

SECTION 1

Total Marks (75)

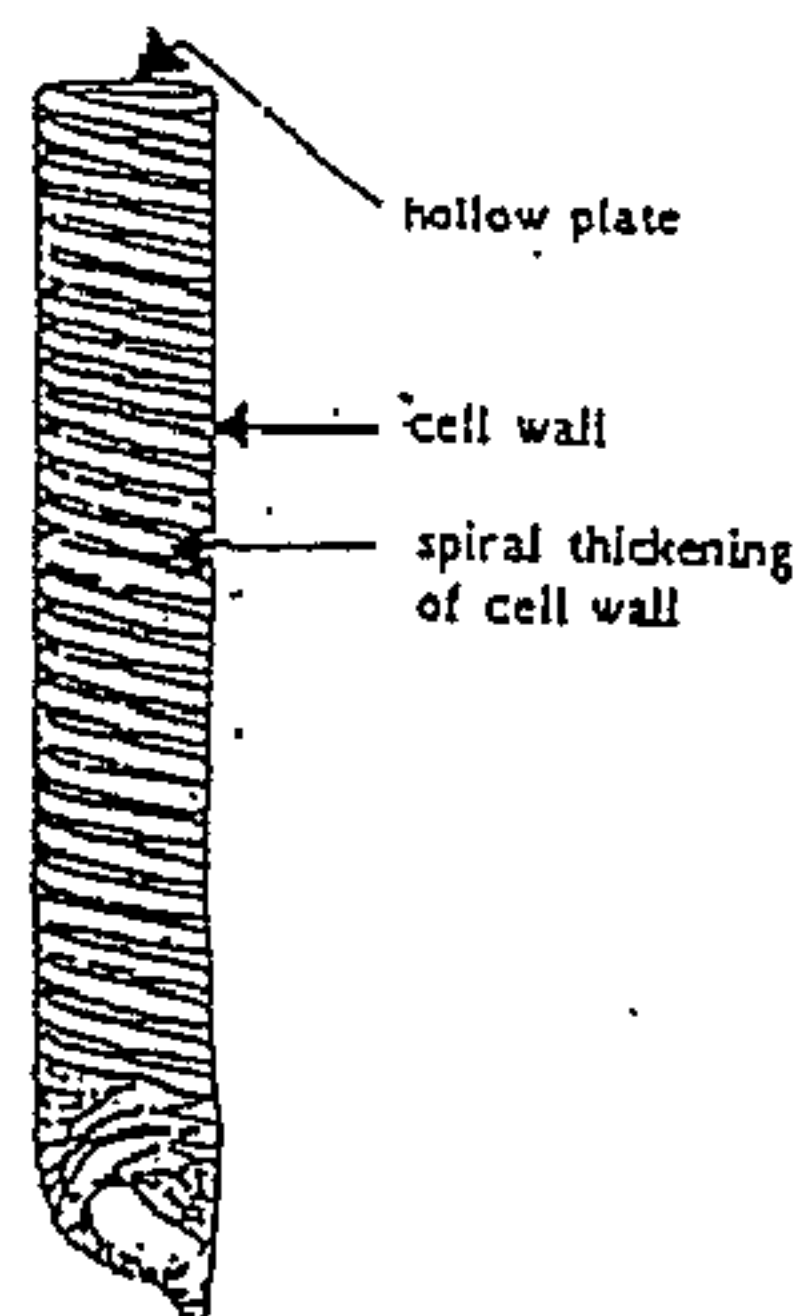
PART A. (15 Marks)

Use the multiple choice answer sheet.

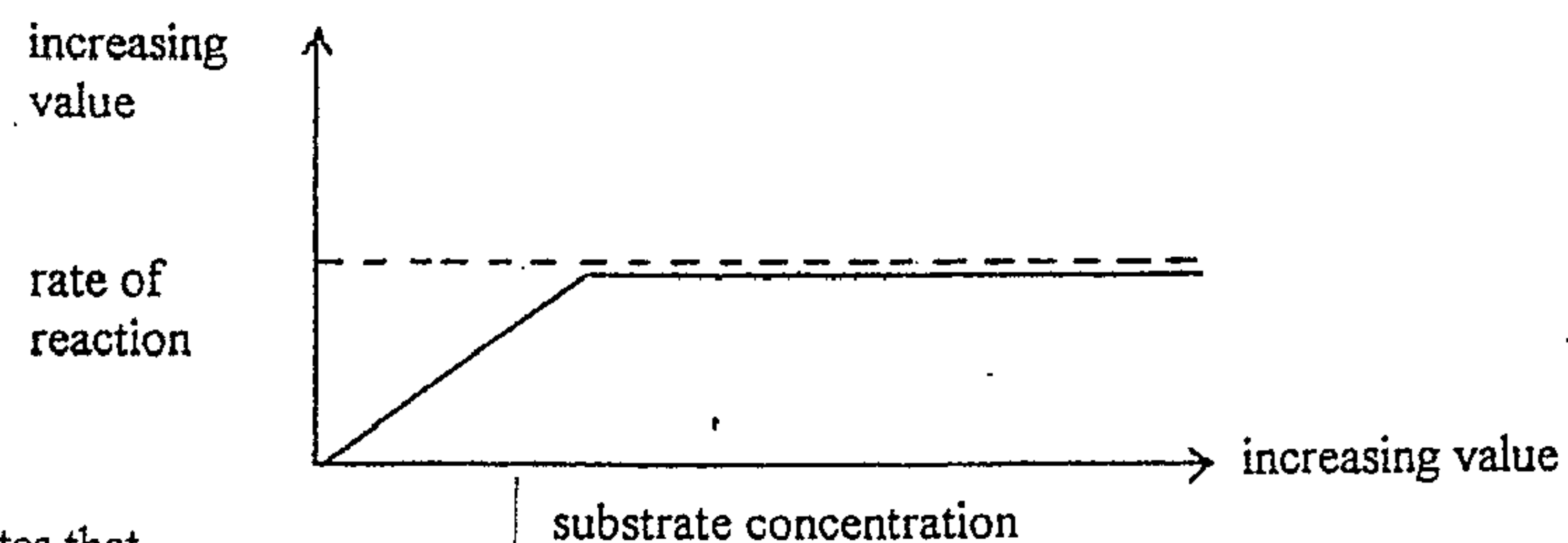
- Arteries are able to withstand high blood pressure because
  - they have a higher surface area to volume ratio than veins
  - they are connected to capillaries which deliver blood to the tissues
  - they have valves to force the blood under high pressure
  - they have a thicker elastic fibre/smooth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

- 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



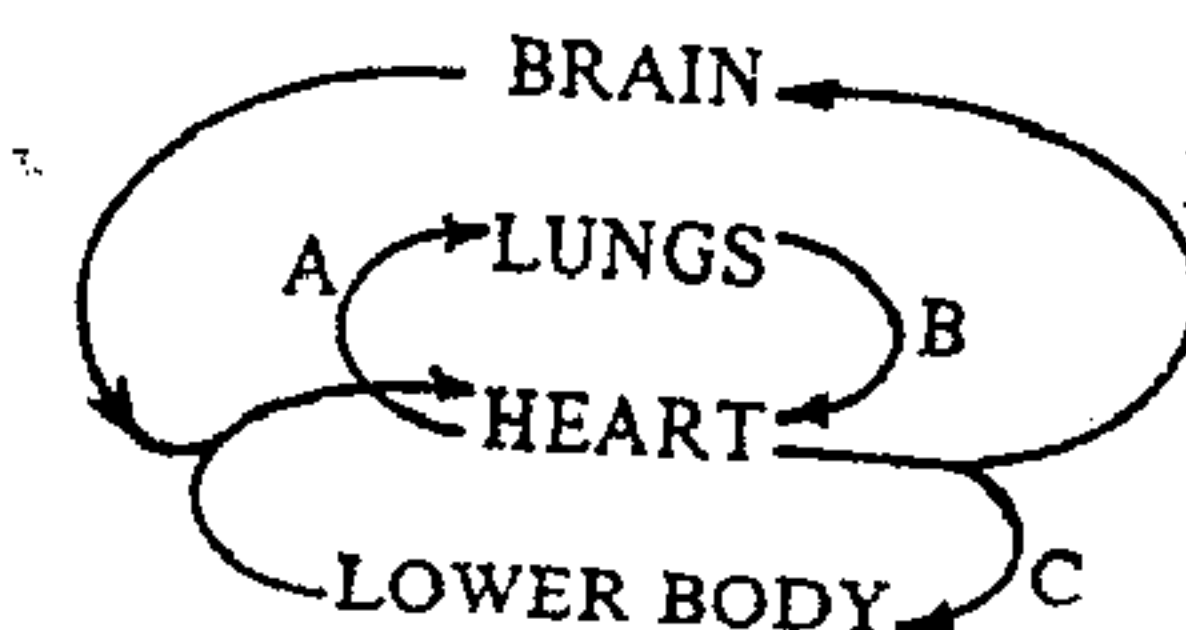
- The following graph shows the effect that the concentration of substrates has on the rate of an enzyme-mediated reaction



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

- 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
- 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
- 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
  - 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
  - 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

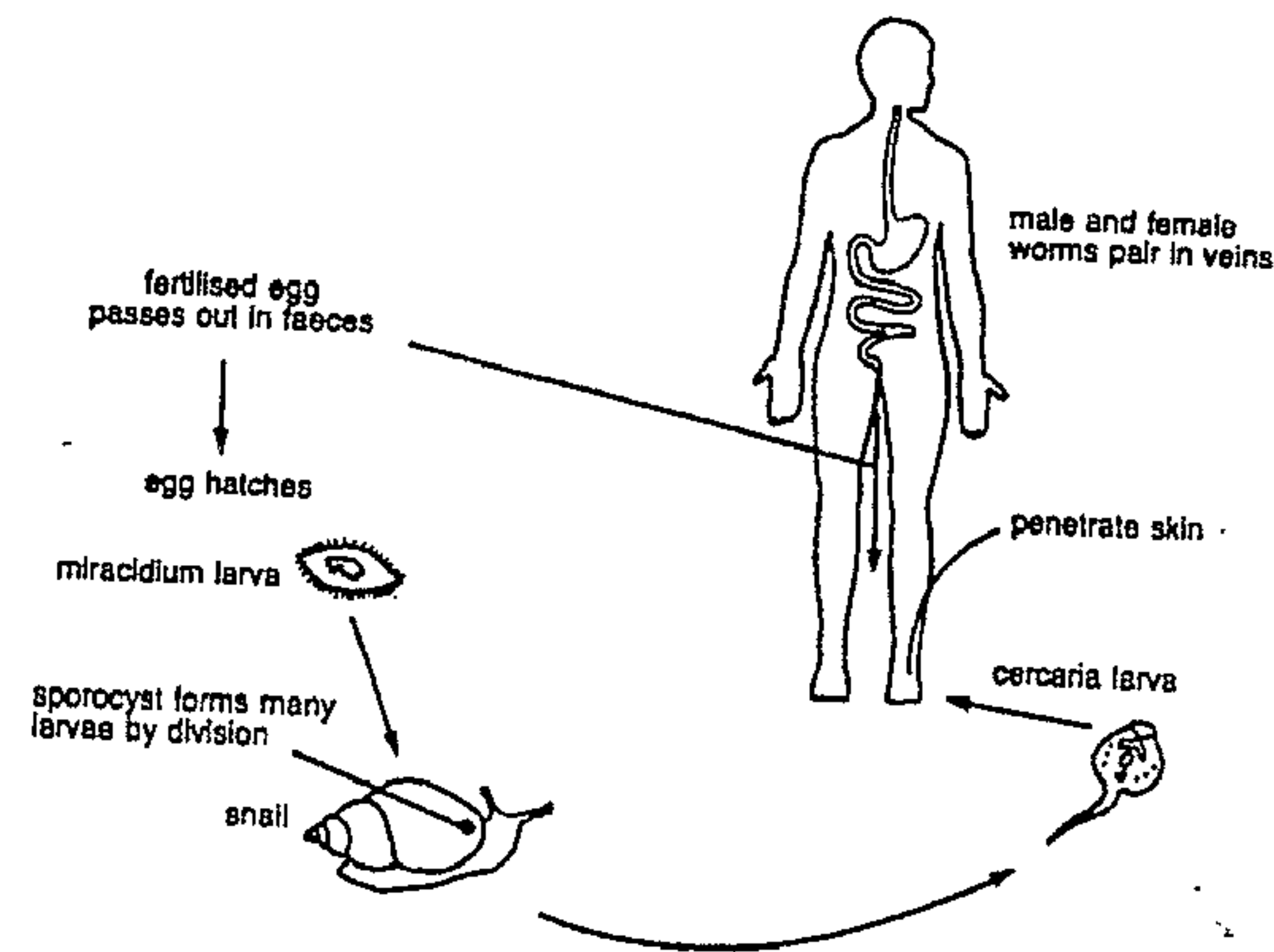
Handwritten notes:  $nn$   $N$  ( $n$ )  $nn$   
 $nn$   $N$   
 $Nn$   $Nn$   $nn$   $nn$   $N$  ( $n$ )  $nn$   
 $Nn$   $Nn$   $nn$   $Nn$   $Nn$   $Nn$   $N$  ( $n$ )

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 ( $\mu\text{m}$ )
a	✓	✓	✓	3 - 10
b		✓	✓	0.5 - 5.0
c				0.01 - 0.3
d	✓		✓	2 - 1000

Handwritten notes:  $nn$   $NA$   $Nn$   
 $NA$

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



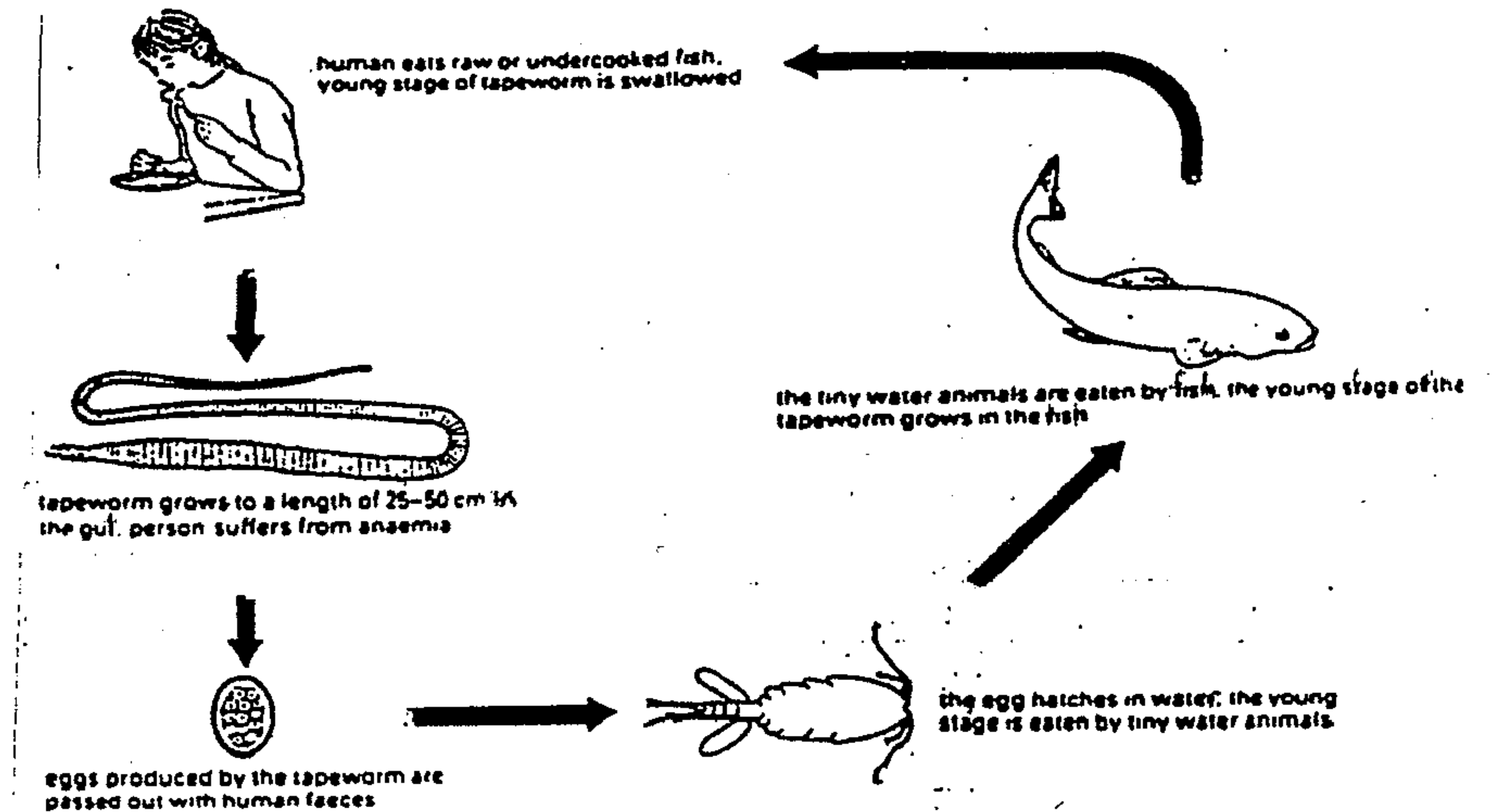
The vector for the disease schistosomiasis is the

- a) human  
 b) ceraria 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

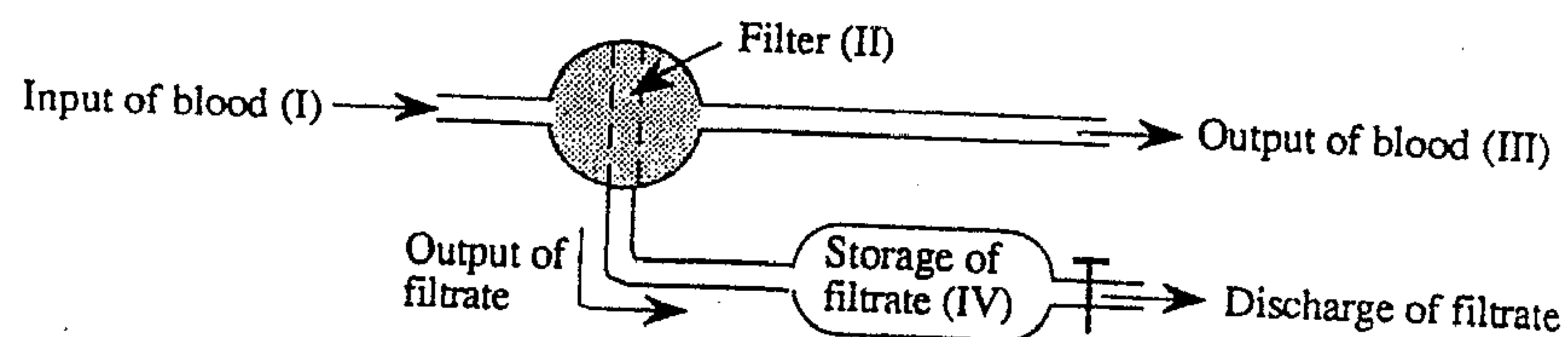
15. A protein molecule that causes disease is called a

- 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.

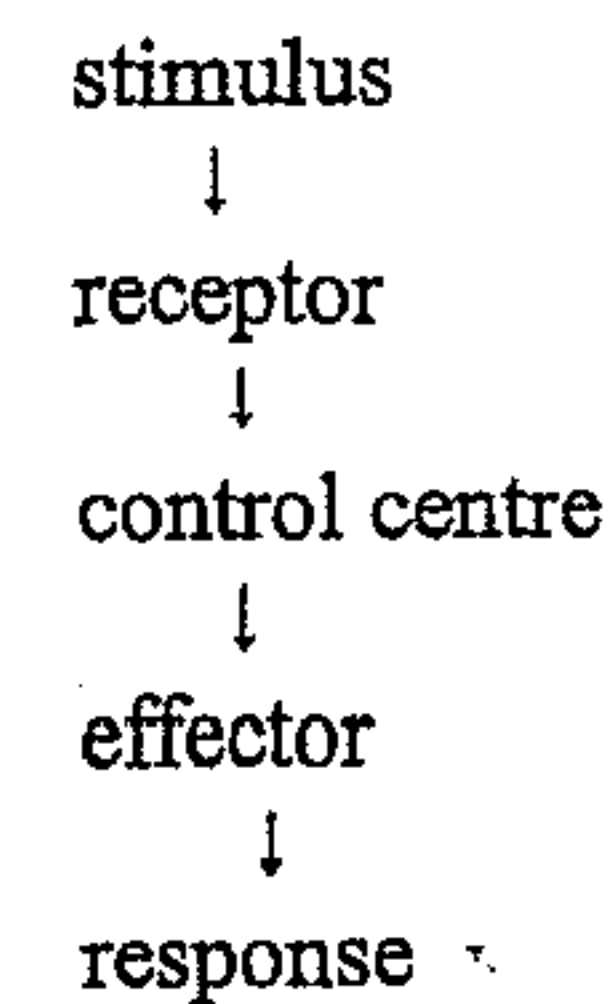


- (a) (i) Name the organ indicated by shading. 1  
 (ii) State the other function, besides filtering, that is performed by the organ indicated by shading? 1  
 (iii) Name TWO substances present in the blood in both I and III. 1  
 (iv) Name TWO substances present in both the blood in I and the filtrate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

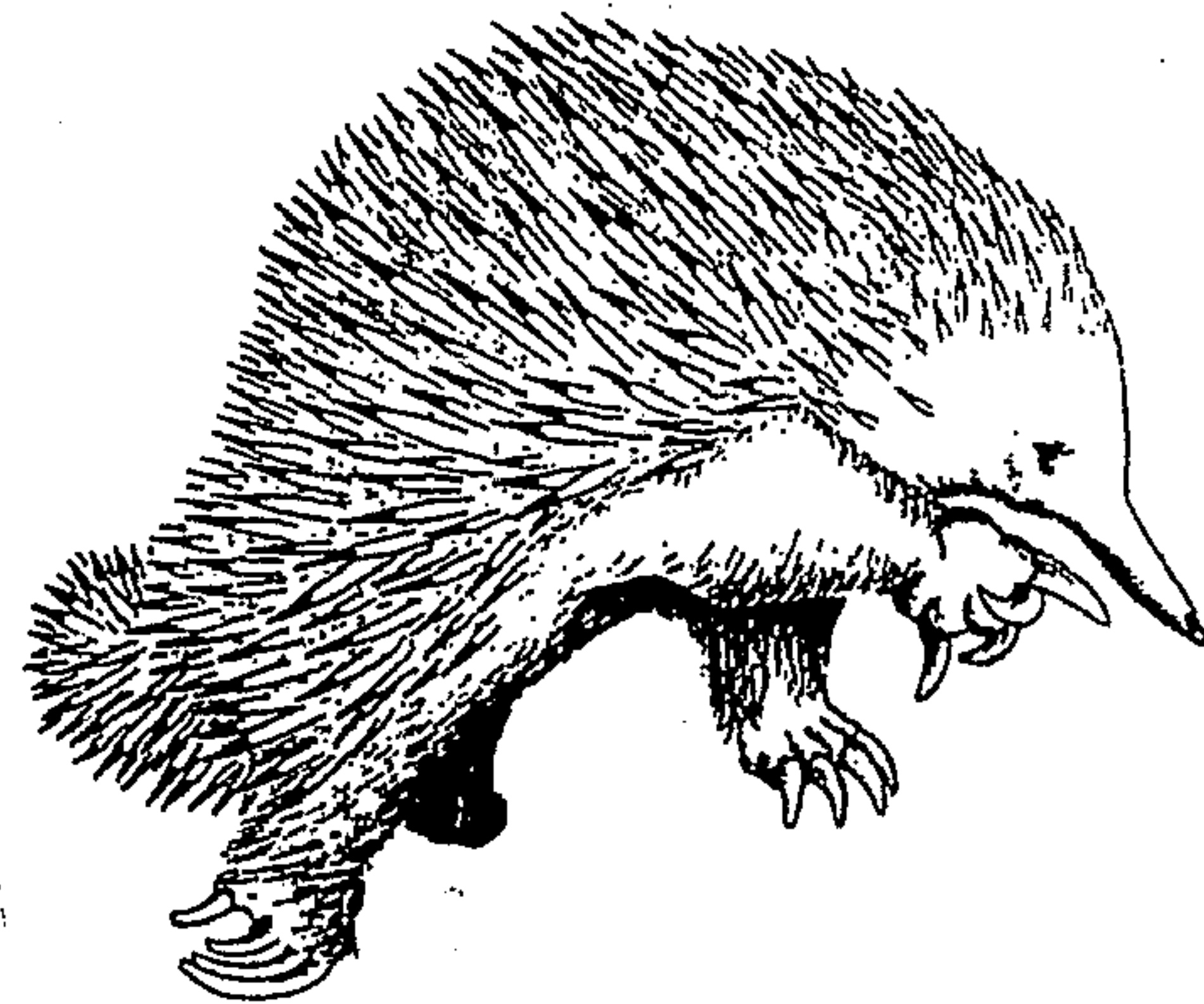


- a) If the stimulus is “lowered CO<sub>2</sub> levels in the blood”, describe the receptor, control centre, effector & response in a similar diagram on your answer sheet. Indicate clearly which part of your example corresponds to each word in the model. 4
- b) Explain the meaning of negative feedback, using the example in part (a). 2
- (6 marks)**
19. 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



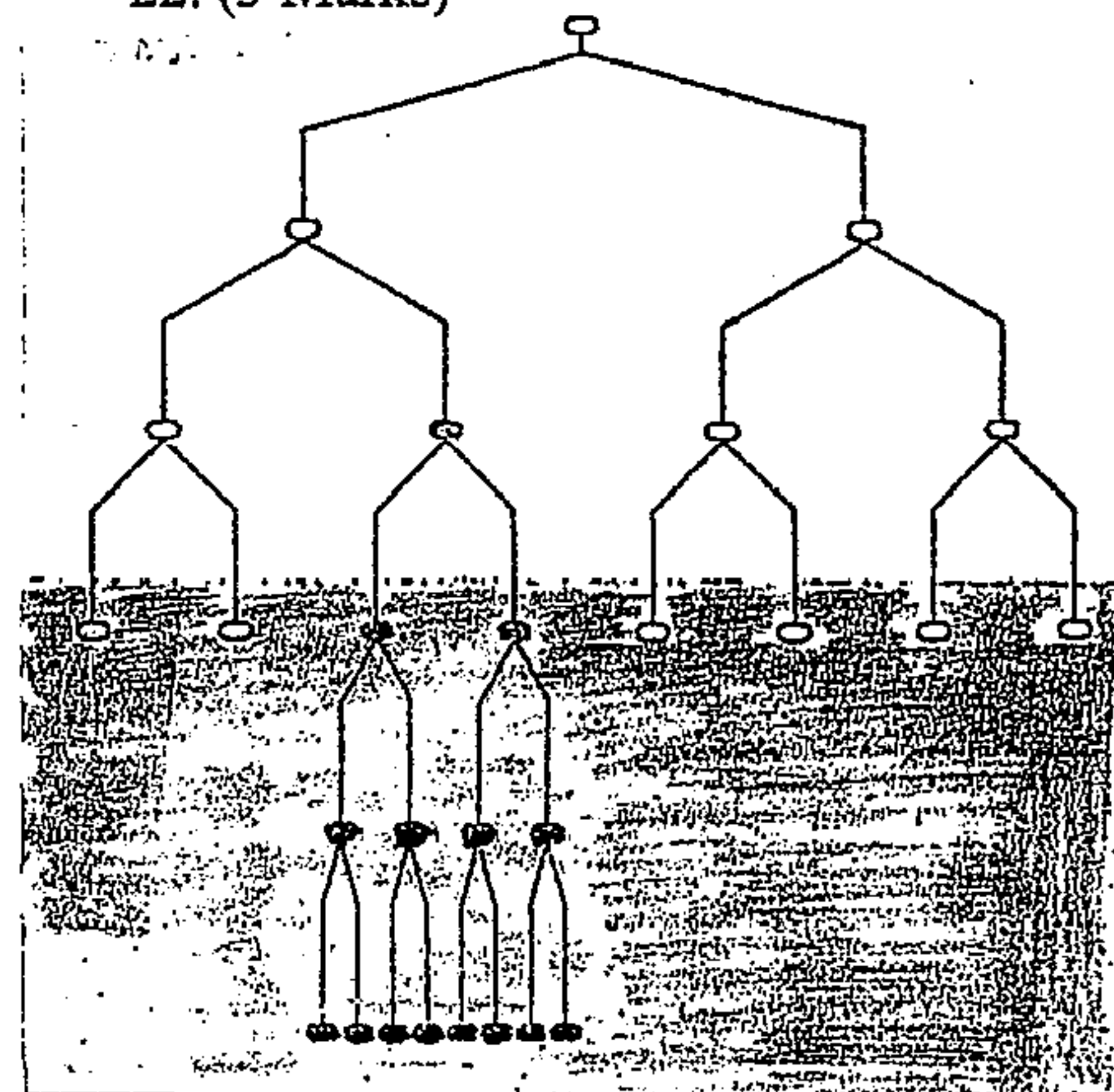
20. The Australian echidna (*Tachyglossus aculeatus*) possesses spines for protection from predators. (9 Marks)

Marks



- a) Explain how Darwin would have explained the evolution of the echidna's spines from normal mammal hair? 3
- b) 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
- c) 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.

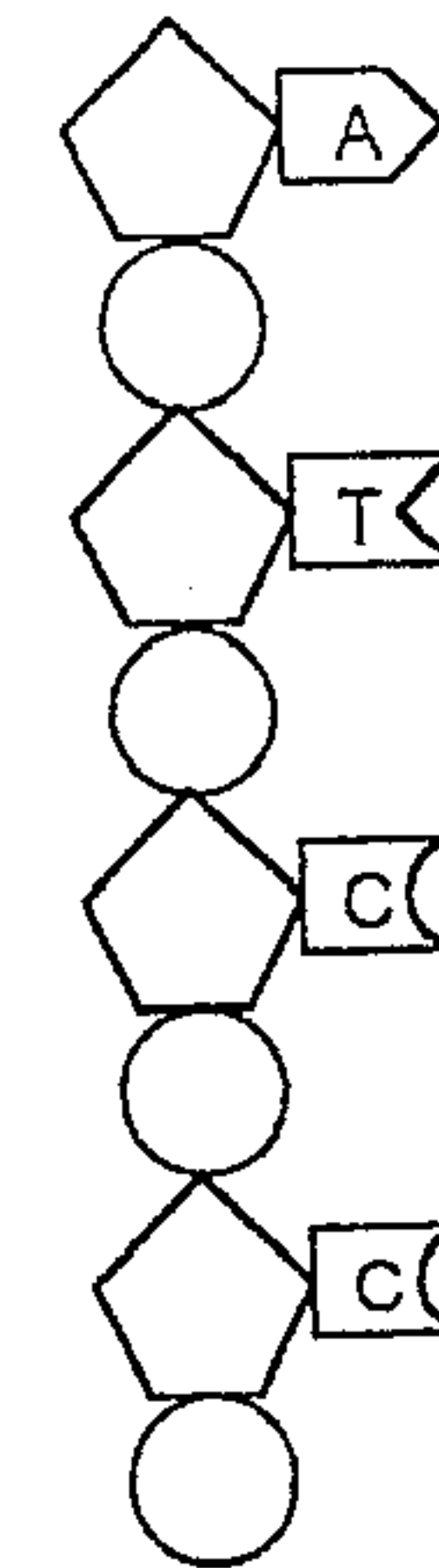
II  
IN A CHANGED ENVIRONMENT where streptomycin is present (grey area).

- a) Explain why the mutant strain in I remain rare? 1
- b) Describe what happens after streptomycin is added in II. 1
- c) 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.

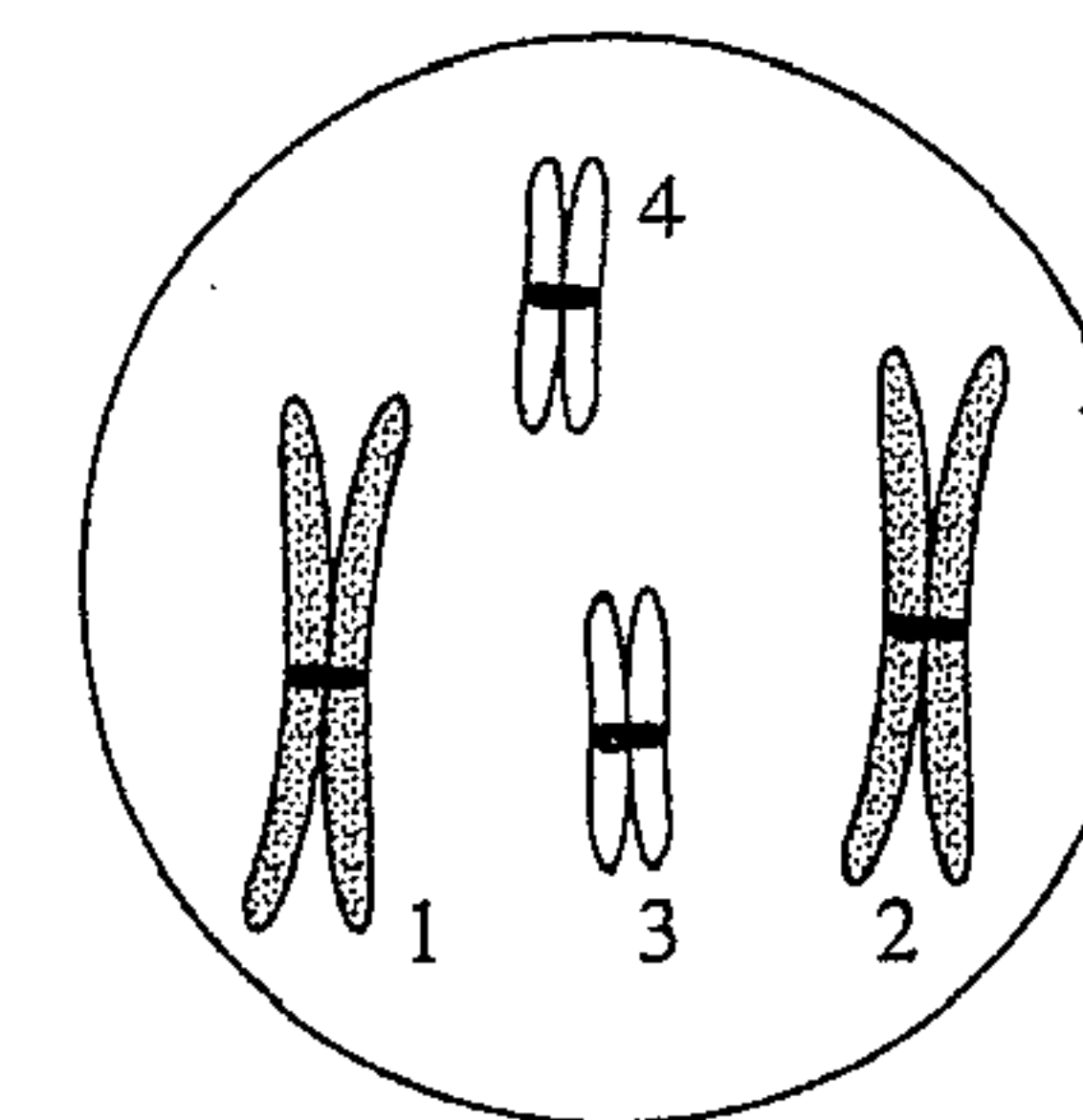
Marks



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.



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

SECTION II

GENETICS – THE CODE BROKEN (25 Marks)

Complete answers in Answer Booklet.

30. (3 Marks)

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. 3

b) (6 Marks)

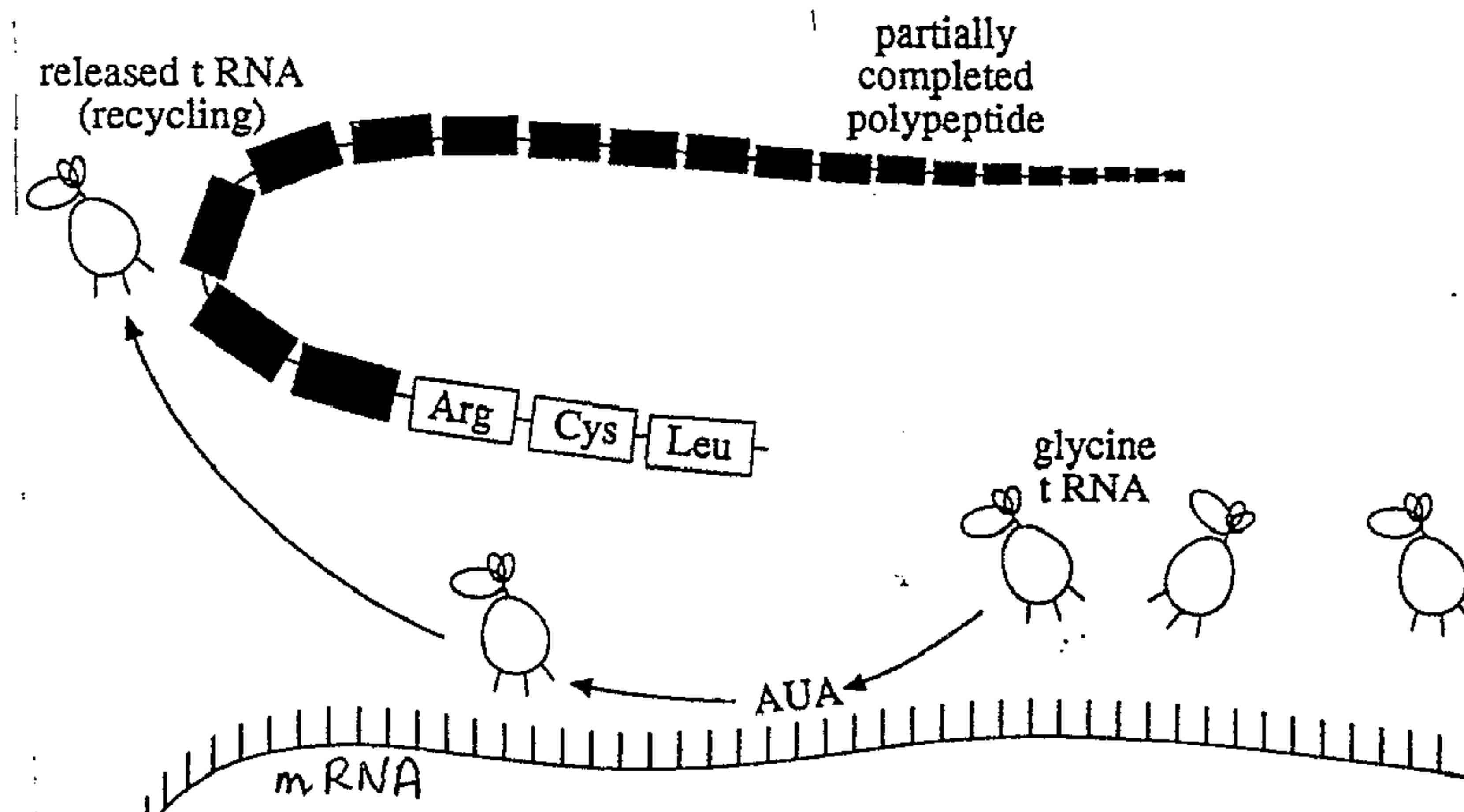
- (i) Assume that you are employed in a laboratory that has been studying recombinant DNA techniques using *E. coli*. The DNA for the coding of human growth hormone has been isolated and your job is to get *E. coli* to produce large amounts of this valuable product.

List the main steps that would have to be followed in order to get *E. coli* to make this hormone. 4

- (ii) Explain how the method of recombinant technology be used to identify the position of a gene on a human chromosome? 2

c) (6 Marks)

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

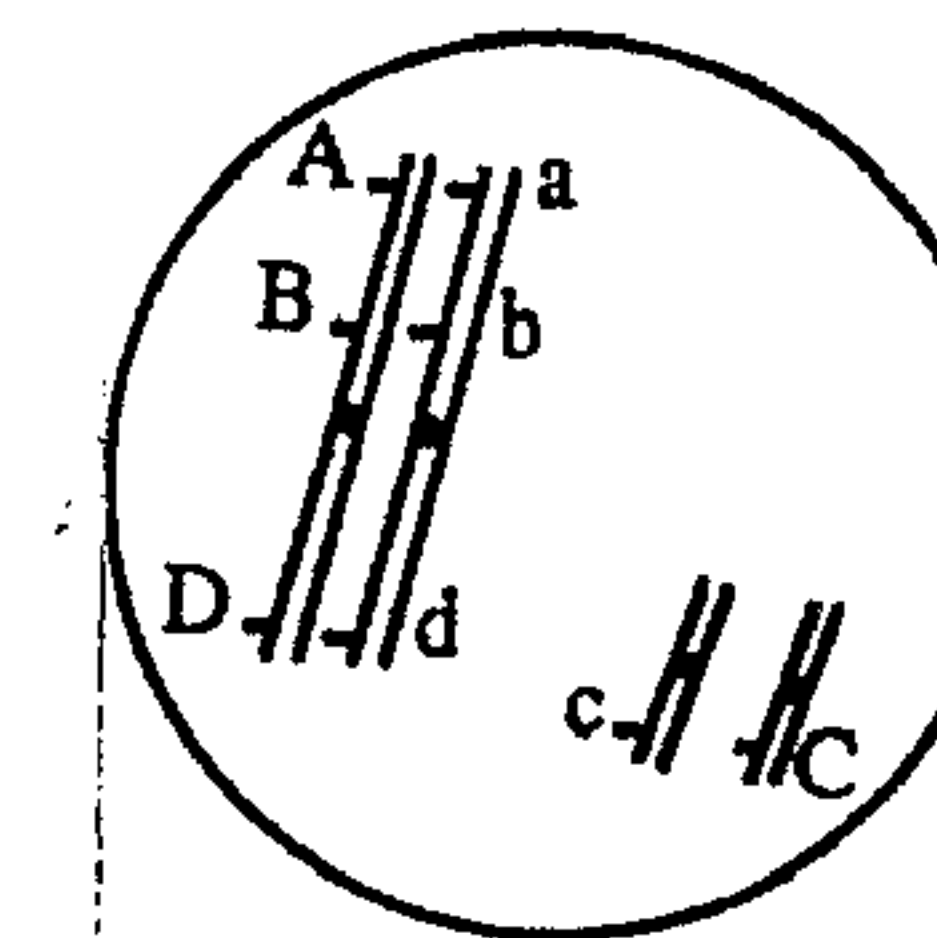


- i) Name the cell organelle which is the site of protein synthesis. 1  
 ii) The codon AUA is shown on the mRNA strand. What is the anticodon on the glycine tRNA that will pair up with the AUA codon? 1  
 iii) State TWO ways in which the structure of DNA differs from that of RNA. 2  
 iv) Discuss the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

d) (3 Marks)

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.



- a) Explain why genes A and B are more likely to be inherited together than genes A and D. 1

- b) Explain why genes A and B are more likely to be inherited together than genes A and C. 2

e) (2 Marks)

The phenotypes of two parents are

- (i) O Rh<sup>+</sup> (whose father was rh<sup>-</sup>)  
 (ii) B rh<sup>-</sup> (whose father was O)

State the possible genotypes and phenotypes of their offspring. Show working. 2

f) (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

25. (3 Marks)

Marks

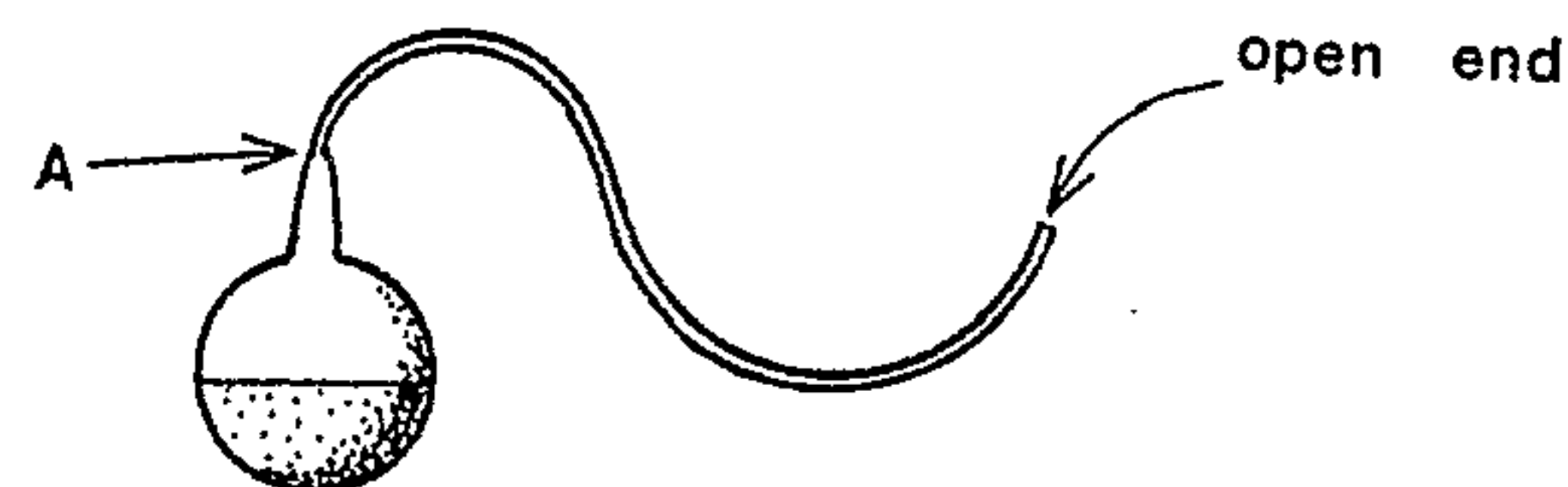
In cats, coat colour is a sex-linked characteristic. Black coat colour ( $B_1$ ) and yellow coat colour ( $B_2$ ) are co-dominant. A heterozygous combination ( $B_1B_2$ ) produces tortoise-shell coat colour.

- 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.

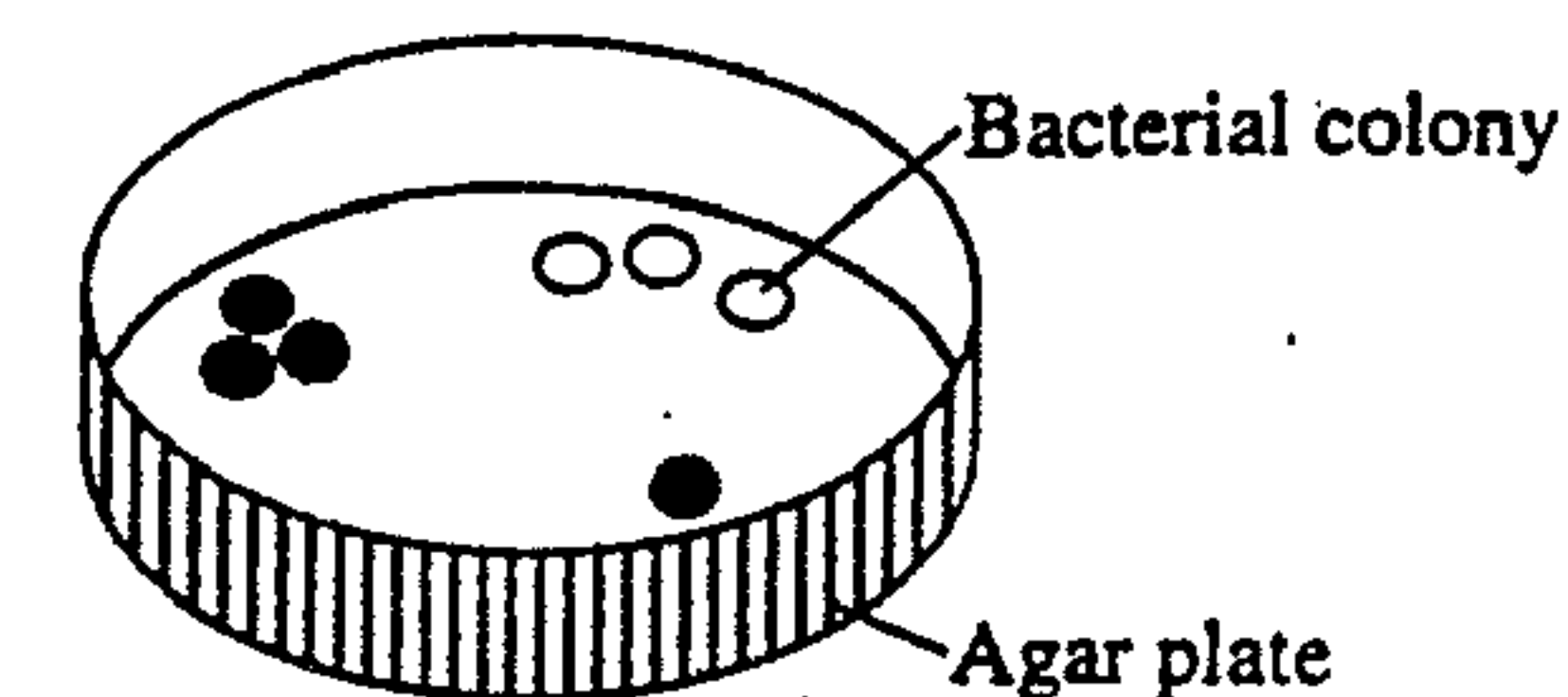
29. (4 Marks)

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



TRIAL HSC BIOLOGY EXAMINATION

2001

ANSWER BOOKLET

NAME: .....STAFF.....

NUMBER: .....

ATTEMPT ALL QUESTIONS.

SECTION 1

Part (a) Questions 1 – 15

Place a cross (x) in the most appropriate space.

	A	B	C	D
1				X
2			X	
3		X		
4			X	
5		X		
6	X			
7		X		
8			X	
9			X	
10	X			
11			X	
12				X
13			X	
14				X
15				X

not x A/c  
nN

SECTION I (Part B) 60 Marks  
 Questions 16 - 29

Question 16. (5 Marks)

- a) (i) kidney question says organ - not nephron
- (ii) reabsorption to maintain homeostasis / osmolarity / blood conc. / water salts
- (iii) protein, RBC  
glucose Keep it simple
- (iv) urea  
water some reabsorb to stable and +
- b) It maintains the blood water level - if there is low water level, more water is reabsorbed into the tubules, less water is excreted & urine is more concentrated, & if there is a high water level, urine is more dilute as less water is reabsorbed & so less water goes into the blood.

Question 17 (6 Marks)

- a) (i) Oxygen, glucose be specific not protein etc.
- (ii) CO<sub>2</sub> (mostly as HCO<sub>3</sub><sup>-</sup>) & H<sub>2</sub>O waste not just excrete
- b) Both consists of long tubing which winds through their tissues (in plants) not just explain what transport system is it transports count needs to be specific

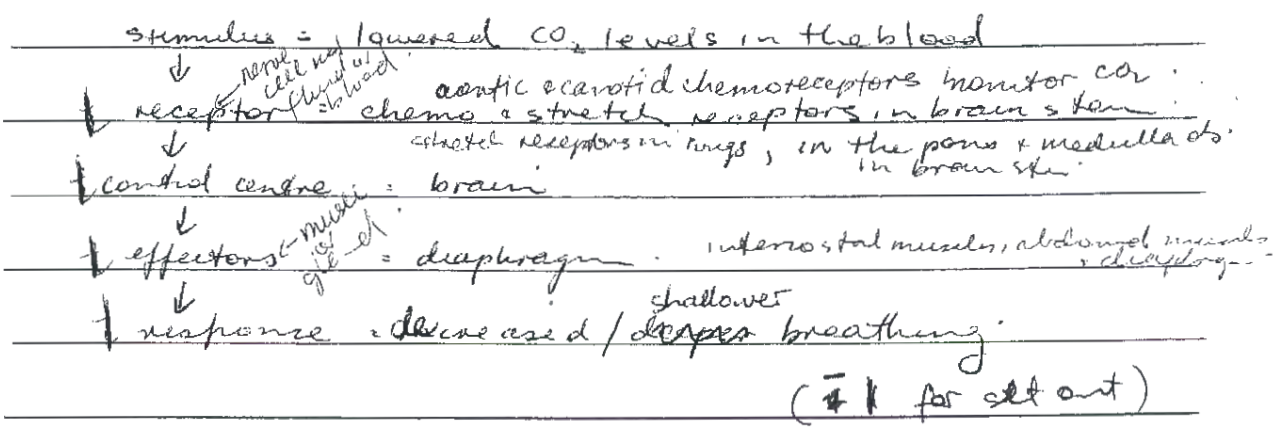
	Mammals	Flowering plants
Vessels	arteries veins capillaries	xylem (↓) phloem (↑)
<small>choice is very diff. path should relate to transport &amp; energy source factors</small>	<small>total 2 types vessel for 11 marks</small> O <sub>2</sub> , glucose, a.c., vitamins, antibodies, water, RBC, WBC, hormones. respiration (ATP) → heat, muscles	<small>sun → transpiration ATP → respiration</small> x - water + mineral ions p - sucrose solution



d) Describe one way - relate to homeostasis  
 waste products are transported to the kidneys  
 for excretion eg urea is carried from liver by the blood to kidneys for removal in urine OR hormones eg aldosterone, ADH transported in blood to target organs to maintain water & salt balance.

Question 18 (4 Marks)  $\frac{1}{2}$  if too general

answer to Q  
 → 19  
 as  
 this  
 is  
 the  
 answer



(b) Negative feedback - an increase in some factor is sensed & lowered eg lowered levels  $CO_2$  is sensed & breathing rate is decreased (increases  $CO_2$  level in blood).

Question 19 (6 Marks)

a) named species genetically altered: don't confuse with genetic engineering  
 genetically modified salmon,  
 impact of the use of genetic engineering on diversity of species or how

answer to  
 → Q18

In the short term it would seem like an increase in genetic diversity. However, in the long term if the organism is successful (eg if released or escape into the wild population they may wipe out other fish populations or transfer their genetically engineered genes to wild population & a decrease in genetic diversity will occur. The creation of new genetic combinations may occur to the point where the original genes may be lost from the population & that species may be vulnerable if environmental conditions change.

b) (see previous page)

Question 20 (6 Marks)

a) <sup>no mutations - 1</sup>  
In the ancestral population of echidnas there were variations - some of the more advantageous characteristics which allowed them to survive, reproduce & <sup>or descendants</sup> pass on their characteristics. <sup>which 1/2</sup> Over many generations <sup>or descendants</sup> an increasing number with the favourable variation.

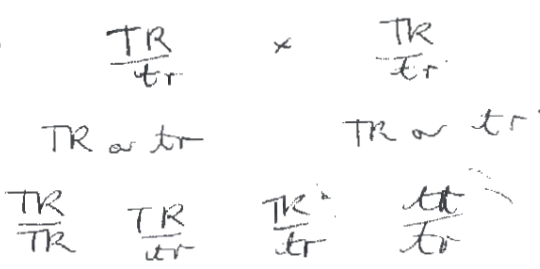
b) Convergent evolution: e.g. seals & dolphins <sup>both have</sup> limbs modified as flippers, strong swimmers, thick layer of fat, because they occupy a similar niche. <sup>could get 2/3 for divergent or convergent</sup> Similar characteristics are selected by natural selection in quite different orders of mammals.

c) <sup>for technology</sup> new technology: biochemical evidence e.g. looking at amino acid sequence in proteins e.g. haemoglobin & DNA hybridisation reveal humans & chimpanzees are more closely related than either is to gorillas. <sup>2 marks discussion</sup> Previously due to fossil evidence & comparative anatomy it was thought gorillas & chimps more closely related than either to humans.

Question 21 (9 marks)

a)  $2N=14$  indicates 7 pairs of homologous chromosomes. The 7 characteristics could be determined by gene pairs on the 7 different pairs.

- a problem for dihybrid ratio, not monohybrid.  
b) Yes if some alleles were linked they would be inherited together (e.g.  $\frac{TR}{tr}$  could produce 2 types of gametes TR or tr but if assorting independently on different pairs of chromosomes TtRr could produce 4 gametes TR, Tr, tR, tr. Mendel would not have got the same results. <sup>messy over would have further complicated the issue</sup>



experimental factors -

c) aspects which led to his success included: pea plants are self pollinating, he could cross pollinate by hand, the characteristics were easy determined by a single pair of genes that were located on separate chromosomes, mendel repeated his experiments many times, kept records of thousands of offspring, applying mathematics to his results  
started with pure breeds

Question 22 (3 Marks)

a) there was no advantage in having the antibiotic resistance in an antibiotic-free environment i.e. numbers low of antibiotic resistant bacteria. (mutations are so few with this form (may be at a disadvantage too))

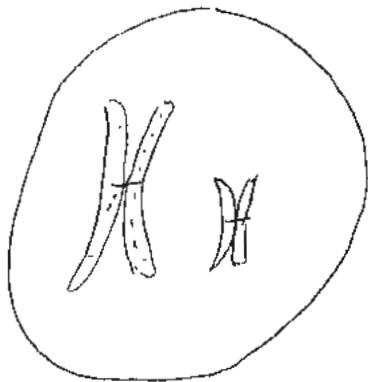
b) there is an increase in the numbers of antibiotic resistant bacteria & a decrease in the normal E. coli bacteria - die out & reproduced

c) theory of evolution by natural selection.

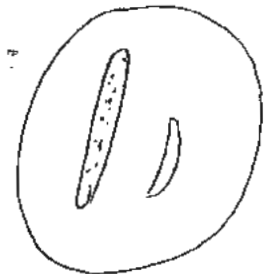
Question 23 (2 Marks)

penicillin would kill a normal cell but may have generations to reproduce

Q24 (a)



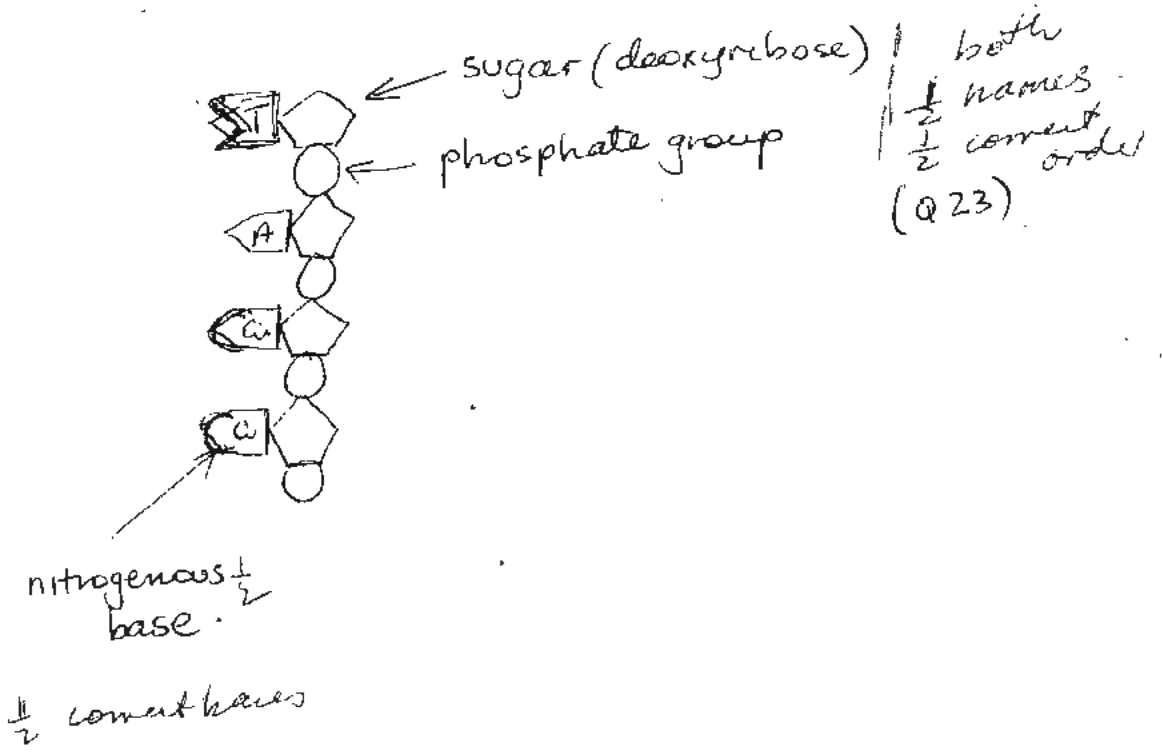
b)





Question 24 (2 marks)

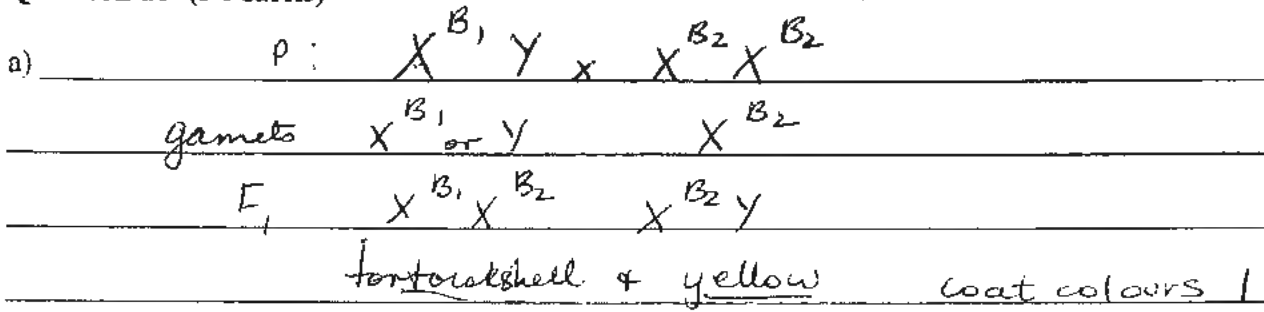
a)



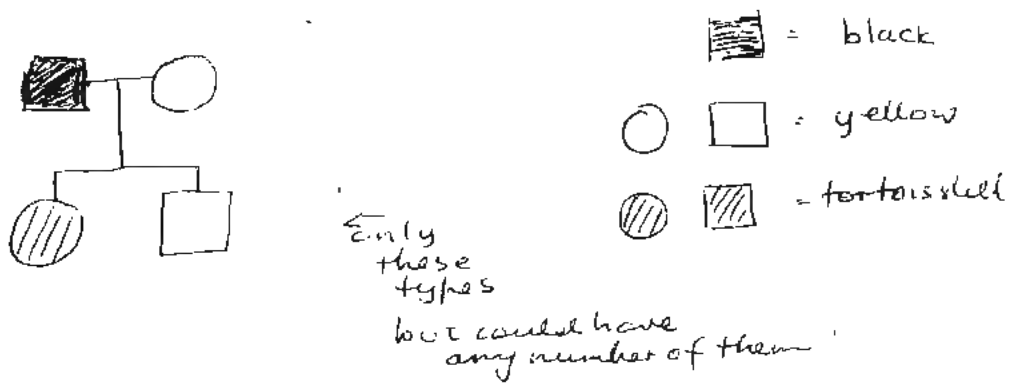
b)

Question 25 (3 Marks)

$B_1$  = black  
 $B_2$  = yellow



b)



1 correct pedigree  
 1 code

If did a Punnett square or cross instead of pedigree then could still get 1 for key/code

Question 26 (4 Marks)

- a) He provided nutrient solution for the microbes to grow & this flask had a curved neck which allowed entry of air but trapped any microbes in the curve & preventing decay of broth.
- any 3
- He boiled the nutrient solution for several minutes & thus killed any microbes that were in curved tube.
  - He allowed the flask to stand for a long time before the neck was broken. This allowed sufficient time for spontaneous generation to occur if it was to happen at all.

Breaking the neck at A allowed direct entry of bacteria thus causing decay

b)

flask  
control: same contents & boiled in  
same way as Pasteur's flask. However the  
control flask would have an uncurved  
tube protruding straight up from the flask.  
together they will show if it takes a month  
before decay shows

(bells were killed  
washed)  
(prefer agar to liquid base)

Question 27 (4 Marks)

a) Obtain 2 agar plates <sup>nutrient</sup> that have been sterilized & sealed  
for 5 mins then seal.  
One plate is exposed in the classroom the other is kept sealed.  
(control). Place both plates in a warm place or incubator <sup>encourage growth</sup> for  
48 hrs & examine them. The "open" plate shows bacterial  
& fungal growth but the control plate remains clear.  
This shows that the air is full of microorganisms. <sup>the result not necessary</sup>

b) The bacterial colonies are <sup>small,</sup> shiny and often cream or yellow  
the fungal colonies; fuzzy appearance, large size  
usually grey, dark green, black.  
OR microscopic examination  
bacteria - prokaryotic (no nucleus) fungus - eukaryotic nucleus



a) (3 Marks)

Propagated by seeds! This is sexual reproduction which produces genetic variation in the offspring. In a changing environment favourable characteristics can be selected & passed on. This enables the species to survive.

mutation can occur (not)

b) (6 Marks)

(i) A plasmid would be extracted from E. coli. A restriction enzyme would be used to cut the plasmid & the gene for human growth hormone at the same place, leaving "sticky ends". The growth hormone gene would then be spliced into the plasmid and the recombinant plasmid would be inserted into E. coli where it would replicate as the bacteria multiplied. Human growth hormone is synthesised by the bacteria & can then be extracted from the bacteria.

(ii) The gene is cloned using recombinant DNA (gene is cut & spliced into bacterial plasmid from human genome). A radioactive probe of the complementary base sequence which can pair with the original gene (annealing and hybridisation). Autoradiography (stains & fluorescent dyes) can reveal the binding site. The ordering of the genes is achieved by gel electrophoresis & probes which allows the ordering of the fragments of chromosomes.

cut using restriction enzymes  
sorted gel electrophoresis  
Southern blotting  
Radioactive probes  
JRAHS - Biology Trial HSC Answer Booklet  
photography (autoradiography)

cloned gene (recombinant DNA)  
↓  
make a probe for a gene (complementary sequence)  
↓  
probe binds to gene identify its position on a (hybridisation)  
particular chromosome  
↓  
autoradiography - position revealed

protein/polypeptide chains damaged

Question 28 (2 Marks)

should state where eg  
alimentary canal - sleep & etc

a) by hydrochloric acid in the stomach destroying  
microbes & by antimicrobial action of saliva.  
(lysosomes)

b) hairs in nose trapping organisms which can be expelled  
by sneezing OR Sticky mucus is produced & traps dust particles & pathogens -  
also sweeps the mucus to back of throat where it is swallowed or coughed out

Question 29 (4 Marks)

• The bacteria A or B should be always present in every  
diseased organism

• The microbe should be isolated from the diseased  
organism & grown in pure culture - it would  
resemble either A or B.

• Microbes taken from the pure culture should be  
injected into healthy <sup>why not!</sup> <sup>lots!</sup> organisms (without disease) & they must  
produce the disease

• Microbes are isolated from these organisms, grown  
in pure culture & compared with the microbes in  
original culture & with A or B on plate & should  
be identical.

c) (6 Marks)

i) ribosome

ii) UAC

iii) DNA RNA

• sugar is deoxyribose      sugar is ribose

• Bases: A G C T      Bases A G C U

• double stranded      • single stranded

iv) The sequence of bases in DNA is transcribed into a sequence of

bases in m-RNA. Each aa is brought to ribosome by t-RNA molecule. Amino acids are assembled in order specified by m-RNA. Thus DNA is translated into a sequence of a.a + hence DNA determines which protein is formed

d) (3 Marks)

a) A + B are closer together than A + D & the chance of them being separated by crossing over is low.

b) A + B are linked on the same chromosome & are not going to be separated when chromosome pass randomly segregate! A + C may ~~seg~~ have this chromosome segregate together or A c. genes don't seg apart.

e) (2 Marks)

P:  $i i R h^+ r h^-$  x  $I^B i r h^+ r h^-$

gametes  $i R h^+$  or  $i r h^-$        $I^B r h^+$  or  $i r h^-$

F<sub>1</sub>  $I^B i R h^+ r h^-$ ,  $i i R h^+ r h^-$ ,  $I^B i r h^+ r h^-$ ,  $i i r h^+ r h^-$  (genotype)

B Rh<sup>+</sup>, O Rh<sup>+</sup>, B Rh<sup>-</sup>, O rh<sup>-</sup> (phenotypes).

preferably do not do separately.



f) (5 Marks)

(All cells contain all the information to produce all types in their nucleus)

(i) Genes can be turned on or off & control cell differentiation

Gene expression is influenced by (i) the position of that cell in

the embryo (chemicals from neighbouring cells can diffuse into a cell, altering the expression) (ii) the presence of certain proteins (activators/repressors) which interact with DNA causing genes to be switched on or off.

(ii) Certain parts of the body requires the switching on of many genes

eg in limb formation, in mammals a sequence is turned on one after the other (proteins produced by each gene regulates expression of the next)

eg genes for the control of blood vessels, nerves, muscles etc.

(iii) or homeotic genes - many <sup>species</sup> organisms share these genes.

these indicate common ancestry eg yeast & humans share certain "hedgehog genes" eg genes that control embryonic development in many different species.

