OXFORD CAMBRIDGE AND RSA EXAMINATIONS
AS GCE

G622/01

APPLIED SCIENCE

Monitoring the Activity of the Human Body

THURSDAY 15 MAY 2014: Morning
DURATION: 1 hour 30 minutes
plus your additional time allowance

MODIFIED ENLARGED

Candidate forename		Candidate surname	

Centre number						Candidate number				

Candidates answer on the Question Paper.

OCR SUPPLIED MATERIALS:

None

OTHER MATERIALS REQUIRED:

Electronic calculator
Ruler (cm/mm)

READ INSTRUCTIONS OVERLEAF

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INSTRUCTIONS TO CANDIDATES

Write your name, centre number and candidate number in the boxes on the first page. Please write clearly and in capital letters.

Use black ink. HB pencil may be used for graphs and diagrams only.

Answer ALL the questions.

Read each question carefully. Make sure you know what you have to do before starting your answer.

Write your answer to each question in the space provided. If additional space is required, you should use the lined pages at the end of this booklet. The question number(s) must be clearly shown.

INFORMATION FOR CANDIDATES

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

The total number of marks for this paper is 90.

You are advised to show all the steps in any calculations.

Where you see this icon you will be awarded marks for the quality of written communication in your answer.

This means, for example, you should:

ensure that text is legible and that spelling, punctuation and grammar are accurate so that meaning is clear;

organise information clearly and coherently, using specialist vocabulary when appropriate.

You may use an electronic calculator.

Any blank pages are indicated.

Answer ALL the questions.

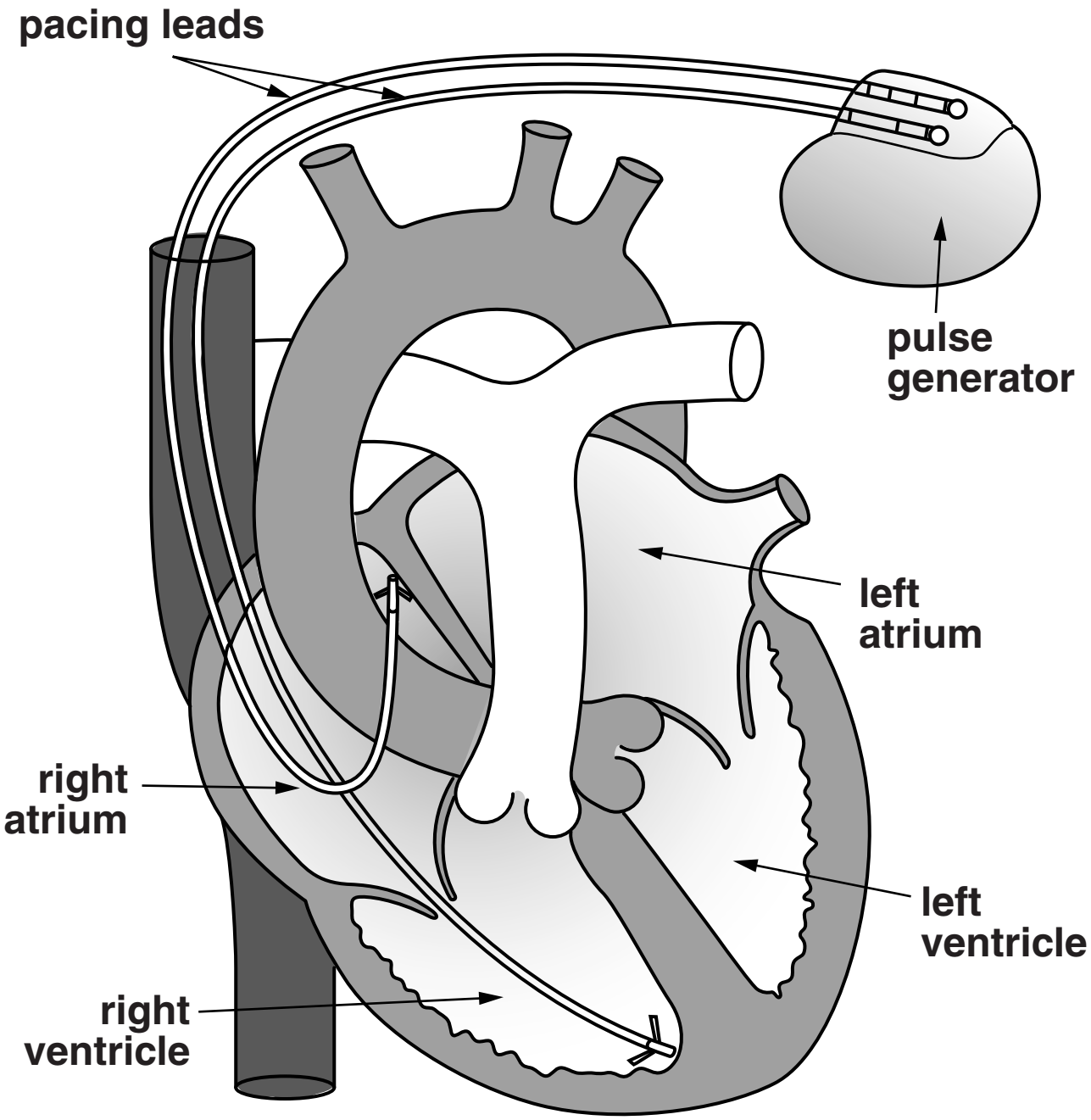
1 Steve has a problem with his heart.

He was born with a condition that affects the nervous control of his heartbeat.

Steve's own pacemaker (sinoatrial node) does NOT function correctly.

When Steve was 40 years old he had an artificial pacemaker (pulse generator) connected to his heart, as shown in Fig. 1.1 opposite.

Fig. 1.1



(a) The location of Steve's own pacemaker (sinoatrial node) is not shown in Fig. 1.1.

State where Steve's own pacemaker is located in his heart.

_____ **[1]**

(b) The artificial pacemaker uses the energy of a tiny battery to generate electrical impulses.

The natural pacemaker (sinoatrial node) would also require a source of energy in order to generate electrical impulses.

(i) Name the molecule found in all the cells of the body that is used to provide an immediate source of energy.

_____ **[1]**

(ii) The electrical impulses from the artificial pacemaker travel along wires (pacing leads).

Describe what will happen to different structures in the heart, and to blood flow through and out of the heart, when the electrical impulses reach the walls of the heart. **[6]**

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(iii) Fig. 1.1 on page 5 shows one of the wires passing through the tricuspid valve.

Suggest how this may affect the function of the tricuspid valve.

_____

_____

_____

_____ **[2]**

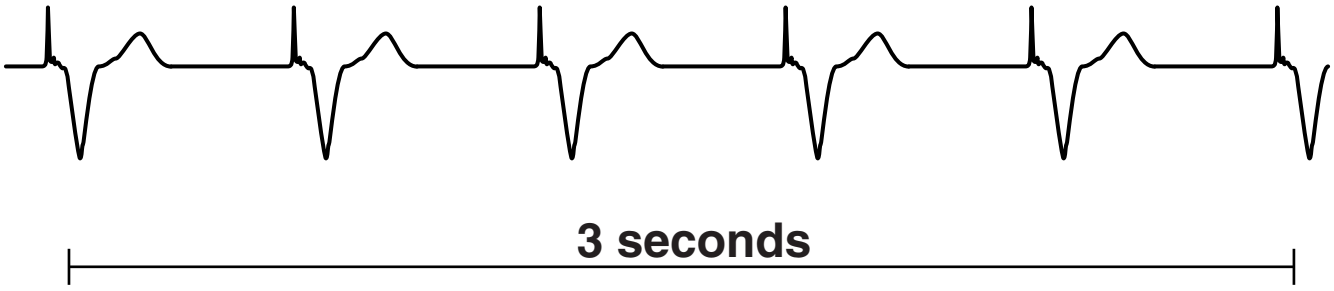
(c) After Steve was fitted with an artificial pacemaker, the electrical activity of his heart was monitored regularly.

(i) Name the equipment that could be used to monitor the electrical activity of Steve's heart.

_____ **[1]**

(ii) The trace for electrical activity generated by Steve's artificial pacemaker is shown in Fig. 1.2.

Fig. 1.2



Describe TWO ways in which the SHAPE of this heart trace is different from the heart trace of a healthy man.

1 _____

_____

2 _____

_____

[2]

(iii) Describe the difference between Steve's pulse rate and the pulse rate of a healthy man.

_____

_____

_____

_____ **[2]**

(d) Now that Steve has an artificial pacemaker, his blood pressure is also monitored regularly.

Steve gets anxious when he visits his local clinic to have his blood pressure checked. He is worried about finding out that his blood pressure is not normal.

This anxiety causes his body to produce more of the hormone adrenaline.

(i) State the normal blood pressure for a healthy 40-year-old male. Include the units in your answer.

value = _____/_____ unit _____ [2]

(ii) Suggest why a rise in Steve's adrenaline levels may not lead to an increase in his heartbeat.

_____

_____

_____ **[1]**

[TOTAL: 18]

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2 Pankaj is studying the structure and function of muscle tissues.

Pankaj examines a photograph, taken with an electron microscope, showing muscle tissue and a blood capillary, Fig. 2.1 opposite.

The blood capillary is seen in cross-section.

(a) Draw a cross (*X*) on Fig. 2.1 to show the location of the blood plasma. [1]

(b) Each muscle cell contains cytoplasm that is packed with mitochondria, as shown in Fig. 2.1 opposite.

(i) State why muscle cells are likely to contain many more mitochondria than skin cells.

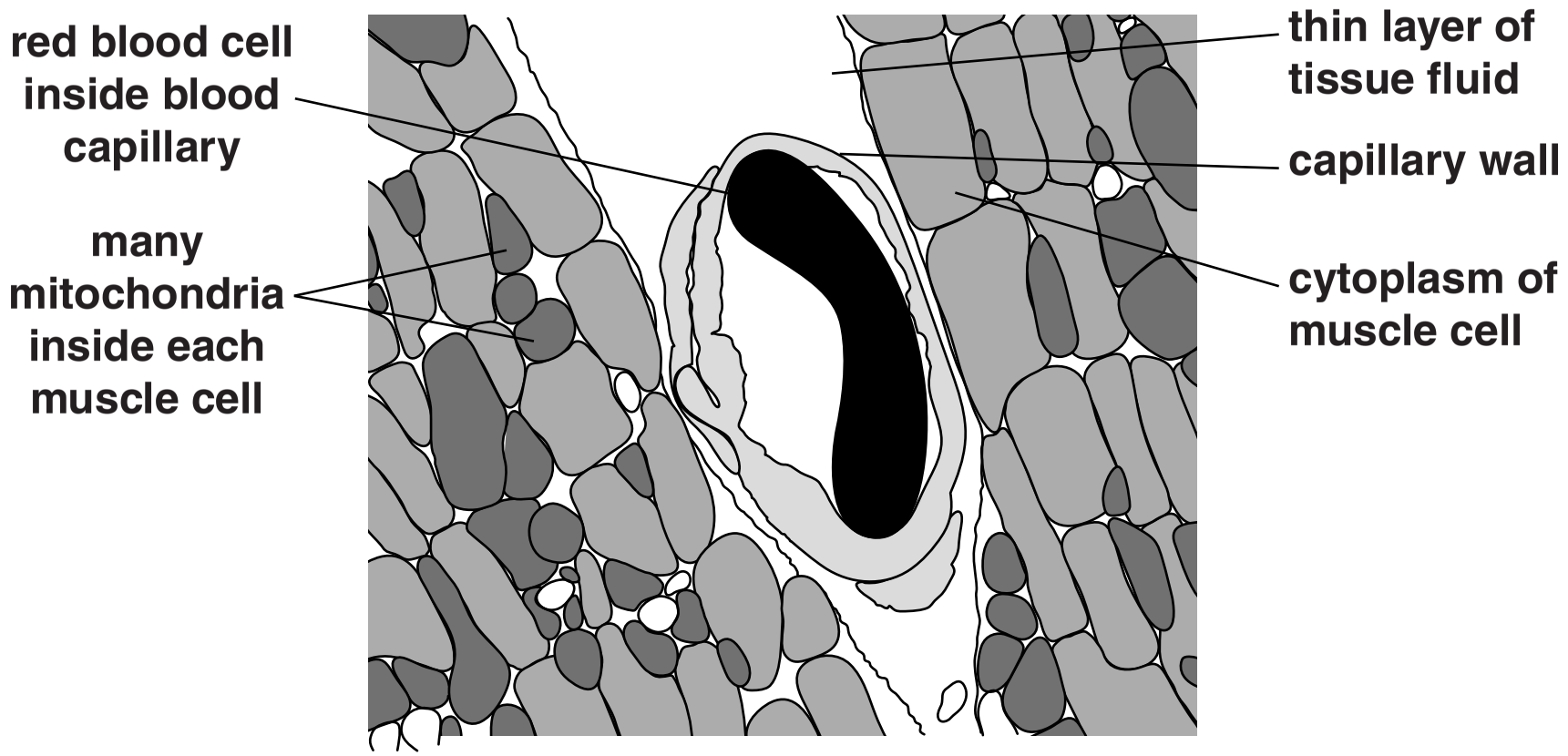
_____ [1]

(ii) Name the type of cellular respiration taking place in the mitochondria and in the cytoplasm outside the mitochondria.

Part of muscle cell	Type of cellular respiration
mitochondria	
cytoplasm outside the mitochondria	

[2]

Fig. 2.1


red blood cell inside blood capillary
many mitochondria inside each muscle cell
thin layer of tissue fluid
capillary wall
cytoplasm of muscle cell

(iii) State TWO changes to the reactions of cellular respiration in the muscle cells as exercise increases.

1 _____

_____

2 _____

_____

[2]

(c) Muscle cells contract.

Muscle cell contraction needs a supply of oxygen and glucose.

Oxygen and glucose molecules enter the muscle cells but carbon dioxide molecules leave the cells.

(i) Describe two STRUCTURAL features shown in Fig. 2.1 that will increase the rate of movement of CARBON DIOXIDE molecules out of the muscle cells.

1 _____

_____

2 _____

_____

[2]

(ii) Explain how oxygen and glucose reach the muscle cells.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____ **[6]**

(d) Pankaj often has problems breathing because he has asthma.

Explain how asthma may lower oxygen uptake into the body.

_____

_____ **[1]**

(e) Pankaj visits his doctor so that his asthma can be monitored using a peak-flow meter.

The peak-flow meter must be used correctly to obtain valid results.

List FIVE steps that are needed to ensure that the results are valid, when using a peak-flow meter.

1	
2	
3	
4	
5	

[5]

[TOTAL: 20]

3 Several scanning techniques are available in hospitals. They range from the use of X-ray and CT scanners to ultrasound and MRI scanners.

ULTRASOUND scanners are used to monitor the development of a fetus during pregnancy.

Suzy is pregnant. She visits her maternity clinic to have an ultrasound scan of her baby. She also has blood samples taken while visiting the clinic.

A technician starts the procedure to carry out an ultrasound scan.

(a) Explain why the technician puts gel on Suzy's skin.

_____

_____

_____

_____ **[2]**

(b) Suzy and the technician can see the image of her baby on a screen.

(i) State TWO similarities and TWO differences between an ULTRASOUND SCANNING image and an X-RAY image used for diagnosis.

Similarities

1 _____

2 _____

Differences

1 _____

2 _____

[4]

(ii) Ultrasound waves are generated by a probe.

Describe how these sound waves produce the image of Suzy's baby.

_____

_____

_____

_____

_____

_____

_____

_____ **[4]**

(c) The results of the ultrasound scan show that Suzy's baby may have inherited a condition affecting the development of its kidneys.

(i) Suggest two BENEFITS of diagnosing this condition during Suzy's pregnancy.

first benefit _____

_____

second benefit _____

_____

[2]

(ii) Suggest two ETHICAL ISSUES for Suzy that arise from this diagnosis.

1 _____

_____

2 _____

_____

[2]

(d) Suzy has three blood samples taken during her visit to the clinic.

The nurse is familiar with the RISK ASSESSMENT when taking blood samples. She knows that there are hazards when taking blood samples. She also knows that these hazards cause risks and that she must use the right procedures to reduce the risks to herself.

(i) Complete the table below to identify TWO hazards and their related risks, and also TWO procedures to reduce these risks to the nurse.

HAZARD when taking blood samples	RISK caused by the hazard	PROCEDURE to reduce the risk to the NURSE
1		
2		

[6]

(ii) Suggest TWO reasons why the nurse took three blood samples from Suzy.

1 _____

_____

2 _____

_____

[2]

(e) The nurse has been monitoring the iron levels in Suzy's blood. The nurse is concerned that Suzy is showing signs of anaemia due to low haemoglobin concentrations in her blood and advises Suzy to take iron supplements.

Iron is needed to make haemoglobin in the red blood cells. The haemoglobin level in normal, healthy women is 120–150 g dm^{-3}.

Table 3.1 shows Suzy's haemoglobin levels during her pregnancy.

Table 3.1

Week of pregnancy	Haemoglobin concentration in g dm^{-3}
12	110
16	106
20	105
24	100
28	115
32	121
36	127
40	131

(i) Using the evidence in Table 3.1, suggest when Suzy started to take iron supplements in her diet.

_____

_____ **[1]**

(ii) Explain why Suzy did not have much energy to do things when her haemoglobin concentration was low.

_____

_____

_____

_____

_____

_____ **[3]**

[TOTAL: 26]

4 Kate is training to be a sports physiologist.

She finds out about the use of a spirometer to monitor lung function.

(a) Kate's lecturer gives her a summary table of different values and ranges related to breathing measurements, when monitored using a spirometer.

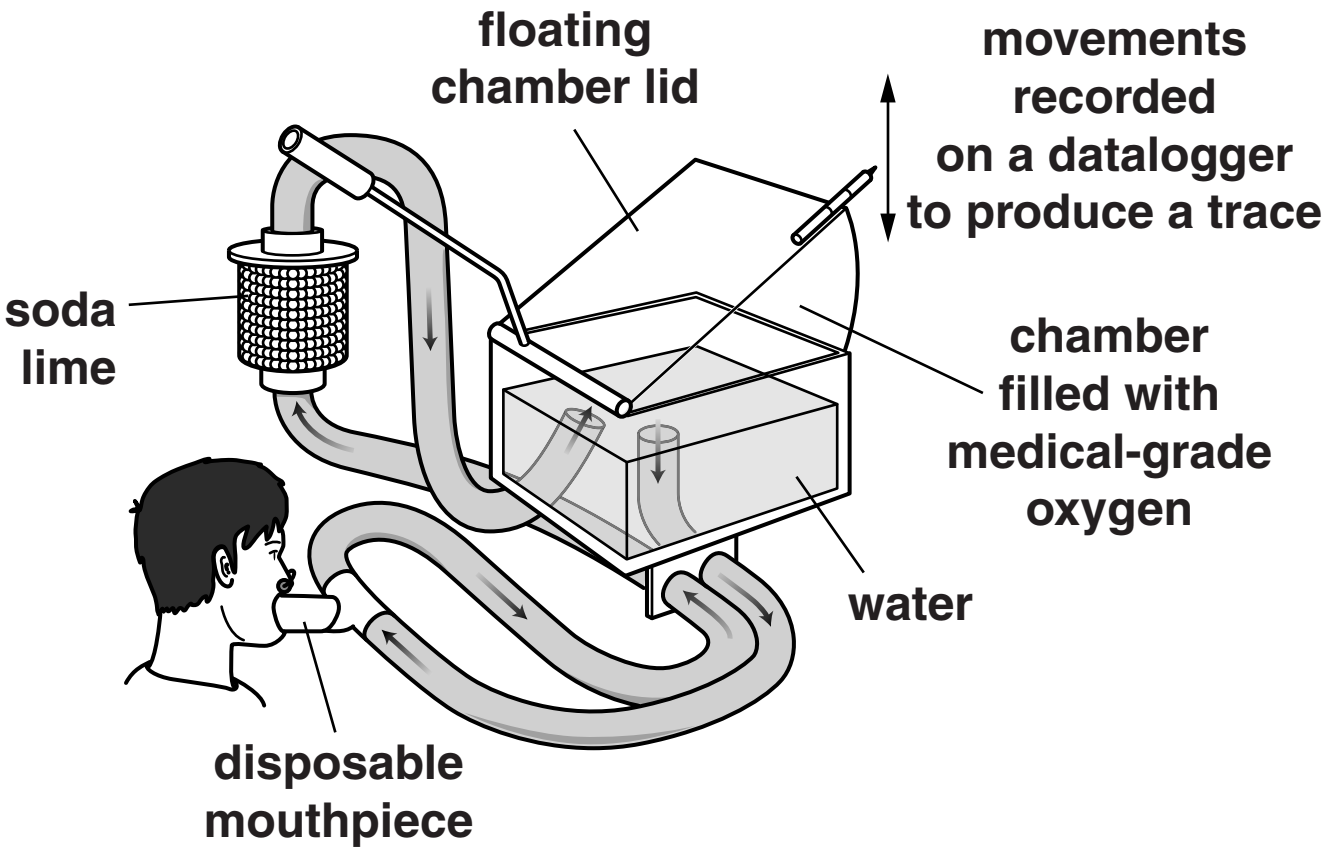
Complete the table below.

Feature measured	Values/range	Units
breathing rate	to	
	0.4 to 0.5	dm^3
vital capacity (male)		dm^3
vital capacity (female)		dm^3

[5]

(b) Kate wants to learn how to use a traditional spirometer, Fig. 4.1.

Fig. 4.1



She plans to use the spirometer to measure the TIDAL BREATHING of a male athlete when he is at rest.

When using a spirometer, some of the stages followed are important for health and safety reasons, some are to ensure that meaningful results are obtained, and some are important for both reasons.

Put a tick (✓) in one or both of the boxes on each row in the table to show the reason or reasons for each stage.

One row has been completed for you.

Stage	For health and safety	For more meaningful results
make sure that the soda-lime container is filled		
fill the air chamber with medical-grade oxygen		
use a disposable mouthpiece		
ask the patient to wear a nose-clip		
make sure the patient does not suffer from asthma		
make sure that the patient is at rest		
make sure that the patient has their lips held tightly around the mouthpiece		✓
ask the patient to breathe in and out of the mouthpiece		
check that the tidal breathing is recorded as a trace on the datalogger		
record a trace for 10 breaths in and out		

[4]

(c) Kate asks the athlete to complete another test to record the VITAL CAPACITY of his lungs.

Suggest THREE instructions for Kate to give the athlete, apart from keeping his lips sealed around the mouthpiece of the apparatus.

1 _____

2 _____

3 _____

[3]

(d) After testing the athlete's vital capacity, Kate tells him to breathe normally again.

The spirometer trace opposite is incomplete for his VITAL CAPACITY reading between points A and B, Fig. 4.2.

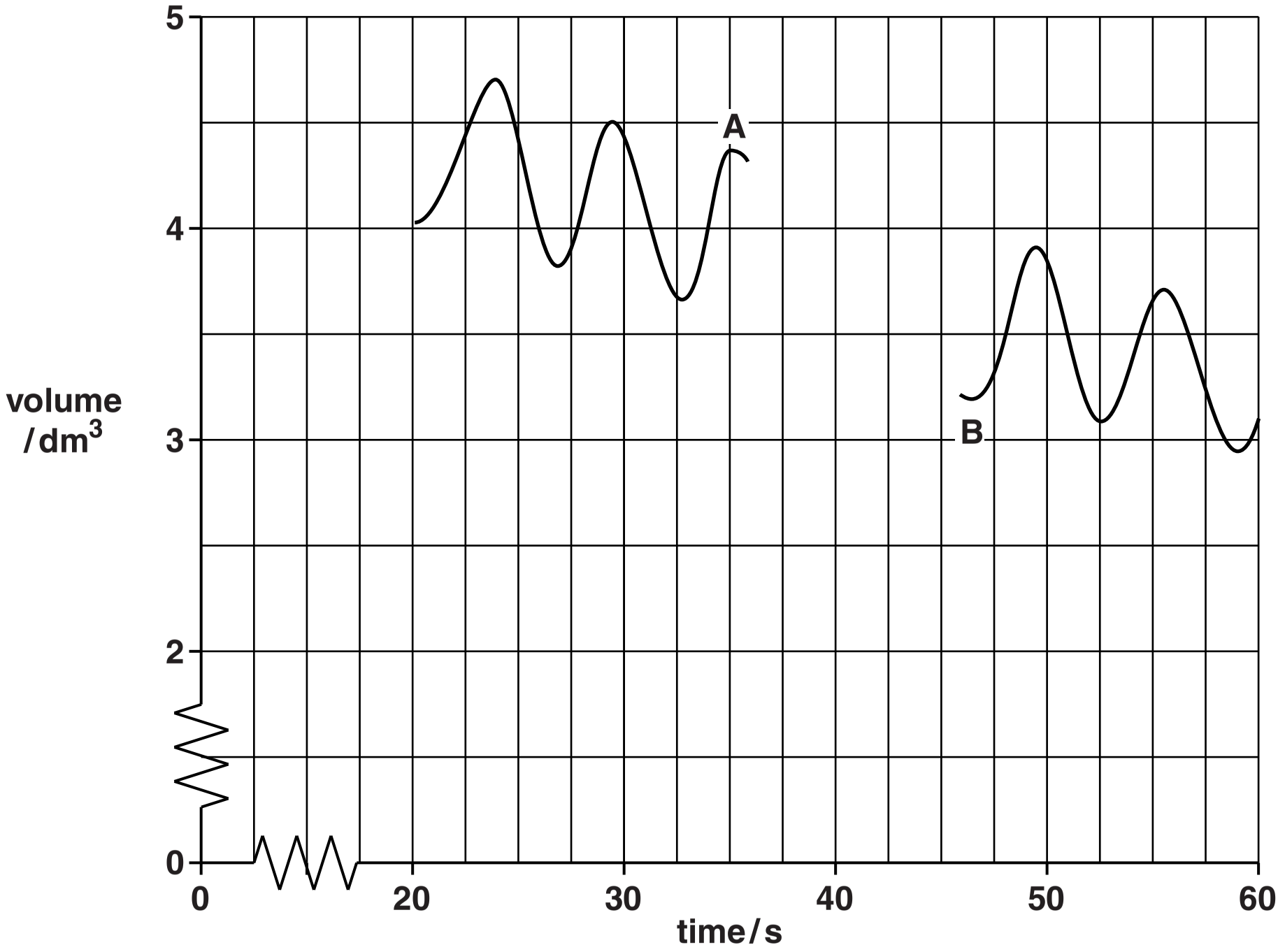
(i) Complete Fig. 4.2 between points A and B to show the typical appearance of a VITAL CAPACITY trace. [2]

(ii) Use the trace to calculate the normal tidal volume of the athlete.

On Fig. 4.2 show, with two crosses (✗), the points you have used to calculate your answer.

tidal volume = _____ dm^3 [2]

Fig. 4.2



(iii) Explain why the general pattern of the spirometer trace continues to drop on either side of the vital capacity reading.

_____

_____

_____

_____

_____

_____ **[3]**

[TOTAL: 19]

5 The ELISA test is used to check for the presence of HIV, the AIDS virus.

(a) Blood samples are taken from patients.

Serum extracted from each blood sample is added to a test well containing a specific antibody.

(i) The AIDS virus has a unique protein coat.

Explain how the presence of this protein would affect the result of the ELISA test.

_____

_____

_____

_____ **[2]**

(ii) The serum added to the well does not contain any red blood cells.

Suggest why this is important.

_____

_____

_____ **[1]**

(iii) **A number of reactions take place during the ELISA test.**

Different reagents are added to the well at each stage of the test.

Suggest why the contents of the test well are rinsed between different stages of the ELISA test.

_____

_____

_____ **[1]**

(b) It is very rare for the ELISA test to give a false POSITIVE result when testing for the AIDS virus.

Suggest TWO disadvantages caused by a false positive result.

1 _____

2 _____

[2]

(c) State ONE risk associated with false NEGATIVE results for the AIDS virus.

_____

_____ **[1]**

[TOTAL: 7]

END OF QUESTION PAPER

ADDITIONAL ANSWER SPACE

If additional answer space is required, you should use the lined pages below. The question number(s) must be clearly shown.

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