GCE AS/A Level

1661/01

APPLIED SCIENCE
UNIT 1

WEDNESDAY, 17 MAY 2017 – AFTERNOON

1 hour 30 minutes

For Examiner's use only		
Question	Maximum Mark	Mark Awarded
Section A 1-7.	31	
Section B 8.	11	
9.	20	
10.	7	
11.	11	
Total	80	

ADDITIONAL MATERIALS

In addition to this examination paper, you will need a calculator.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES

Section A is based on the pre-release article (included).

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

You are reminded that assessment will take into account the quality of written communication used in your answers.

A data sheet can be found on page 26.

1   **Strokes**

Strokes are life-threatening medical conditions that happen when the blood supply to part of the brain is stopped or cut off. They are medical emergencies and require urgent treatment. The sooner a person receives treatment for the stroke, the less damage occurs to that person.
5   Strokes occur in all countries in Europe, but numbers vary greatly from country to country. Graph 1 below shows the stroke rates from selected European countries. They are the third most common cause of death in Wales.
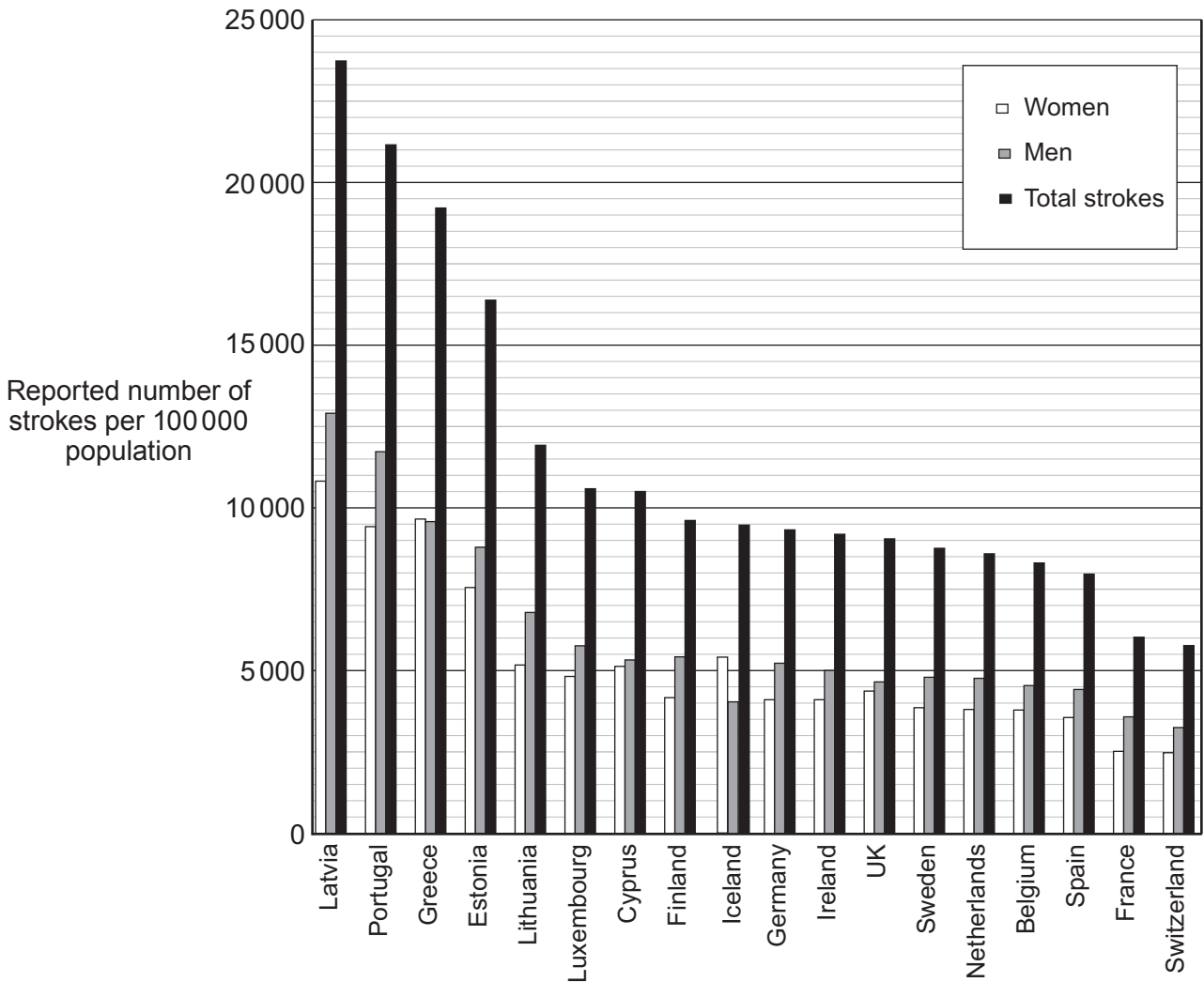
Graph 1: Stroke rates in selected European countries

1. Stroke statistics

- In the UK there are approximately 152 000 strokes each year.
- There are around 1.2 million stroke survivors in the UK.
- 3 in 10 stroke survivors will go on to have a recurrent stroke or transient ischaemic attack (TIA).
- 1 in 8 strokes are fatal within the first 30 days, with 1 in 4 strokes being fatal within a year.
- By the age of 75, 1 in 5 women and 1 in 6 men will have had a stroke.
- For every cancer patient living in the UK, £241 is spent each year on medical research, compared with just £48 a year for every stroke patient.

Country	Number of strokes per year		
	Men	Women	Total
England	57 488	68 457	125 945
Scotland	6 532	7 830	14 362
Wales	3 333	3 912	7 245
Northern Ireland	2 209	2 207	4 416
UK Total	69 562	82 406	151 968

Table 1: Incidence of strokes in UK countries

Graph 2 shows survival over one year following an admission to hospital with a stroke in Wales, by the two major categories of stroke.
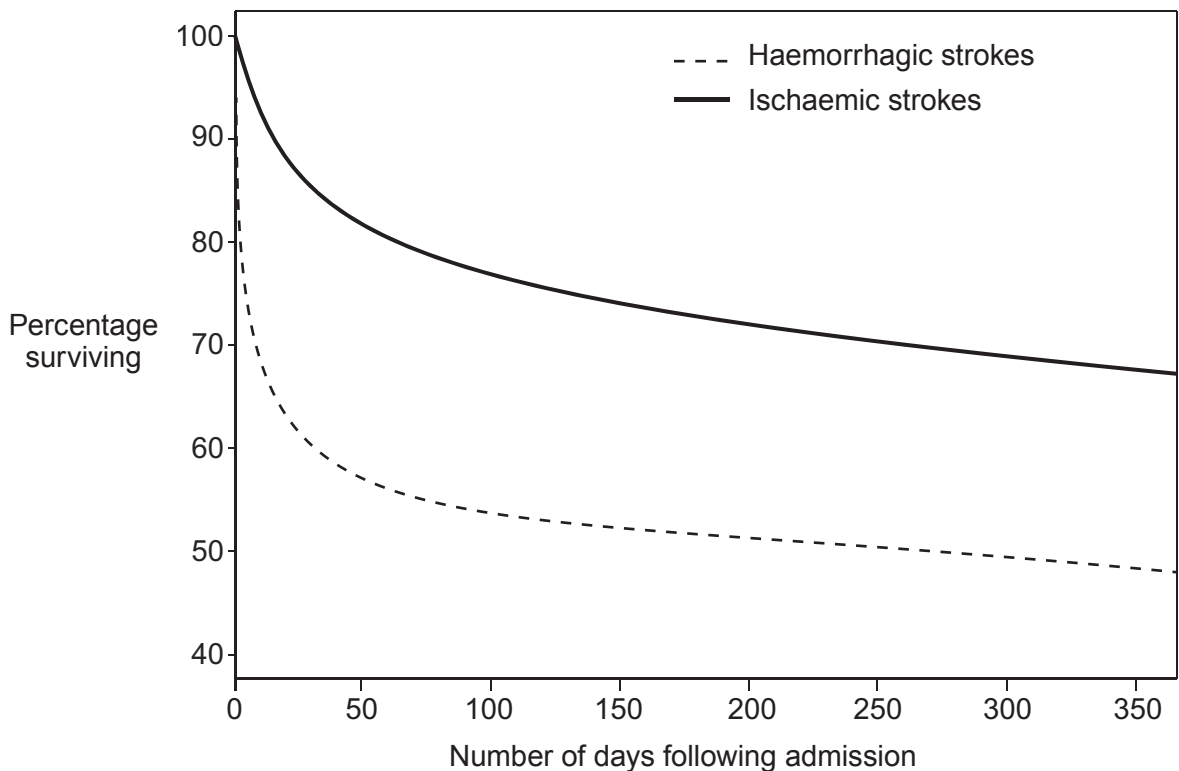
2. **Symptoms and signs of a stroke**

It is possible to remember the main symptoms of a stroke by using the acronym **FAST**.

| Has their face fallen on one side? Can they smile? | Can they raise both arms and keep them there? | Is their speech slurred? | Time to call **999** if you see any one of these signs. |
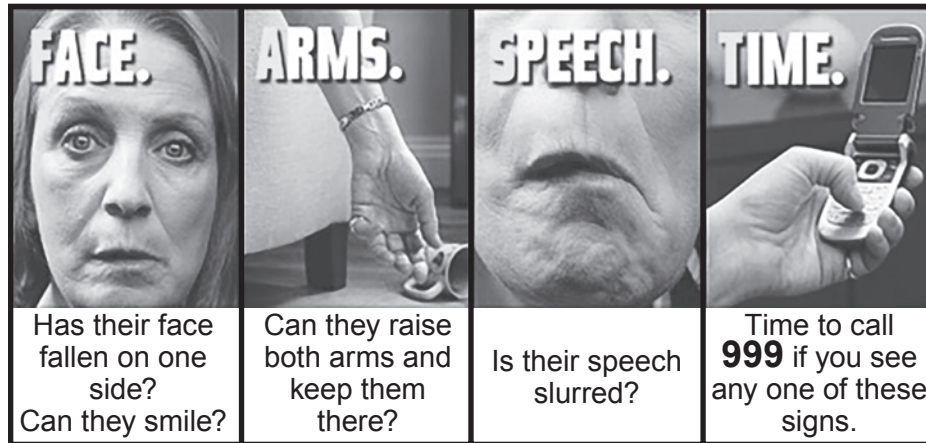
20 *(a)* **FAST** stands for; Face-Arms-Speech-Time.

- **Face**: The face may have dropped on one side. It may be difficult for the person to smile or the side of the mouth may have dropped.
- **Arms**: The person may not be able to lift both arms and keep them there due to arm weakness, or there could be a feeling of numbness in one arm.
25 - **Speech**: The person may have slurred or muddled speech, or they may not be able to talk even when they seem to be awake.
- **Time**: If you see any of these signs or symptoms then it's time to dial 999.

(b) **Other symptoms**

Even though **FAST** shows the most common symptoms of a stroke there are
30 others, as shown in **table 2** below:

Difficulty	% of people affected
Upper limb/arm weakness	77
Lower limb/leg weakness	72
Visual problems	60
Facial weakness	54
Slurred speech	50
Incontinence	50
Swallowing	45
Aphasia (using the wrong words)	33
Sensory loss	33
Depression	33
Inattention/neglect	28
Emotionalism	20
Reduced consciousness	19
Identified dementia one-year post stroke	7

Table 2: Symptoms of a stroke.

The symptoms of a stroke may disappear while waiting for the ambulance to arrive. If this happens then the person should still go to be checked at the hospital. Sometimes symptoms may disappear in less than 24 hours. This could mean that the person has suffered a transient ischaemic attack (TIA) which leaves the person at risk of having a full stroke in the future.

35 **3. Transient ischaemic attack (TIA)**

A '**mini-stroke**' or **TIA** has the same symptoms as a stroke but is very short lived, usually disappearing within 24 hours. This could be a warning that there is a problem with the blood supply to the brain and this could mean that the person is at a higher risk of having a stroke in the future. The blood supply to the brain could be temporarily
40 blocked and normal blood supply is resumed after a short period of time. This is different to a full stroke when the blood supply is completely cut off.

4. Types of stroke

There are two types of strokes:
  * ischaemic stroke
45 * haemorrhagic stroke.

(a) **Ischaemic strokes**

These are the most common type of stroke. During an ischaemic stroke, a blood clot blocks the blood flow to the brain, resulting in the brain becoming deprived of oxygen. This usually occurs where the arteries have become narrower or blocked
50 over time. This blocking is usually caused by a fatty deposit called plaque. This process is called atherosclerosis.
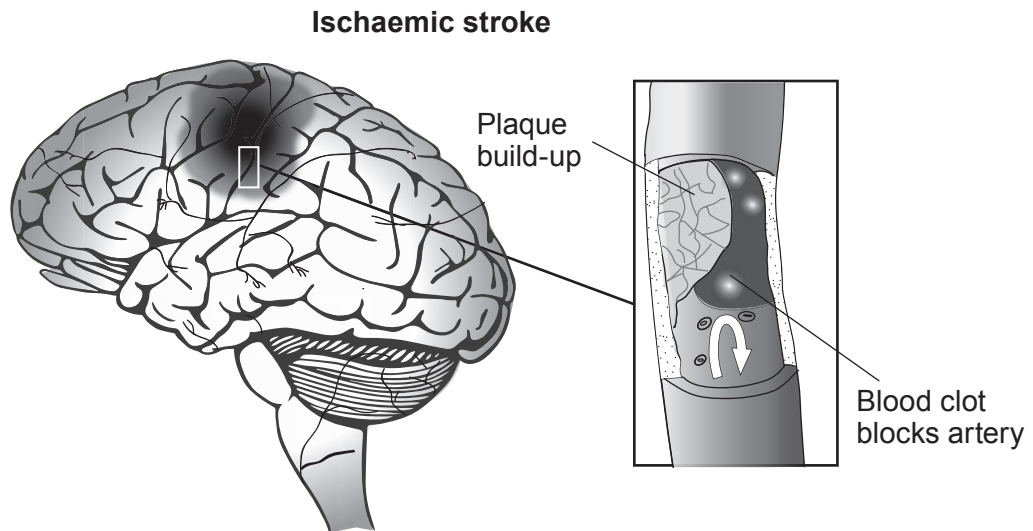
Ischaemic stroke

With age, the arteries can narrow naturally. However, this can be made worse by:

  * Smoking
  * Hypertension (high blood pressure)
55 * Obesity
  * High cholesterol levels

An irregular heartbeat or atrial fibrillation can also cause an ischaemic stroke as this can cause blood clots in the heart that can break and escape, becoming lodged in the blood vessels to the brain.

60 Atrial fibrillation can be caused by many factors including:
- Heart valve disease
- Lung disease
- Coronary heart disease
- Overactive thyroid gland

65 *(b)* **Haemorrhagic strokes**

Haemorrhagic strokes are less common than ischaemic strokes. They occur when a blood vessel within the skull bursts and bleeds into and around the brain. High blood pressure is the main cause of a haemorrhagic stroke. This causes the arteries to become weak and more prone to split or rupture. They can also occur 70 as a result of the rupture of a balloon-like expansion of a blood vessel called a brain aneurysm or when blood-vessels in the brain are badly formed.

Haemorrhagic stroke

Leakage of blood

Ruptured blood vessel
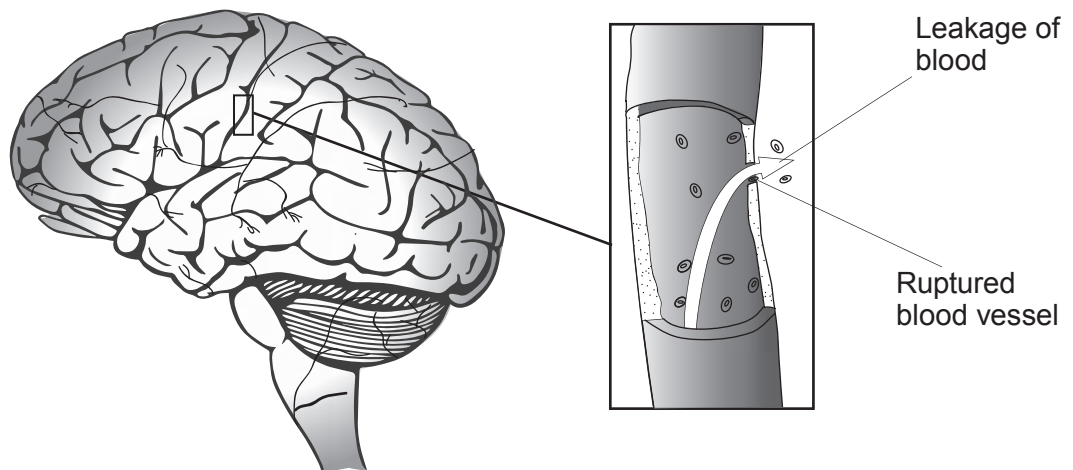
5. **Diagnosing a stroke**

As the different types of stroke need different treatments, recognising the stroke type as quickly as possible is very important for the patient.

75   *(a)* **Initial tests**

On arrival at the hospital, a doctor will try to find out as much as possible about the stroke symptoms. A number of tests can be carried out to confirm the diagnosis and determine the cause of the stroke. These tests could include an ECG to check for irregular heartbeat, a blood test to check cholesterol and blood sugar levels,
80   and also testing of blood pressure.

    (b) **Swallow tests**

The ability to swallow is affected by a stroke, so testing this in suspected stroke sufferers is important. If the person cannot swallow properly they are at risk of food and drink entering their trachea and their lungs. This can then lead to pneumonia
85   and other chest infections.

How the test works.

- The person is given a few teaspoons of water to drink.
- If they swallow these without choking or coughing they are asked to swallow half a glass of water.
90 - If they have difficulty swallowing they will be referred to the speech and language therapist for a more detailed assessment.
- They will not be allowed to eat or drink normally until they have seen the therapist and will be given fluids or foods intravenously (through a vein) or through a tube inserted into their stomach through their nose.

95   *(c)* **Brain scans**

Brain scans are also used as a diagnostic tool. A brain scan is usually carried out within 24 hours of a suspected stroke so that the doctor can determine how severe the stroke is, which part of the brain is affected, and also if the stroke has been caused by a blocked artery or burst blood vessel.

100 In some circumstances, a person will be scanned within an hour of the symptoms being noticed. People who would be given this early brain scan include:

- Someone that would benefit from drugs to reduce blood clots such as an early anticoagulant treatment.
- Someone that is already on anticoagulant treatments.
105 - Someone that has a lower consciousness level.

There are two main types of scan used to assess the brain in people with suspected strokes - CT scans and MRI scans. The type of scan given to the patient depends on their symptoms.

110 Both of these scanning methods produce an image or series of images of the brain. These will help show where the damage is and what type of stroke has been suffered by the patient.

A CT scan is usually carried out as it is a quicker process which means the person is able to be diagnosed more quickly allowing treatment to be given sooner.

This CT Scan is from a stroke patient. The arrow shows bleeding on the brain.
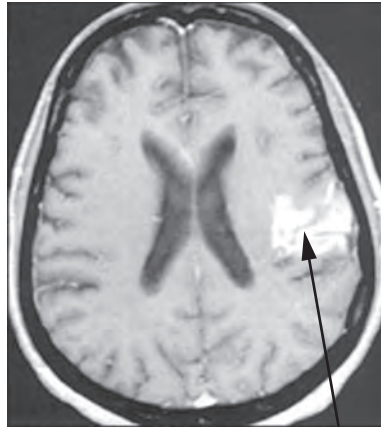
This is an MRI image of a person that has suffered a stroke. The arrow shows where the brain has been affected.

(d) **Ultrasound**

115 A carotid ultrasound scan can help show if the neck arteries leading to the brain are narrowed or blocked. This usually happens within 48 hours of a suspected stroke.

Additionally, an echocardiograph can be carried out to produce images of the heart and measure its blood flow.

120 **6. Treating a stroke**

Treatment depends on the type of stroke that has been suffered by the person. It usually involves taking one or more different medications, although some people may need to undergo surgery.

Ischaemic stroke treatment	Haemorrhagic stroke treatment
Alteplase, this dissolves blood clots and restores blood flow to the brain. Care needs to be taken to ensure that the stroke is an ischaemic stroke or it can cause further bleeding in a haemorrhagic stroke.	Blood pressure lowering medication such as beta-blockers and calcium channel blockers.
Aspirin, this is a pain killer and makes platelets less sticky, so reduces the chances of another clot forming.	Anticoagulant medication must be **stopped** if it was taken before the stroke occurred.
Anticoagulant, this reduces the risk of blood clots developing in the future. An example of an anticoagulant is **Warfarin**.	**Craniotomy**, emergency surgery may be needed to remove blood from the brain and to repair burst blood vessel damage.
High blood pressure medication such as beta-blockers and calcium channel blockers.	**Surgery to treat hydrocephalus**, this is when the stroke damage has caused cerebrospinal fluid to build up in the brain causing headaches, vomiting and loss of balance.
Cholesterol-lowering medication known as statins.	
Carotid endarterectomy, this surgery will unblock the artery in the neck by opening the artery and removing the fatty plaques.	

7. Risk factors for strokes.

125 Strokes are more common when someone gets older because there are a number of factors that cannot be changed. These factors include:

- **Age -** People over 65 years old are more likely to suffer from a stroke. About a quarter of strokes happen in younger people.
130 - **Family history -** Close relatives that have had a stroke increase the risk of having one.
- **The patient's medical history -** A person that has previously had a stroke or heart attack is at a greater risk.
- **Ethnicity -** African, Caribbean and South Asian people are at a higher risk of a stroke, partly due to high blood pressure rates being higher in these groups.

135 It is possible to reduce the risk of having a stroke by making lifestyle changes that will avoid problems such as atherosclerosis and high blood pressure.

These lifestyle changes include:
- Having a healthy diet
- Exercising regularly
140 - Not smoking
- Reducing the consumption of alcohol

SECTION A

*Answer **all** questions.*

1. List **three** symptoms of a stroke. [1]

....

....

....

2. *(a)* Calculate the number of people in the UK that will suffer from a recurrent stroke or TIA. Use information from lines 8-17. [2]

answer ....

(b) The most common physical effects and symptoms of strokes are given below.

Physical Difficulty/ Symptom	% of people affected
Upper limb / arm weakness	77
Lower limb / leg weakness	72
Visual problems	60
Facial weakness	54
Slurred speech	50
Bladder control	50

(i)   Plot these data on the grid below.   [4]
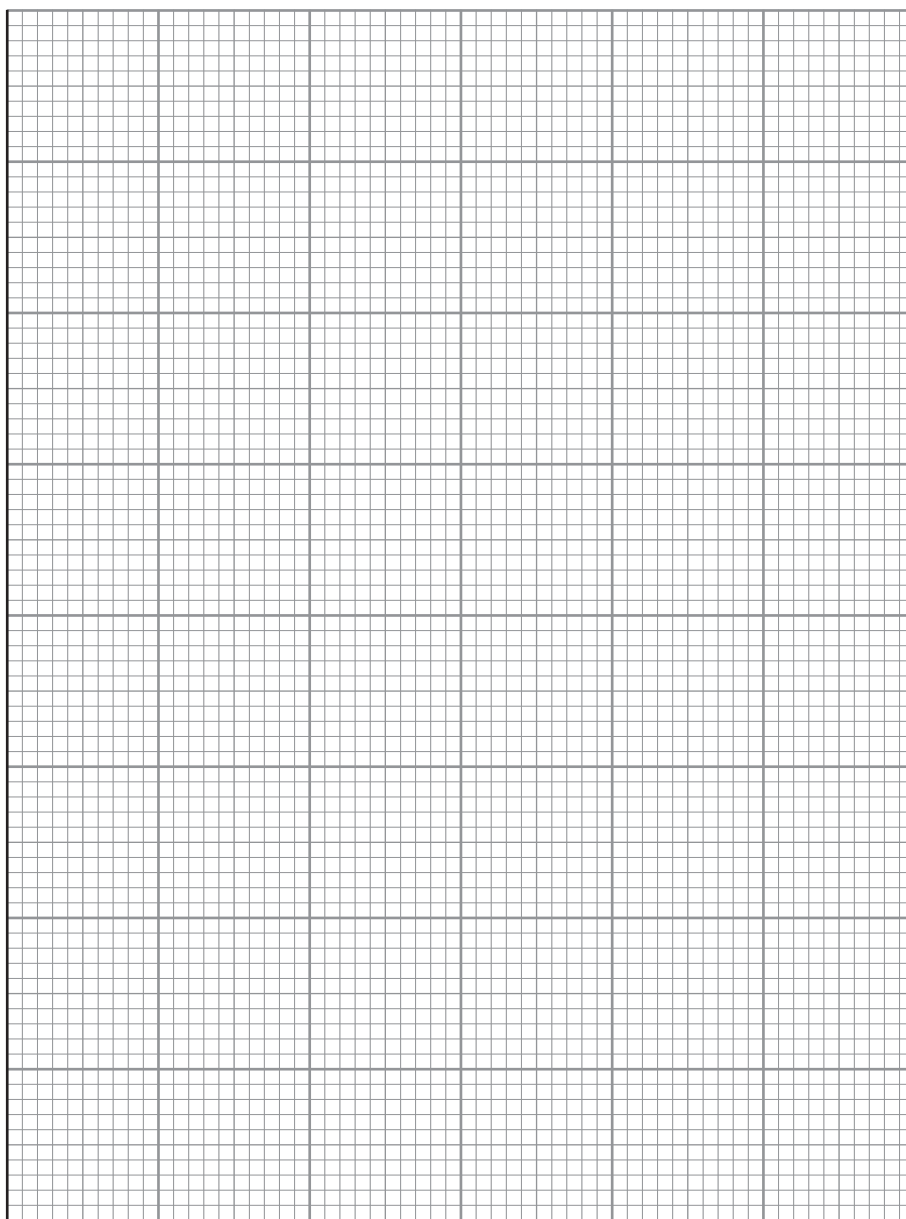
(ii)   Using **Table 2** on page 4, state which **two** symptoms are the least common in people affected by a stroke.   [1]

....

....

3. *(a)* State **one** difference between symptoms of a TIA and a haemorrhagic stroke. [1]

....

....

(b) State the cause of a haemorrhagic stroke. [1]

....

....

(c) Suggest **one** reason why ischaemic strokes are more common than haemorrhagic strokes. [1]

....

....

(d) Complete the table below describing the main physical characteristics of blood vessels. [3]

Blood Vessel	Main physical characteristics
Arteries	
Veins	
Capillaries	

4. *(a)* Why is it important that someone suffering from a suspected stroke is given a brain scan within 24 hours of their symptoms appearing? [1]

....

....

(b) Below is a photograph of a machine used to carry out a brain scan using radio waves.

(i) Name the type of scanner that can produce images in this way. [1]

....

(ii) A contrast medium is sometimes used during this scan. What is the purpose of a contrast medium? [1]

....

(c) Images from another screening method used to diagnose a stroke are shown below.
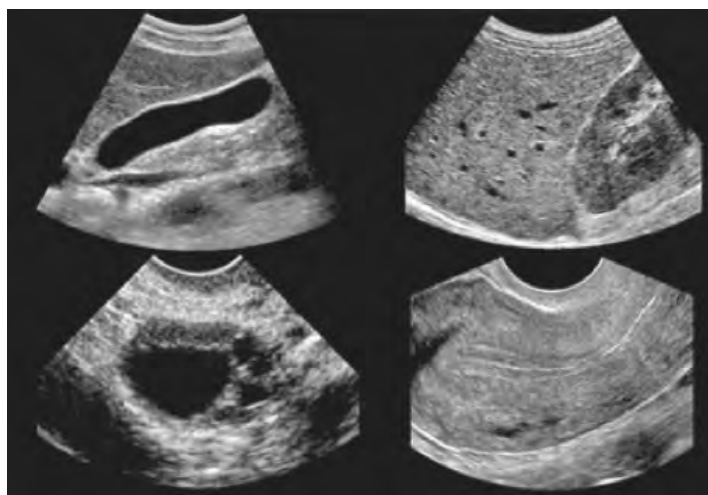
(i) Name this method of screening. [1]

....

(ii) Give **two** examples, other than diagnosis of strokes, when this method of screening
is used. [1]

1. ....

2. ....

(iii) Describe how this method produces an image on the screen. [2]

....

....

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....

5. *(a)* Treatments for people that have suffered from a stroke vary. Suggest why someone that has had a stroke would be prescribed beta-blockers. [1]

....

....

(b) Suggest why it might be necessary for someone to receive surgery after having suffered a stroke. [2]

....

....

(c) How can the risk of a stroke be reduced? [1]

....

....

6. *(a)* Using **Table 1** on page 3, calculate the overall percentage of stroke sufferers in the UK that are male. [2]

Answer ....

(b) Which country in the UK has the least difference between the number of males and females that have had a stroke? [1]

....

7. *(a)* State **two** countries in Europe where more women than men suffer from strokes. [1]

.... **and** ....

(b) Describe the trend(s) shown in graph 2 on page 3. [2]

....

....

SECTION B

*Answer **all** questions.*

8. Diseases caused by high blood pressure (hypertension) are estimated to cost the NHS £2 billion a year.

   Below is a graph showing the proportion of individuals being treated for hypertension in Wales in 2013. They are grouped by gender and age.

Percentage of individuals being treated for hypertension in Wales in 2013, by gender and age

Male ☐ Female ▉
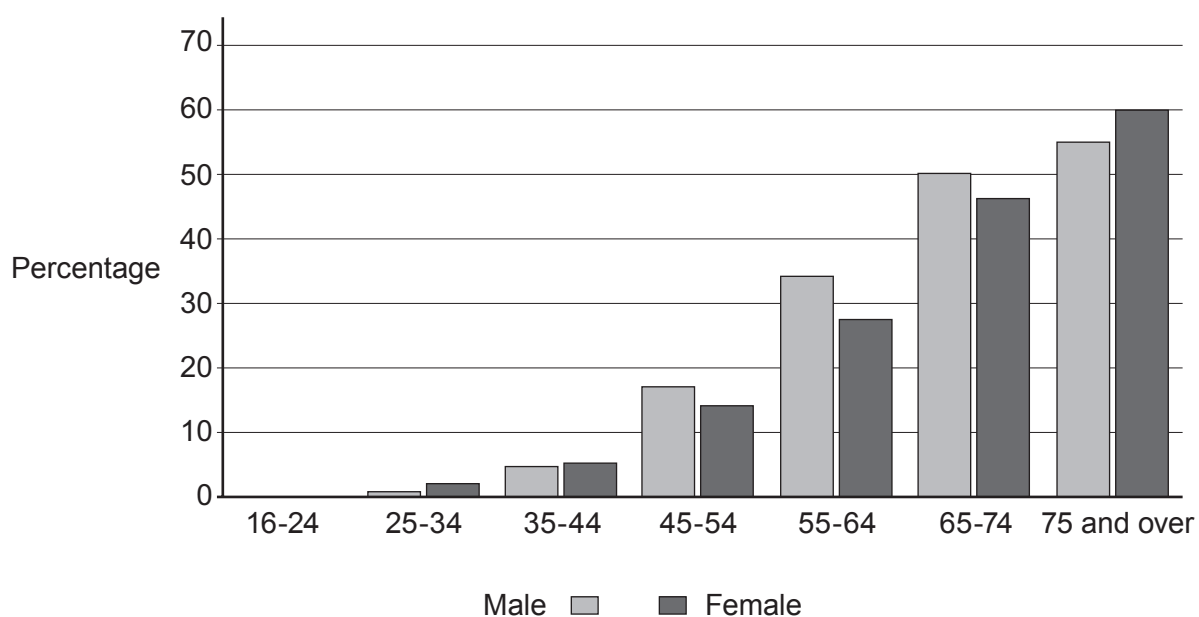
(a) Describe the trend shown for hypertension with age. [1]

....

....

(b) In 2013, 21 600 men aged 55-64 volunteered for a health survey. Use the graph to estimate how many of these suffered from hypertension. [2]

Answer = ...

(c) (i) State the **two** measurements taken from the patient to assess their blood pressure **and** describe what these measurements show. [4]

1. ....

....

2. ....

....

(ii) Describe and explain how the blood pressure of a 40 year old female with hypertension would differ from that of a 40 year old female that has normal blood pressure. [2]

....

....

....

(iii) What recommendations might a medical professional suggest to a female suffering from hypertension to try and lower her blood pressure? [2]

....

....

....

11

9. *(a)* The respiratory system is responsible for ventilation and gas exchange.

C ....

A ....

B ....

D ....
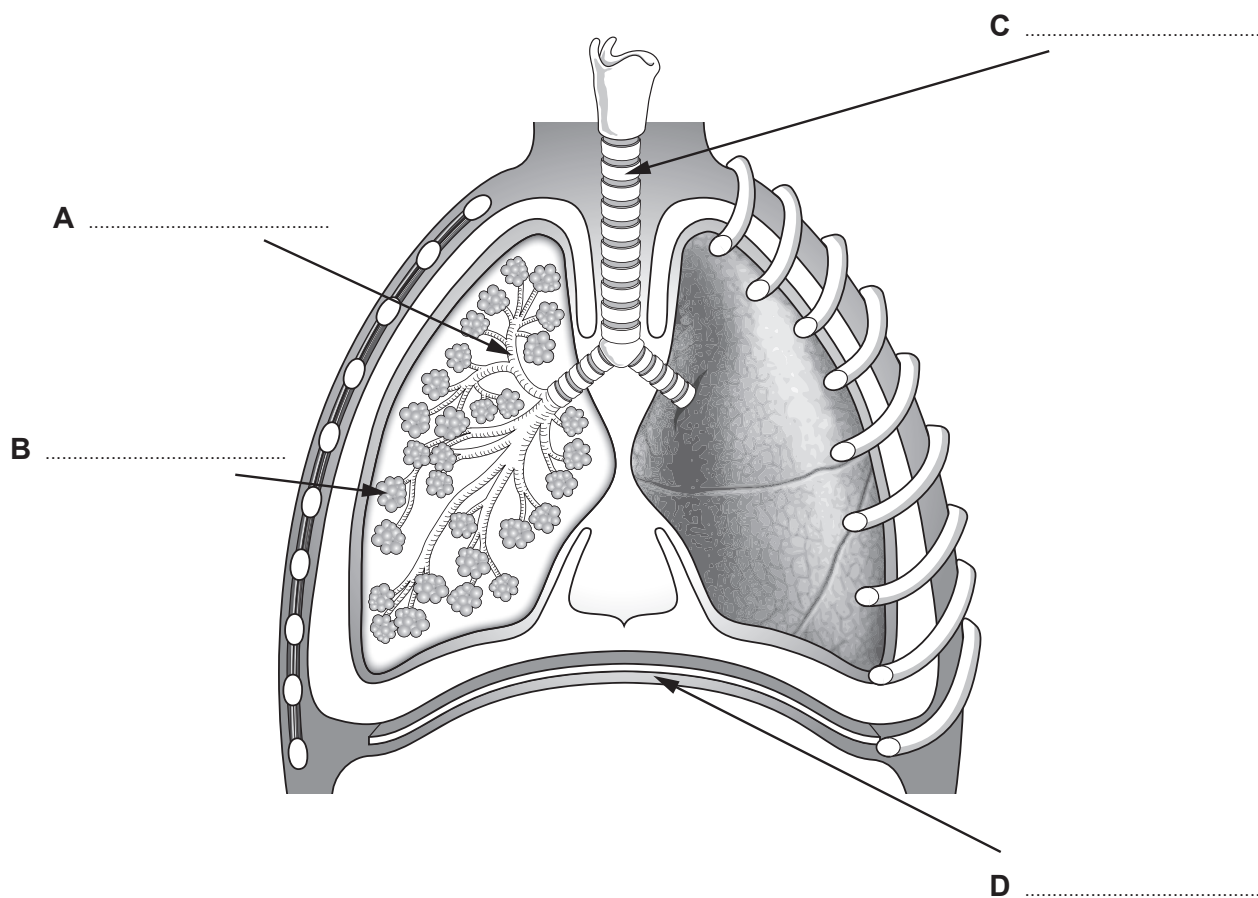
(i) Label structures **A – D**. [2]

(ii) Describe the process of expiration. [4]

....

....

....

....

....

....

(iii) Describe how gases are exchanged during breathing. [3]

....

....

....

....

....

19

Examiner
only

(b) Below is a section of cells from a healthy lung.
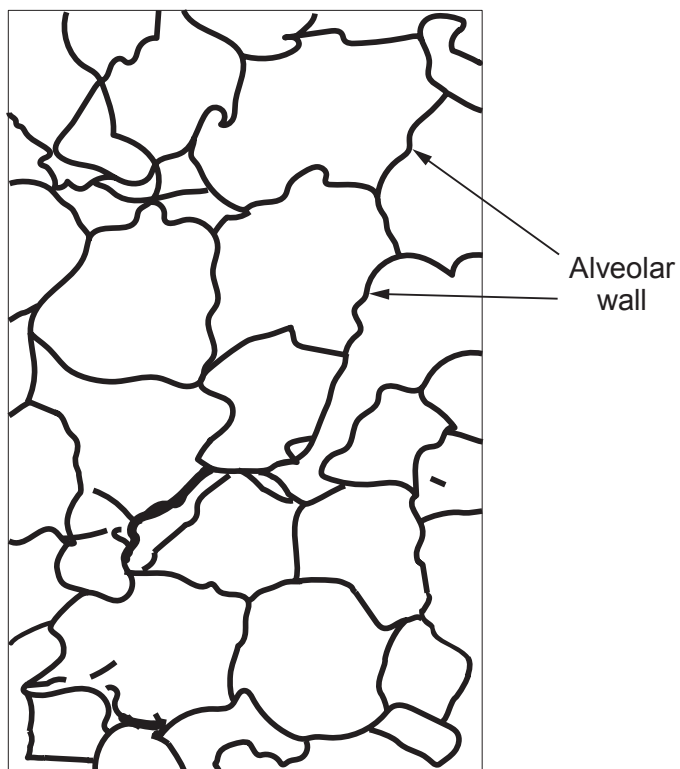
Microscopic section
(Low magnification)

Alveolar
wall

(i) In the box below, draw a diagram of the section of cells you would expect to see in someone that is suffering from emphysema. [2]

© WJEC CBAC Ltd. (1661-01) **Turn over.**

(ii) Explain how the breathing rate of someone suffering from emphysema would differ from that of someone with healthy lungs. [2]

....

....

....

....

....

(c) (i) Suggest **two** ways that a healthy individual can increase their lung capacity. [1]

....

....

(ii) State **one** piece of apparatus that could be used to test lung capacity. [1]

....

(d) Asthma is another disease of the lungs. Describe its effect on the structure and function of the lungs. [3]

....

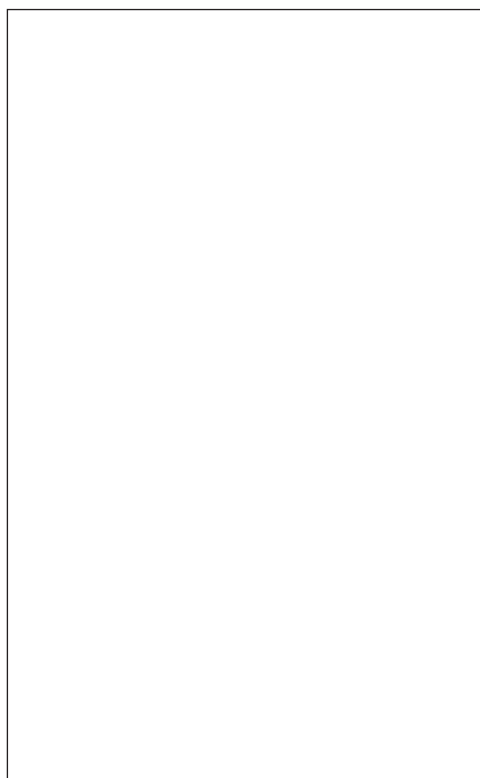...

....

....

....

(e) (i) Surfactant is essential within the respiratory system. State the function of surfactant found on the inner surface of the alveoli. [1]

....

....

(ii) Give **one** medical use of artificial surfactant. [1]

....

....

20

10. *(a)* Explain how the labelled adaptations of the erythrocyte aid its function: [3]

Nucleus absent

Haemoglobin

Concave surface
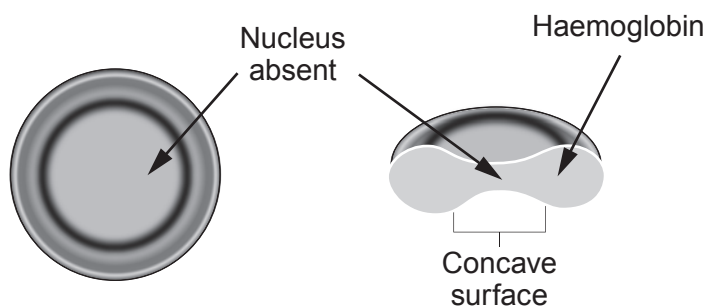
Adaptation 1: No nucleus ....

....

Adaptation 2: Haemoglobin ....

....

Adaptation 3: Biconcave shape ....

....

(b) Other than erythrocytes, state another component of blood and describe its function. [2]

Component: ....

Function: ....

....

(c) Describe and explain how the blood count of an anaemia sufferer is different from the normal value. [2]

....

....

....

7

11. Research has shown that stem cells can be used to treat both cardiovascular disease and heart attacks.

A blockage causes a **HEART ATTACK**

which damages heart tissue and cells

over time this can result in **HEART FAILURE**
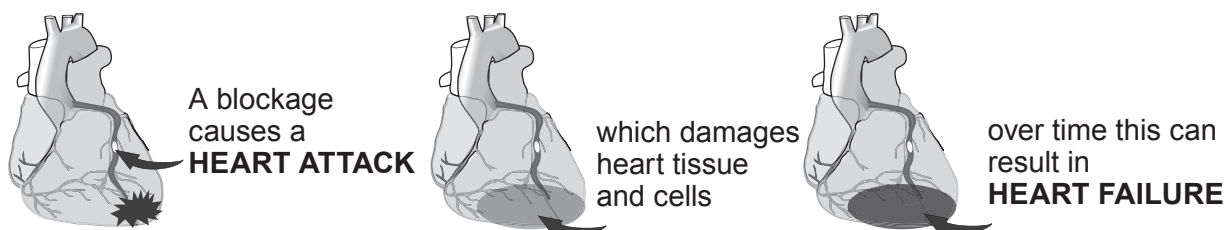
Researchers have found that adult stem cells may help patients who have cardiovascular disease. Patients' own stem cells have been used to repair heart tissue that was damaged after a heart attack.

Here's how it was done –

FAT TISSUE was **HARVESTED** from the patient's abdomen or side via **liposuction** and then processed

Anti-inflammatory cells and **STEM CELLS** were obtained

STEM CELLS were **injected** into the heart tissue
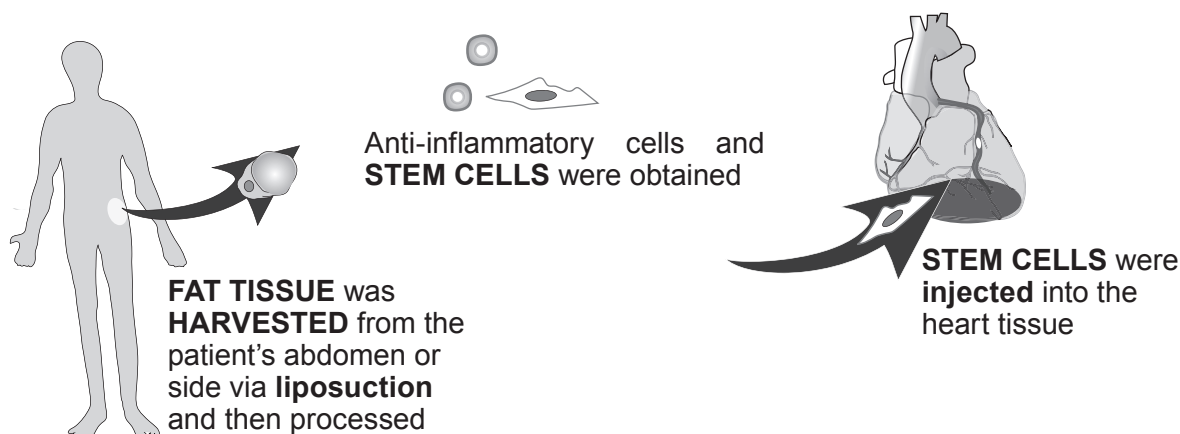
(a) From which part of the body are the stem cells that are used in such treatment extracted? [1]

....

(b) (i) During a heart attack the supply of blood to the heart is blocked. This results in serious damage to the heart. Name the tissue that makes up the heart. [1]

....

(ii) Name the vessels in the heart that become blocked during a heart attack. [1]

....

(c) An electrocardiogram (ECG) is used to assess heart function. It records electrical changes in the heart that are shown on a trace.

Trace A

t-wave
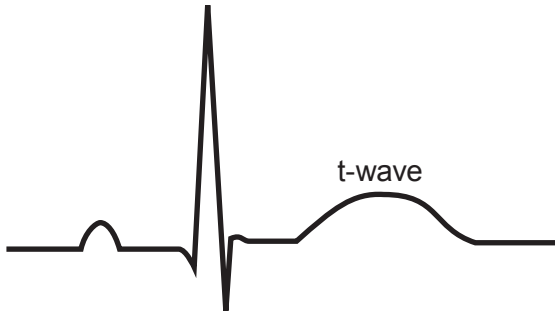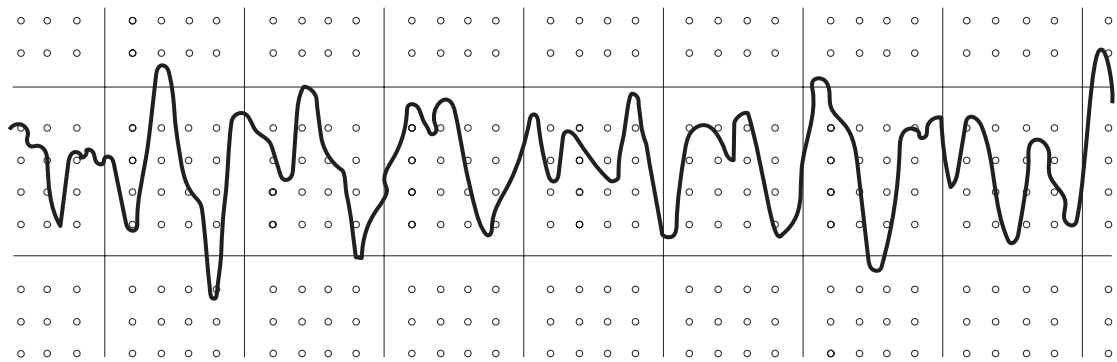
Trace B

(i) Label **trace A**. [2]

(ii) What condition does **trace B** represent? [1]

(d)   Describe the cardiac cycle.   [5]

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11

END OF PAPER

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Data Sheet

Table 1   Normal values for some physiological indicators

Indicator	Adult Male	Adult Female
Pulse Rate	60 – 80 beats per minute	60 – 80 beats per minute
BREATHING Rate Tidal volume Vital Capacity Peak Flow	 12 – 15 breaths per minute 400 – 500 cm^3 4.8 dm^3 400 – 600 dm^3 min^{-1}	 12 – 15 breaths per minute 400 – 500 cm^3 3.1 dm^3 400 – 600 dm^3 min^{-1}
BLOOD PRESSURE 20 years old 40 years old	 125/80 mmHg 135/85 mmHg	 123/80 mmHg 133/85 mmHg

Table 2   Reference ranges for some common blood tests

Test	Adult Male	Adult Female
Glucose (Fasting)	4.5 – 6.1 mmol dm^{-3}	4.5 – 6.1 mmol dm^{-3}
Sodium ions	133 – 147 mmol dm^{-3}	133 – 147 mmol dm^{-3}
Potassium ions	3.5 – 5.0 mmol dm^{-3}	3.5 – 5.0 mmol dm^{-3}
Calcium ions	1.15 – 1.29 mmol dm^{-3}	1.15 – 1.29 mmol dm^{-3}
Zinc ions	10 – 17 µmol dm^{-3}	10 – 17 µmol dm^{-3}
RED BLOOD CELLS Haemoglobin Red Cell count	 140 – 180 g dm^{-3} 4.5 – 6.5 × 10^{12} dm^{-3}	 115 – 160 g dm^{-3} 3.8 – 5.8 × 10^{12} dm^{-3}
WHITE BLOOD CELL COUNT	4 – 11 × 10^9 dm^{-3}	4 – 11 × 10^9 dm^{-3}
PLATELET COUNT	150 – 400 × 10^9 dm^{-3}	150 – 400 × 10^9 dm^{-3}

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