be produced at the end of the first meiotic division. 1
- Draw an example of a cell that could be produced at the end of the second meiotic division. 1

25. (3 Marks)

In cats, coat colour is a sex-linked characteristic. Black coat colour (B_1) and yellow coat colour (B_2) are co-dominant. A heterozygous combination (B_1B_2) produces tortoiseshell coat colour.

a) State the coat colours you would expect to observe in the offspring if you crossed a black male with a yellow female? 1

b) Draw a pedigree for the above cross. 2

26. (4 Marks)

Louis Pasteur used the results from a series of experiments to support the hypothesis that the bacteria responsible for the decay of food came from the air and did not arise spontaneously.

In one of these experiments he placed some nutrient solution in a flask, drew out the neck of the flask over a flame so that it contained a number of curves and then boiled the liquid for several minutes until steam issued freely through the opening of the neck.



Pasteur's swan neck flask

The flask was allowed to stand for a month during which time there was no sign of decay. Pasteur then broke off the neck at A and decay was observed 24 hours later.

a) Identify three important steps in Pasteur's experiment, explaining why they were important in terms of the final results. 3

b) Design a suitable control for this experiment. 1

27. (4 Marks)

a) Outline another simple experiment different to the one in Q 26 to show that the air is teeming with bacterial and fungal spores, describing the steps involved and their importance. 3

b) Describe how the bacteria and fungi from your experiment could be distinguished? 1

28. (2 Marks)

The entry of pathogens to the body is prevented at several points two of which are:

a) the alimentary canal 1

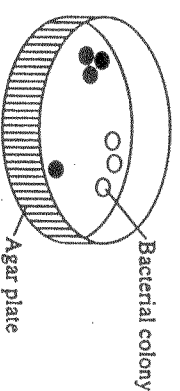
b) respiratory surfaces 1

Describe how the entry of pathogens is prevented in each case.

29. (4 Marks)

Blood from an organism with a bacterial disease was diluted and smeared onto a nutrient-rich agar plate. Two different species of bacteria grew on the plate as shown in the figure.

Type of bacterial colony
○ Bacteria A
● Bacteria B



Describe how you could use Koch's postulates to identify the bacterium responsible for the disease? 4

SECTION II

GENETICS – THE CODE BROKEN (25 Marks)

Complete answers in Answer Booklet.

30. (3 Marks)

- a) Many flowering plants can be propagated by cuttings, and it is observed that the offspring are almost identical to the parent plant. In comparison, when propagated by seeds, the offspring are often very different in appearance to the parent plants.

Which method of propagation gives the plant species an evolutionary advantage? Explain.

Marks

b) (6 Marks)

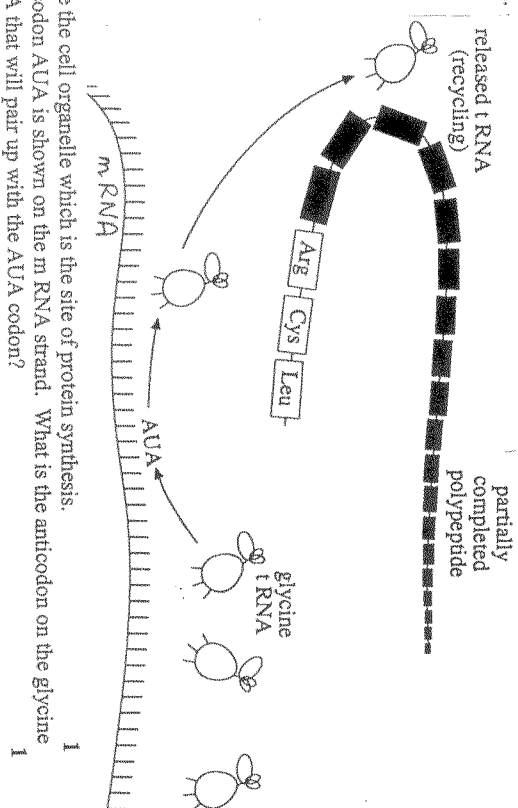
- (i) Assume that you are employed in a laboratory that has been studying recombinant DNA techniques using *E. coli*. The DNA for the coding of human growth hormone has been isolated and your job is to get *E. coli* to produce large amounts of this valuable product.

List the main steps that would have to be followed in order to get *E. coli* to make this hormone.

- (ii) Explain how the method of recombinant technology be used to identify the position of a gene on a human chromosome?

c) (6 Marks)

The following diagram represents the process of protein synthesis occurring within a cell.

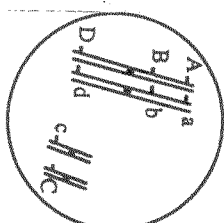


- i) Name the cell organelle which is the site of protein synthesis. 1
 ii) The codon AUA is shown on the mRNA strand. What is the anticodon on the glycine tRNA that will pair up with the AUA codon? 1
 iii) State TWO ways in which the structure of DNA differs from that of RNA. 2
 iv) Discuss the role of DNA in protein synthesis. 2

d) (3 Marks)

The Diagram below shows pairs of homologous chromosomes and the location of genes A, B, C, and D and their alleles a, b, c, and d, in the nucleus of a dividing cell.

Marks



- a) Explain why genes A and B are more likely to be inherited together than genes A and D.

- b) Explain why genes A and B are more likely to be inherited together than genes A and C.

c) (2 Marks)

The phenotypes of two parents are

- (i) O Rh+ (whose father was rh)
 (ii) B rh- (whose father was O)

State the possible genotypes and phenotypes of their offspring. Show working.

d) (5 Marks)

All body cells in an animal have identical genetic information but cells in different tissues become increasingly specialised in shape, chemical composition and function.

- (i) Identify the role of genes in embryonic development. 2
 (ii) Describe & give an example of a gene cascade. 2
 (iii) Explain the term "gene homologues"? 1