

CATHOLIC JUNIOR COLLEGE  
JC2 Preliminary Examinations  
in preparation for General Certificate of Education Advanced Level  
Higher 1

CANDIDATE  
NAME

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INDEX  
NUMBER

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## BIOLOGY

**8875/02**

Paper 2 Core Paper

**28 August 2015**

**2 hours**

Additional Materials: Answer Paper

### READ THESE INSTRUCTIONS FIRST

Write your index number and name 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.

#### Section A

Answer **all** questions in the spaces provided on the question paper.

#### Section B

Answer any **one** question on the answer paper provided.

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

For Examiner's Use	
1	
2	
3	
4	
5 or 6	
Total	

This document consists of **14** printed pages

**[Turn over**

### Section A

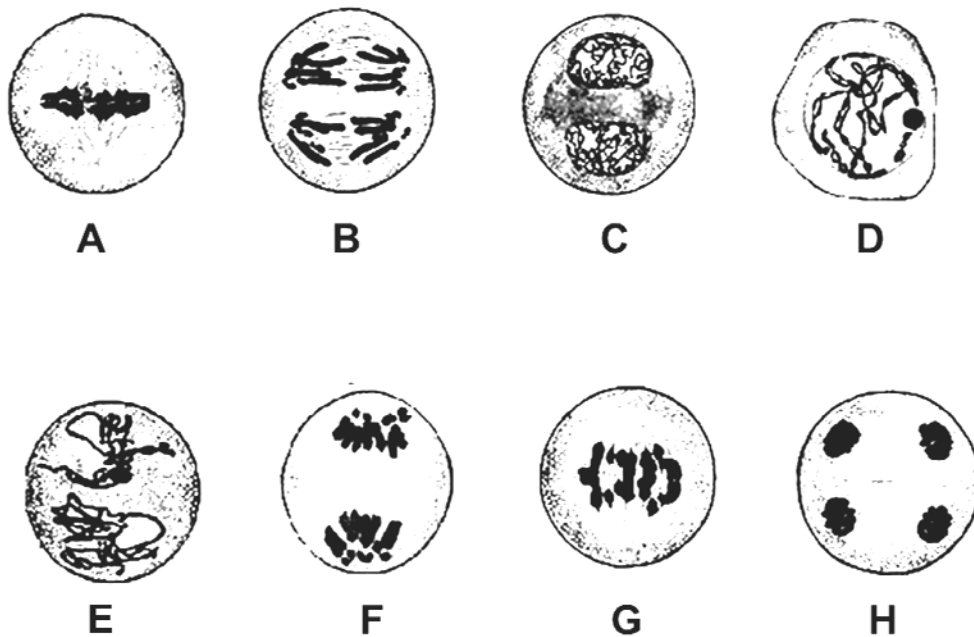
Answer **all** the questions in this section.

- 1** Meiosis is an important event which is required) prior to fertilisation in sexual reproduction.

- (a)** Explain the need for reduction division (meiosis) prior to fertilisation in sexual reproduction.

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 .....  
 .....  
 .....[2]

Fig. 1.1 below shows 8 different micrographs taken at the different timing during the meiosis of a cell.



**Fig. 1.1**

- (b)** Arrange the 8 stages (A - H) in chronological order.

.....[1]

(c) With reference to Fig. 1.1,

(i) identify **one** stage (A - H) that will result in genetic variation.

.....[1]

(ii) explain how this stage results in genetic variation.

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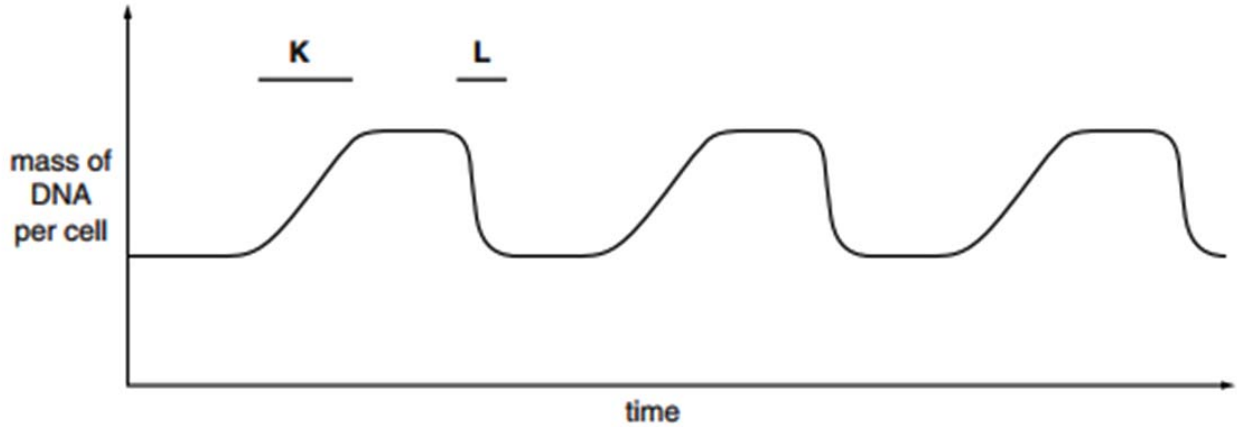
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.....[2]

Bone marrow contains stem cells that divide by mitosis to form blood cells. Each time a stem cell divides it forms a replacement stem cell and a cell that develops into a blood cell.

Fig. 1.2 shows changes in the mass of DNA in a human stem cell from the bone marrow during three cell cycles.



**Fig. 1.2**

**(d)** With reference to Fig. 1.2, state:

- (i)** what happens to bring about the changes in the mass of DNA per cell at **K** and at **L**.

.....  
 .....  
 .....  
 .....[2]

- (ii)** how many blood cells are formed from the stem cell in the time shown.

.....[1]

- (iii)** what happens to the number of chromosomes in the stem cell.

.....[1]

[Total: 10]

- 2** In mice, fur colour is controlled by a gene with multiple alleles. These alleles are listed below in no particular order.

yellow =  $C^y$

agouti =  $C^a$

black =  $C^b$

- (a)** Suggest explanations for the results of the following crosses between mice.

- (i)** Mice with agouti fur crossed with mice with black fur may produce all agouti offspring or some agouti and some black offspring.

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 .....  
 .....  
 .....[2]

- (ii)** Crosses between heterozygous parents with the genotype  $C^y C^b$  always produce a ratio of two yellow mice to one black mouse.

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 .....[2]

**[Turn over]**

- (b) The budgerigar, *Melopsittacus undulatus*, is a small type of parrot that is native to Australia.

Fig. 2.1 shows a budgerigar.



**Fig. 2.1**

A budgerigar can have blue, green, yellow or white feathers.

Two genes, **A/a** and **D/d**, are involved in the inheritance of feather colour in budgerigars.

- A bird which has at least one dominant allele **A** but is homozygous for **d** has blue feathers.
- A bird which has at least one dominant allele **D** but is homozygous for **a** has yellow feathers.
- A bird with at least one dominant **A** allele and one dominant **D** allele has green feathers.
- A bird that is homozygous for **a** and **d** has white feathers.

Two green-feathered budgerigars, heterozygous at both gene loci, were crossed. Draw a genetic diagram of this cross to show the probability of producing offspring with yellow feathers.

[6]

[Total: 10]

**[Turn over**

- 3 MRSA is a variety of *Staphylococcus aureus*. It is difficult to treat infections caused by this bacterium because it is resistant to methicillin and to some other antibiotics. As a result, some patients who are already very ill may die if they become infected with MRSA.
- (a) The antibiotic methicillin inhibits the enzyme transpeptidase. This enzyme is used by some bacteria to join monomers together during cell wall formation. Methicillin has a similar structure to these monomers.

Use this information to explain how methicillin inhibits the enzyme transpeptidase.

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.....[2]



- (b) Fig. 3.1 shows the number of deaths in England and Wales between 1994 and 2008 caused by MRSA.

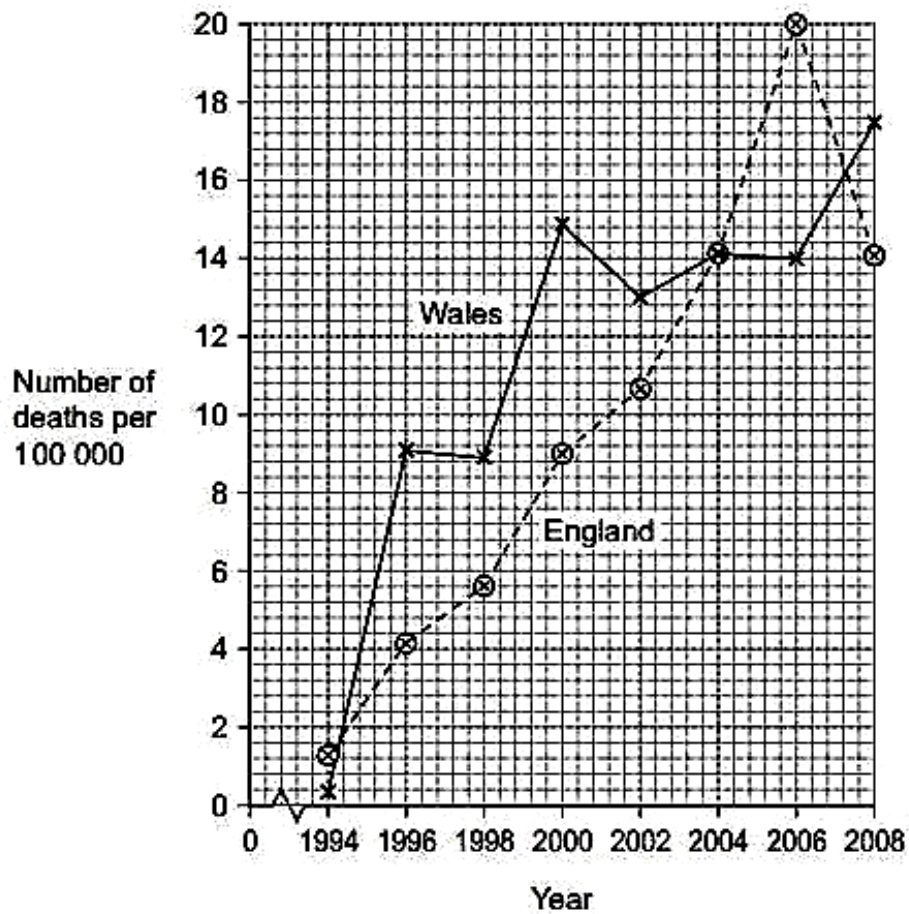


Fig. 3.1

Describe the change in the number of deaths caused by MRSA in England in the period shown in the graph.

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..... [1]

[Turn over

- (c) Describe how natural selection has increased the difficulty of treating bacterial infections with antibiotics.

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.....[4]

[Total: 7]

- 4 The artificial plasmid, pBR322, was constructed to act as a vector. It has often been used to insert human genes, such as the human insulin gene, into the bacterium, *Escherichia coli*.

The plasmid was constructed to include two genes, each giving resistance to a different antibiotic: an ampicillin resistance gene and a tetracycline resistance gene. The plasmid also has a target site for the restriction enzyme, *Bam*HI, in the middle of the tetracycline resistance gene.

A pBR322 plasmid was cut using *Bam*HI and the cDNA gene for human insulin inserted into it. Fig. 4.1 shows pBR322 and the recombinant plasmid.

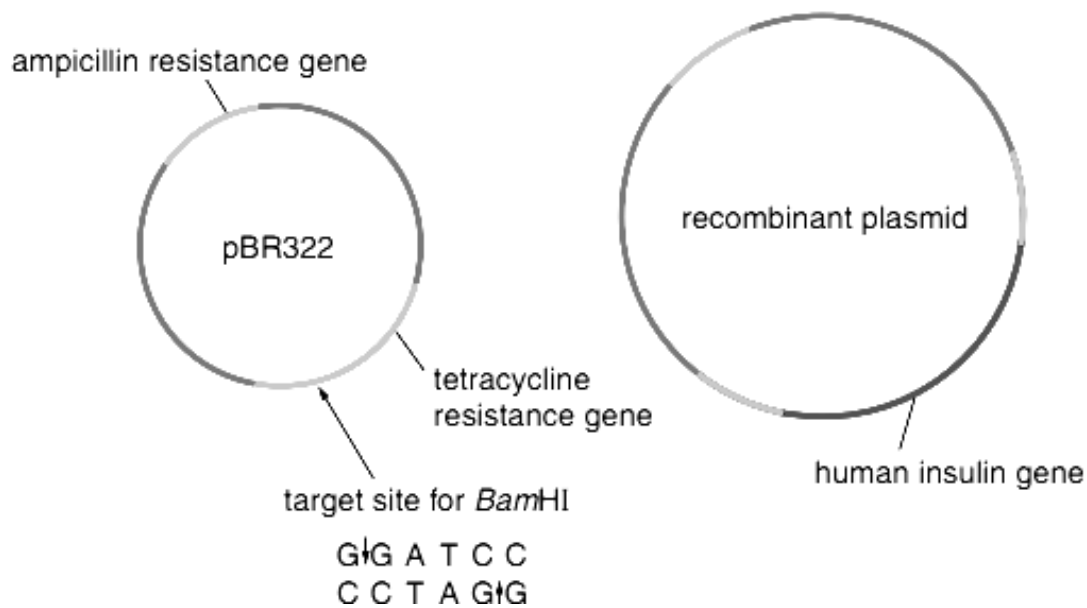


Fig. 4.1

- (a) With reference to Fig. 4.1, describe how a cDNA human insulin gene can be inserted into pBR322 that has been cut by *Bam*HI.

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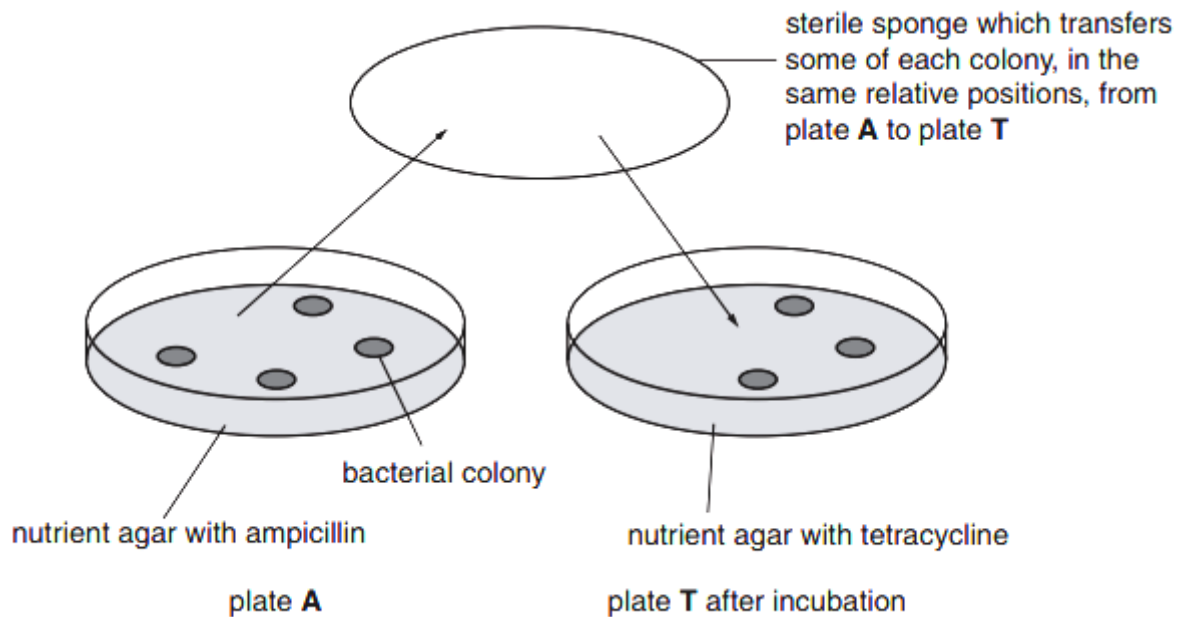
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.....[4]

[Turn over

(b) Bacteria were then mixed with the recombinant plasmids. Those bacteria which had successfully taken up recombinant plasmids were identified using the following steps:

- step 1 – the bacteria were spread onto culture plates containing nutrient agar and ampicillin and incubated to allow colonies to form
- step 2 – some bacteria from each of the colonies growing on these plates were transferred to plates containing nutrient agar and tetracycline, as shown in Fig. 4.2.



**Fig. 4.2**

(i) Explain why the bacteria were first spread onto plates containing ampicillin.

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.....[3]

- (ii) Explain why it is important, for identifying bacteria that have successfully taken up the recombinant plasmid, that on pBR322 the target site for *Bam*HI is in the middle of the tetracycline resistance gene.

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.....[3]

- (iii) Use a label line and the letter **C** to identify, on Fig. 4.2, a colony of bacteria that contain the recombinant plasmid.

Put your answer onto Fig. 4.2 on **page 12**.

[1]

- (c) Plasmid vectors carrying antibiotic resistance genes are now rarely used in gene technology.

Suggest one type of gene that has replaced antibiotic resistance genes in plasmid vectors and indicate how its presence can be detected.

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.....[2]

[Total: 13]

[Turn over

**Section B****Answer EITHER 5 OR 6.**

Write your answers on separate answer paper provided.

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

Your answer must be in continuous prose, where appropriate.

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

- 5**    **(a)** Compare the structures and roles of DNA and RNA. [8]
- (b)** Describe the process of translation. [6]
- (c)** Explain how competitive and non-competitive inhibitors affect a reaction catalyzed by an enzyme. [6]

[Total: 20]

- 6**    **(a)** Describe the pathway taken by cell-membrane bound proteins following their synthesis. [7]
- (b)** Describe the roles of NAD and NADP in cells. [8]
- (c)** Discuss the ethical implications of genetically modifying plants. [5]

[Total: 20]