

Candidate Number.....

# The Institute of Animal Technology



## FELLOWSHIP EXAMINATION 2002

### Section B – BACKGROUND SUBJECTS

Afternoon, Tuesday 11<sup>th</sup> 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*

***Please turn over***

## ***Attempt THREE questions***

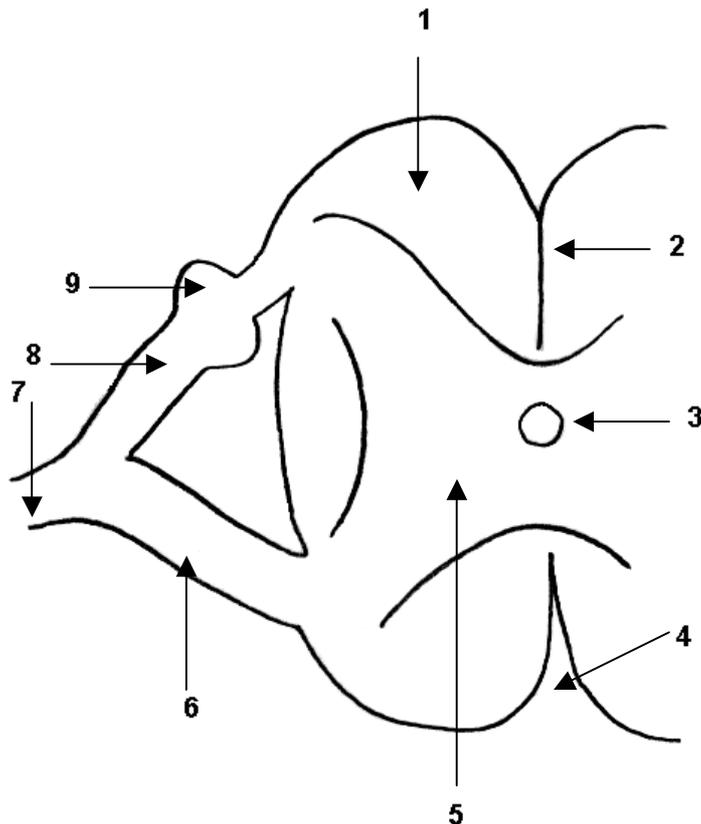
1. Explain how mammals regulate their body temperature when:
  - a) the external temperature falls; **(50%)**
  - b) the external temperature rises. **(50%)**
  
2. Draw a diagram to show the structure of a synovial joint. **(20%)**  
  
Describe the structure and functions of the tissue types found in the joint. **(80%)**
  
3. How are carbohydrates digested and utilised by mammals? **(100%)**
  
4. Define a reflex action. **(10%)**  
  
On the diagram of a cross section of a spinal cord, label the indicated structures.  
On the same diagram draw and label the nervous pathway of a reflex action, indicating the direction of impulse passage. **(50%)**  
  
Explain how impulse transmission occurs:
  - a) along a nerve fibre
  - b) across a synapse **(40%)**

**End of Part I**

Candidate Number.....

# The Institute of Animal Technology

Fellowship Examination 2002 Section B Part I Question 4



1.....

2.....

3.....

4.....

5.....

6.....

7.....

8.....

9.....

*Write your candidate number in the top right hand corner.*

*Remember to hand this sheet in with the rest of your answer.*

*Continue your answer on the lined paper provided.*

# **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

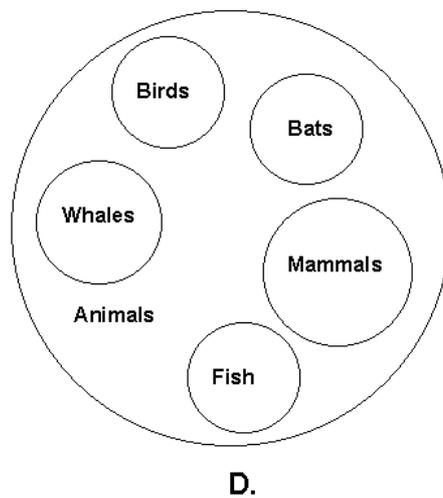
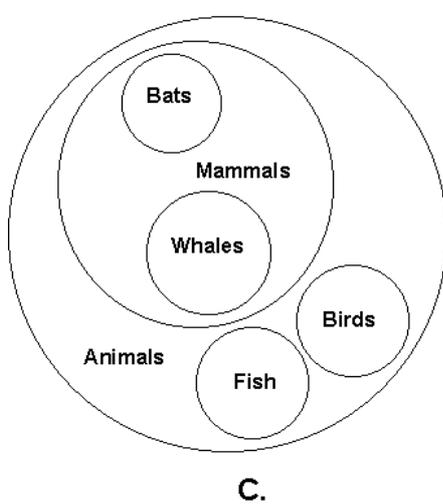
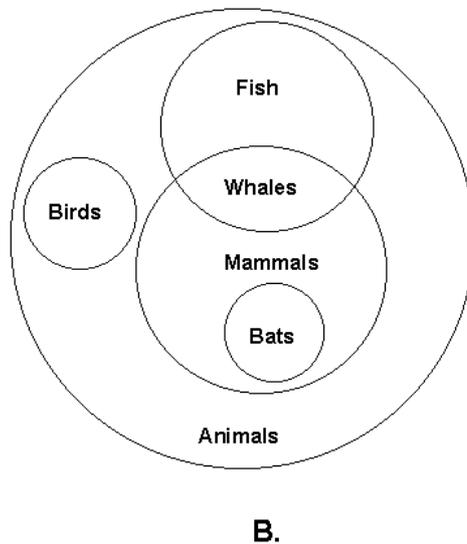
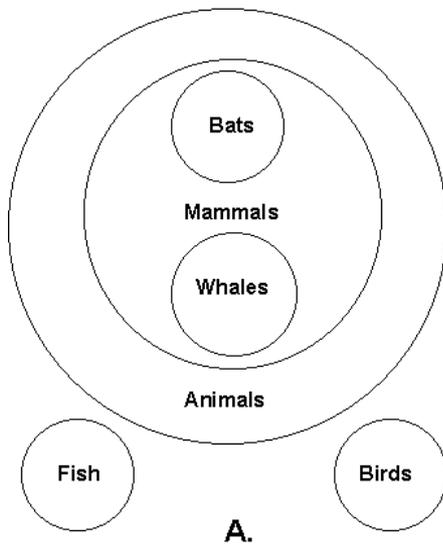
1. Place the taxonomic groups in ascending order of size.

Species    Order    Genus    Phylum    Family    Kingdom

---

(1)

2. Which diagram below correctly represents the relationship between the taxa shown?



.....  
3. What distinguishes the order Lagomorpha from the order Rodentia?

(3)

.....  
.....

(1)

Give the common names of two lagomorphs

.....

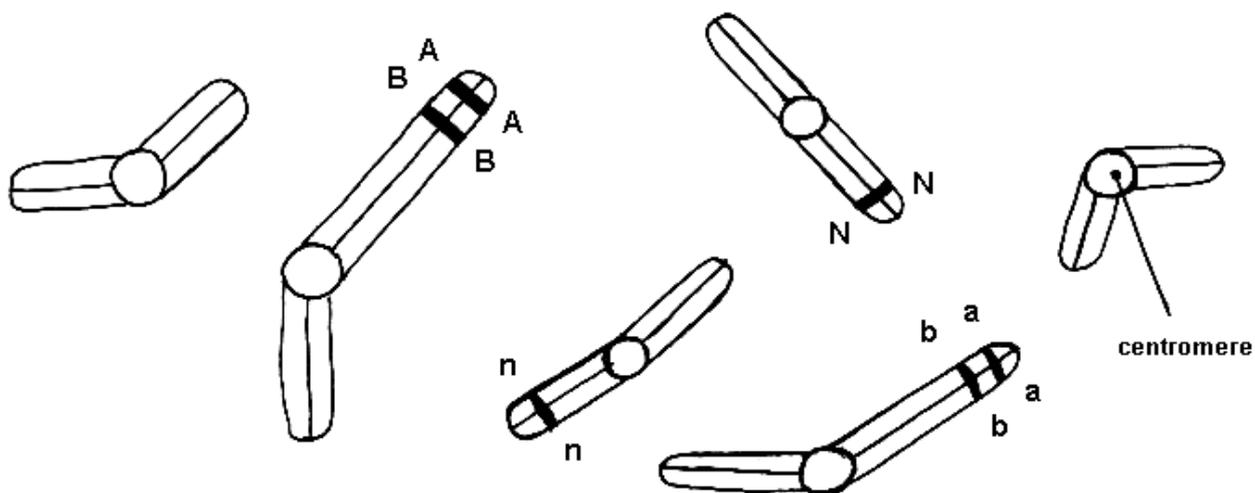
(1)

4. By means of genetic diagrams, and stating any assumptions made, explain the results of the following genetic crosses:

<u>CROSS</u>	<u>PROGENY RATIO</u>
Manx cat x normal cat	1 Manx: 1 normal
Manx cat x Manx cat	2 Manx: 1 normal

(5)

5. The diagram shows the chromosomes from a cell which is undergoing meiosis. The position of three pairs of alleles are shown.



Complete the following table:

	Stage of meiosis		
	Prophase I	Prophase II	Telophase II
Amount of DNA present in each nucleus at each of these stages.	12x		
Number of centromeres present in each nucleus at each of these stages.			

(2)

Use your knowledge of meiosis to explain why:

a) some of the gametes produced have the genotype **ABN** while others have the genotype **Abn**.

.....

(1)

b) although most of the gametes produced have the genotype **AB** or **ab**, a few have the genotype **Ab** or **aB**.

.....  
(1)

6. In a species of bird the allele for green feathers **G** is dominant to the allele for blue feathers **g**. A second gene locus on another chromosome controls the intensity of colouring with the heterozygote **CACa** intermediate between the two homozygotes **CACA** (dark) and **CaCa** (pale). The complete range of colours is shown in the table below:

Colour of feathers	Intensity of colouring		
	Pale	Intermediate	Dark
Green	Light green	Dark green	Olive
Blue	Sky blue	Cobalt	Mauve

What name describes the condition in which the heterozygote is intermediate in appearance between the homozygotes?

.....  
(1)

Complete the following table to show the expected results of a cross between cobalt and homozygous light green birds:

Parental phenotypes	Cobalt x homozygous light green	
Genotypes		
Gamete genotypes		
Offspring genotypes		
Expected ratio		

(3)

Explain why the ratio of the different offspring types obtained from this cross may not be exactly equal to the expected ratio.

.....  
.....

- .....
- (2)**
7. The resistance of houseflies to an insecticide is controlled by a gene with two alleles. The allele **R** for resistance is dominant to the allele **r** for susceptibility (no resistance). In a survey 1300 houseflies were trapped and 630 of these were found to be resistant to the insecticide.

Calculate:

- a) the frequency of flies susceptible to the insecticide

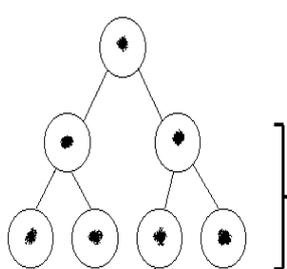
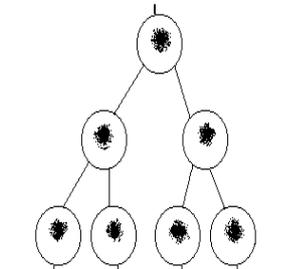
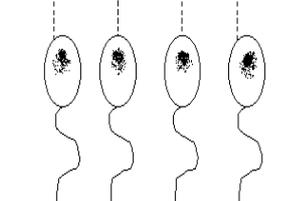
.....

**(2)**

- b) the frequency of the **r** allele

(3)

8. Complete the table below concerning spermatogenesis in a mammal.

Phase of development	Mechanism of division	Type of germ cell	No. of chromosomes
		 <p>Germinal epithelial cells _____</p> <p>_____</p>	<b>26</b>
		 <p>_____</p> <p>_____</p>	
		 <p>_____</p>	

(8)

9. The duodenum and ileum receive secretions from the pancreas and liver.

Name three components of pancreatic juice.

.....

.....

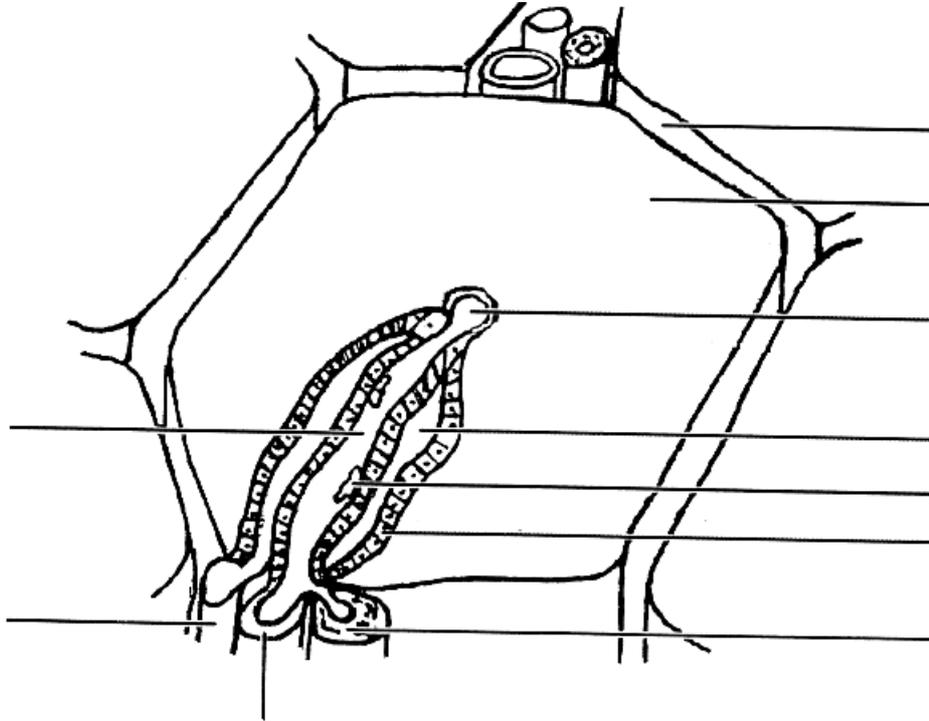
(1 ½)

Name three components of bile.

.....

.....  
(1 ½)

10. Label the ten structures indicated on the diagram of the liver.



(5)

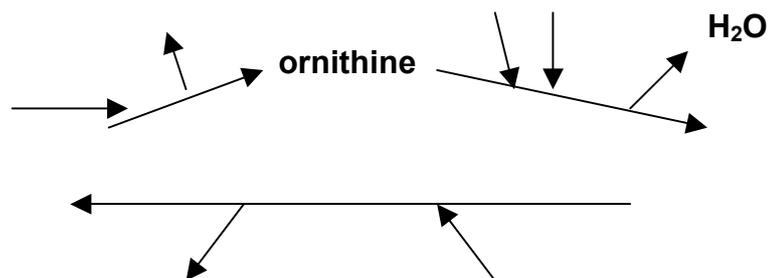
11. One function of the liver is the deamination of amino acids by the ornithine cycle.

What is meant by the term “deamination”?

.....  
.....

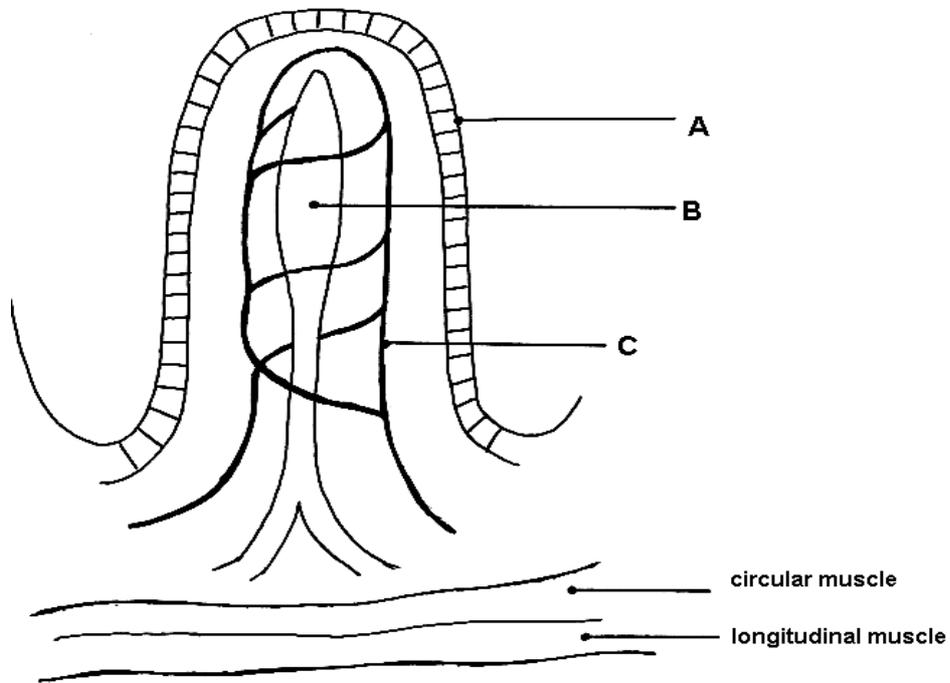
(1)

12. Complete the diagram of the ornithine cycle.



(4)

13. The diagram below shows part of a transverse section through a mammalian ileum.  
Name the parts labelled **A**, **B** and **C**.



A.....

B.....

C.....

(3)

Briefly describe how these three features enable the ileum to perform its function of absorption.

A .....

B.....

**C**.....  
**(3)**  
Of what type of muscle do the layers of circular and longitudinal muscle consist?

.....  
**(1)**

What is the function of this type of muscle in the ileum?

.....  
**(1)**

How is this function achieved?

.....  
.....  
**(1)**

**14.** Describe the basic structure of simple squamous epithelium.

.....  
.....  
**(1)**

How does its structure suit it to its purpose?

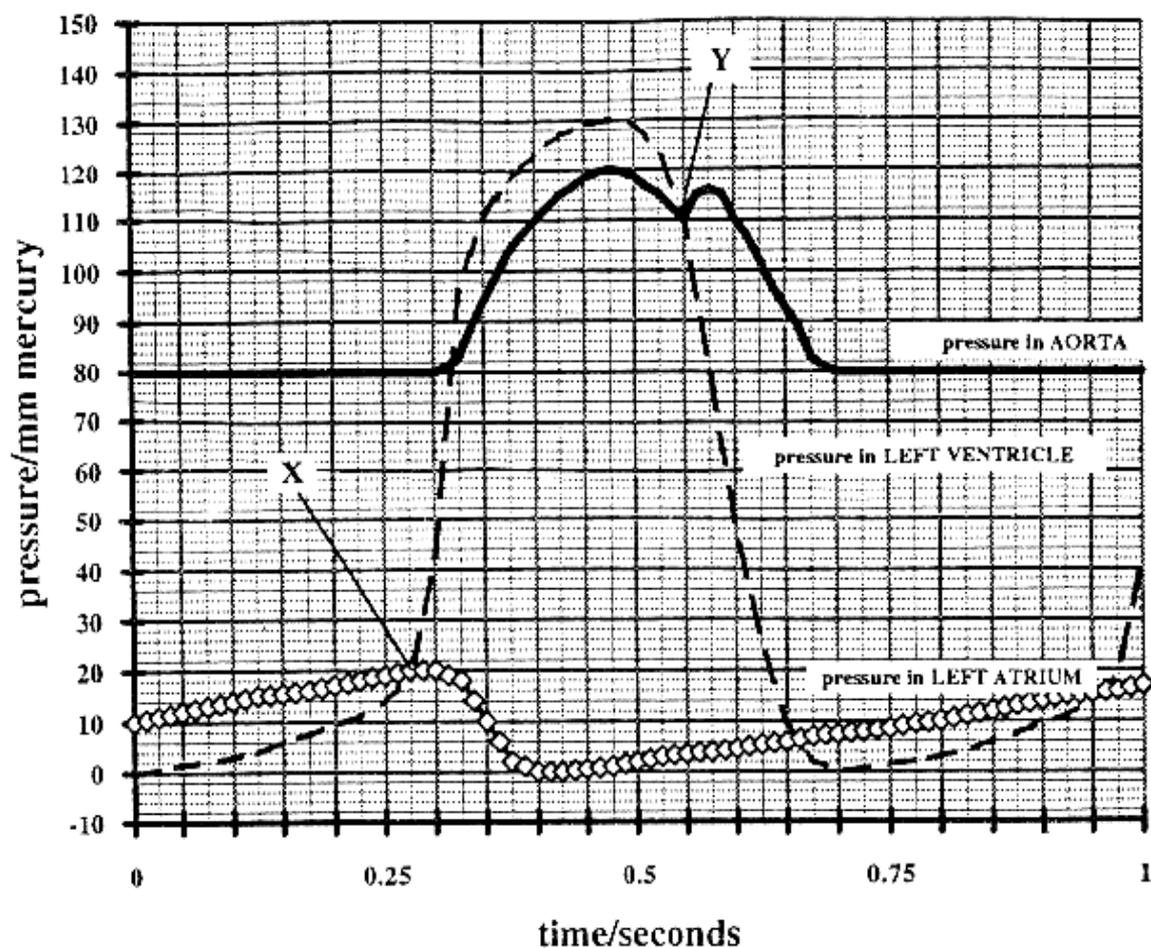
.....  
.....  
**(1)**

Name two tissues where you would find it.

.....

(1)

15. The graph shows some pressure changes that occur during one complete beat of a mammalian heart.



How long does one complete beat of the heart last?

(1)

Calculate the number of beats per minute.

.....  
**(1)**  
The maximum pressure reached in the left ventricle is five times that reached in the right ventricle. Calculate the maximum pressure reached in the right ventricle.

.....  
**(1)**

From your knowledge of the structure of the heart, explain how this difference in pressure between the ventricles is achieved.

.....  
**(1)**

Explain the connection between the pressure in the left ventricle and the pressure in the aorta between 0.3 and 0.5 seconds.

.....  
**(1)**

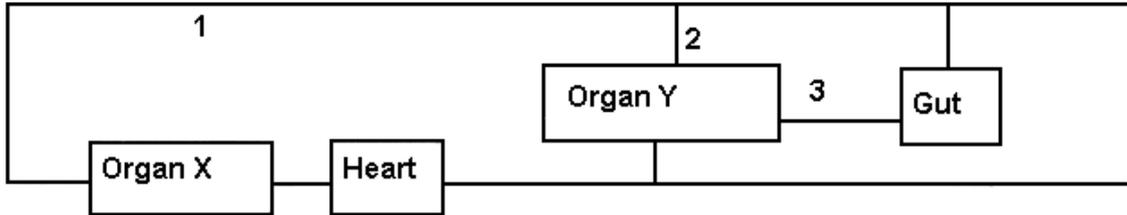
From your knowledge of how the heart works, suggest which valve closes at point **X** and which at point **Y**. In each case explain why the valve closes at that point.

	<b>X</b>	<b>Y</b>
Name of valve closing		
Reason for closing		

--	--	--

(2)

16. The diagram represents blood circulation in a fish.



Draw arrows on the diagram to indicate the direction of blood flow through the vessels numbered 1, 2 and 3.

(1)

Name the organs labelled X and Y

X.....

Y.....

(1)

17. Name three ways in which CO<sub>2</sub> is transported in mammalian blood.

.....

.....

.....

(3)

18. Define the term “antibody”.

.....

.....  
**19.** What type of chemical compound is an antibody? **(1)**

.....  
**(1)**

What type of substance causes the production of an antibody?

.....  
**(1)**

What are the four main groups of antibodies?

.....  
.....  
.....  
.....  
**(4)**

**20.** Draw diagrams to show the structure of the following types of white blood corpuscles:

Neutrophil:

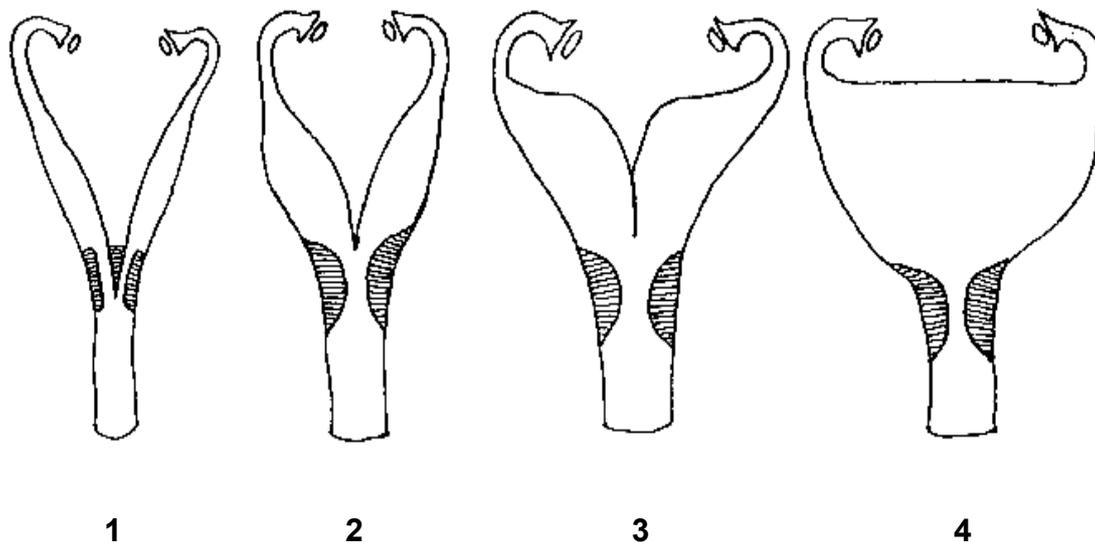
Monocyte:

Lymphocyte:

Eosinophil:

(4)

21. The diagrams below (not to scale) represent the four basic anatomical types of uterus found in mammals: the cervix of each has been emphasised (shaded area).



Encircle the letter of the row of labels which correctly identifies the uteri.

	1	2	3	4
<b>A:</b>	bicornuate	bipartite	duplex	simplex
<b>B:</b>	duplex	bicornuate	bipartite	simplex
<b>C:</b>	duplex	bipartite	bicornuate	simplex
<b>D:</b>	simplex	bicornuate	bipartite	duplex

(1)

Name one species of an animal exhibiting these different types of uterus.

Simplex: .....

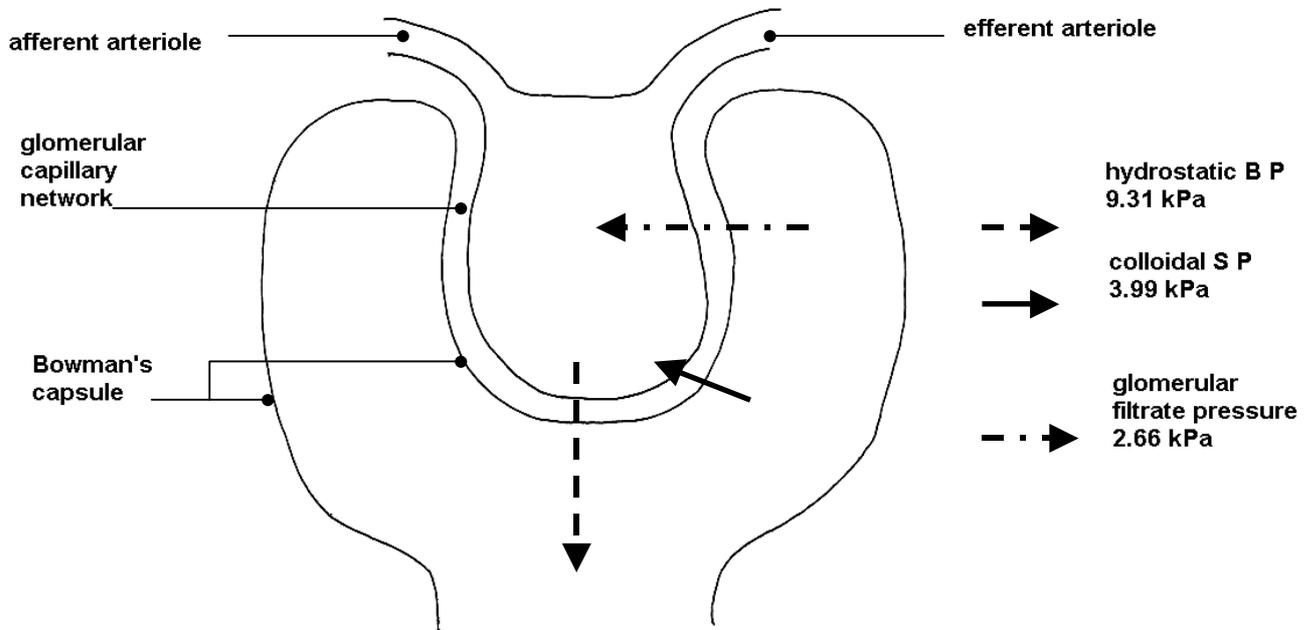
Duplex: .....

Bipartite: .....

Bicornuate: .....

(4)

22. The diagram below shows the direction and magnitude of pressures influencing the filtration pressures in the mammalian glomerulus.



From the information given calculate the filtration pressure.

.....  
(2)

23. State three features of respiratory surfaces which are common to all vertebrate animals and briefly explain why each is important.

FEATURE	EXPLANATION
1.	
2.	
3.	

--	--

(3)

24. Describe the sequence of events in the process of inspiration in a mammal.

.....

.....

.....

(3)

25. Name the main parts of the pituitary gland and two hormones secreted by each.

.....

.....

.....

(6)

26. Complete the following table:

Hormone	Site of secretion	Target cells	Action
	Cells of Islets of Langerhans	Most body cells	
Anti-diuretic Hormone (ADH)			Increases permeability to water
		Cells of thyroid gland	Increases secretion of thyroxine
	Duodenal mucosa	Smooth muscle cells of gall bladder	

--	--	--	--

(4)

27. Give three differences between nervous and endocrine co-ordination.

.....

.....

.....

(3)

28. If an animals spins round rapidly and then stops, why may it not be able to stand steadily for some time?

.....

.....

(1)

29. Name the photoreceptors in the eye that are sensitive to dim light.

.....

(1)

State the photopigment found in such photoreceptors.

.....

(1)

Name the vitamin associated with adequate formation of this photopigment.

.....

(1)

What is a common consequence of such a vitamin deficiency?

.....  
**30.** When light rays from an object enter the eye they are refracted. Name four places where refraction occurs. **(1)**

.....

.....

**(2)**

**31.** Complete the table with a **tick** if the statement is true and a **cross** if the statement is false

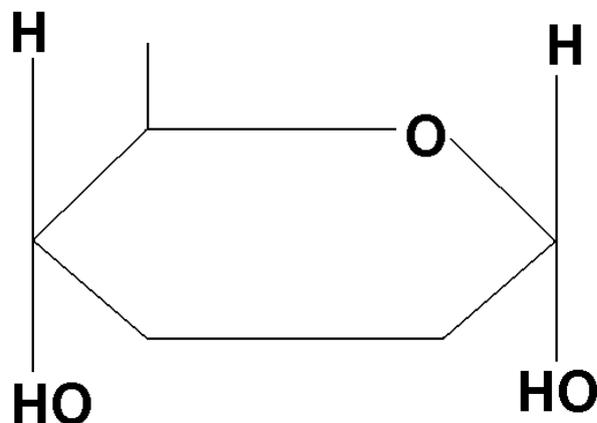
Statement	Biochemical substance				
	Starch	Protein	Tri-glyceride	DNA	RNA
Contains carbon, hydrogen and oxygen only.					
Contains nitrogen.					
Contains phosphate groups.					
Is hydrolysed to smaller units during digestion.					
Contains uracil.					

**(5)**

**32.** What is the difference between the molecular and structural formula of an organic substance?

.....

- .....  
(2)  
33. The diagram below shows the structure of a glucose molecule in a simplified form:



Show how two such molecules may combine chemically to form a disaccharide

(2)

What is the name given to this chemical process?

.....  
(1)

What is the name of the disaccharide formed?

.....  
**34.** What is the molecular formula for:

**(1)**

a pentose;

.....  
a hexose;

.....  
a triose?

.....  
**(3)**

**35.** Let the letters **A** and **B** represent two different amino acids.

Write down the sequences of all the possible tripeptides that can be formed from the two different amino acids

**(2)**

What is the formula for calculating the number of different tripeptides that can be formed from two different amino acids?

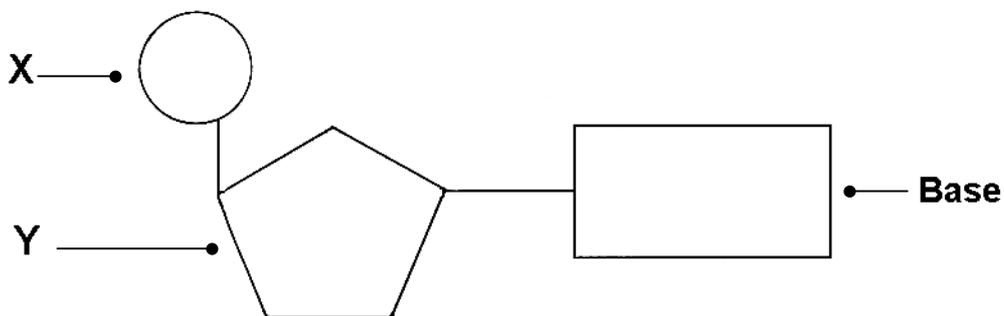
.....  
**(1)**

**36.** Describe two differences between the structure of DNA and RNA.

.....

.....  
(2)

37. The diagram shows the structure of a DNA nucleotide.



Name the parts of the nucleotide labelled X and Y.

X.....

Y.....

(1)

38. The table below shows the percentage composition of bases in the DNA of cattle and sheep. Calculate the missing values and complete the table

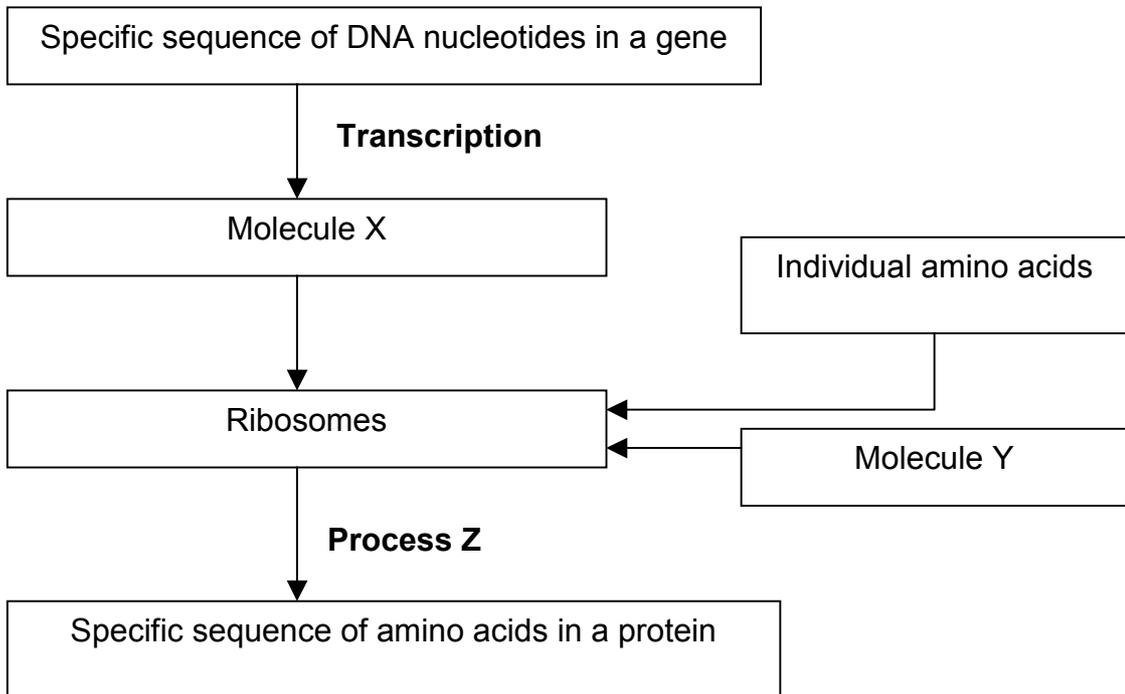
Organism	Adenine	Cytosine	Guanine	Thymine
Cattle	29		21	
Sheep	33			33

(2)

Explain how the missing values were derived.

.....

.....  
**39.** The flow chart below shows some steps in the production of a protein. **(2)**



Name the organelle in which transcription occurs.

.....  
**(1)**

Name molecule **X**.....  
**(1)**

Name molecule **Y**.....  
**(1)**

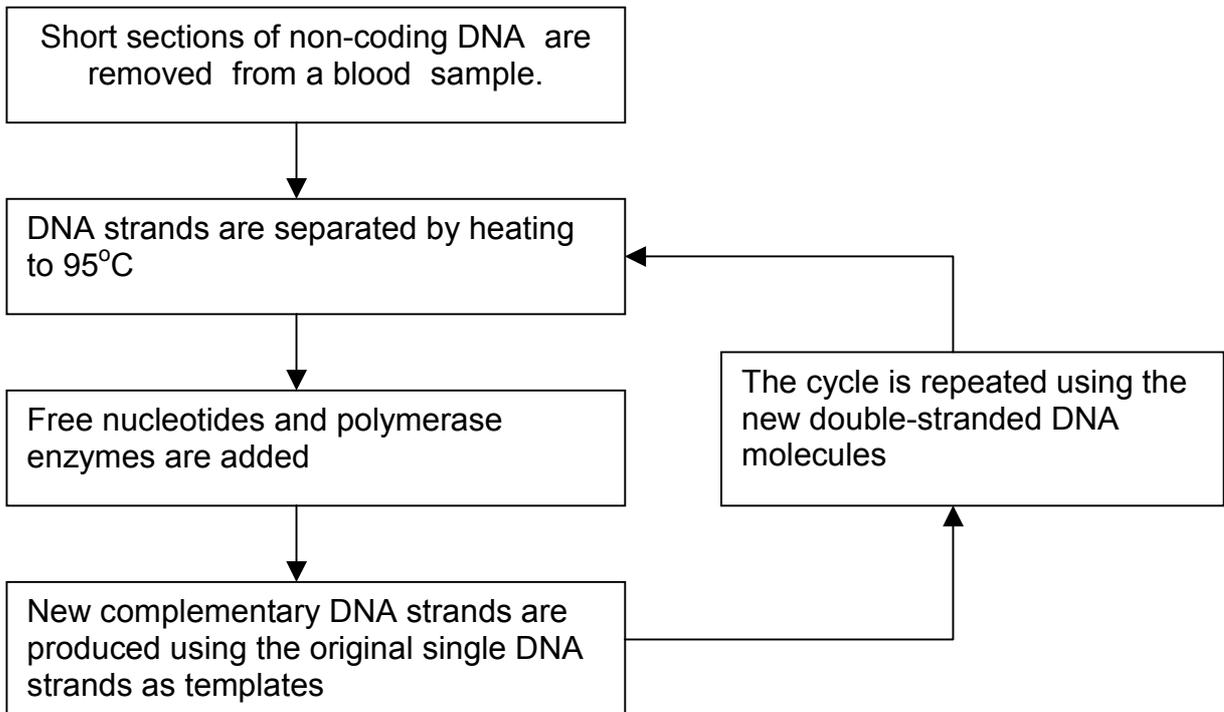
Explain the role of molecule **Y**.  
.....  
**(1)**

Name process **Z**.  
.....  
**(1)**

How many amino acids will be present in the protein if molecule **X** has 282 nucleotides?

(1)

40. The flow chart below shows some of the steps involved in a single cycle of the polymerase chain reaction (PCR) which is used to increase the amount of DNA for analysis.



Explain what is meant by “non-coding” DNA.

.....

.....

(2)

Explain how heating the DNA causes the strands to separate.

.....

.....

(2)

41. Complete the table below. (Use a **tick** to indicate a true statement and a **cross** to indicate a false statement)

Statement	Polymerase chain reaction	DNA replication in living organisms	Transcription in living organisms
DNA polymerase is required.			
The two strands of the DNA are separated			
Ribosomes are required.			

(3)

42. The rate of diffusion through a membrane is proportional to:

$$\frac{\text{surface area} \times \text{difference in concentration}}{\text{thickness of membrane}}$$

Predict whether values of each variable will be high or low when the rate of diffusion through the membrane is at a maximum.

..... (1)

43. Define the following processes.

Oxidation:.....

..... (1)

Reduction: .....

.....  
44. Define the following statistical terms.

(1)

Mean: .....

.....  
(1)

Mode: .....

.....  
(1)

Median: .....

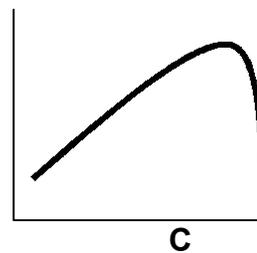
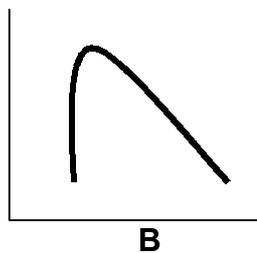
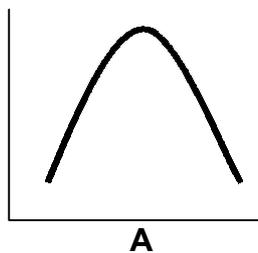
.....  
(1)

45. Explain what is meant by the term “randomised experimental study”.

.....  
.....  
.....

(2)

46. Consider the three graphs **A**, **B** and **C** below:



Which graph shows a “positively-skewed” distribution?

.....  
**47.** What is meant by the term “half-life”, in relation to a radioactive isotope?

**(1)**

.....  
.....

**(1)**

What fraction of a radioactive isotope remains after 5 half-lives?

.....  
**(1)**

A radioactive isotope has a half-value layer of 1.2 cm of lead. What would be the effect on the radiation level of shielding with a layer of lead 36mm thick?

.....  
**(1)**

**48.** What is the SI unit used when measuring the dose of radiation received by personnel?

.....  
**(1)**

**49.** Explain the difference between “instantaneous dose” and “committed dose”.

.....  
.....

.....  
**(2)**  
**50.** Which type of emitter is most likely to give rise to a high instantaneous dose? Give a reason for your answer.

.....  
.....  
.....  
.....

**(2)**

**End of Part II**