

The Heart

Question Paper 3

Level	International A Level
Subject	Biology
Exam Board	CIE
Topic	Transport in mammals
Sub Topic	The Heart
Booklet	Theory
Paper Type	Question Paper 3

Time Allowed : 68 minutes

Score : / 56

Percentage : /100

Grade Boundaries:

A*	A	B	C	D	E	U
>85%	'77.5%	70%	62.5%	57.5%	45%	<45%

- 1 (a) The glycoproteins CD28 and CD40 are found on the surface of T-lymphocytes (T-cells). They are binding sites for cell-signalling molecules and are essential for triggering the cloning of T-cells in an immune response.

A monoclonal antibody (mAb), which could block the CD40 signalling pathway, was produced from hamsters using the hybridoma method.

Outline the procedure, starting with a hamster, for producing mAbs suitable for use in another mammal, such as a mouse.

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(b) The ability of the mAb produced in (a) to prevent rejection of transplanted hearts in mice was compared with that of a protein, P, which blocks the CD28 signalling pathway.

Four groups of mice were treated as follows:

- group A – no treatment
- group B – treated with protein P only
- group C – treated with mAb only
- group D – treated with both mAb and protein P.

Fig. 2.1 shows the percentage survival of the transplanted hearts in the four groups of mice over a period of 80 days.

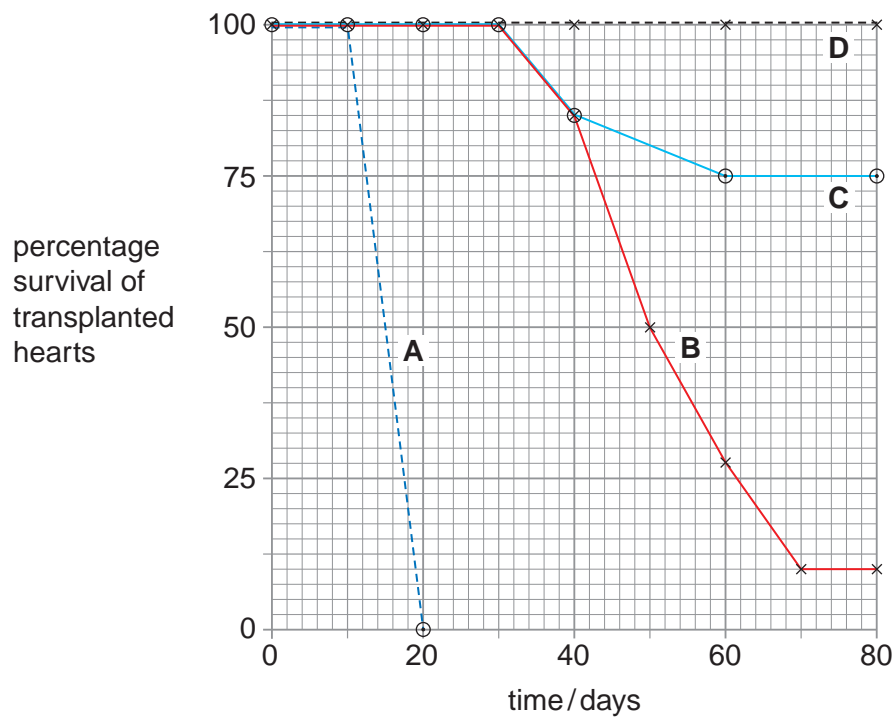


Fig. 2.1

With reference to Fig. 2.1

(i) describe the effectiveness of the four different treatments

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- (ii) suggest an explanation for the differences in survival of the transplanted hearts in groups **B** and **D**.

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- (c) Examination of the transplanted hearts showed that the hearts in group **A** had significant damage to their coronary arteries, whereas in group **D** these blood vessels appeared normal.

Explain the importance of the coronary arteries of the heart.

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- (d) State two uses of mAbs in humans, other than preventing rejection of transplanted tissue.

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[Total: 15]

2 Fig. 1.1 shows the outline of a ciliated cell from the human gas exchange system.

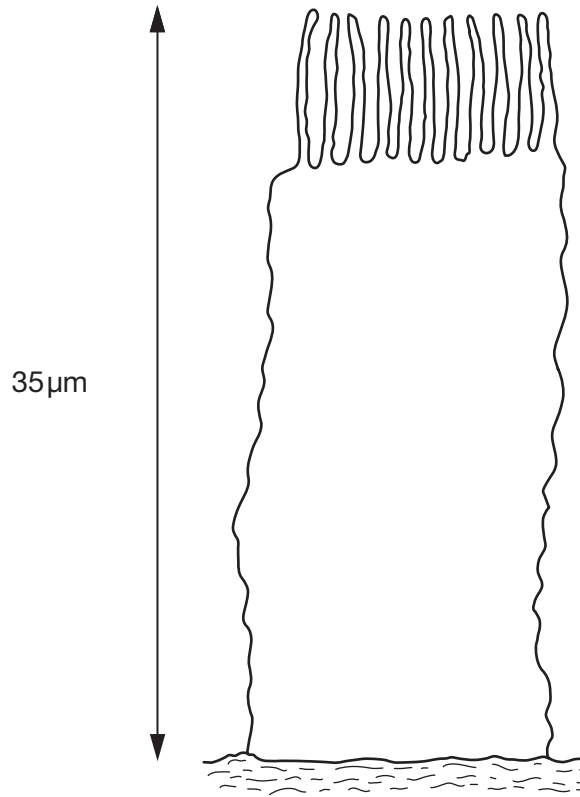


Fig. 1.1

- (a) (i) Inside the ciliated cell in Fig. 1.1, draw the nuclear envelope and a mitochondrion as they would be seen with an electron microscope.
Label these structures. [3]
- (ii) Calculate the magnification of the ciliated cell in Fig. 1.1.
Show your working and express your answer to the nearest whole number.

magnification = [2]

Fig. 1.2 is a drawing of *Mycobacterium tuberculosis*.

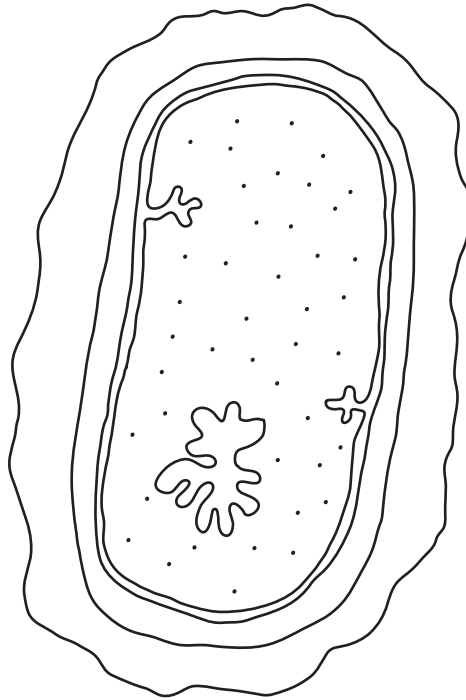


Fig. 1.2

(b) State three structural features that are found in **both** *M. tuberculosis* and animal cells, such as the ciliated cell in Fig. 1.1.

1.
2.
3. [3]

(c) Describe how *M. tuberculosis* is transmitted from an infected person to an uninfected person.

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- [2]

Table 1.1 shows the numbers of new cases of tuberculosis (TB) and the death rates from TB in selected countries in 2005. The fatality ratio is the number of deaths as a proportion of the number of new cases.

Table 1.1

country	number of new cases per 100 000 people	number of deaths per 100 000 people	fatality ratio
China	100	16	0.16
Pakistan	181	37	0.20
South Africa	600	71	0.12
Uganda	369	91	
United Kingdom	14	1	0.07
United States of America	5	0	0.00

(d) Complete Table 1.1 by calculating the fatality ratio for Uganda.

Enter your result in Table 1.1. [1]

(ii) Suggest why fatality ratios are higher in some of the countries shown in Table 1.1 than in others.

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[Total: 15]

3 Fig. 4.1 is a diagram of a section through a mammalian heart.

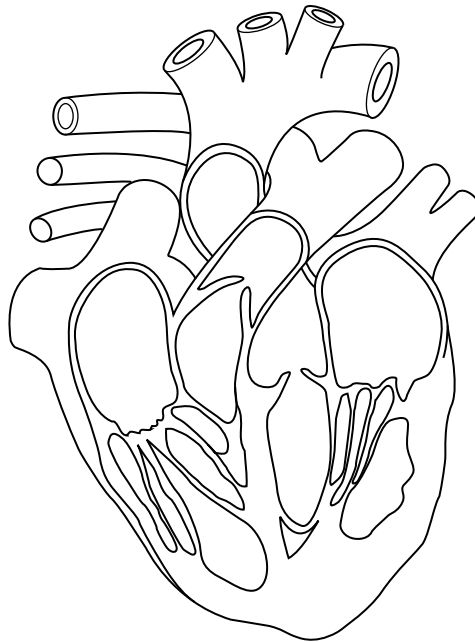


Fig. 4.1

(a) Use a label line and the appropriate letter to label each of the following on Fig. 4.1:

W right atrium

X tricuspid valve

Y aorta.

[3]

(b) Starting from the left ventricle, describe the route taken by the blood as it travels to the lungs.

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- (c) Describe **and** explain how the structure of the human **gas exchange surface** is adapted for maximum efficiency.

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[Total: 10]

4 Mammals have closed, double circulatory systems.

(a) Explain what are meant by the terms *closed* and *double* as applied to mammalian circulatory systems.

closed

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double

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..... [2]

Fig. 5.1 shows a longitudinal section through a mammalian heart.

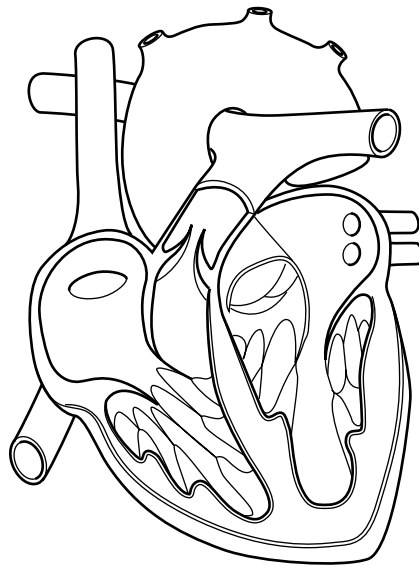


Fig. 5.1

(b) Use label lines and the letters **P**, **Q**, **R** and **S** to label the following on Fig. 5.1:

P the right atrium

Q a semilunar valve

R a blood vessel that carries deoxygenated blood

S the position of Purkyne tissue

[4]

Catheters are small tubes that are inserted into blood vessels. A catheter was inserted into an artery in the arm and then moved into the aorta and then into the left ventricle during a diagnostic investigation. The catheter contained a device to measure the blood pressure in the aorta and in the left ventricle. The results are shown in Fig. 5.2.

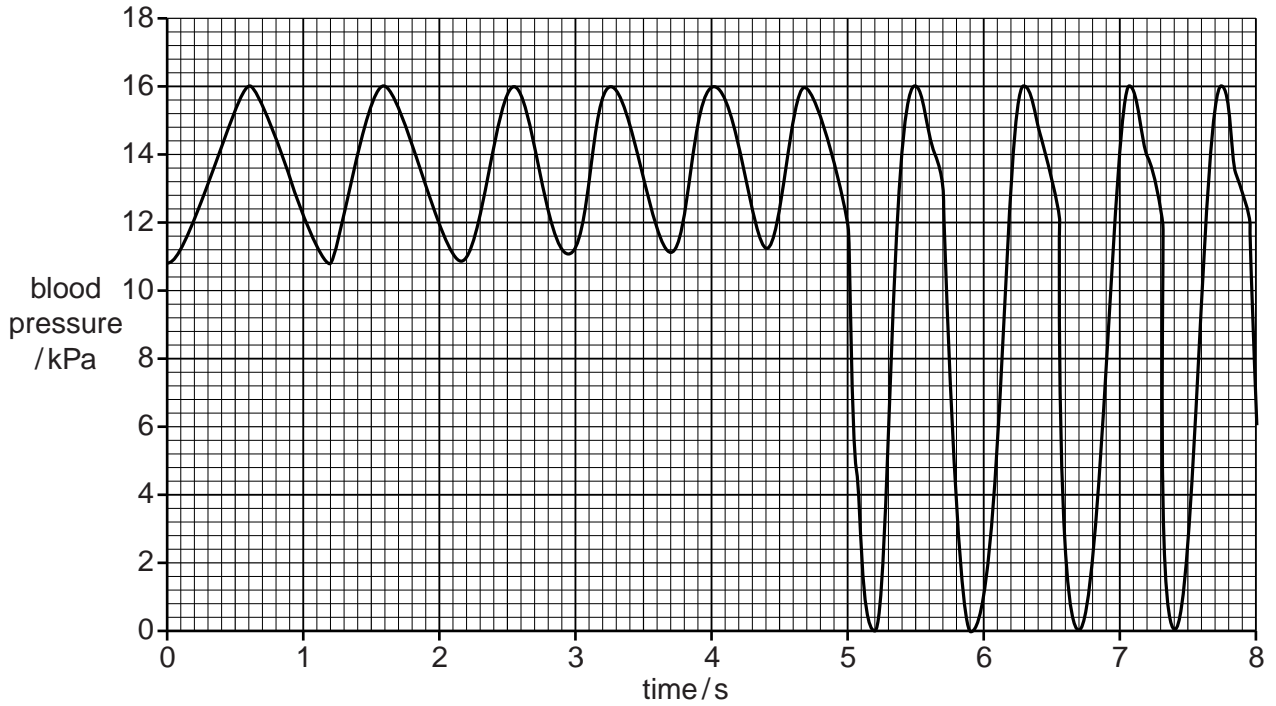


Fig. 5.2

- (c) (i) Calculate the heart rate during the period of the investigation.

Show your working.

answer[2]

- (ii) Describe **and** explain the differences in pressure as the catheter moves from the aorta into the left ventricle.

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[4]

Fig. 5.3 is an X-ray showing narrowing in the blood vessels supplying muscles in the heart. A catheter is used to insert a dye into the blood vessels so that they appear clearly in the X-ray. The arrows indicate where there is narrowing of the blood vessels.



Fig. 5.3

(d) (i) Name the blood vessels shown in Fig. 5.3.

.....[1]

(ii) State the likely effect of narrowing of these blood vessels.

.....[1]

(e) Suggest ways in which the condition shown in Fig. 5.3 may be treated.

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.....[2]

[Total: 16]