Surname		Other Names	
Centre Number			Candidate Number									
Candidate Signature												

For Examiner's Use

General Certificate of Education
January 2008
Advanced Level Examination

ASSESSMENT and QUALIFICATIONS ALLIANCE

BIOLOGY/HUMAN BIOLOGY (SPECIFICATION A) BYA5
Unit 5 Inheritance, Evolution and Ecosystems

Wednesday 23 January 2008 9.00 am to 10.30 am

For this paper you must have:
- a ruler with millimetre measurements.

You may use a calculator.

Time allowed: 1 hour 30 minutes

Instructions

- Use blue or black ink or ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- Answer the questions in the spaces provided.
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information

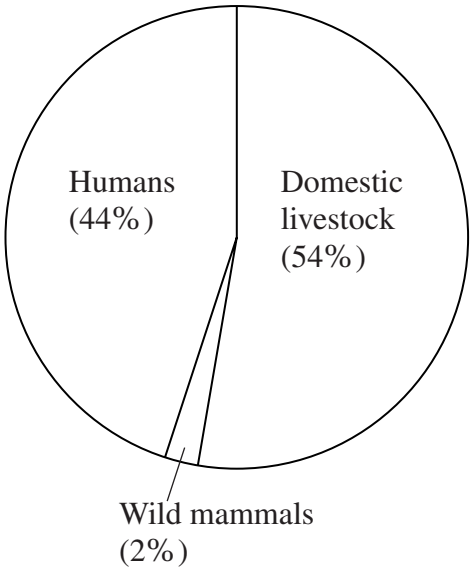
- The maximum mark for this paper is 75.
- The marks for questions are shown in brackets.
- You will be marked on your ability to use good English, to organise information clearly and to use accurate scientific terminology where appropriate.

For Examiner's Use			
Question	Mark	Question	Mark
1		9	
2			
3			
4			
5			
6			
7			
8			
Total (Column 1) →			
Total (Column 2) →			
TOTAL			
Examiner's Initials			

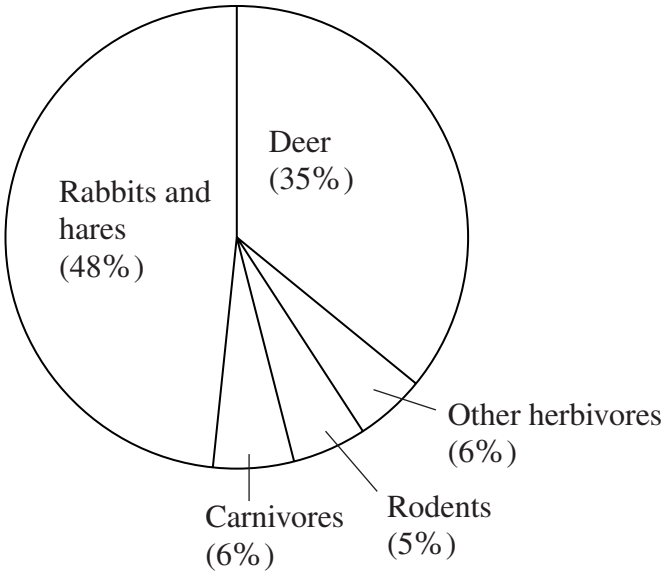
Answer **all** questions in the spaces provided.

1 The pie charts show the percentage biomass of different mammals in Great Britain. Chart **A** shows all mammals. Chart **B** shows different groups of wild mammals.

A



B



(a) The total biomass of the carnivores is less than the total biomass of all the other groups shown in chart **B**. Explain this difference.

.....

.....

.....

.....

(2 marks)

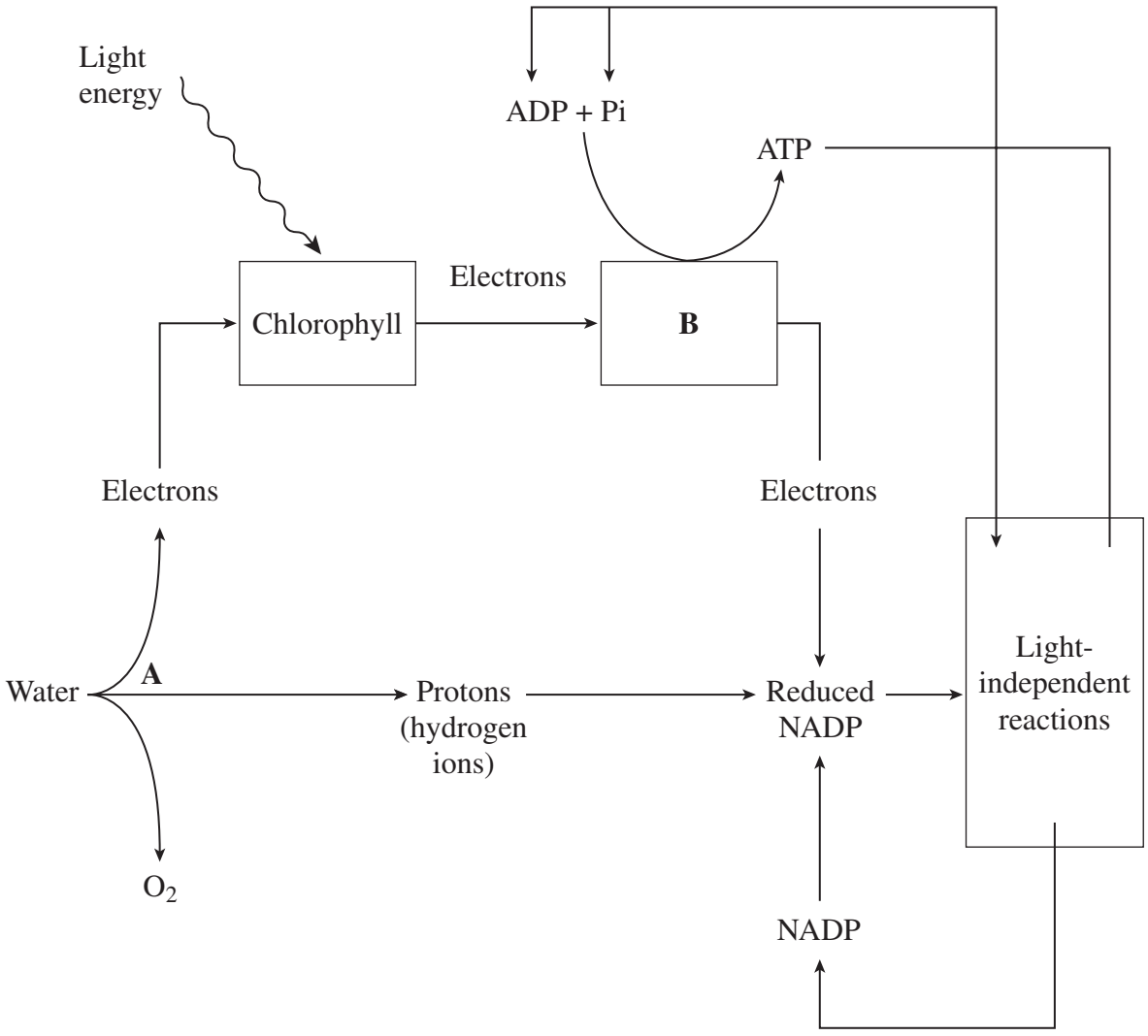
(b) The biomass of deer in Great Britain is 45 000 tonnes. Calculate the biomass of the domestic livestock in Great Britain. Show your working.

Biomass of domestic livestock ..... tonnes *(2 marks)*

4

Turn over for the next question

2 The diagram shows some reactions of photosynthesis.



(a) Name process **A**.

.....

(1 mark)

(b) Describe how ATP is produced at **B**.

.....

.....

.....

.....

.....

.....

(3 marks)

(c) Reduced NADP is recycled to NADP in the light-independent reactions. Explain how.

.....

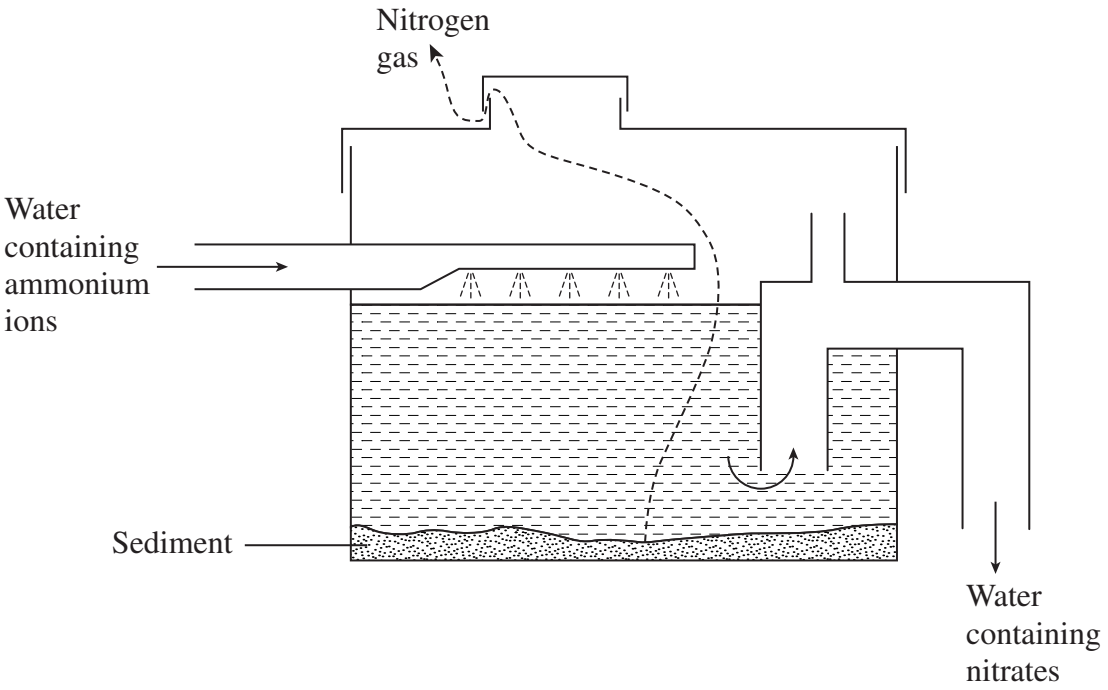
.....

(1 mark)

5

Turn over for the next question

3 In fishponds, ammonium ions are produced by the fish. Bio-filters may be used to remove these ions from the water. The diagram shows one type of bio-filter.



The nitrates and nitrogen gas are produced by microorganisms. Describe how microorganisms produce

(a) nitrates

.....

.....

.....

.....

.....

.....

(3 marks)

(b) nitrogen gas.

.....

.....

.....

.....

(2 marks)

4 Willow trees are fast growing and can be burned as fuel. They are grown in plantations and coppiced. Coppicing involves cutting the tree back to just above ground level. The tree then grows again from the stump. Maintaining a plantation of willows for coppicing involves cutting back some of the trees each year in a 4-year cycle.

(a) (i) Which willow trees are coppiced each year?

.....

.....

(1 mark)

(ii) Suggest and explain **one** benefit of coppicing only some of the trees each year.

.....

.....

.....

.....

(2 marks)

(b) Burning fossil fuels and willow trees releases carbon dioxide, a greenhouse gas, into the atmosphere. However, it is considered more 'environmentally friendly' to burn willow trees rather than fossil fuels. Suggest why.

.....

.....

.....

.....

.....

.....

(3 marks)

6

5 (a) Give **two** properties of an ATP molecule that make it suitable as an immediate source of energy in cells.

1 .....

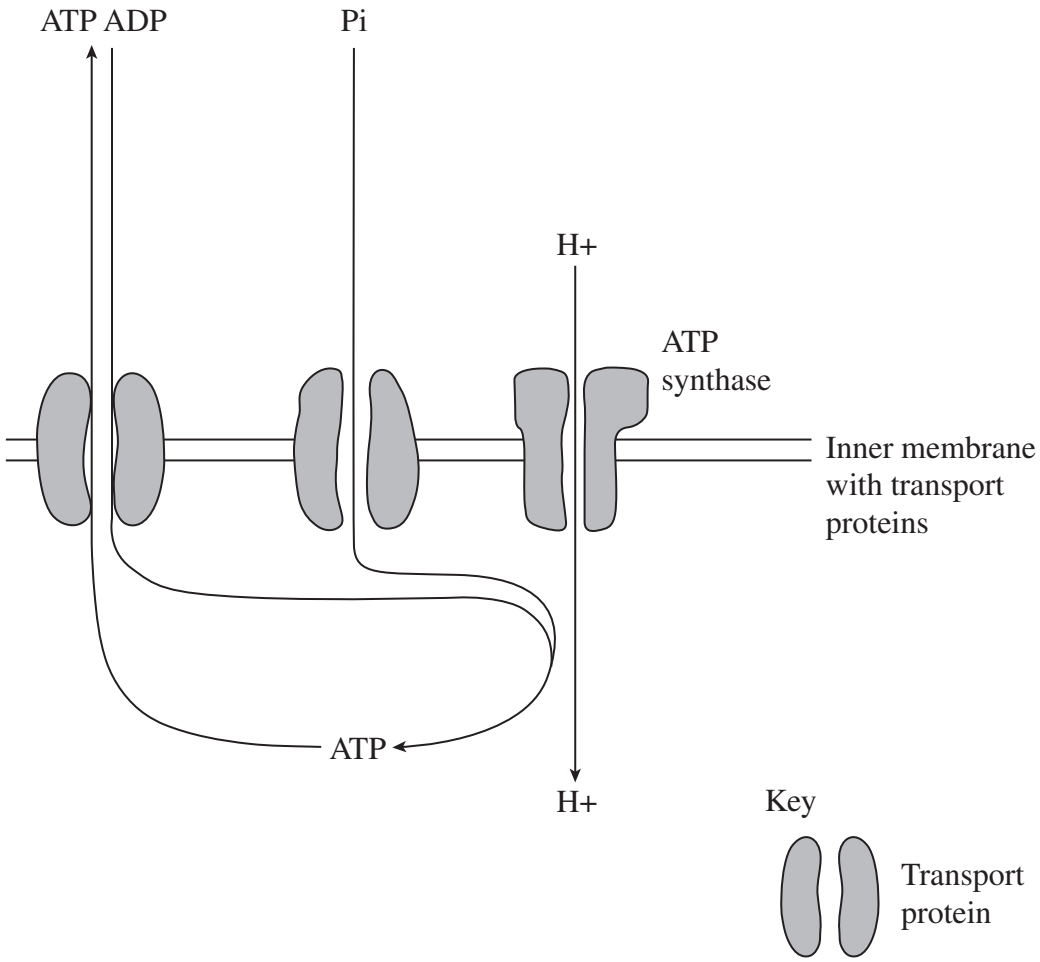
.....

2 .....

.....

(2 marks)

(b) The diagram shows part of the membranes surrounding a mitochondrion.



When protons (H^+) pass through the ATP synthase protein, they release energy. This energy is used to synthesise ATP.

(i) Two other transport proteins are shown in the diagram.
Describe their function.

.....

.....

.....

.....

(2 marks)

(ii) People who suffer from chronic fatigue syndrome have mitochondria in which some of these transport proteins are damaged. Explain how this might result in the fatigue that is a feature of the condition.

.....

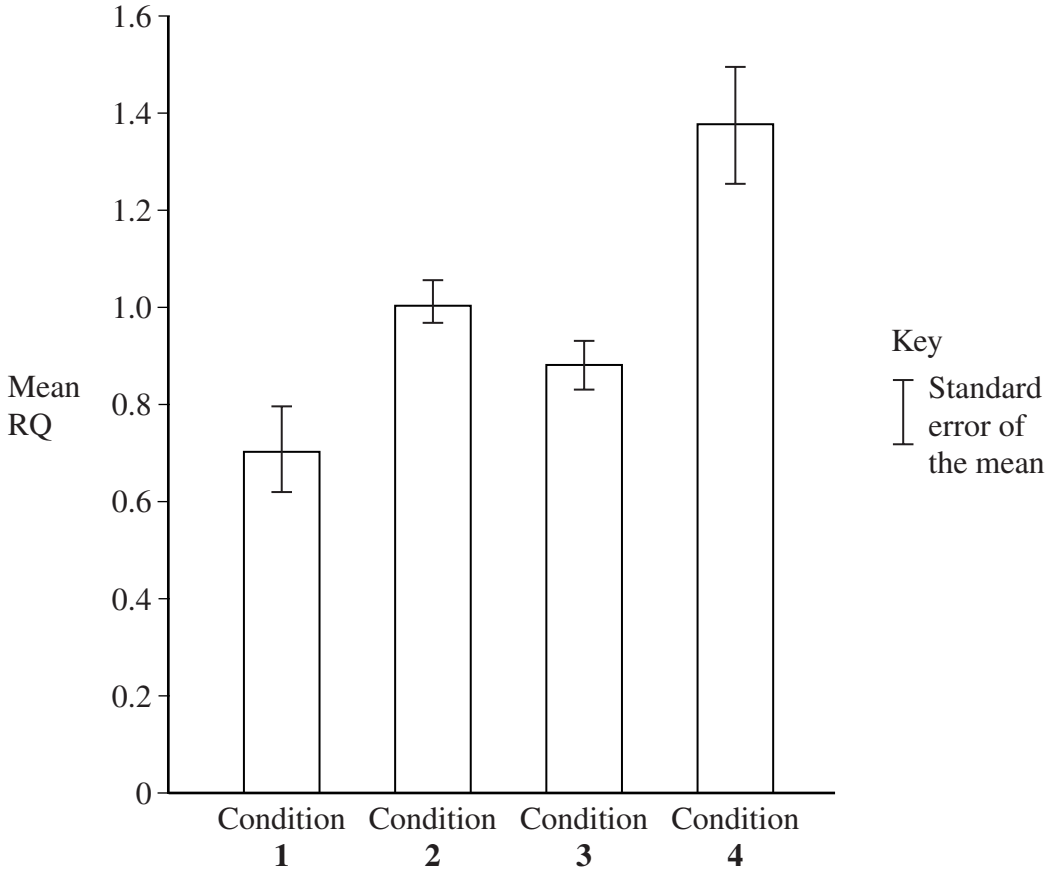
.....

(1 mark)

5

Turn over for the next question

6 Students investigated respiration in yeast and determined the respiratory quotient (RQ) under different conditions. The students pooled their results to calculate the mean RQ and standard error of the mean for each condition. Their results are shown in the bar chart.



(a) What is meant by standard error of the mean?

.....

.....

(1 mark)

(b) The formula used to calculate the respiratory quotient is

$$RQ = \frac{CO_2 \text{ produced}}{O_2 \text{ used}} \text{ per unit time}$$

Use this formula to answer the following questions.

(i) Which of the results from conditions **1**, **2** and **3** represents the aerobic respiration of carbohydrates only? Explain your answer.

.....

.....

(1 mark)

(ii) In condition **4** some anaerobic respiration took place. Explain the evidence that supports this statement.

.....

.....

.....

.....

.....

.....

(3 marks)

5

Turn over for the next question

There are no questions printed on this page

7 (a) Meiosis results in cells that have the haploid number of chromosomes and show genetic variation. Explain how.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(6 marks)

Question 7 continues on the next page

(b) In mice, two genes affecting coat colour are on different chromosomes.
One gene controls whether there is any black pigment in the hairs. The dominant allele of this gene, **B**, results in black fur. The recessive allele, **b**, results in white fur. The second gene controls banding of the fur. The dominant allele, **A**, causes a yellow band to develop on each hair. The resulting coat colour is called agouti. The recessive allele, **a**, results in hairs with no bands on them. This gene has no effect on mice with white fur; white mice do not develop bands, even if they have the **A** allele.

Breeders performed many crosses in which agouti mice were crossed with white mice, homozygous for both genes. They expected agouti, black and white mice in the offspring in a 1 : 1 : 2 ratio.

(i) Complete the genetic diagram to show how this ratio of phenotypes would be produced.

Parental phenotypes Agouti White

Parental genotypes

Gamete genotypes

Offspring genotypes

Offspring phenotypes

(4 marks)

(ii) The actual numbers of offspring with each phenotype were

Agouti	34
Black	35
White	51

The χ^2 test can be used to test the hypothesis that there is no significant difference between these results and the expected 1 : 1 : 2 ratio. Complete the table to calculate the value of χ^2 for these results.

Colour of offspring	**Observed (O)**	**Expected (E)**	**(O – E)**	**$(O - E)^2$**	**$\frac{(O - E)^2}{E}$**
Agouti	34				
Black	35				
White	51				
			$\sum \frac{(O - E)^2}{E}$ =		

(2 marks)

(iii) The table shows values for χ^2 at different levels of probability and for different degrees of freedom.

Degrees of freedom	**Probability, p**				
	0.2	**0.1**	**0.05**	**0.02**	**0.01**
1	1.64	2.71	3.84	5.41	6.64
2	3.22	4.61	5.99	7.82	9.21
3	4.64	6.25	7.82	9.84	11.35
4	5.99	7.78	9.49	11.67	13.28
5	7.29	9.24	11.07	13.39	15.09

What should the breeders conclude about the significance of their results? Explain your answer.

.....

.....

.....

.....

.....

.....

(3 marks)

15

8 (a) The cheetah (*Acinonyx jubatus*) and the lion (*Panthera leo*) belong to the order Carnivora and the family Felidae. Give **two** other taxa (classification levels) that

(i) the cheetah and the lion share

1 .....

2 .....

(1 mark)

(ii) the cheetah and the lion do not share.

1 .....

2 .....

(1 mark)

(b) The fur of most cheetahs has a characteristic pattern of spots. Some cheetahs, called king cheetahs, have a different pattern of spots. The king cheetah coat pattern is caused by a recessive allele. The allele arose as a result of a gene mutation.

(i) Name **two** types of gene mutation.

1 .....

2 .....

(1 mark)

(ii) Some types of gene mutations have a greater effect than others on the protein produced. Explain why.

.....

.....

.....

.....

.....

.....

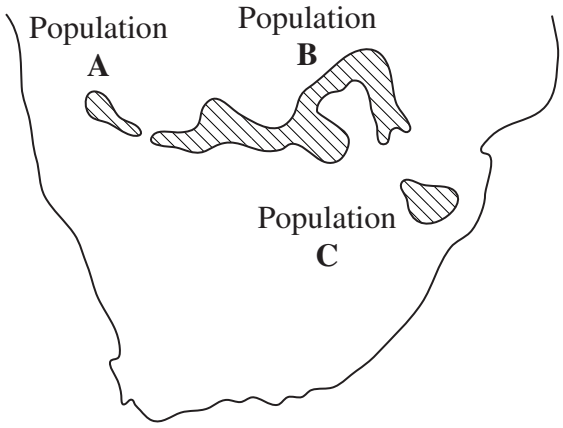
(3 marks)

(iii) One cheetah population in South Africa consists of a total of 1250 animals. There are 25 king cheetahs in this population. Assuming the conditions of the Hardy–Weinberg equilibrium apply, calculate the number of cheetahs present in this population that are heterozygous for the king cheetah allele. Show your working.

Number of heterozygotes ..... *(3 marks)*

Question 8 continues on the next page

(c) The map shows the present-day distribution of cheetahs in South Africa. All the cheetahs in the three populations are thought to be descended from very few animals. These animals were the survivors of a huge fall in the cheetah population about 12 000 years ago.



(i) The animals from all three populations belong to the same species. How could this be proved?

.....

.....

(1 mark)

(ii) Geographic isolation can lead to the evolution of a new species. Explain how.

.....

.....

.....

.....

.....

.....

(3 marks)

(iii) Despite having been geographically isolated for a long time, it is not likely that the cheetahs in populations **B** and **C** will evolve into different species. Explain why.

.....

.....

.....

.....

(2 marks)

9 (a) Describe the main features of an ecological succession.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(5 marks)

(b) Daisies are small flowering plants. Describe how you would estimate the number of daisies growing in a playing field.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(6 marks)

Question 9 continues on the next page

(c) Describe how you would use the mark-release-recapture technique to estimate the number of small mammals in an area of woodland.

.....

.....

.....

.....

.....

.....

(4 marks)

15

END OF QUESTIONS