

Thursday 16 May 2013 – Morning

AS GCE APPLIED SCIENCE

G622/01 Monitoring the Activity of the Human Body

Candidates answer on the Question Paper.

OCR supplied materials:

None

Other materials required:

- Electronic calculator
- Ruler (cm/mm)

Duration: 1 hour 30 minutes



Candidate forename		Candidate surname	
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Centre number							Candidate number				
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INSTRUCTIONS TO CANDIDATES

- Write your name, centre number and candidate number in the boxes above. 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.
- Do **not** write in the bar codes.

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.
- This document consists of **24** pages. Any blank pages are indicated.

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Answer **all** the questions.

- 1 Katya is a dancer. She is experiencing a lot of pain in her knee joint.

Fig. 1.1 shows a diagram of a knee joint.

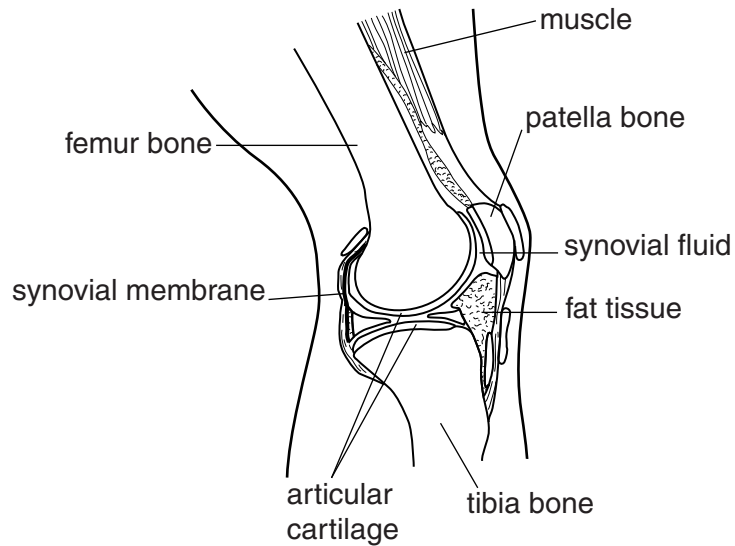


Fig. 1.1

- (a) Katya has an appointment at her local hospital for an X-ray.

Only some parts of the knee joint will be seen in Katya's X-ray image.

Put a tick (✓) in the box next to the **three** parts of the knee joint that would be seen in the X-ray image.

articular cartilage	
fat tissue	
femur bone	
patella bone	
muscle	
tibia bone	
synovial fluid	
synovial membrane	

[2]

- (b) After studying the X-ray image, the doctor is unsure about the diagnosis and needs to obtain more information.

Katya is sent to another department in the hospital to have an **MRI scan** of her knee joint.

The MRI radiographer is trained to avoid unnecessary risks to patients during the scanning procedure.

State **two** risks to the patient having an MRI scan and describe what safety precautions the radiographer needs to take to reduce these risks.

Complete the table below.

risk 1
safety precaution
.....
risk 2
safety precaution
.....

[2]

- 2 The human circulatory system is based on the pumping action of the heart and the flow of blood along vessels.

Fig. 2.1 shows a section through one of the blood vessels, an artery.

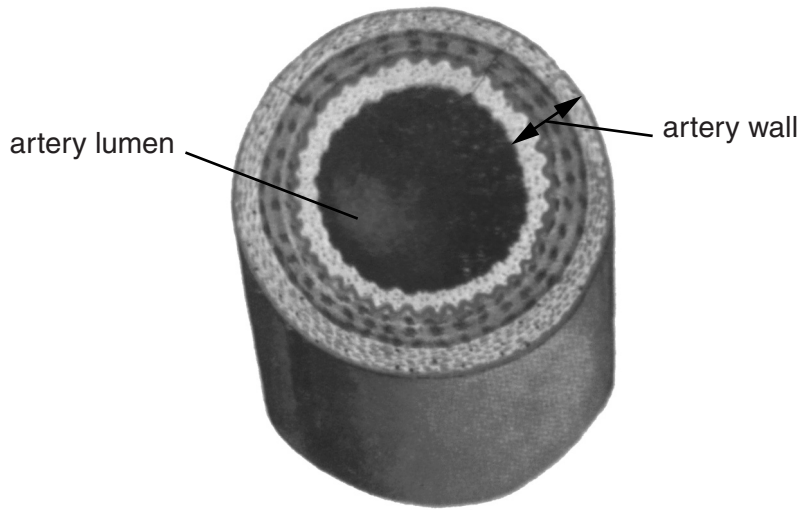


Fig. 2.1

- (a) Use Fig. 2.1 to identify two characteristic **structural** features of an artery that distinguish it from a vein.

1

2 [2]

- (b) State one reason why the **pulmonary vein** is considered to be different from other veins.

..... [1]

- (c) Describe the function of the atrio-ventricular and semi-lunar valves on the **left** side of the human heart.

atrio-ventricular valve.....

.....

.....

semi-lunar valve.....

.....

..... [2]

(f) A sphygmomanometer measures blood pressure.

It is important to follow the correct steps when taking blood pressure measurements using an **electronic digital** sphygmomanometer.

The steps **A** to **G** below are not in the correct order.

- A** wait for the machine to indicate that it is ready to show the values
- B** check that the machine is set to zero
- C** turn the machine on
- D** allow the cuff to inflate
- E** turn the machine off
- F** take the two values shown on the screen
- G** attach the cuff to the upper arm

Write the correct letter in each box to show the correct order of steps.

The first and last boxes have been completed for you.

G							E
----------	--	--	--	--	--	--	----------

[4]

(g) (i) State the blood pressure values (with units) of a typical 18-year-old.

..... [2]

(ii) How do the typical blood pressure values of an 18-year-old differ from those of a 40-year-old? Suggest a reason for the difference.

.....
.....
.....
..... [2]

(h) The electrical activity of the heart can be monitored using an ECG.

Fig. 2.2 shows part of an ECG trace for a healthy 18-year-old.

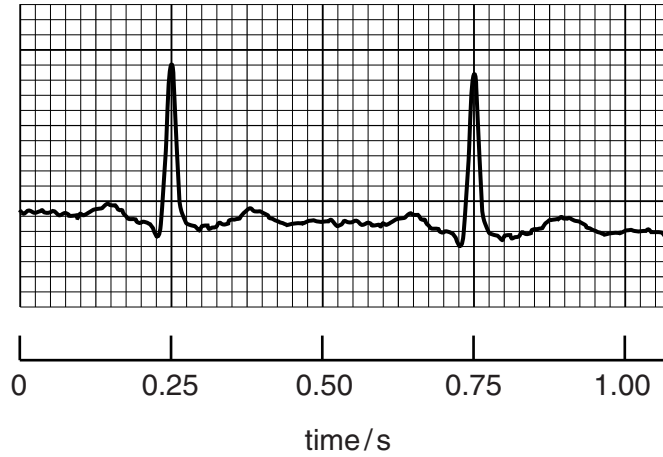


Fig. 2.2

(i) Calculate the heart rate in beats per minute for this person.

heart rate = beats per minute [2]

(ii) A student is analysing the ECG trace shown in Fig. 2.2. He concludes that the person is **exercising**.

Give an explanation for his conclusion.

.....

.....

.....

..... [2]

[Total: 24]

- 3 (a) A spirometer trace, as shown in Fig. 3.1 below, is used to measure different aspects of lung function.

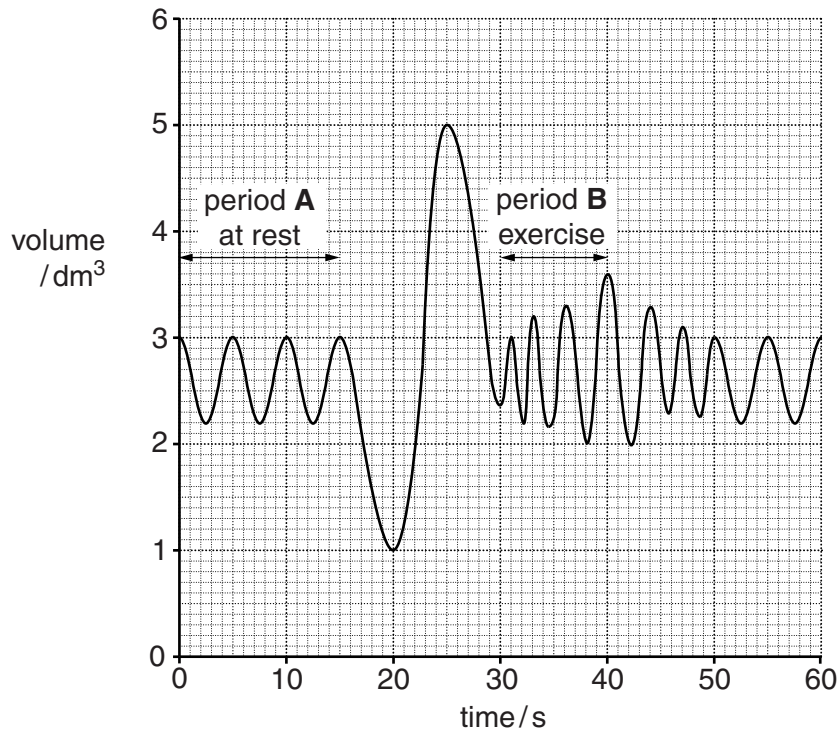


Fig. 3.1

- (i) There is a **period of rest (A)** during the first 15 seconds of the spirometer trace.

Use the trace to calculate the **breathing rate** at rest.

rate = breaths per minute [1]

- (ii) The trace shows maximum inhalation at 20 seconds and maximum exhalation at 25 seconds. This enables the vital capacity to be measured.

Calculate the difference between the vital capacity shown on the trace in Fig. 3.1 and that of a typical male.

vital capacity shown in Fig. 3.1 = dm³

vital capacity of typical male = dm³

difference = dm³ [2]

(iii) Use the spirometer trace in Fig. 3.1 to calculate the percentage **difference** in the **tidal volume** at 10 seconds compared to 40 seconds.

Show your working.

tidal volume at 10 seconds = dm³

tidal volume at 40 seconds = dm³

percentage difference =% [2]

(iv) The spirometer trace in Fig. 3.1 shows two features:

- the trace is different in period **A** compared to period **B**
- the trace changes **within** period **B**.

Explain how and why these changes take place.

.....

.....

.....

.....

.....

.....

..... [3]

(v) Use the trace in Fig. 3.1 to calculate the recovery period following period **B**.

recovery period = seconds [1]

- (vi) Ventilation involves the use of different muscles in the body, such as abdominal muscles, the diaphragm and the external intercostal muscles.

Complete the table below to show what happens to these muscles.

Put a tick (✓) in the correct boxes for each row.

Muscle type	Inspiration			Expiration		
	Contract	Relax	Not involved	Contract	Relax	Not involved
Abdominal						
Diaphragm						
External intercostal						

[3]

- (b) Andrew is 18 years old and is very keen to increase his fitness levels. He joins a local fitness centre. The centre has a sports physiologist who takes measurements to assess fitness levels.

Andrew is concerned that he may have a respiratory problem. His spirometer trace, however, does **not** indicate that this is the case.

The physiologist asks Andrew to use a peak-flow meter to obtain more evidence.

- (i) Write numbers **2** to **6** in the boxes below to show the correct order of stages that Andrew should follow when he uses the peak-flow meter.

The first stage has been completed for you.

Stage	Order
sterilise the mouthpiece	1
repeat to obtain three readings	
put his lips tightly around the mouthpiece	
breathe in as deeply as possible	
breathe out as hard as possible	
check the meter is set at zero	

[3]

(ii) Andrew breathed into the peak-flow meter and obtained three readings.

345 dm³ 410 dm³ 360 dm³

Is Andrew's peak-flow reading within the normal range?

Use a tick (✓) to show your conclusion.

yes no

Give an explanation to support your answer.

.....
.....
.....
..... [2]

(c) People with asthma may produce very different peak-flow values. Asthma is a chronic, inflammatory, lung disease. It can result in a narrowing of the airways.

Describe and **explain** the likely effect of asthma on:

(i) the rate of gaseous exchange at the lungs

.....
.....
.....
..... [2]

(ii) the contraction of muscles during exercise.

.....
.....
.....
..... [2]

(d) Vital capacity, tidal volume and peak-flow readings are called physiological indicators.

Explain why it is useful for sports physiologists to know the 'normal' average values and ranges for physiological indicators for males and females when at rest.

.....

.....

.....

..... [2]

[Total: 23]

15
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Question 4 begins on page 16
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4 Lucy is running in a race at her school's sports day. The day is **very hot**.

Fig. 4.1 shows Lucy and some other children during the race.



Fig. 4.1

(a) Lucy suffers from heat exhaustion after the race. She needs medical attention from a school first-aider.

Her body temperature is taken using a temperature-sensitive plastic strip. The strip is placed on Lucy's forehead and a reading is taken.

(i) State **one** advantage and **one** disadvantage of using this plastic strip compared to using a clinical glass thermometer.

advantage.....

.....

disadvantage.....

.....

[2]

(ii) Other types of thermometer can be used to measure the temperature of the human body.

Name **two** different types of thermometer, other than a clinical glass thermometer, used to measure body temperature.

1

2

[2]

(b) Lucy is having difficulty in maintaining a normal body temperature.

State three **physiological** mechanisms that her body uses to maintain a normal body temperature when the external environment is very hot.

1

2

3

[3]

(c) Lucy does not cope with the hot conditions and she develops hyperthermia. Hyperthermia is likely if the body temperature is above a critical value.

State the critical body temperature for hyperthermia.

above °C [1]

[Total: 8]

- 5 Alice is 93 years old. She is experiencing severe abdominal pain and it is suspected that she has kidney stones, caused by deposits of calcium.

Alice is examined by an ultrasound technician.

- (a) The technician obtains ultrasound images of Alice’s kidneys.

Fig. 5.1 shows that Alice has a collection of large kidney stones.



Fig. 5.1

- (i) Give **two** reasons why the use of ultrasound imaging is described as ‘low risk’ to the patient.

1

2 [2]

- (ii) Explain why gel is applied to the surface of the skin when using an ultrasound probe.

.....

.....

.....

..... [2]

- (iii) State how Alice can benefit from the diagnosis obtained from the ultrasound.

.....

..... [1]

(iv) Describe and explain how the quality of an ultrasound image may be affected by obesity.

.....
.....
.....
..... [2]

(b) Another abdominal ultrasound shows that Alice has cancerous tumours in her colon (part of the large intestine). A combination of chemotherapy and surgical treatments is available to treat cancer of the colon.

State **two** reasons why a doctor might advise against treating Alice.

1
.....
2
..... [2]

(c) Alice’s doctors take some blood samples to monitor her condition.

Describe two **safety procedures** to be followed by medical teams when taking blood samples and give a reason for each procedure.

safety procedure 1
reason
.....
safety procedure 2
reason
..... [4]

[Total: 13]

- 6 HIV tests are used to find the human immunodeficiency virus (HIV) in humans.

The HIV virus causes acquired immunodeficiency syndrome (AIDS). The virus is found in blood serum, saliva and urine.

- (a) A number of different HIV tests are carried out, including the **ELISA** test. The ELISA test is applied to blood samples taken from patients.

A series of steps must be followed for this test to work.

The list of steps below is **not** in the correct order.

- A** the patient's blood sample is treated so that the serum is obtained
- B** the plate is washed again
- C** a secondary antibody is applied to the plate
- D** the enzyme is allowed to carry out a reaction involving the substrate
- E** blood serum is added to a plate containing HIV antigens
- F** blood serum is diluted 400-fold
- G** a substrate is added to the plate to show the presence of a special enzyme, linked to the secondary antibody
- H** the plate is washed to remove other parts of the serum
- I** the reaction results in a change in colour or fluorescence
- J** the amount of HIV present is indicated by the level of change in colour or fluorescence present

Complete the boxes to show the correct order of steps to be followed.

Four have been completed for you.

A			H			G			J
----------	--	--	----------	--	--	----------	--	--	----------

[4]

- (b) The ELISA test is very sensitive. To ensure that the results are valid, the technician must wear gloves when carrying out the test.

Suggest why the ELISA test results may **not** be **valid** if the technician does **not** wear gloves.

.....
..... [1]

- (c) Suggest what is meant by a **false negative** result for the ELISA test and explain how this could affect the spread of AIDS.

.....
.....
.....
.....
.....
.....
..... [3]

- (d) State **one** other human disease or condition that can be diagnosed using the ELISA test.

..... [1]

Question 6 continues on page 22

- (e) T-cells (or T-lymphocytes) are white blood cells that play important roles in the immune system. One type of white blood cell is called the CD4 T-cell.

A team of researchers who were working on HIV carried out a trial on twenty people. They based their trial on CD4 T-cell counts.

- Healthy, non-HIV people have CD4 T-cell counts of 600 to 1200 per mm³ of blood sampled.
- People who have CD4 T-cell counts of 200 to 250 per mm³ of blood are at risk of contracting serious infections, including pneumonia.
- The CD4 T-cell counts for people with AIDS fall below the normal range for healthy, non-HIV people.

Table 6.1 shows the data published by the researchers. The data show the CD4 T-cell counts for the twenty people who took part in the trial.

CD4 T-cell counts (per mm ³ blood)									
218	610	543	1100	248	1035	598	225	357	319
428	213	229	529	1190	1002	744	231	753	899

Table 6.1

- (i) Calculate the percentage of people who, judging from the CD4 T-cell counts, could be:
- 1 HIV positive%
- 2 at risk of contracting a serious infection.%
- [1]**

- (ii) The researchers are planning to use the data in Table 6.1 to estimate the number of people across the world who might have AIDS.

State **three** ways in which the data could be improved if this trial were repeated.

- 1
-
- 2
-
- 3
-

[3]

[Total: 13]

ADDITIONAL ANSWER SPACE

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

A large area of lined paper for writing answers. It consists of horizontal dotted lines spaced evenly down the page. A vertical solid line runs down the left side of the page, creating a margin. The lines extend across the width of the page.

