

B O A R D O F S T U D I E S
NEW SOUTH WALES

2012

**HIGHER SCHOOL CERTIFICATE
EXAMINATION**

Biology

General Instructions

- Reading time – 5 minutes
- Working time – 3 hours
- Write using black or blue pen
Black pen is preferred
- Draw diagrams using pencil
- Board-approved calculators may be used
- Write your Centre Number and Student Number at the top of pages 9, 13, 15, 17 and 19

Total marks – 100

Section I Pages 2–22

75 marks

This section has two parts, Part A and Part B

Part A – 20 marks

- Attempt Questions 1–20
- Allow about 35 minutes for this part

Part B – 55 marks

- Attempt Questions 21–30
- Allow about 1 hour and 40 minutes for this part

Section II Pages 23–30

25 marks

- Attempt ONE question from Questions 31–35
- Allow about 45 minutes for this section

Section I

75 marks

Part A – 20 marks

Attempt Questions 1–20

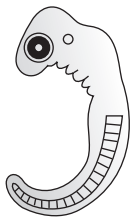
Allow about 35 minutes for this part

Use the multiple-choice answer sheet for Questions 1–20.

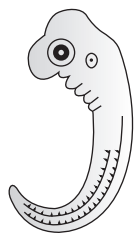
1 What is the name of the process that results in organisms containing DNA from different species?

- (A) Transcription
- (B) Transgenics
- (C) Translation
- (D) Translocation

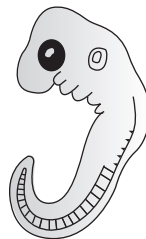
2 The diagram shows different vertebrate embryos at the same stage of development.



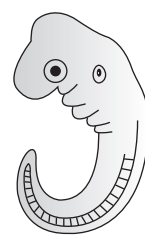
Fish



Amphibian



Bird

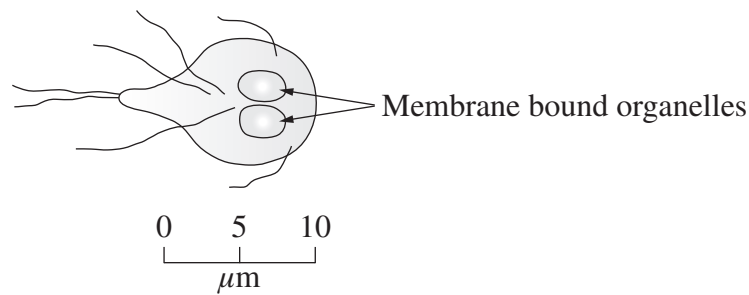


Human

How do the embryos provide evidence for evolution?

- (A) The embryos have different shaped eyes.
 - (B) Different adults evolve from the embryos.
 - (C) The embryos have structures that look similar.
 - (D) Divergent evolution results in common characteristics in the embryos.
- 3 Which of the following are all forms of defence that prevent the entry of pathogens into the body?
- (A) Cilia, sweat, saliva
 - (B) T cells, B cells, antibodies
 - (C) Inflammation, skin, phagocytosis
 - (D) Stomach acid, mucus, lymph system

4 The diagram shows a pathogen called Giardia.



What type of pathogen is Giardia?

- (A) Bacterium
- (B) Prion
- (C) Protozoan
- (D) Virus

5

Huntington's Disease is caused by an inherited gene that codes for a toxic protein.

Kwashiorkor is a disease caused by a deficiency of proteins in the body.

Mesothelioma is a disease caused by a gene mutation in the lungs after exposure to asbestos.

Which row in the table correctly classifies these diseases?

	<i>Huntington's Disease</i>	<i>Kwashiorkor</i>	<i>Mesothelioma</i>
(A)	Genetic	Nutritional	Environmental
(B)	Nutritional	Environmental	Environmental
(C)	Genetic	Nutritional	Genetic
(D)	Nutritional	Environmental	Genetic

6 How do vaccinations prevent disease?

- (A) They increase the inflammation process.
- (B) They enable the infected cells to seal off the pathogen.
- (C) They increase the number of antibodies against the pathogen.
- (D) They decrease the number of antigens that trigger the immune response.

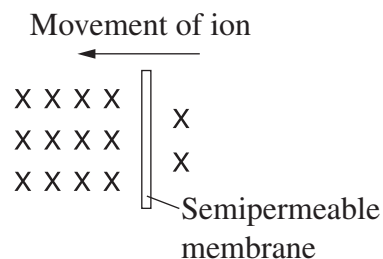
- 7 Why is it important to continue research into new antibiotics?
- (A) New prion diseases have been recently discovered.
 - (B) Resistant bacteria have evolved from the overuse of antibiotics.
 - (C) Viral infections require a broad range of antibiotics for eradication.
 - (D) New diseases are discovered regularly and all require new antibiotics.

- 8 Identical twins have the same genotype.

Why are there small differences between the phenotypes of identical twins?

- (A) Some genes are not co-dominant.
 - (B) Environment affects the expression of genes.
 - (C) Both parents are homozygous for those phenotypes.
 - (D) Chromosomes segregate independently during meiosis.
- 9 What feature can be used to distinguish mature xylem cells from mature phloem cells?
- (A) Phloem cells are located in vascular bundles.
 - (B) Phloem cells have a cytoplasm.
 - (C) Xylem cells are located in the leaves.
 - (D) Xylem cells have cell walls.

- 10 The diagram shows a model of the movement of ions (represented by X) across a semipermeable membrane.



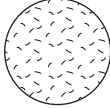
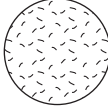
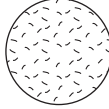
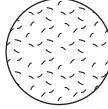
What type of process is modelled in the diagram?

- (A) Osmosis
- (B) Filtration
- (C) Diffusion
- (D) Active transport

- 11** Which of the following is an example of *hybridisation*?
- (A) The insertion of a bacterial gene for herbicide resistance into a cotton plant
 - (B) The culturing of a cell taken from the root of a carrot to form a small plant
 - (C) Artificial insemination of a domestic cat with wild cat semen to produce a Bengal cat
 - (D) A cutting taken from one variety of apple tree grafted onto the stem of a different variety of apple tree
- 12** Nitrogenous waste is at its highest concentration in
- (A) plasma in the renal vein.
 - (B) plasma in the renal artery.
 - (C) fluid in the collecting ducts of the kidney.
 - (D) interstitial fluid in the cortex of the kidney.
- 13** Why do organ transplants trigger an immune response in a recipient?
- (A) Antigens in the recipient's body recognise the organ as foreign.
 - (B) Cell surface markers on the organ attack the recipient's white blood cells.
 - (C) Antibodies in the recipient stimulate the production of antigens on the organ.
 - (D) The recipient's white blood cells recognise the antigens on the organ as foreign.
- 14** What is a role of the kidney in freshwater fish?
- (A) To remove water from the fish
 - (B) To absorb salt from the environment
 - (C) To excrete concentrated urine from the fish
 - (D) To decrease nitrogenous waste lost to the environment
- 15** Which of the following results in an increased absorption of water from the collecting tubule of the nephron?
- (A) An increase in the length of the collecting tubule
 - (B) A decrease in ADH released into the blood by the pituitary
 - (C) A decrease in glucose moving from the renal tubule into capillaries
 - (D) An increase in the concentration of dialysate solution in renal dialysis

- 16 A student carried out an investigation to identify the presence of microbes in water from different sources.

The student's lab notes are shown.

	<i>Control</i>	<i>Bottled water</i>	<i>Tap water</i>	<i>Tank water</i>
Inoculation of an agar plate with water sample	X	✓	✓	✓
Incubation at 37°C	✓	✓	✓	✓
Appearance of agar plate				

What can be inferred from these results?

- (A) The inoculation loop was not sterilised properly.
 (B) The water from each of these sources is unsafe to drink.
 (C) These water sources are contaminated with the same microbe.
 (D) The agar plates were contaminated prior to the beginning of the experiment.
- 17 Which of the following correctly identifies the relationship between alleles, chromosomes and genes?
- (A) Genes contain chromosomes and alleles.
 (B) Chromosomes contain genes but not alleles.
 (C) Alleles are found in chromosomes but not in genes.
 (D) Genes are parts of chromosomes and have different alleles.
- 18 How does a plant respond in order to keep cool on an extremely hot day?
- (A) It grows smaller leaves.
 (B) It opens stomata in the leaves.
 (C) It grows more hairs on the surface of the leaves.
 (D) It decreases the number of stomata on the top of the leaves.

- 19** Haemoglobin provides an adaptive advantage to an endotherm in a cold environment because it allows
- (A) more oxygen to be dissolved in plasma.
 - (B) the organism to decrease its metabolic rate.
 - (C) more energy to be available to the organism.
 - (D) less carbon dioxide to be transported in the blood.
- 20** A student performed a first-hand investigation in an attempt to model natural selection.

Each week, a jar was refilled with a fresh packet of cream biscuits containing five different types for people to eat. After a month, there were mostly lemon cream biscuits in the jar.

What is the limitation of this investigation as a model for natural selection?

- (A) There is no variation in the 'species'.
- (B) Characteristics are not transmitted to successive generations.
- (C) Variants of the 'species' do not have the same chance of 'survival'.
- (D) Unfavourable characteristics are selected out of the population over time.

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2012 HIGHER SCHOOL CERTIFICATE EXAMINATION

Biology

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Centre Number

Section I (continued)

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Student Number

Part B – 55 marks

Attempt Questions 21–30

Allow about 1 hour and 40 minutes for this part

Answer the questions in the spaces provided. These spaces provide guidance for the expected length of response.

Question 21 (5 marks)

You performed a first-hand investigation to estimate the size of blood cells.

- (a) How did you estimate the size of the cells? 2

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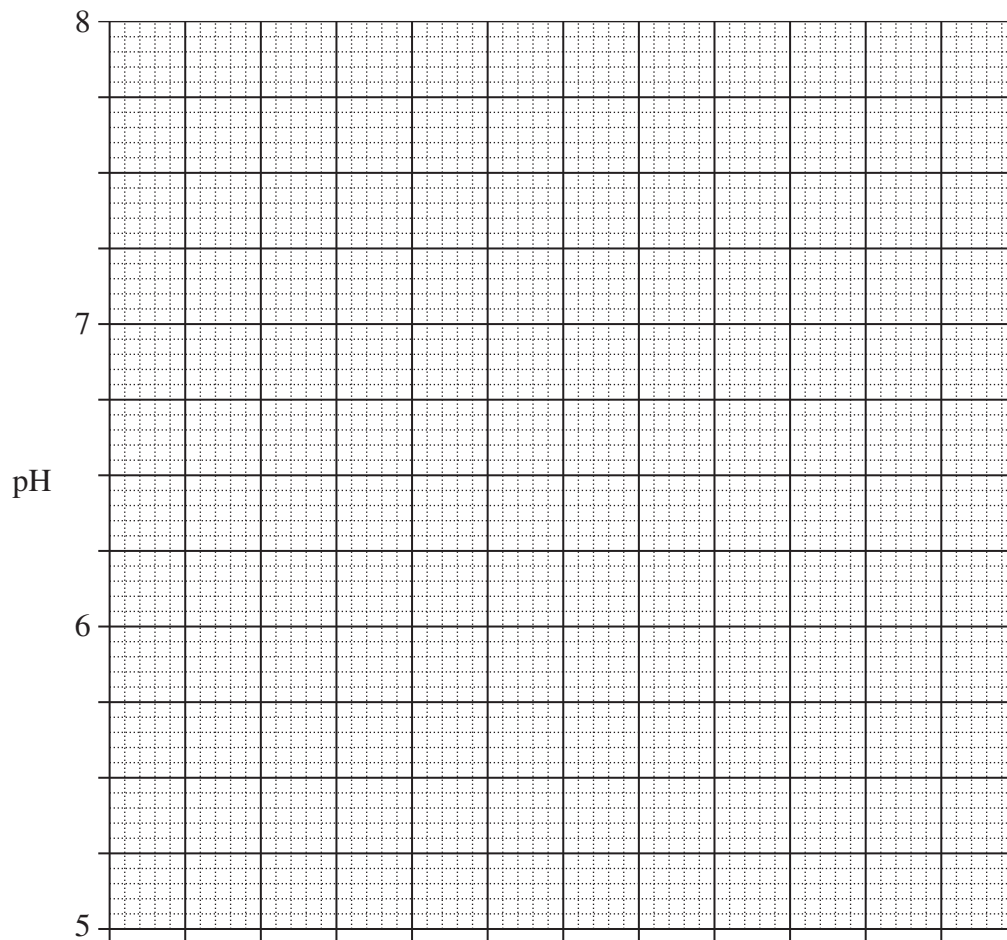
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- (b) Draw a scaled diagram that shows the features of both a red blood cell and a white blood cell. 3

Question 22 (continued)

- (b) On the grid below, plot the data from the table in part (a) and draw a curve of best fit. 3



- (c) Why is it better to represent these results as a curve of best fit rather than as a column graph? 2

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End of Question 22



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2012 HIGHER SCHOOL CERTIFICATE EXAMINATION

Biology

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Centre Number

Section I – Part B (continued)

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Student Number

Question 23 (5 marks)

A non-infectious disease was observed in a mother and her four sons who live with her. She has no daughters. The father of these children does not have the disease and does not live with them. The woman’s parents and her two sisters who live overseas do not have the disease.

- (a) Her doctor suspects that the disease is NOT inherited. Identify data that could be collected to investigate a non-inheritable cause of the disease. 1

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- (b) A geneticist suspects that the disease is inherited.
- (i) Draw the family pedigree for this disease. 2

- (ii) From the evidence, what indicates that the disease could be the result of a recessive allele and not be sex linked? 2

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Question 24 (5 marks)

You conducted first-hand investigations to test the effects of temperature, pH and substrate concentration on enzyme activity.

- (a) Complete the following table by identifying the variables for ONE of your investigations. **1**

<i>Independent variable</i>	<i>Dependent variable</i>	<i>Kept constant</i>
.....	pH, substrate concentration, enzyme concentration

- (b) Outline how you measured the activity of an enzyme in your investigation. In your answer, name the enzyme. **2**

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- (c) Describe how a condition needed for optimal enzyme activity would be expected to vary between endotherms and ectotherms. **2**

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2012 HIGHER SCHOOL CERTIFICATE EXAMINATION

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Centre Number

Section I – Part B (continued)

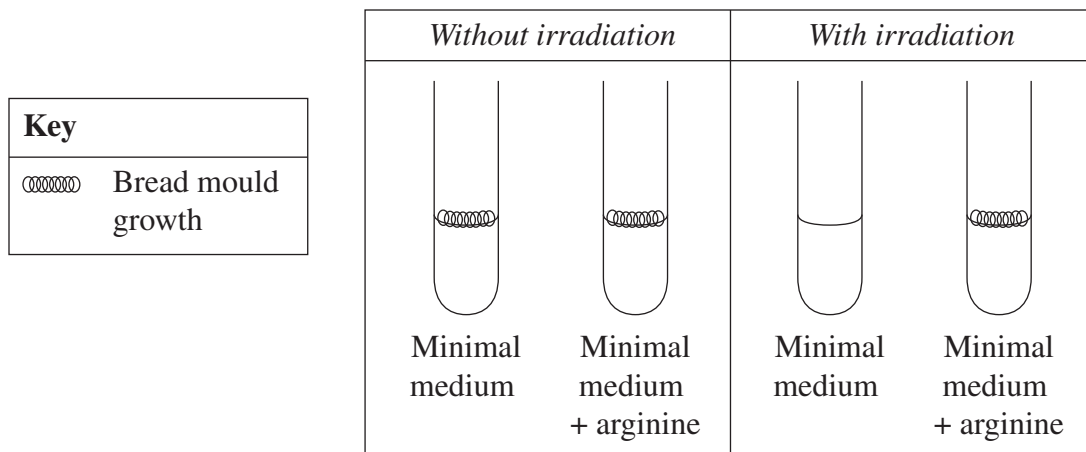
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Student Number

Question 25 (6 marks)

Beadle and Tatum’s experiment involved the analysis of bread mould growth. Bread mould uses an enzyme to make the amino acid arginine.

The diagram shows bread mould growth after culturing on two different media. In one part of the experiment, the bread mould had been irradiated before culturing.



(a) How do these results support the ‘one gene – one protein’ hypothesis? 4

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(b) Justify the types of secondary sources that would be acceptable to use to research Beadle and Tatum’s experiment. 2

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Question 26 (5 marks)

A scientist performed an epidemiological study to investigate the cause and effect relationship of smoking and lung cancer as follows:

5

1. Handed out a scientifically valid questionnaire to all colleagues (n = 144) at work
2. Checked that there were an equal number of male and female respondents
3. Discovered that there were more non-smoking respondents than smoking respondents. Removed some of the non-smokers until both groups had equal numbers
4. Checked that all the respondents had a medical check-up in the past year
5. Analysed data, wrote the paper and published it in a scientific blog.

From the information provided, analyse the methodology used by this scientist.

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2012 HIGHER SCHOOL CERTIFICATE EXAMINATION

Biology

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Centre Number

Section I – Part B (continued)

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Student Number

Question 27 (4 marks)

During a major international horse event in Australia, a group of horses, including some from overseas, is discovered to be infected by a deadly virus. This virus is only found in Australia.

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Give reasons for strategies that could be carried out to control this disease outbreak.

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Question 28 (5 marks)

Explain the relationship between replication of DNA and evolution.

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2012 HIGHER SCHOOL CERTIFICATE EXAMINATION

Biology

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Centre Number

Section I – Part B (continued)

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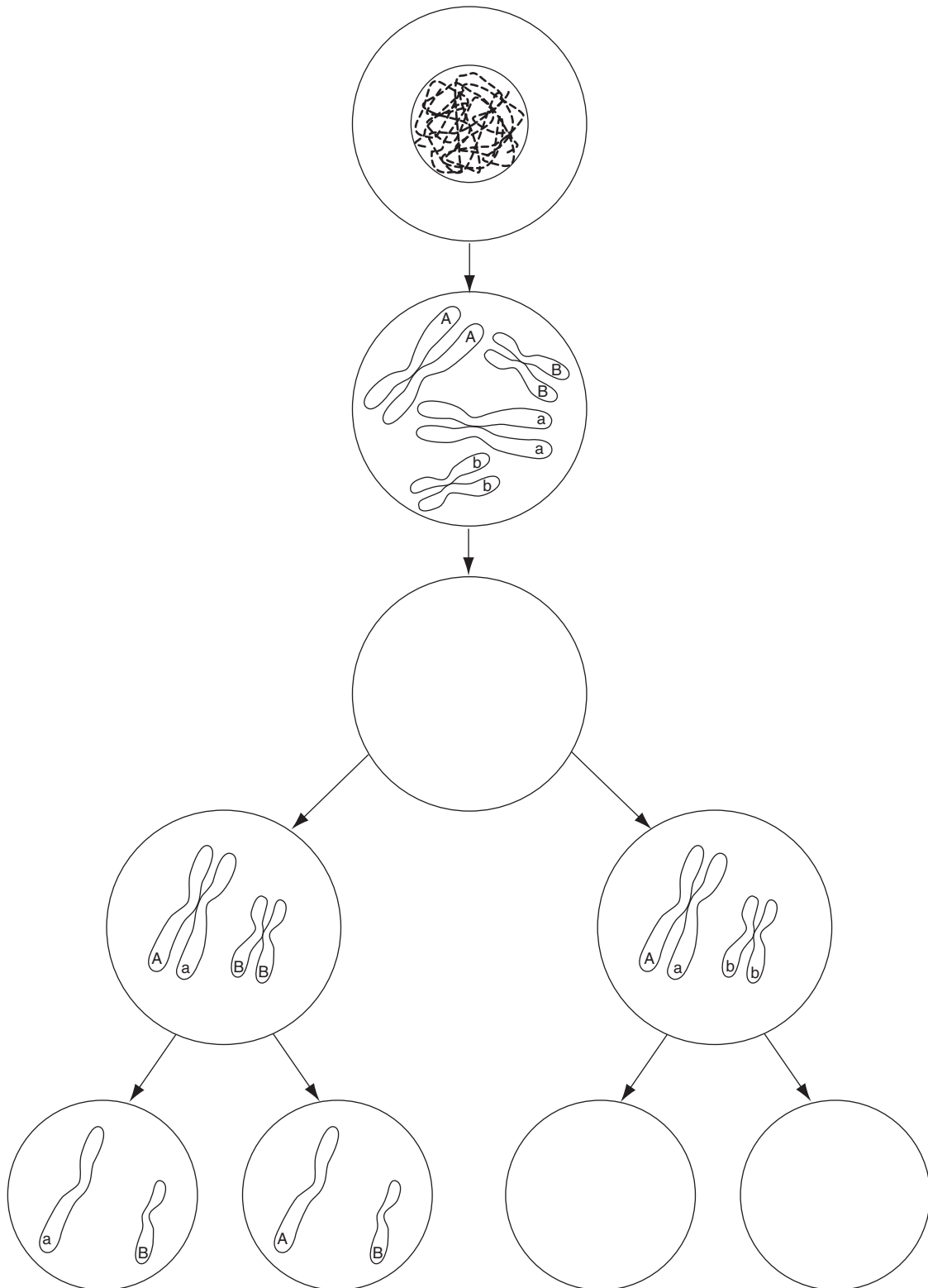
Student Number

Question 29 (5 marks)

Please turn over

Question 29 (5 marks)

- (a) Complete the following diagram to show the process by which gametes are formed. **3**



Question 29 continues on page 21



Question 29 (continued)

- (b) How does the segregation of chromosomes during meiosis lead to a wide variety of gametes being produced? **2**

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End of Question 29

Please turn over



Biology

Section II

25 marks

Attempt ONE question from Questions 31–35

Allow about 45 minutes for this section

There are four Section II Answer Booklets labelled Part (a), Part (b), Part (c) and Part (d).

Answer each part of the question in the relevant Answer Booklet.

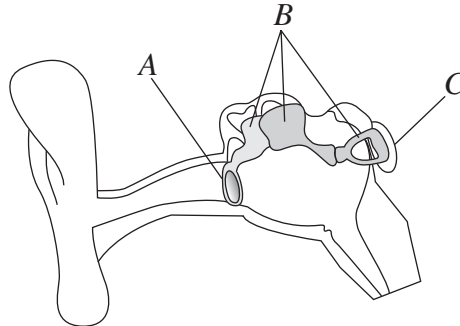
Extra writing booklets are available.

	Page
Question 31 Communication	24–25
Question 32 Biotechnology	26
Question 33 Genetics: The Code Broken?	27
Question 34 The Human Story	28–29
Question 35 Biochemistry	30

Question 31 — Communication (25 marks)

Answer part (a) in Section II Answer Booklet – Part (a).

(a) Parts of the ear are shown below.

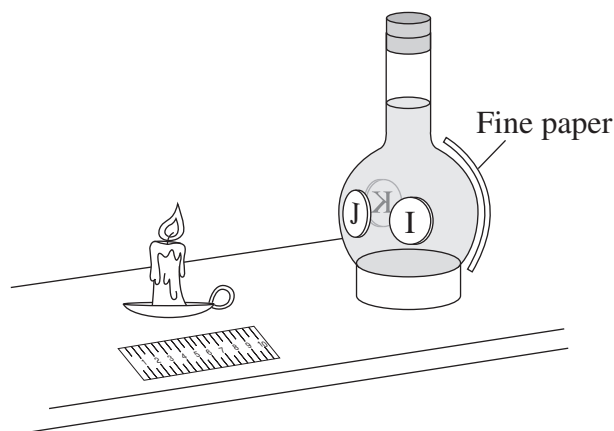


- (i) Identify the parts *A*, *B* and *C*. 2
- (ii) Outline the functions of part *B*. 2

Answer part (b) in Section II Answer Booklet – Part (b).

(b) An experiment was performed to model accommodation in the eye:

- a round bottom flask was filled with a solution
- the flask was placed on a stand on which it was able to rotate
- three lenses (I, J and K) of different thicknesses were attached to the surface of the flask
- a layer of fine paper was stuck around the opposite side of the flask
- a candle was placed near the flask
- different lenses could be brought into the light path by rotating the flask
- an image of the candle was observed on the layer of fine paper.



Question 31 continues on page 25

Question 31 (continued)

- (i) Match THREE pieces of apparatus used in this experiment with THREE identified parts of the eye. **2**
- (ii) Describe the quantitative data that could be collected in the experiment. **2**
- (iii) Compare this model to mechanisms of accommodation in the eye. **2**

Answer part (c) in Section II Answer Booklet – Part (c).

- (c) (i) Relate specialised features of the eyes of TWO named animals to their environment. **2**
- (ii) Describe the detection of vibrations by fish and insects, and the events which lead to a response. **5**

Answer part (d) in Section II Answer Booklet – Part (d).

- (d) Demonstrate how technologies help correct specific biological problems associated with human communication. **8**

End of Question 31

Question 32 — Biotechnology (25 marks)

Answer part (a) in Section II Answer Booklet – Part (a).

- (a) With reference to TWO biotechnological practices that use yeast, copy and complete the following table in your answer booklet. **4**

<i>Biotechnological practice</i>	<i>Name of chemical produced by yeast</i>	<i>Purpose of chemical produced</i>

Answer part (b) in Section II Answer Booklet – Part (b).

- (b) (i) Explain the purpose of a named transgenic organism. **3**
- (ii) Construct a diagram that demonstrates the sequence of events that results in the formation of recombinant DNA in a transgenic organism. **3**

Answer part (c) in Section II Answer Booklet – Part (c).

- (c) (i) Why could aquaculture be considered a biotechnology? **2**
- (ii) Compare aquaculture with early biotechnologies applied to agriculture. **5**

Answer part (d) in Section II Answer Booklet – Part (d).

- (d) Explain how a detailed understanding of cell chemistry has resulted in society making more effective use of biotechnology. Support your answer with examples. **8**

Question 33 — Genetics: The Code Broken? (25 marks)

Answer part (a) in Section II Answer Booklet – Part (a).

- (a) With reference to TWO types of cloning, copy and complete the following table in your answer booklet. **4**

<i>Type of cloning</i>	<i>Process used</i>	<i>Example</i>

Answer part (b) in Section II Answer Booklet – Part (b).

- (b) (i) Construct a model of a section of a double stranded DNA molecule containing the sequence GAT using a selection of the symbols below. Include a key in your answer. **3**

Ⓒ ⒫ Ⓔ Ⓐ Ⓖ Ⓓ Ⓤ

- (ii) Outline how genes are expressed. **3**

Answer part (c) in Section II Answer Booklet – Part (c).

- (c) (i) What is the Human Genome Project? **2**
- (ii) Explain how recombinant DNA technologies can be used to identify the position of a gene on a chromosome. **5**

Answer part (d) in Section II Answer Booklet – Part (d).

- (d) Compare and contrast the effects of germ line mutation and transposable genetic elements on whole organisms. **8**

Question 34 – The Human Story (25 marks)

Answer part (a) in Section II Answer Booklet – Part (a).

- (a) (i) Using the diagram, name TWO features of the *Homo sapiens* skeleton which make it unique among the primates. **2**



- (ii) Outline how ONE named non-skeletal characteristic has assisted primates in their evolution. **2**

Question 34 continues on page 29

Question 34 (continued)

Answer part (b) in Section II Answer Booklet – Part (b).

(b) Examine the data collected on *Homo neanderthalensis* fossils found in recent years.

<i>Date</i>	<i>Data</i>
2008	<ul style="list-style-type: none"> • Full sequence of mitochondrial DNA of a range of Neanderthal fossils from within and between different fossil sites • The sequence is nearly identical within one fossil site • The sequence is very different between fossil sites
2010	<ul style="list-style-type: none"> • Full sequence of Neanderthal nuclear DNA • 1%–4% of genes in European modern humans are specific Neanderthal genes • No identifiable specific Neanderthal genes in modern sub-Saharan African humans • No specific modern human genes in nuclear DNA of Neanderthal fossils

- (i) What inferences can be made about Neanderthal populations, based on the data collected in 2008? **3**
- (ii) What inferences can be made about migration and breeding, based on the data collected in 2010? **3**

Answer part (c) in Section II Answer Booklet – Part (c).

- (c) How have polymorphism and clinal gradation contributed to the diversity of human populations? In your answer, use at least one human phenotype as an example. **7**

Answer part (d) in Section II Answer Booklet – Part (d).

- (d) (i) For TWO named hominids, describe fossil evidence that infers the use of technology which led to cultural development. **2**
- (ii) Predict and justify future directions of human biological evolution in the context of TWO technologies already developed by modern humans. **6**

End of Question 34

Question 35 — Biochemistry (25 marks)

Answer part (a) in Section II Answer Booklet – Part (a).

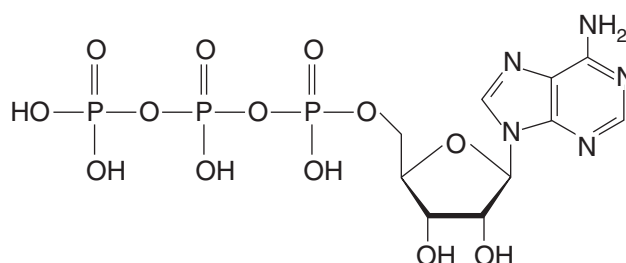
- (a) (i) Name a product of photosynthesis and its chemical source. **2**
- (ii) Outline how photosynthesis could be used to replace materials presently obtained from non-renewable resources. **2**

Answer part (b) in Section II Answer Booklet – Part (b).

- (b) You performed a first-hand investigation to determine the effect of light intensity on production of gas in a suitable pond weed.
- (i) Draw a labelled diagram of the experimental set-up. **2**
- (ii) Describe the quantitative data you collected in the experiment. **2**
- (iii) How would you alter this investigation to measure the effect of carbon dioxide on photosynthesis? **2**

Answer part (c) in Section II Answer Booklet – Part (c).

- (c) A diagram of adenosine triphosphate (ATP) is shown.



- (i) With reference to the diagram, describe how ATP performs its biological function. **2**
- (ii) Explain how light energy is converted to ATP and NADPH during the light-dependent reaction. **5**

Answer part (d) in Section II Answer Booklet – Part (d).

- (d) Explain how knowledge of biochemical pathways has been enhanced by an understanding of radioactive isotopes. **8**

End of paper