The Institute of Animal Technology

FELLOWSHIP EXAMINATION 2001

Section B – BACKGROUND SUBJECTS

Afternoon, Tuesday 12th June

(TOTAL TIME: 3 HOURS)

Part I

Long Answer Questions

Part II

Short Answer Questions

Write your candidate number in the top right hand corner of this cover sheet

Read the instructions for each part carefully

Part I

Long Answer Questions

Attempt THREE of the four questions

Write your answers on the paper provided

Start each new answer on a fresh sheet of paper
Write on one side of the paper only

Write your candidate number in the top right hand corner and the question number in the top left hand corner of every answer sheet

You are advised to spend half an hour on each question

Equal marks are available for each question. The approximate percentage of marks available for each section of the question is indicated

Credit will be given for suitable illustration

You must hand in all answer sheets at the end of the examination

Attempt THREE questions

1. Describe the way in which lymphocytes react to antigens.

(100%)

2. What is the role of mitosis in growth?

(10%)

Describe mitotic cell division in animal cells.

(90%)

3. How does the structure of a nephron suit it to its function?

(100%)

4. Give an account of the principal adaptations shown by the parasites of mammals.

(100%)

End of Part I

Part II

Short Answer Questions

Attempt ALL Questions

Write your answers in the spaces provided

Numbers in brackets indicate the marks available for each question

You are advised to spend one and a half hours on this part

Hand in this book, together with your answers to Part I, at the end of the examination

Attempt ALL Questions

1. Give the terms of which the following are definitions:

one form of a gene

……………………………………………………..………………………..
(1)

having three or more chromosome sets

……………………………………………………………………………..
(1)

process by which an inheritable change occurs in a gene

……………………………………………………………………………….
(1)

the sum total of the genes in a breeding population

……………………………………………………………………………….
(1)

2. Explain the meaning of the following genetic terms:

heterogametic ……………………………………………………………..

……………………………………………………………………………..
(1)

autosomes ……………………………………………………………………

……………………………………………………………………………..
(1)

lethal in the homozygous condition …………………………………………...

……………………………………………………………………………..
(1)

3. Mice from a group known to be heterozygous for genes A and B were mated with a group known to be homozygous recessive for both genes.

The resultant offspring are shown in the table:

Genotypes	Numbers
AaBb	151
aabb	146
Aabb	53
aaBb	59

If the genes A and B were independently inherited, in what ratio would you have expected the four genotypes above to occur?

…………………………………………………………………………………..

(1)

Do the actual results obtained confirm your predictions?

…………………………………………………………………………………..

(1)

How could the actual results be explained? Explain your answer.

……………………………………………………………………………………

…………………………………………………………………………………..

(1)

4. Coat colour in rabbits is determined by multiple alleles. Chinchilla coat (C^{ch}) is dominant to Himalayan coat (C^h). The allele for full coat colour (**C**) is dominant to both these, whereas the albino allele (**c**) is recessive to all the others.

What is meant by 'multiple alleles'?

……………………………………………………………………………………

…………………………………………………………………………………..

(1)

State the number of alleles for coat colour that would be found in the cells of an individual rabbit.

……………………………………………………………………………………………..

(1)

List all the possible genotypes for the following rabbits:

heterozygous for full coat

……………………………………………………………………………………..

(1)

homozygous for Himalayan coat

……………………………………………………………………………………..

(1)

heterozygous for chinchilla coat

……………………………………………………………………………………..

(1)

What offspring phenotypic ratios would be expected from the following crosses:

C^hC^{ch} x C^hC^{ch}:

……………………………………………………………………………………..

(2)

Cc x C^hC^{ch}:

……………………………………………………………………………………..

(2)

5. Define the term 'species'.

……………………………………………………………………………………

………………………………………………………………………………..

(2)

6. Consider the following information which relates to three animal species, **A**, **B** and **C**.

Feature	Species A	Species B	Species C
Adult habitat	Water	Marine	Terrestrial
Mating site	Water	Water	Land
Site of embryo development	Water	Uterus	Egg
Type of skeleton	Internal	Internal	Internal
Epidermal covering	Mucus	Hair	Scales

In which species is fertilisation internal? …………………………………..

Which species will release the largest number of eggs at any one time, and why?

……………………………………………………………………………………

…………………………………………………………………………………..

Which species uses gills for gaseous exchange during an independent stage of its life cycle?

…………………………………………………………………………………..

Which taxonomic Class does each of the species belong to?

Species **A**…………………………   Species **B**……………………………

Species **C**…………………………

(Total:8)

7. Lice and ticks are wingless arthropods. Give **two** criteria by which they can be distinguished.

………………………………………………………………………………

………………………………………………………………………………
(2)

8. Name the stages in the life cycle of:

a flea …………………………………………………………………...
(1)

a cockroach …………………………………………………………
(1)

9. In the space below draw a diagram to show the general structure of a bacteriophage : clearly label **two** important components.

(2)

Which component of the bacteriophage enters the host cell during the process of infection?

…………………………………………………………………………..
(1)

What subsequently happens to this component?

…………………………………………………………………………..
(1)

10. Name **one** laboratory animal disease caused by a virus.

………………………………………………………………………………………
(1)

Give **two** ways in which viruses are transmitted from one host to another.

………………………………………………………………………………….…
………………………………………………………………………………………..
(2)

11. Define the following terms:

tissue …………………………………………………………………………….

………………………………………………………………………………………..
(2)

organ …………………………………………………………………………..

………………………………………………………………………………………..
(2)

12. What type of epithelia line the following:

dog stomach…………………………………………………………………………

rat stomach …………………………………………………………………………..

bladder ………………………………………………………………………………..

bronchus ……………………………………………………………………………..

nasal cavity …………………………………………………………………………..
(6)

13. The diagram represents a group of body cells and some parts of the circulatory system. The arrows show the direction of movement of fluids.
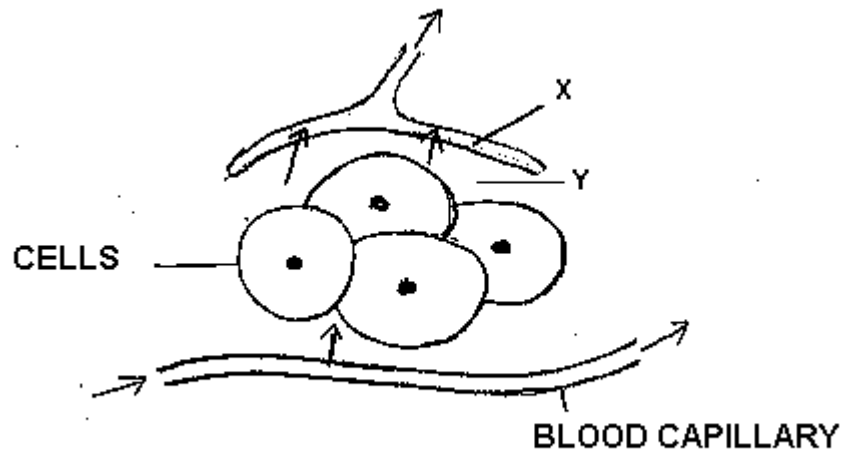
Name the fluid contained in **X**.

……………………………………………………………………………………
(1)

Name the fluid contained in **Y**.

……………………………………………………………………………………
(1)

Describe how the fluid in **X** is returned to the general blood circulation.

……………………………………………………………………………………
(1)

14. Complete the table to give **four** differences between arteries and veins.

Arteries	Veins

(4)

15. Name the major vessels supplying and removing blood from the liver.

....

....

....

(3)

16. Describe the role of each of the following in the process of blood clotting:

platelets ....

....

thrombin ....

....

calcium ions..

....

damaged tissue ....

....

fibrin ....

....

the liver ....

....

(6)

17. Briefly explain what the following measurements are:

systolic arterial blood pressure…………………………………………….. ……………………………………………………………………………………….
(1)

diastolic arterial blood pressure …………………………………………... ……………………………………………………………………………………….
(1)

mean arterial blood pressure ………………………………………………… ……………………………………………………………………………………….
(1)

central venous pressure …………………………………………………. ……………………………………………………………………………………….
(1)

18. State where the following hormones are produced in the mammalian body:

insulin …………………………………………………………………………

testosterone……………………………………………………………………..

oestrogen ………………………………………………………………………...

adrenaline ……………………………………………………………………..

thyroxine …………………………………………………………………………
(5)

19. List the main ways in which substances may be transported across the cell membrane.

………………………………   …………………………………
………………………………   …………………………………
(4)

20. Hormones are distributed by blood and tissue fluid to all cells of the body, but they affect only certain cells. Suggest an explanation for this.

....

....

(2)

21. Complete the table to give **three** examples of the protective role of the mammalian skeleton.

PROTECTIVE ROLE OF THE SKELETON	PART OF THE SKELETON INVOLVED	ORGAN PROTECTED

(6)

State **two** other functions of the mammalian skeleton.

....

....
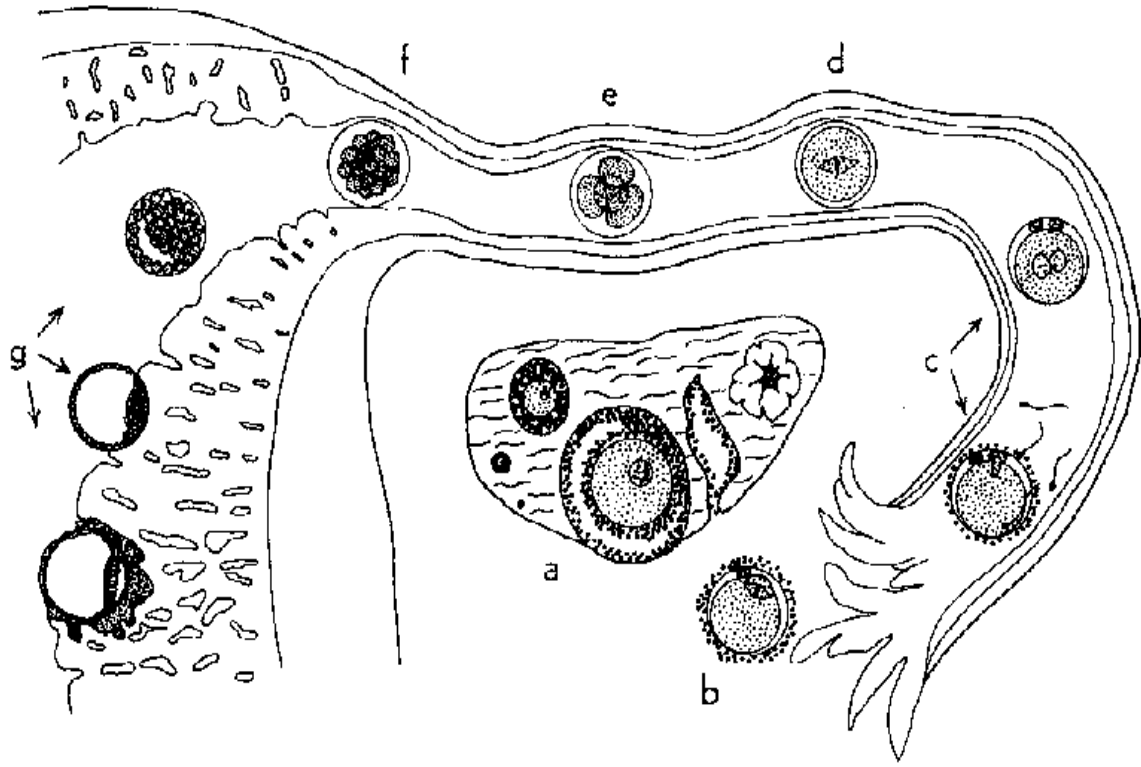
(2)

22. Proteins in the body of a mammal are used for a wide range of functions, some of which are listed below. Name **one** protein for each function given.

FUNCTION	PROTEIN
Storage	
Enzymatic	
Contractile	
Immunological	
Protection	

(5)

23. The diagram below shows various stages in the development of an egg. Identify the stages indicated by **a** to **g.**

a ....

b ....

c ....

d ....

e ....

f ....

g ....

(7)

24. Name **two** energy storage compounds in the mammalian body and state a site where each may be found.

	Name	**Site**
Compound 1		
Compound 2		

(4)

25. Different stimuli result in the secretion of different digestive juices in the mammalian gut. Describe **one** stimulus for each of the following:

saliva ……………………………………………………………………..

gastric juice ………………………………………………………………

pancreatic juice …………………………………………………………..

(3)

26. Draw a diagram of an intestinal villus and label **three** different components of its structure.

(3)

Give **one** function of each labelled component.

……………………………………………………………………………

……………………………………………………………………………

……………………………………………………………………………

(3)

27. The diagram shows the stomach of a ruminant
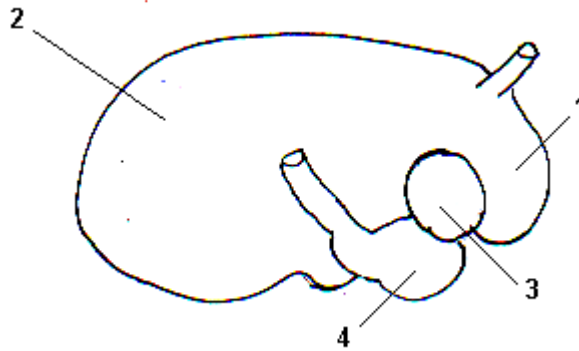
Name each of the numbered parts and give **one** function of each

NAME	FUNCTION
1.	
2.	
3.	
4	

(4)

28. What would be the effect of a decrease in the environmental temperature on the rate of gas exchange in a small mammal?

…………………………………………………………………………………

…………………………………………………………………………………

(1)

Explain your answer.

…………………………………………………………………………………..

…………………………………………………………………………………

…………………………………………………………………………………..

(2)

29. What is meant by each of the following terms:

peptide link ……………………………………………………………………

……………………………………………………………………………………..

(2)

conjugated protein …………………………………………………………….....

……………………………………………………………………………………..

(1)

30. An electron micrograph of active ribosomes is represented in the diagram below.
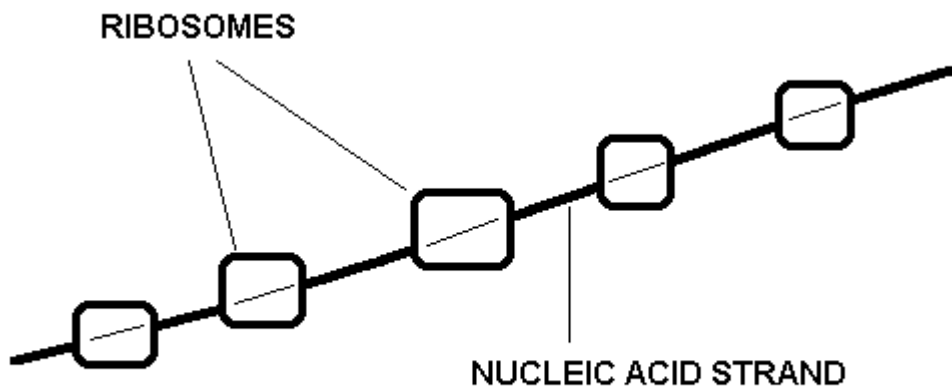
Name the nucleic acid strand.

……………………………………………………………………………………..

(1)

What is the advantage of the nucleic acid strand passing through five ribosomes at one time?

……………………………………………………………………………………..

(1)

Where are ribosomes such as those shown likely to be found in a cell?

……………………………………………………………………………………..

(1)

31. Give the role in protein synthesis of each of the following:

transfer RNA ………………………………………………………………………

………………………………………………………………………………………..

(1)

ribosomes ………………………………………………………………………….

………………………………………………………………………………………..

(1)

32. DNA and RNA are the information molecules of the cell. Explain clearly the differences in the basic structure of these two molecules.

…………………………………………………………………………………

…………………………………………………………………………………….

…………………………………………………………………………………….

………………………………………………………………………………………..

(3)

33. The diagram shows one strand of a DNA molecule.
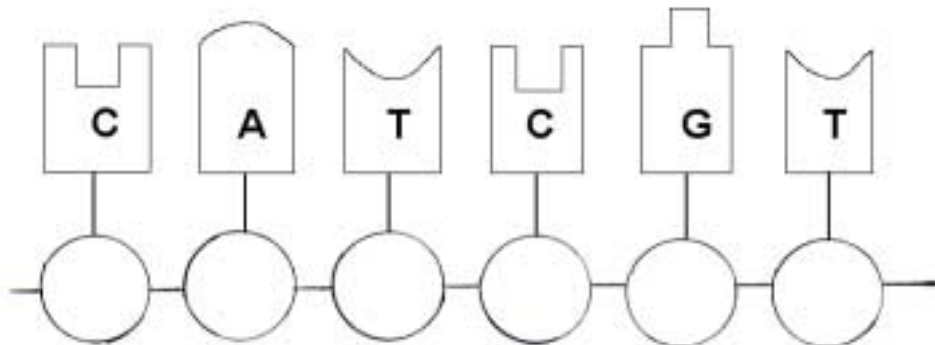
For how many amino acids could this section of DNA code?

…………………………………………………………………………………….

(1)

What would be the order of bases on the corresponding piece of DNA?

………………………………………………………………………………………..

(2)

34. The mRNA codons for three amino acids are:

Alanine = **GCG**

Tyrosine = **UAC**

Valine = **GUG**

Draw the section of DNA molecule to show the sequence of bases necessary for these three amino acids in the order given above.

(2)

35. Define the term 'antibiotic'……………………………………………………………

………………………………………………………………………………………..

………………………………………………………………………………………..

(1)

36. Explain the meaning of the term 'broad-spectrum' antibiotic.

………………………………………………………………………………………..

………………………………………………………………………………………..

………………………………………………………………………………………..
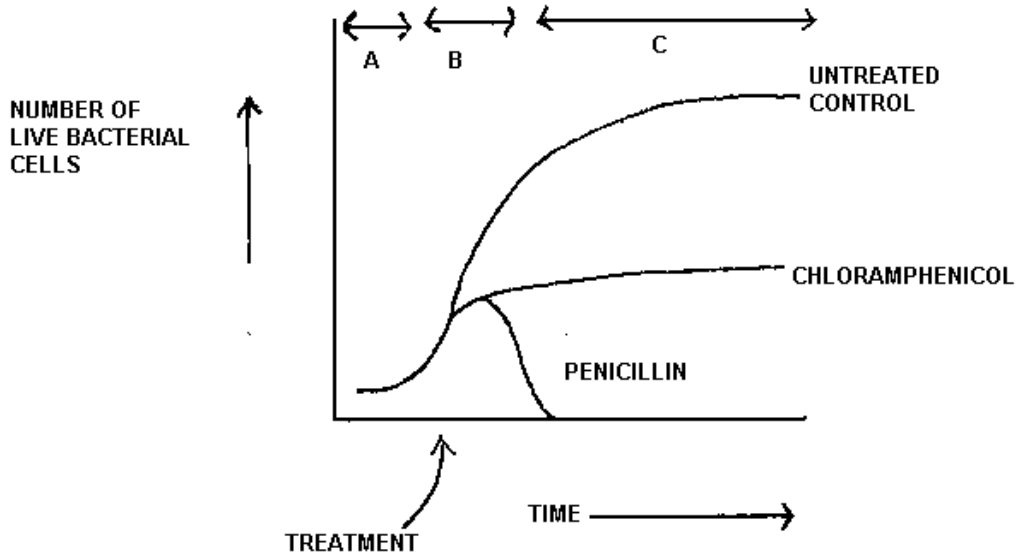
(1)

37. The graph shows the effect of the antibiotics penicillin and chloramphenicol upon bacterial growth in a limited nutrient medium. Each antibiotic was added at the time shown by the arrow to separate identical exponentially growing cultures of bacteria.

Briefly explain the shape of the control curve in each of the regions **A**, **B** and **C**.

…………………………………………………………………………………………

…………………………………………………………………………………………

…………………………………………………………………………………………

………………………………………………………………………………………….

(3)

Explain the actions of each of the antibiotics on the growth of bacteria used in the experiment.

…………………………………………………………………………………………..

…………………………………………………………………………………………..

…………………………………………………………………………………………..

…………………………………………………………………………………………..

(2)

38. A chemical transmitter is necessary to carry nerve impulses across a synapse. Name **one** such chemical.

…………………………………………………………………………………..

(1)

Explain how the chemical transmits the impulse.

…………………………………………………………………………………..

…………………………………………………………………………………..

(1)

What happens to the chemical after it has performed this role?

…………………………………………………………………………………..

…………………………………………………………………………………..

(1)

Give **one** important role performed by synapses in the nervous system.

…………………………………………………………………………………..

(1)

39. Define the following terms with respect to nervous transmission:

'all or nothing' law …………………………………………………………………

………………………………………………………………………………………….

(1)

refractory period …………………………………………………………………

…………………………………………………………………………………………..

(1)

stimulus …………………………………………………………………………..

..………………………………………………………………………………………

(1)

40. The table below refers to pupil dilation and accommodation for near vision in the mammalian eye.

Indicate which statements are correct by placing a tick in the box.

Statement	Pupil dilation	Near accommodation
Is capable of voluntary control		
Alters the refracting power of the lens		
Is an example of a reflex action		
Alters the amount of light entering the eye		
Is brought about by contraction of circular muscles		

(5)

41. Which organs of the mammalian ear are sensitive to:

turning movements of the head

…………………………………………………………………………..

sound

…………………………………………………………………………..

gravitational effects on the head

…………………………………………………………………………..

(3)

42. Define the term 'relative humidity'.

……………………………………………………………………………………
……………………………………………………………………………………
(1)

Name **three** principles by which relative humidity may be measured.

……………………………………………………………………………………
……………………………………………………………………………………
……………………………………………………………………………………
(3)

43. Define the term 'density'.……………………………………………………………
……………………………………………………………………………………..
(1)

Give the accepted SI unit of density.

……………………………………………………………………………………..
(1)

44. Circle the isotopes listed below that are radioactive.

    14C   **12C**   **32P**   **34P**   **14N**   **15N**
(1)

Which isotope would be most useful to a scientist who wished to study the incorporation of amino acids into tissue protein?

……………………………………………………………………………………
(1)

Give a reason for your answer.……………………………………………………
……………………………………………………………………………………..
(1)

45. Consider the following information with regard to the elements potassium and chlorine.

Number of:	Potassium	Chlorine
protons in one atom	19	17
protons in one ion	19	17
electrons in one atom	19	17
electrons in one ion	18	18

Explain the difference between:

a potassium atom and a potassium ion ……………………………………...

……………………………………………………………………………………….

(1)

a chlorine atom and a chlorine ion ……………………………………………...

……………………………………………………………………………………….

(1)

46. In an experiment to determine the renal threshold of the harmless substance **A**, 1g of it was injected into the blood stream of a small mammal with a plasma volume of 250 cm³. The total volume of urine collected during the next 24 hours was 150 cm³. The concentration of substance **A** in this urine was 5.0 mg/cm³. Calculate the renal threshold of substance **A** in mg/cm³. *(Show your workings).*

……..……………………………………………………………………………….

(3)

47. Of 400 animals inoculated with a vaccine against a disease 38 later developed the disease. Among a control unvaccinated group of 400 animals 80 developed the disease. A chi-square test (χ^2) was used to test the hypothesis that there was no difference between the results in the two groups.

Complete the table below:

	Developed the disease	Did not develop the disease
Observed results (O) *(vaccinated group)*		
Expected result if vaccine ineffective (E) *(unvaccinated group)*		
O – E		
(O – E) ²		
(O – E) ² / **E**		

(3)

Calculate the value of χ^2

……………………………………………………………………………………

(2)

How many degrees of freedom are there in this χ^2 test?

……………………………………………………………………………………..

(1)

Use the probability table below to decide whether the vaccine had a significant effect. Explain your answer.

Degrees of freedom	Probability Value					
	.99	.95	0.1	0.05	0.01	0.001
1	.001	.0039	2.71	3.84	6.63	10.83
2	.020	.103	4.61	5.99	11.34	16.27
3	.297	.711	7.78	9.49	13.28	18.47

……………………………………………………………………………………

……………………………………………………………………………………

(2)

End of Part II