The circulatory system

Question Paper 3

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

Time Allowed : **62 minutes**

Score : **/ 51**

Percentage : **/100**

Grade Boundaries:

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

1 **(a)** As blood passes through the capillaries in the lungs it becomes oxygenated.

Explain how the structure of haemoglobin aids the uptake of oxygen in the lungs.

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Fig. 3.1 shows the dissociation curve of adult haemoglobin.

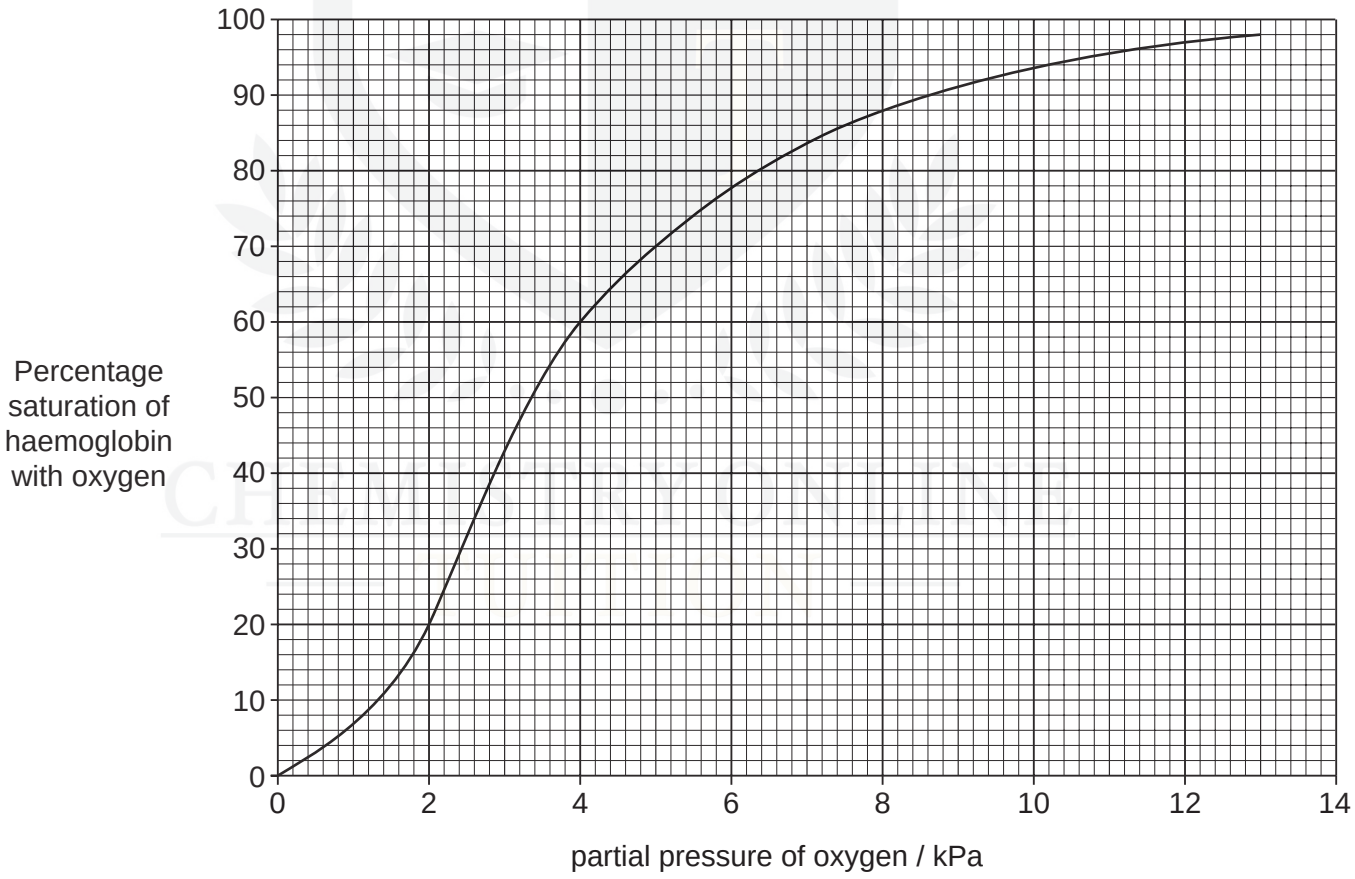

Fig. 3.1

(b) Use the information given in Fig. 3.1 to complete the table below.

part of the circulation	partial pressure of oxygen / kPa	percentage saturation of haemoglobin
capillaries in the lungs		98
capillaries in muscle tissue at rest		70
capillaries in muscle tissue during strenuous exercise	2.0	

[3]

(c) During exercise the concentration of carbon dioxide in muscle tissue increases. This stimulates an increase in the release of oxygen from the blood.

Explain how carbon dioxide stimulates the release of oxygen from the blood.

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[Total: 10]

2 **(a)** Substances are exchanged between the plasma, tissue fluid, lymph and red blood cells.

Complete the table below to show which of the statements apply to each of these components of the body.

Fill in each box using a tick (✓) to show that the statement applies or a cross (✗) if it does not. The first row has been completed for you.

statement	plasma	tissue fluid	lymph	cytoplasm of red blood cells
formed by leakage from capillaries	✗	✔		✗
contains haemoglobin				
contains water				
contains antibodies				
in direct contact with muscle cells				

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(b) Nicotine is the drug in tobacco smoke.

State **two** effects of nicotine on the cardiovascular system.

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Table 6.1 shows information on smoking and lung cancer in six countries.

Table 6.1 shows:

- the percentage of male and female adults who smoke regularly in each country;
- the death rates from lung cancer expressed as deaths per 100 000 of the population of each country.

Table 6.1

country	percentage of the population who smoke		deaths from lung cancer / deaths per 100 000	
	males	females	males	females
China	53.4	4.0	22.7	10.5
France	33.0	21.0	73.3	14.4
Malaysia	49.2	3.5	5.6	2.3
New Zealand	25.1	24.8	47.3	29.2
South Africa	43.8	11.7	13.8	5.4
Trinidad and Tobago	42.1	8.0	12.3	4.2

(c) Explain whether or not there is any evidence in Table 6.1 to support the following statements.
Use the data in the table to support your answer.

Men are more at risk of dying from lung cancer than women.

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Countries where a high percentage of the population smoke have high death rates from lung cancer.

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(d) Table 6.1 shows that a larger percentage of men in some countries, such as Malaysia, smoke compared with New Zealand. It also shows that the death rate from lung cancer for men in Malaysia is much lower.

Suggest **two other** pieces of information about men who smoke that would be useful in evaluating the risks of developing lung cancer.

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[Total: 11]

3 In mammals, oxygen is transported by red blood cells in a system that is described as a closed double circulation. The majority of oxygen molecules are transported as oxyhaemoglobin. At the respiring tissues, oxygen dissociates from haemoglobin and diffuses to the surrounding cells.

(a) Explain what is meant by a *closed double circulation*.

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(b) Fig. 3.1 is a diagram that highlights the tertiary and quaternary structure of a haemoglobin molecule.

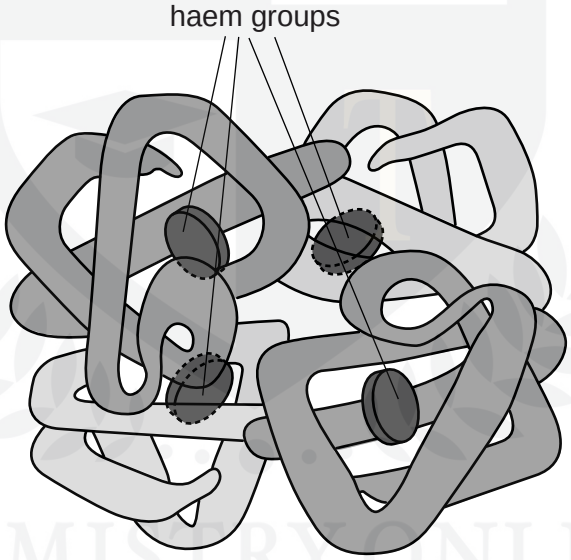

Fig. 3.1

Explain how the tertiary and quaternary levels of protein structure of the haemoglobin molecule contribute to its role in the transport of oxygen.

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(c) At high altitudes, the partial pressure of inspired oxygen is considerably lower than at sea level. This means that the partial pressure of oxygen in the blood is also much lower at high altitudes than at sea level.

Fig. 3.2 is an oxygen dissociation curve of adult oxyhaemoglobin.

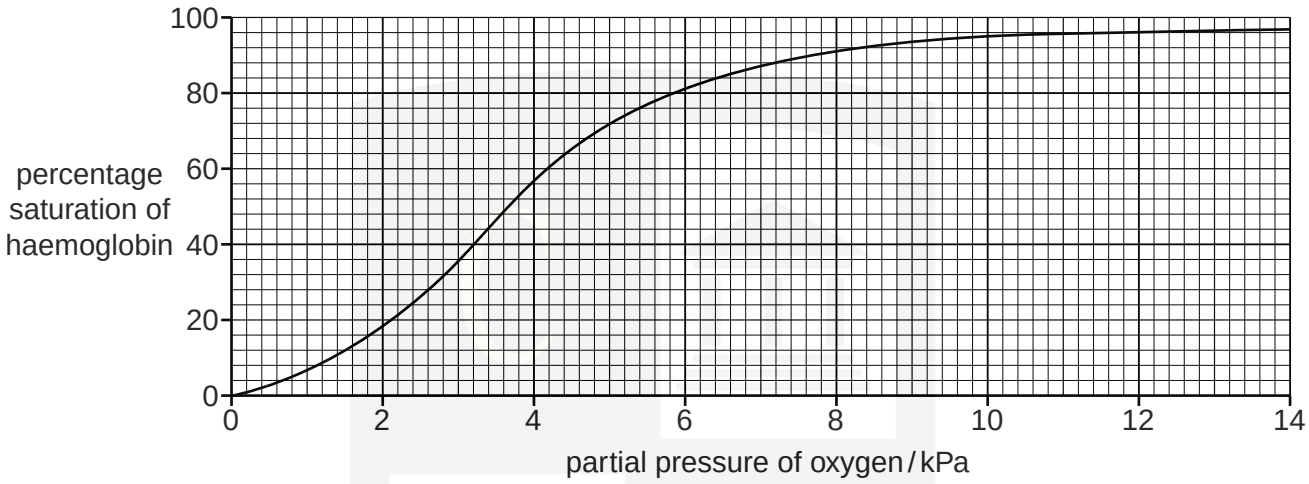

Fig. 3.2

With reference to Fig. 3.2, calculate the difference in percentage saturation of haemoglobin at sea level, where the partial pressure of oxygen is 13.0 kPa, and at a higher altitude, where the partial pressure of oxygen is 6.2 kPa.

Show your working.

answer ..... % [2]

(d) After spending time at altitude, a person can become acclimatised. One feature of acclimatisation is an increase in the red blood cell count.

Explain the importance of the increase in the red blood cell count.

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(e) Before acclimatisation can occur, some people develop a condition known as acute mountain sickness when they travel to high altitude areas.
Acetazolamide is a non-competitive enzyme inhibitor that is used as a drug to prevent and treat acute mountain sickness.

Explain the effects of a non-competitive inhibitor on the rate of enzyme activity.

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(f) Tobacco smoking can have an effect on the transport of oxygen by haemoglobin.
Fig. 3.3 shows oxygen dissociation curves with and without the presence of carbon monoxide (CO).

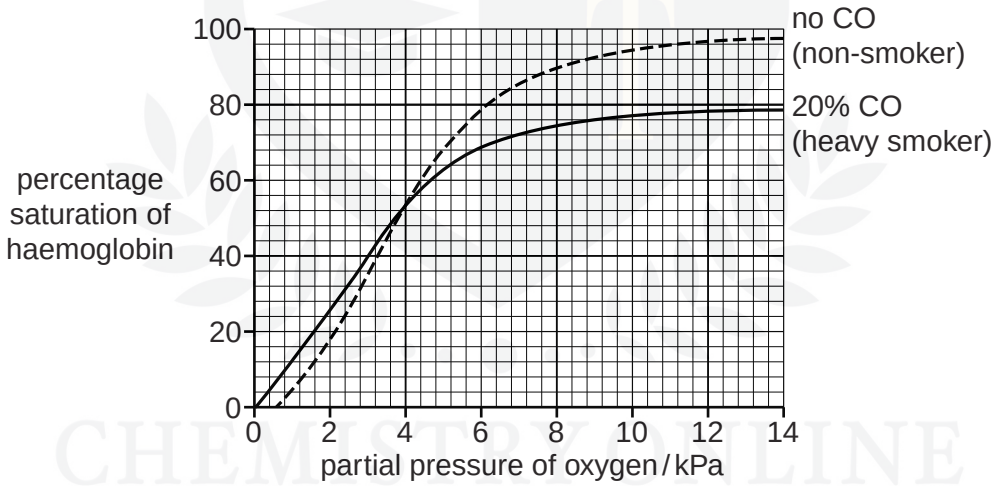

Fig. 3.3

With reference to Fig. 3.3, describe the effect of carbon monoxide on the cardiovascular system.

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[Total: 16]

4 **(a)** Blood samples were taken from a 29 year old woman each day for a period of 43 days. The concentrations of oestrogen, progesterone and luteinising hormone (LH) in each sample were measured. The results are shown in Fig. 4.1.

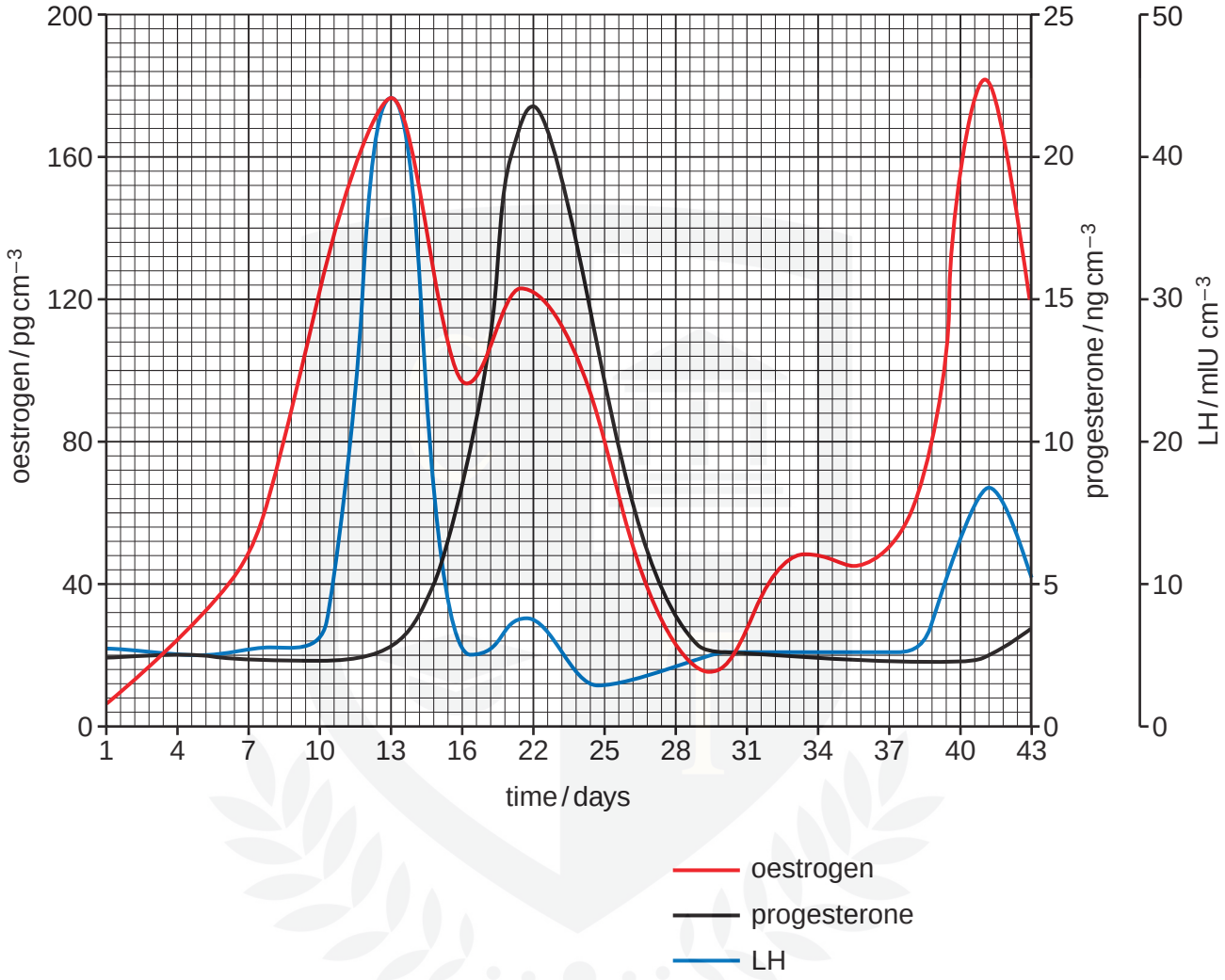

Fig. 4.1

(i) Estimate the length of the woman's menstrual cycle. Show how you worked out your answer.

answer ..... (days) [2]

(ii) The luteal phase is the part of the cycle when a corpus luteum is present in the ovaries. It begins immediately after ovulation, and ends when menstruation starts.

Use Fig. 4.1 to suggest when the luteal phase began and ended.

began ..... *ended* ..... [2]

(iii) Name the organ that secretes LH.

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(iv) Describe the roles of LH in the menstrual cycle.

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(b) An investigation was carried out to determine whether the ability of a woman to perform a task involving spatial ability varied at different times of her menstrual cycle.

The investigation involved 12 women. They each performed 24 similar spatial tasks on day 2 and day 22 of their menstrual cycle, for six successive cycles. The tasks involved mentally rotating 3-D shapes.

The researchers used two methods to determine the phase of the menstrual cycle.

- Each woman was asked when her previous menstrual period had begun.
- After each test, a blood sample was taken and the concentrations of oestrogen, progesterone and LH were measured.

(i) Suggest why the researchers used two methods to determine the phase of the menstrual cycle.

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(ii) The mean score for women taking the tests on day 2 of their cycle was 10.50 out of 24. The mean score for women taking the tests on day 22 of their cycle was 7.38 out of 24.

Discuss whether or not these results support the hypothesis that the concentration of oestrogen in the blood affects the ability to perform spatial tasks.

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[Total: 14]