



CANDIDATE
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BIOLOGY

9790/03

Paper 3 Long Answer

May/June 2012

2 hours 30 minutes

Candidates answer on the Question Paper.

No additional materials are required.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.

Write in dark blue or black pen.

You may use a soft pencil for any diagrams, graphs or rough working.

Do not use staples, paper clips, highlighters, glue or correction fluid.

DO **NOT** WRITE IN ANY BARCODES.

Section A

Answer **all** questions.

Write your answers in the spaces provided on the Question Paper.

Section B

Answer **all** questions.

Write your answers in the spaces provided on the Question Paper.

Section C

Answer **one** question.

Write your answer on the Question Paper. Separate answer paper will be available if required.

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	
1	
2	
3	
4	
Section B	
Section C	
Total	

This document consists of **20** printed pages.



Section A

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

You are advised to spend no longer than 50 minutes on this section.

- 1 The hawksbill turtle, *Eretmochelys imbricata*, shown in Fig. 1.1, is classified as critically endangered by the International Union For Conservation of Nature (IUCN).

This turtle is slow-growing, with females only reaching breeding age at around 30 years old. Nesting sites are undisturbed tropical sandy beaches. It is omnivorous and its diet includes sea sponges that contain sharp crystals of silica. Many of these sponges contain toxins that are lethal to other animals. The turtle can also feed on venomous jellyfish, as it is resistant to the effects of the venom.



Fig. 1.1

- (a) *E. imbricata* occupies a unique niche in its ecosystem. With reference to the information given, suggest **one** adaptation which enables it to survive successfully in this niche.

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 [1]

- (b) Suggest two factors which contribute to *E. imbricata* becoming a critically endangered species.

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2

..... [2]

(c) Explain why species become endangered when their population falls to very low numbers.

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(d) In recent years, marine biologists have begun to fit small satellite transponders to the shells of some sea turtles. This enables the biologists to track the movements of the turtles. Some turtles have been found to travel over 1000km from the nest site where they hatched.

Explain the importance of this tracking in protecting sea turtles.

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[Total: 8]

- 2 Cell membranes consist mainly of proteins and phospholipids. The arrangement of these molecules in cell membrane structure is described by the fluid mosaic model.

(a) Give **one** example of the function of proteins in membranes.

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 [1]

(b) Fatty acid chains of natural membrane phospholipids may be saturated or Z-unsaturated. Unsaturated fatty acid chains include one or more double bonds.

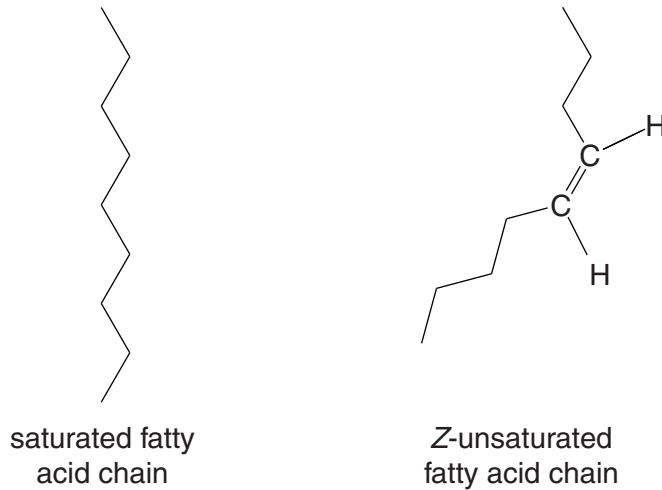


Fig. 2.1

(i) Explain why a membrane whose phospholipids contain mainly Z-unsaturated fatty acids has a greater fluidity than one whose phospholipids predominantly contain saturated.

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 [3]

(ii) Explain why the presence of phospholipids with Z-unsaturated chains eases the passage of small, non-polar molecules, such as oxygen, through membranes.

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(c) In an experiment, a mouse cell and a human cell were fused. The cell surface membranes of mouse and human cells possess species-specific proteins. The species-specific proteins did not remain at opposite ends of the fused cell, but became intermingled.

Explain what this observation suggests about membrane structure.

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..... [2]

[Total: 9]

- 3 One laboratory method for investigating possible evolutionary relationships between mammals uses immunology and is summarised in Fig. 3.1.

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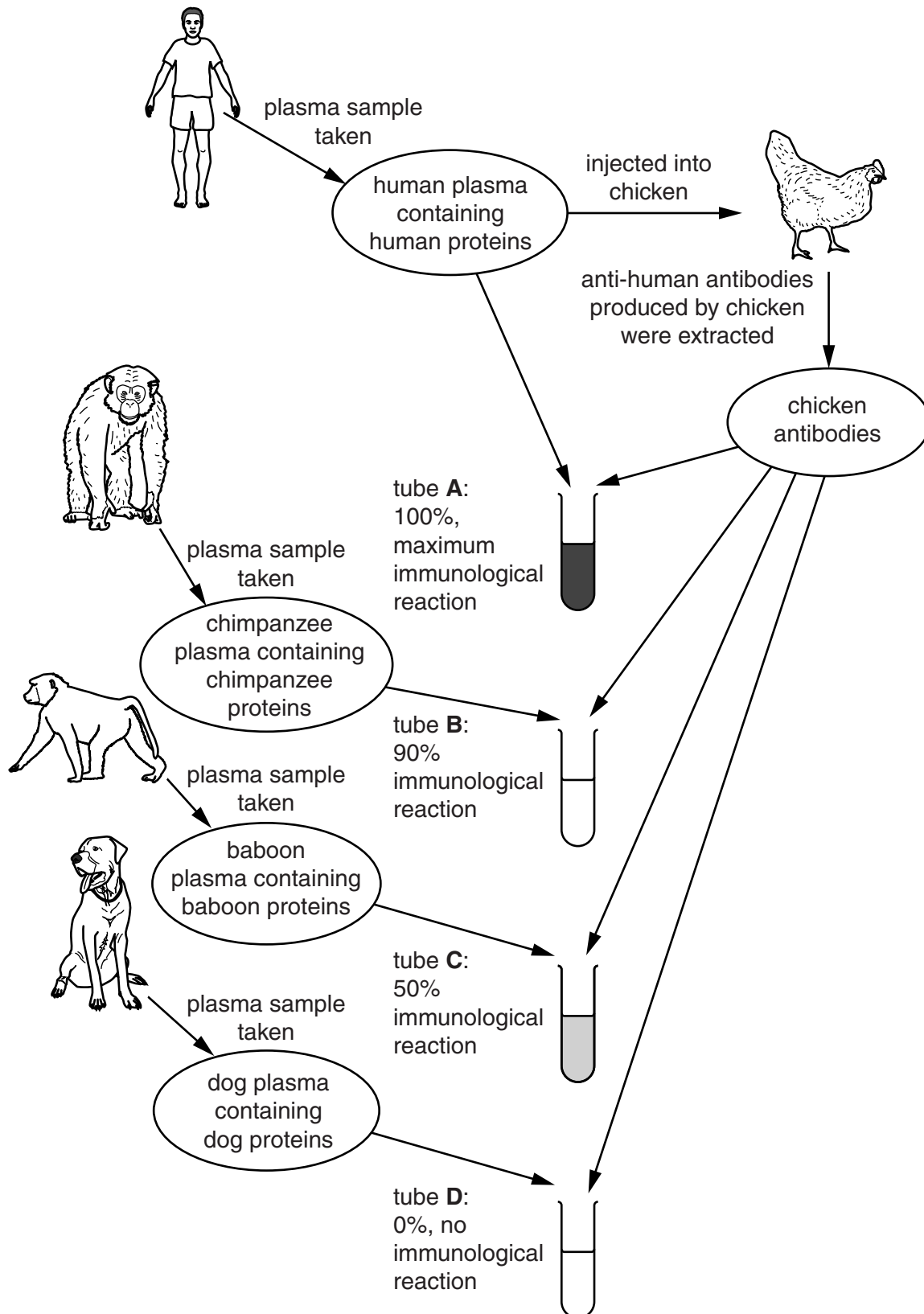


Fig. 3.1

(a) The immune system of birds is similar to that of mammals. With reference to Fig. 3.1,

(i) explain why injecting human proteins into a chicken causes an immune response

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..... [2]

(ii) suggest why investigators described the reaction of the chicken antibodies with the human proteins as 100% (tube **A**).

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..... [2]

(b) Describe **and** explain the conclusions which could be made about the evolutionary relationships between the **mammals** shown in Fig. 3.1.

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[Total: 9]

- 4 Fig. 4.1 shows a vertical section through the human heart. The structures labelled **X**, **Y** and **Z** are each involved with an aspect of the control and coordination of the heart beat.

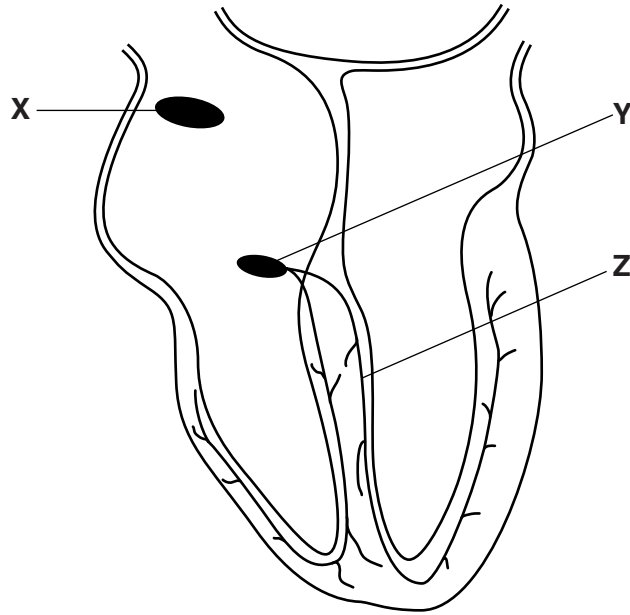


Fig. 4.1

- (a) Name the structures labelled **Y** and **Z**.

Y

Z

[2]

- (b) Structure **X** is often referred to as the 'pacemaker'. Explain why it is so called by describing the role it takes in controlling heart beat.

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[3]

(c) Explain the role of structure Y in the control and coordination of the heart beat.

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(d) The electrical activity of heart muscle can be recorded using electrodes placed at various positions on a person's body. The resulting trace is called an electrocardiogram (ECG) and is a useful diagnostic tool in assessing the functioning of the heart.

On an ECG

- P corresponds to the atria filling and then contracting,
- QRS corresponds to the ventricles contracting,
- T corresponds to the recovery phase.

Fig. 4.2 shows ECGs for two people.

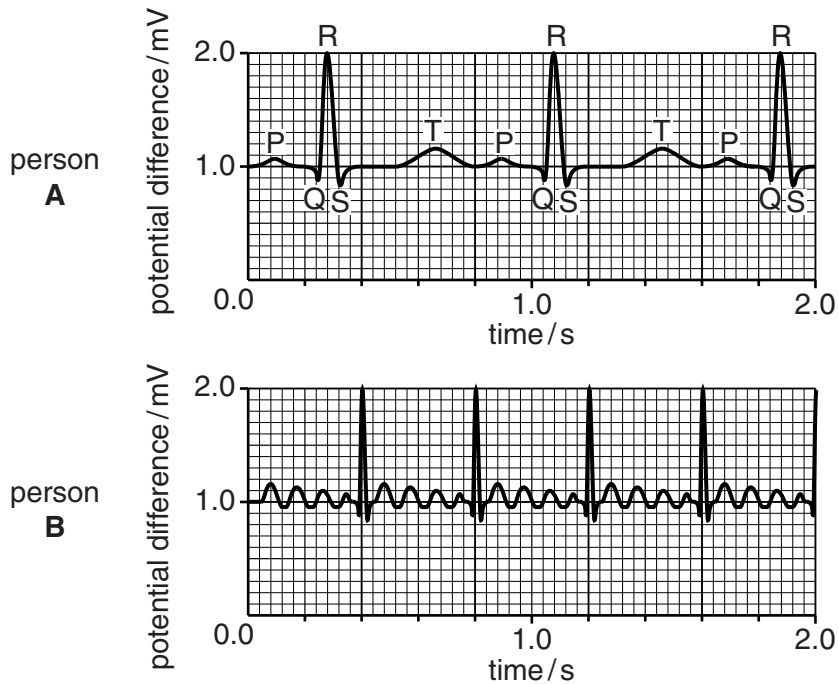


Fig. 4.2

- (i) Person **A** in Fig. 4.2 has a normal ECG. Calculate the heart rate from this ECG.

Show your working.

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Answer = [2]

- (ii) Suggest the likely effects on the control and coordination of heart beat of person **B**, indicated by the ECG shown in Fig. 4.2.

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[Total: 14]

Section B

Read the passage carefully and answer **all** the questions in the spaces provided.

You are advised to spend no longer than 50 minutes on this section

Stem cells: recent progress in medical application

In 2008, a woman had her damaged left bronchus replaced by one constructed using her own stem cells. A section of the trachea from a donor was treated in order to remove the cells of the donor, leaving only a framework of collagen. Adult stem cells derived from the woman's own bone marrow were then added to this collagen framework. Samples of these stem cells, together with cells derived from the lining of her trachea, were placed in a bioreactor for four days during which time they multiplied to coat the collagen framework. This was used to replace the damaged section of her bronchus. A month later the transplanted tissue had developed its own blood supply. This was claimed to be the first successful transplant using tissues derived from the patient's own stem cells.

Treatment of leukaemia using bone marrow transplants from donors with matching tissue types was first carried out in 1968. Treatment with adult stem cells extracted from the patient's bone marrow is a much more recent treatment. After removal of the stem cells, the remaining bone marrow cells and white blood cells in the patient, including the cancer cells, are killed. The stem cells are separated from the cancer cells in the extract. The remaining stem cells are returned to the patient's body. This procedure is still rarely used as it currently gives a greater risk of cancer in the future.

Embryonic stem cells have been shown to be effective in treating serious spinal injuries in rats. Trials have begun treating human spinal cord injuries with embryonic stem cells.

- 5 (a) Outline the advantages of using a patient's own stem cells to treat a damaged bronchus, as described in the passage, rather than transplanting a complete bronchus.

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- (b) Stem cells from human bone marrow that are involved in blood cell formation are described as multipotent, rather than totipotent.

Distinguish between multipotent cells and totipotent cells.

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- (c) Name three types of cell which may form from bone marrow stem cells.

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3 [3]

6 Once most stem cells differentiate they lose their ability to turn into other types of cells. However, some fully differentiated cells can be stimulated to change back into stem cells in tissue culture. Such cells are called induced pluripotent stem cells (iPS cells).

- (a) In experiments with mice it was discovered that the introduction of four genes would cause certain fully differentiated cells to change to iPS cells.

(i) Suggest two possible means by which the four genes were introduced into the cells.

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(ii) Suggest how the researchers identified the cells which had taken up the genes.

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(iii) Suggest how the addition of only a few genes may influence the activity of many other genes.

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..... [1]

(b) There is evidence to suggest that the introduction of the four genes mentioned in (a) caused an increase in the production of telomerase reverse transcriptase (TERT) in the fully differentiated cells.

Explain how TERT may help to change the cells back into stem cells.

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7 A cybrid (cytoplasmic hybrid cell) is produced as shown in Fig. 7.1.

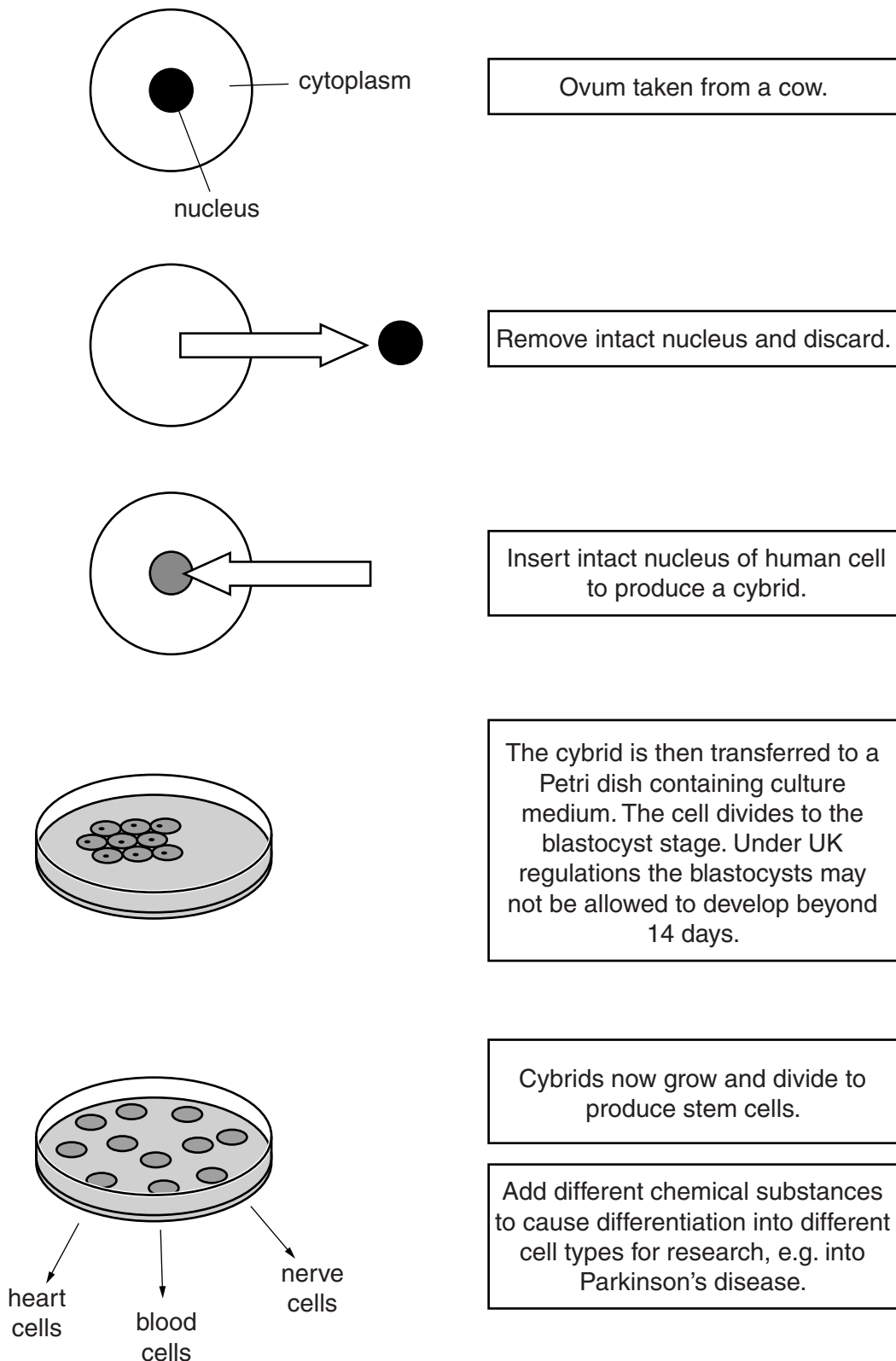


Fig. 7.1

- (a) The DNA of such a cybrid is 99.6% human. The remaining 0.4% of the DNA is in the cytoplasm. Explain why there is DNA in the cytoplasm of the cybrid.

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- (b) When the Human Fertilisation and Embryology Bill was considered by the UK Parliament in 2008, some people argued that it is unethical to allow the production of cybrids.

State whether you agree **or** disagree that this is unethical **and** explain why you reached this decision.

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Section C

Answer **one** question on the lined paper that follows.

You are advised to spend no more than 50 minutes on this section of the examination.

Credit will be given for answers that draw from a wide range of syllabus material and also for evidence of reading around the subject.

- 8** A study of photosynthesis and the structures involved in it reveals much about the evolutionary history of photosynthetic organisms and their adaptation to changes in the Earth's atmosphere. Discuss this statement.
- 9** Carl Linnaeus introduced, in 1735, a system of naming and classifying living organisms just over one hundred years before Darwin and Wallace published their theory of evolution. He wrote:
- 'All the species recognized by Scientists came forth from God's hand, and the number of these is now and always will be exactly the same.'
 - 'The species are as numerous as the different forms which exist upon this globe – they produce others similar to themselves but in greater numbers.'
 - 'Organisms are divided into two kingdoms of nature: viz. the vegetable and animal kingdoms.'
 - 'The species and the genus are always the work of nature; the class and the order are the work of nature and art.'

Compare Linnaeus' views of the nature of a species and their classification with those of modern biologists, and account for any differences.

- 10** Complex multicellular organisms, such as flowering plants and vertebrates, have evolved, in addition to transport at a cellular scale, a variety of strategies for longer distance transport within their bodies. Describe these different strategies and their relative merits. Do not include transport into and out of cells.

[Total: 30]

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