

NANYANG JUNIOR COLLEGE
JC 2 PRELIMINARY EXAMINATIONS
Higher 1

CANDIDATE
NAME

CLASS

BIOLOGY

8875/02

Paper 2 Structured Questions

14 September 2017

Additional Materials: Answer Paper

2 hours

READ THESE INSTRUCTIONS FIRST

Write your name and CT on all the work you hand in.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, highlighters, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions in the spaces provided on the Question Paper

The use of an approved scientific calculator is expected, where appropriate.
You may lose marks if you do not show your working or if you do not use appropriate units.

At the end of the examination, fasten all your work securely together.

The number of marks is given in brackets [] at the end of each question or part question.

For Examiner's Use	
Section A	
1	
2	
3	
4	
Section B	
Total	

This document consists of **10 printed pages.**

[Turn over

Answer **all** the questions in this section.

1 **Table 1.1** shows some features of four biological molecules that are all polymers.

(a) Complete Table 1.1 by using a tick (✓) to indicate the features that apply to each polymer.

Table 1.1

feature	amylopectin	cellulose	RNA	polypeptide
synthesised from amino acid monomers				
contains glycosidic bonds				
polymer is branched				
contains nitrogen				
can be found in both animal and plant cells				

[4]

(b) **Fig. 1.1** is a simple diagram of a phospholipid molecule.

Explain how the structure of a phospholipid molecule makes it suitable for its function in cell membranes. You may label and annotate **Fig. 1.1** as part of your answer.



Fig. 1.1

[3]

- (c) State two components of a cell surface membrane other than phospholipid molecules and describe their function.

[4]

[Total: 11]

- 2 Fig. 2.1 below shows a diagram of a cell. The parts of a diagram are not drawn to scale.

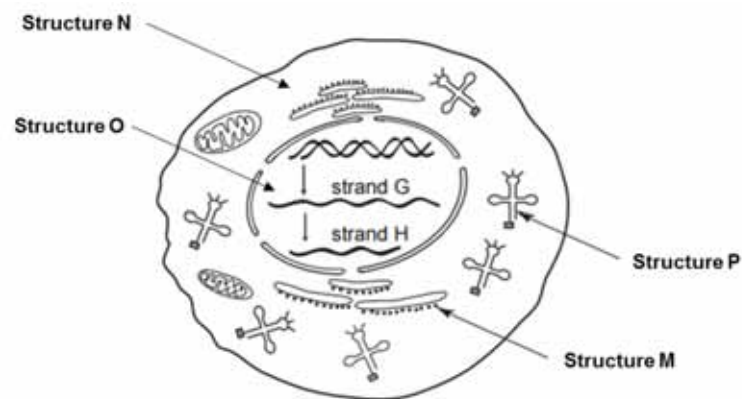


Fig. 2.1

- (a) (i) In which structure would RNA polymerase be found?

[1]

(ii) Explain the mode of action of RNA polymerase.

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[4]

(b) Strand H is shorter than strand G. Describe the process that results in this shortening, using appropriate names for both strands.

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[2]

(c) Name strand H and structures P and M. Explain how each contributes to protein synthesis.

Strand H:

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Structure P:

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Structure M:

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[3]

[Total: 10]

- 3 (a) Sometimes a gene has more than two alleles, termed *multiple alleles*.

The ABO blood group system in humans is controlled by a gene with three alleles, I^A , I^B and I^o . Alleles I^A and I^B are codominant and I^o is recessive to both.

The blood group **AB** is the result of codominance.

Explain what is meant by *codominance* in this context.

[3]

- (b) In humans, a gene that codes for the production of a protein, called factor VIII, is located on the X chromosome. The dominant allele for this gene produces factor VIII, but the recessive allele does not produce factor VIII.

A person who is unable to make factor VIII has haemophilia in which the blood fails to clot properly.

Explain why a man with haemophilia cannot pass haemophilia to his son but may pass haemophilia to his grandson.

[3]

- (c) A gene for feather colour in chickens is carried on an autosome. This gene has two alleles, black (C^B) and splashed-white (C^W). When a male chicken with black feathers is mated with a female chicken with splashed-white feathers, all the offspring have blue feathers. This also occurs when a male chicken with splashed-white feathers is crossed with a female with black feathers.

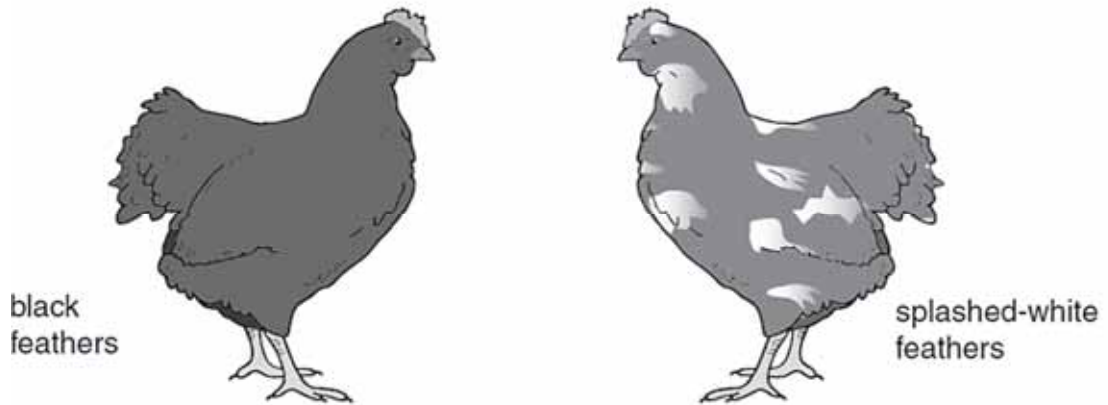


Fig. 3.1

Another gene may cause stripes on feathers (barred feathers). This gene is carried on the X chromosome. The allele for barred feathers (X^A) is dominant to the allele for nonbarred feathers (X^a).

In chickens, the male is homogametic and has two X chromosomes while the female is heterogametic and has one X chromosome and one Y chromosome.

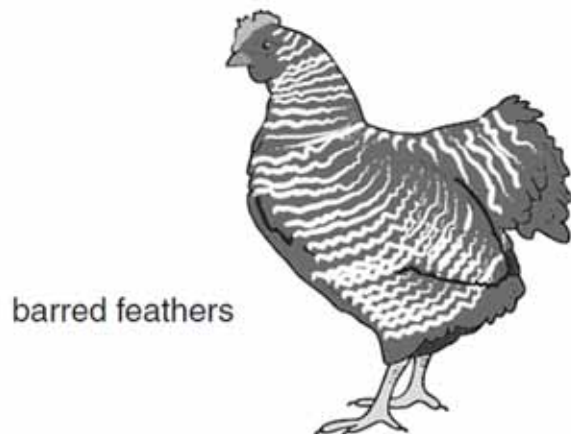


Fig. 3.2

- (i) A male chicken with black, non-barred feathers was crossed with a female chicken with splashed-white, barred feathers. All the offspring had blue feathers, but the males were barred and the females were non-barred.

Using the symbols given above draw a genetic diagram to show this cross.

[3]

- (ii) Explain how a farmer could use a breeding programme to find out the genotype of a male chicken with blue, barred feathers.

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[3]

[Total: 12]

- 4 Genetic information in humans can be obtained by DNA profiling.
In DNA profiling, the polymerase chain reaction is used by a scientist to amplify a particular sequence of DNA.

(a) Briefly describe the steps of polymerase chain reaction.

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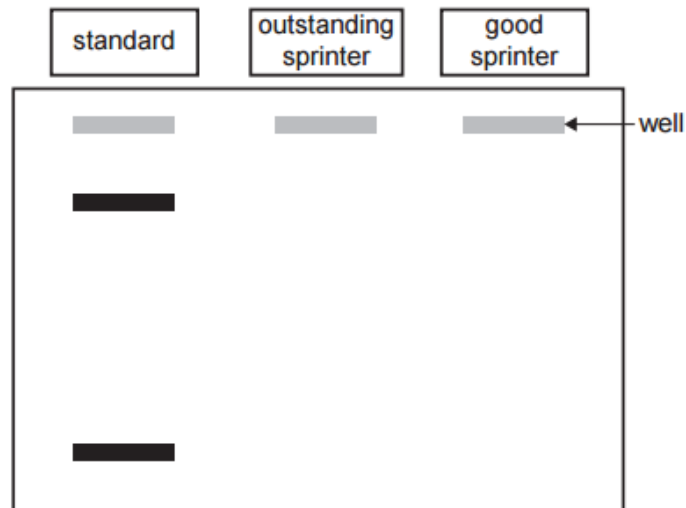
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[4]

Scientists investigating the performance of athletes found that one gene contributing to the performance of sprinters is the ACTN3 gene. There are two alleles of the gene, the 577R allele and the 577X allele. The 577X allele codes for a very short protein fragment in muscle fibres due to a stop codon mutation. The table below summarises the athletic potential for the three possible genotypes for the ACTN3 gene.

ACTN3 genotype	Athletic potential
577R / 577R	outstanding sprinter
577R / 577X	good sprinter or long-distance runner
577X / 577X	very good long-distance runner

- (b) A scientist tested sprinters to see if they possessed the 577R allele. Samples were obtained from athletes' muscle fibres. A standard containing proteins of the same lengths as the proteins coded for by both alleles 577X and 577R was used as a comparison. The standard and the samples were exposed to gel electrophoresis. In gel electrophoresis, protein molecules separate according to size and charge in the same way as DNA molecules. The result for the standard is shown below.



- (i) On the diagram of the gel above, draw the bands expected for an outstanding sprinter and for a good sprinter. [1]
- (ii) Explain why you have placed the bands in these positions. [2]

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[2]
[Total: 7]

Section B

Answer EITHER 4 or 5.

Write your answers on the separate answer paper provided.

Your answers should be illustrated by large, clearly labelled diagrams, where appropriate.

Your answers must be in continuous prose, where appropriate.

Your answers must be set out in sections **(a)**, **(b)** etc., as indicated in the question.

Either

- 5 (a) Describe the structures of chloroplasts and mitochondria. [6]
- (b) State the similarities between ATP production in chloroplasts and mitochondria and suggest why these similarities exist. [6]
- (c) Distinguish between the processes of Krebs cycle and Calvin cycle. [8]

Or

- 6 (a) A guppy (*Poecilia reticulata*) is a species of small fish which originates in the freshwater mountain streams of the islands of Trinidad and Tobago.
- It was observed in one stream, the guppies have bright and colorful rainbow markings, while in another nearby stream they would be less brightly colored.
- Describe how natural selection may bring about the evolution of the less brightly colored guppies in the other stream. [5]
- (b) Explain how variation could arise in a sexually-reproducing population. [7]
- (c) Describe the unique features of stem cells and with reference to **named examples**, outline the normal functions of stem cells in a living organism. [8]