Surname	Centre Number	Candidate Number
Other Names		2

GCE AS/A level

1661/01

S15-1661-01

APPLIED SCIENCE
UNIT 1

P.M. TUESDAY, 12 May 2015

1 hour 30 minutes

	For Examiner's use only		
	Question	**Maximum Mark**	**Mark Awarded**
Section A	**1-8**	**31**	
	9	**14**	
	10	**13**	
Section B	**11**	**10**	
	12	**12**	
	Total	**80**	

1661
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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 24.

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Butter and cheese are better than trans-fat margarines, says heart specialist

Butter, cheese and even red meat are not as bad for the heart as has been maintained, a cardiologist has said in a leading medical journal, adding that it is time to "bust the myth" of saturated fat.

Kate Moore, cardiology specialist at Willowdene University hospital, London, also argues that statins have been over-prescribed because of the government's obsession with lowering cholesterol in an attempt to reduce heart disease – and that the side-effects outweigh the benefits for millions of people who take them every day.

She adds that it may depend on what sort of foods the saturated fat comes from. Dairy products contain vitamin D, a lack of which has been linked to increased heart disease, and calcium and phosphorus, which may have blood pressure lowering effects. Eating processed meat has been linked to higher rates of heart disease and diabetes, but not red meat.

She tells her patients that butter and cheese – though not processed cheese – are better for them than low-fat spreads and that the odd steak will not hurt. Rather than take statins, she said, people with cardiovascular risks should eat a Mediterranean diet, rich in olive oil, fruit, vegetables, fish and nuts. She pointed to a recent study that showed that adopting a Mediterranean diet after a heart attack is three times more effective in preventing further illness than statins.

Neither Public Health England nor the British Heart Foundation agreed with Dr Moore's argument. A spokesperson from the British Heart Foundation, said: "Studies on the link between diet and disease frequently produce conflicting results because, unlike drug trials, it's difficult to undertake a properly controlled, randomised study. However, people with the highest cholesterol levels are at the highest risk of a heart attack and it's clear that lowering cholesterol, by whatever means, lowers risk."

Liz Neill, director of diet and obesity at Public Health England, said: "we recommend that no more than 11% of a person's average energy intake should come from saturated fats, as there is evidence to show increased levels of saturated fats can raise blood cholesterol levels, in turn raising the risk of cardiovascular disease."

The extract above is based upon an article that appeared in The Guardian on Wednesday 23 October 2013.

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The following information is based upon an article found on the nhsdirect.wales.nhs.uk website.

Coronary heart disease

Coronary heart disease (CHD) is the UK's biggest killer, causing around 82 000 deaths each year. About one in five men and one in eight women die from the disease. In the UK, there are an estimated 2.7 million people living with the condition and 2 million people affected by angina (the most common symptom of coronary heart disease). CHD generally affects more men than women, but from the age of 50 the chances of developing CHD are similar for men and women.

Symptoms of CHD

1. Angina

If the coronary arteries become partially blocked, it can cause chest pain (angina).

This can be a mild, uncomfortable feeling similar to indigestion. However, a severe angina attack can cause a painful feeling of heaviness or tightness, usually in the centre of the chest, which may spread to the arms, neck, jaw, back or stomach.

Angina is often triggered by physical activity or stressful situations. Symptoms usually pass in less than 10 minutes and can be relieved by resting or using a glyceryl trinitrate tablet or spray.

1661
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2. Heart attacks

If the coronary arteries become completely blocked, it can cause a heart attack (myocardial infarction). Heart attacks can cause permanent damage to the heart muscle and, if not treated straight away, can be fatal. Although symptoms can vary, the discomfort or pain of a heart attack is usually similar to that of angina, but it is often more severe. During a heart attack patients also experience the following symptoms:

- sweating
- light-headedness
- nausea
- breathlessness.

A heart attack can happen at any time, including while at rest. If heart pains last longer than 15 minutes, it may be the start of a heart attack. Unlike angina, the symptoms of a heart attack are not usually relieved using a glyceryl trinitrate tablet or spray.

3. Heart failure

Heart failure can also occur in people with CHD when the heart becomes too weak to pump blood around the body, which can cause fluid to build up in the lungs that makes it increasingly difficult to breathe. Heart failure can happen suddenly (acute heart failure) or gradually over time (chronic heart failure).

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Causes of heart disease

Coronary heart disease (CHD) is usually caused by a build-up of fatty deposits on the walls of the arteries around the heart (coronary arteries). The fatty deposits, called atheroma, are made up of cholesterol and other waste substances.

The build-up of atheroma on the walls of the coronary arteries makes the arteries narrower and restricts the flow of blood to the heart (see **Figure 1**). This process is called atherosclerosis. The risk of developing atherosclerosis is significantly increased if a patient:

- smokes
- has high blood pressure (hypertension)
- has a high blood cholesterol level
- does not take regular exercise
- has diabetes.

Other risk factors for developing atherosclerosis include:

- being obese or overweight
- having a family history of CHD – the risk is increased if there is a male relative with CHD under 55 or a female relative under 65.

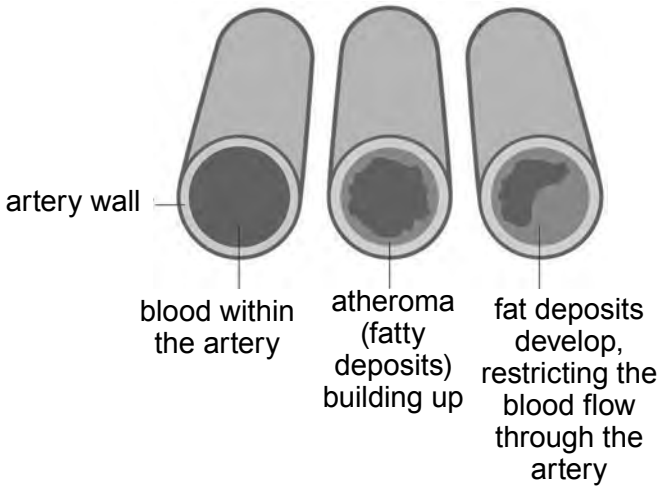

Figure 1 How atheroma builds up

Risk factors for coronary heart disease

1. Cholesterol

Cholesterol is a fat made by the liver from the saturated fat that we eat. Cholesterol is essential for healthy cells, but if there is too much in the blood it can lead to CHD.
Cholesterol is carried in the blood stream by molecules called lipoproteins. There are several different types of lipoproteins, but two of the main ones are low-density lipoproteins (LDL) and high-density lipoproteins (HDL).

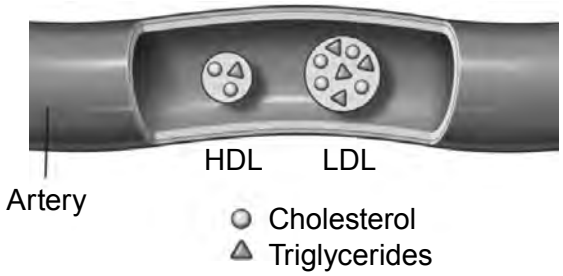

Figure 2 HDL and LDL cholesterol

LDL, often referred to as "bad cholesterol", takes cholesterol from the liver and delivers it to cells. LDL cholesterol tends to build up on the walls of the coronary arteries, increasing the risk of heart disease.
HDL, often referred to as "good cholesterol", carries cholesterol away from the cells and back to the liver, where it is broken down or passed from the body as a waste product.
In the UK, the current government recommendation is that a person should have a total blood cholesterol level of less than 5 mmol dm^{-3}, and an LDL cholesterol level of under 3 mmol dm^{-3}. This should be even lower if there are symptoms of CHD.

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2. High blood pressure

High blood pressure (hypertension) puts a strain on the heart and can lead to CHD. High blood pressure is defined as a systolic pressure of 140 mmHg or more, or a diastolic pressure of 90 mmHg or more.

3. Smoking

Smoking is a major risk factor. Carbon monoxide (from the smoke) and nicotine both put a strain on the heart by making it work faster. They also increase your risk of blood clots.
Other chemicals in cigarette smoke damage the lining of your coronary arteries, leading to furring of the arteries. Smokers increase the risk of developing heart disease by 24%.

4. Thrombosis

A thrombosis is a blood clot within an artery (or a vein). If a thrombosis occurs in a coronary artery (coronary thrombosis), it will cause the artery to narrow, preventing the blood supply from reaching the heart muscle. This increases your chance of having a heart attack. Coronary thrombosis usually happens at the same place that the atherosclerosis is forming (furring of the coronary arteries).

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5. Body shape

Body shape may increase the risk of CHD. The incidence of heart disease and diabetes is higher in people who are “apple-shaped” (who store fat around their abdomens) than in those who are “pear-shaped” (people with fat mostly around the hips and thighs).

Diagnosing coronary heart disease

If a doctor feels a patient is at risk of CHD, they may carry out a risk assessment. This involves asking about the patient’s medical and family history, their lifestyle and taking a blood test.

Further tests may be needed to confirm a diagnosis of CHD, including:

- an electrocardiogram (ECG)
- an X-ray
- blood tests
- echocardiogram
- a MRI scan
- a CT scan
- coronary angiography.

Treating coronary heart disease

Effective treatment of coronary heart disease (CHD) saves lives. Since 2000, there has been a 40% reduction in deaths from heart disease in people under 75. A national review of heart disease services sets out standards that define good heart disease care:

- tackling factors that increase the risk of heart disease, such as smoking, poor diet and little physical exercise
- preventing CHD in high-risk patients and, where patients have CHD, avoiding complications and tackling the progression of the disease
- rapid treatment for heart attack, including the choice of angioplasty in a specialist cardiac centre
- rapid diagnosis of heart disease and access to diagnostic tests
- rapid access and choice of treatment centre for specialised cardiac care.

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Treatment overview

1. Lifestyle changes

For those that have been diagnosed with CHD, the risk of further episodes can be reduced by making simple lifestyle changes. For example, stopping smoking after a heart attack will quickly reduce the risk of having a heart attack in the future to near that of a non-smoker. Other lifestyle changes, such as eating more healthily and doing regular exercise, will also reduce the future risk of heart disease.

2. Medicines

Many different medicines are used to treat CHD. Usually they either aim to reduce blood pressure, reduce cholesterol or widen the arteries.

(a) Antiplatelets

Antiplatelets are a type of medicine that can help reduce the risk of a heart attack by preventing the blood from clotting.

(b) Statins

If a patient has high blood cholesterol level, cholesterol-lowering medicine called statins may be prescribed. They work by blocking the formation of cholesterol and increasing the number of LDL receptors in the liver, which helps remove the LDL cholesterol from the blood. This helps slow the progression of CHD, and will make having a heart attack less likely.

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(c) Beta-blockers

Beta-blockers are often used to prevent angina and treat high blood pressure. They work by blocking the effects of a particular hormone in the body, which slows down the heartbeat and improves blood flow.

(d) Nitrates

Nitrates are “vasodilators” which means they make the arteries become wider. They are available in a variety of forms, including tablets, sprays, skin patches and ointments.

3. Procedures and surgery

If the blood vessels are narrow due to a build-up of atheroma (fatty deposits), or if symptoms cannot be controlled using medication, surgery may be needed to open up or replace blocked arteries. Some of the main procedures used to treat blocked arteries are outlined on page 8 and 9.

Procedures used to treat blocked arteries

1. Coronary angioplasty

Coronary angioplasty may be a planned procedure for some people with angina, or an urgent treatment if the symptoms have become unstable. Having a coronary angiogram will determine if a patient is suitable for treatment. Coronary angioplasty can also be performed as an emergency treatment during a heart attack.

During angioplasty, a small balloon is inserted to push the fatty tissue in the narrowed artery outwards. This allows the blood to flow more easily. A metal stent (a short, wire mesh tube) is usually placed in the artery to hold it open.

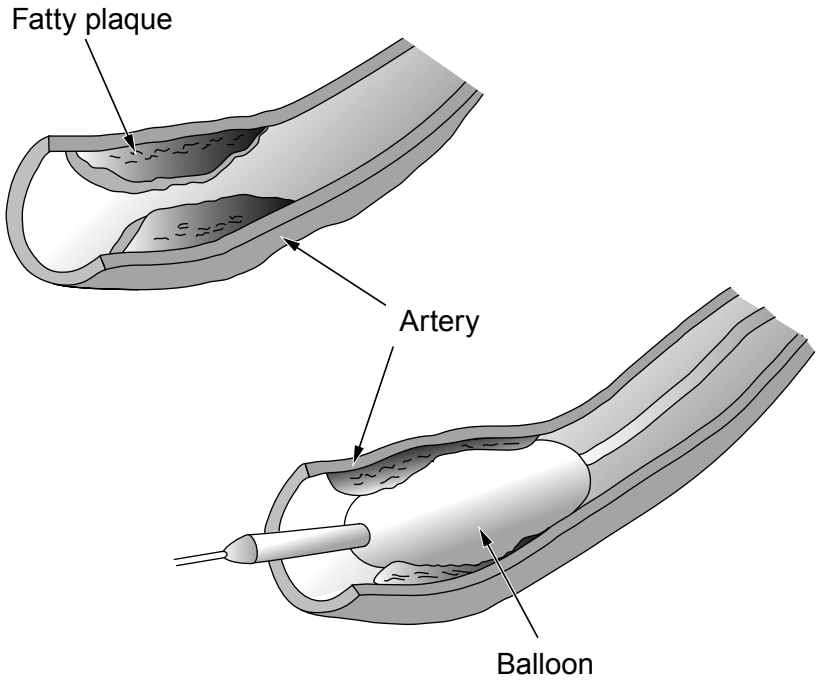

Figure 3 Coronary angioplasty

2. Coronary artery bypass graft

Coronary artery bypass grafting is performed in patients where the arteries become narrowed or blocked. A coronary angiogram determines if a patient is suitable for treatment.
A blood vessel is inserted (grafted) between the aorta (the main artery leaving the heart) and a part of the coronary artery beyond the narrowed or blocked area. This allows the blood to bypass (get around) the narrowed sections of coronary arteries.

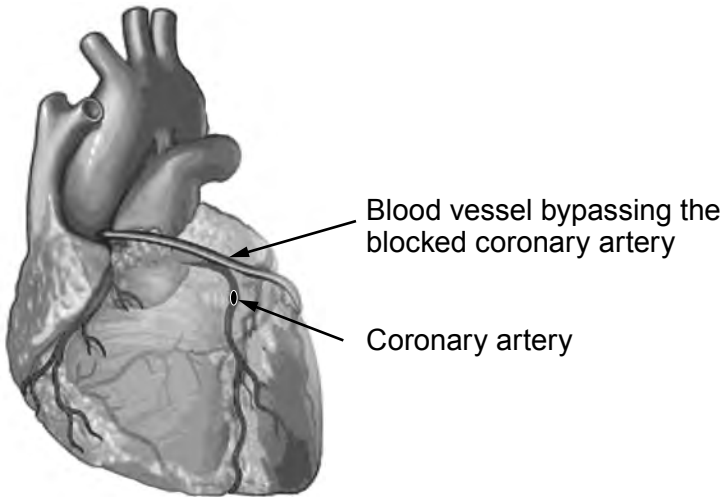

Figure 4 Coronary artery bypass

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3. Heart transplant

In a small number of cases, when the heart is severely damaged and medicine is not effective, or when the heart becomes unable to adequately pump blood around the body (heart failure), a heart transplant may be needed. A heart transplant involves replacing a heart that is damaged or is not working properly with a healthy donor heart.

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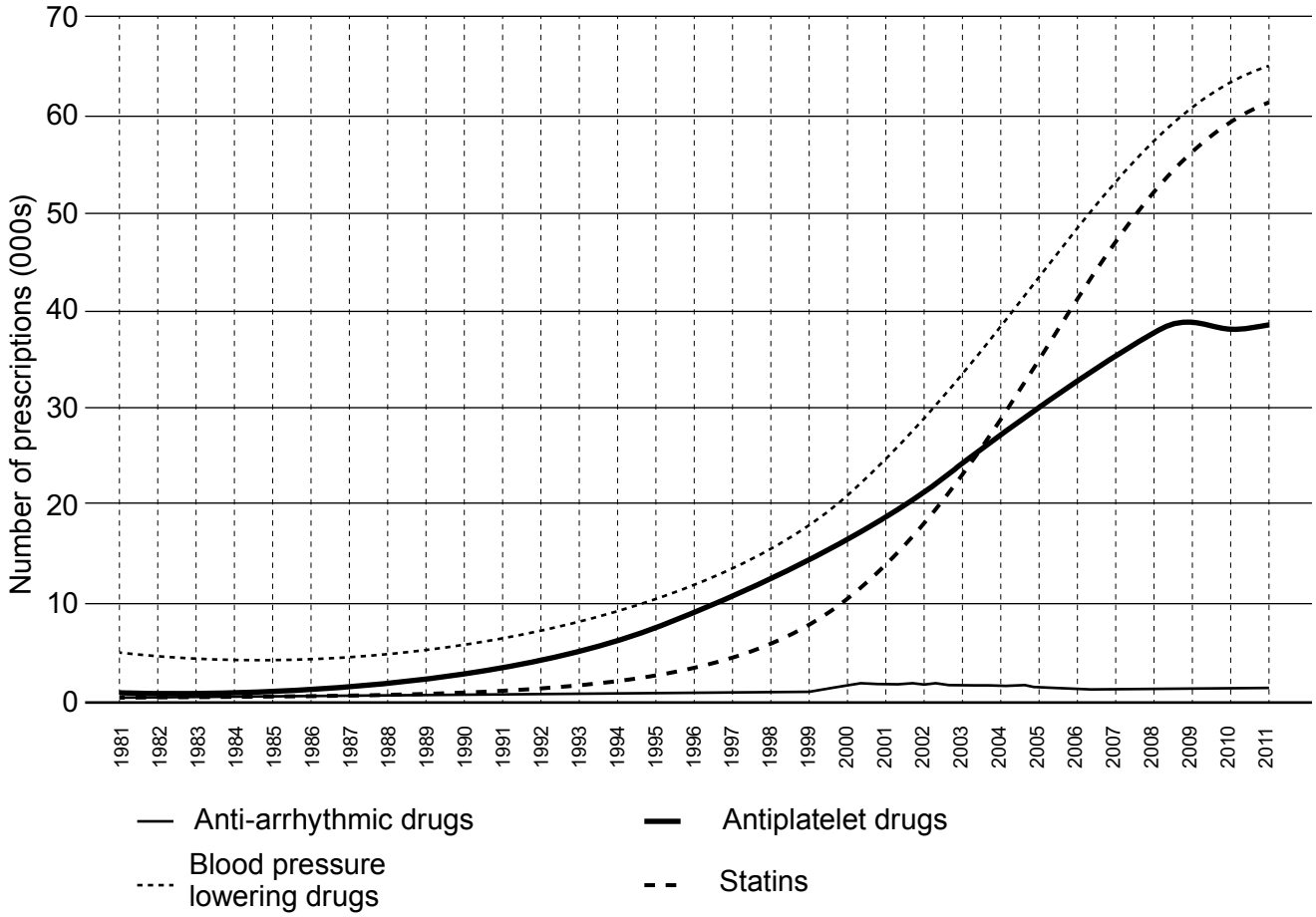
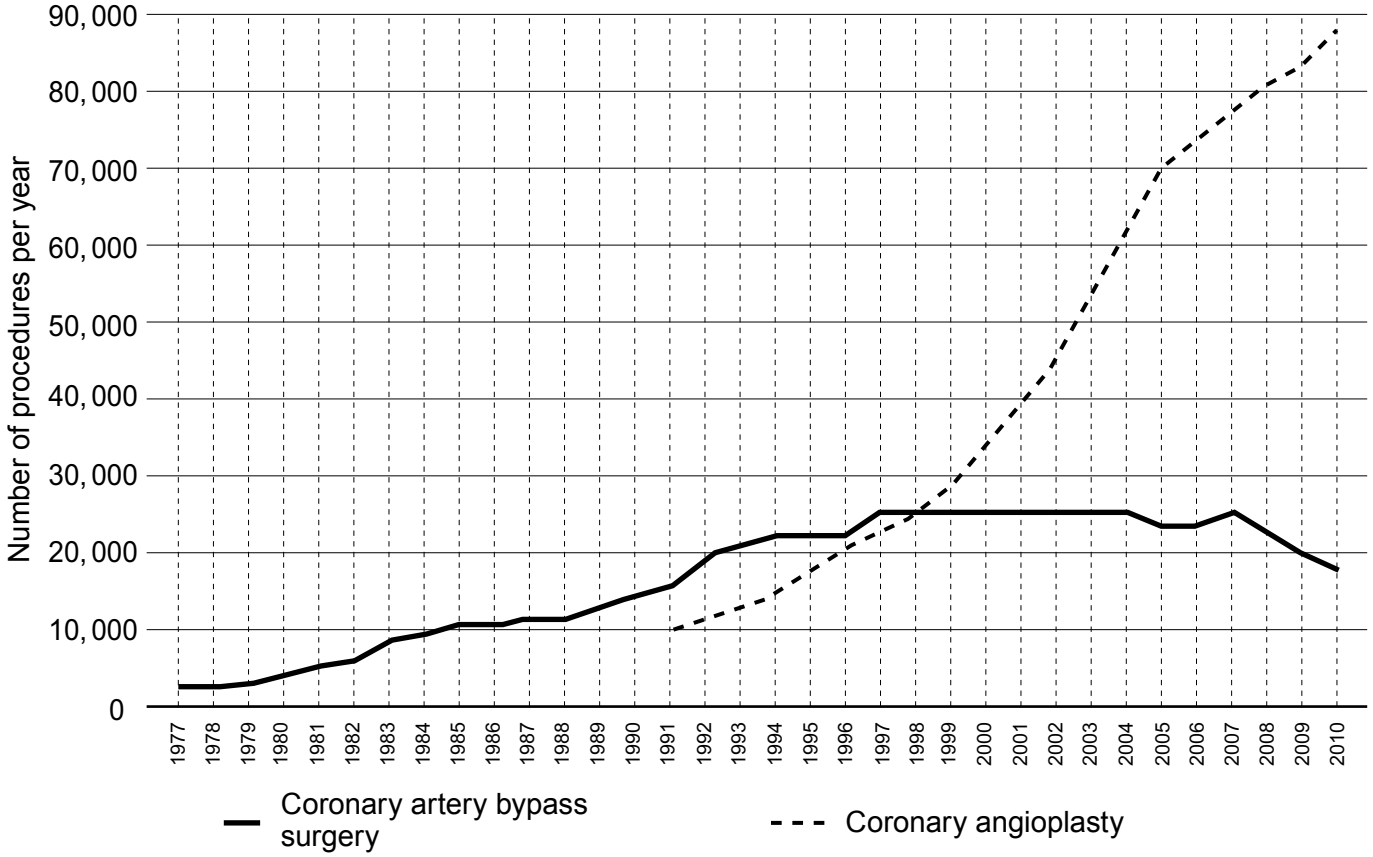
Turn over.

Graph 1 Prescriptions used in the prevention and treatment of CHD, England 1981 to 2011



Graph 2 Number of coronary artery bypass and coronary angioplasty operations per year United Kingdom 1977 to 2010



The above graphs are taken from BHF website.

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SECTION A

Answer **all** *questions*.

1. State **three** symptoms of coronary heart disease. [3]

.....

.....

.....

2. *(a)* (i) State the name of the vessels that deliver blood to the heart muscle. [1]

.....

(ii) State **one** substance delivered by the blood in these vessels. [1]

.....

(b) Give **one** reason why a patient experiences chest pain when the coronary arteries become partially blocked. [1]

.....

(c) Explain how a glyceryl trinitrate spray can relieve chest pain. [2]

.....

.....

.....

3. The UK population is currently 65 million. Calculate the percentage of the UK population living with CHD. (Lines 36-41) [1]

.....

.....

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4. High blood pressure (hypertension) is a risk factor for coronary heart disease.

(a) Describe what is meant by the terms *systolic pressure* and *diastolic pressure*. [2]

Systolic pressure: .....

.....

Diastolic pressure: .....

.....

(b) The blood pressure of three people is given below.

Person	Blood Pressure mmHg
Jeremy	120/80
Andrew	145/98
Richard	135/85

Explain which person is considered to suffer from high blood pressure. [2]

.....

.....

.....

(c) List **two** risk factors of coronary heart disease. [2]

1. .....

2. .....

5. Coronary arteries are affected by atheroma. Give **one** reason why coronary veins are less likely to be affected by atheroma. [1]

.....

.....

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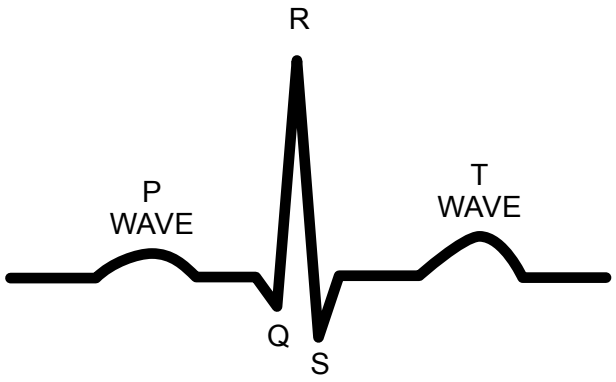
6. Electrocardiograms can be used to diagnose CHD. Abnormal QRS complexes and T waves are characteristic of a patient suffering from CHD.



(a) State what is shown by the QRS complex and T wave of an ECG trace. [2]

QRS: .....

T wave: .....

(b) A heart attack can result in ventricular fibrillation. Describe how an ECG trace of a patient suffering from ventricular fibrillation would differ from a normal ECG trace. [1]

.....

.....

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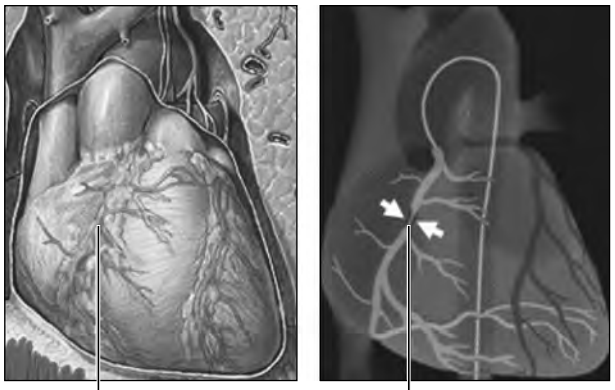
7. Coronary angiography is a method used to diagnose CHD. During the procedure a catheter (tube) is fed in to the coronary arteries. A special type of dye called contrast medium is injected into the catheter and X-ray images (angiograms) are taken to highlight any blood vessels that are narrowed or blocked.



(a) Describe how an X-ray image is produced. [3]

.....

.....

.....

.....

.....

(b) One precaution taken by a radiographer when taking an X-ray is to wear a dosimeter badge. Give **two** other safety precautions that a radiographer should take. [2]

1. .....

2. .....

(c) Explain why is it necessary to use a contrast medium during angiography. [2]

.....

.....

.....

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8. Please refer to **Graph 1** and **Graph 2** on page 10 to answer this question.

(a) Describe the trend in prescription of blood pressure lowering drugs and statins since 1981. [1]

.....

(b) Compare the trend for the number of coronary artery bypass operations and coronary angioplasty operations since 2007. [2]

.....

.....

.....

(c) Give **two** reasons for the observed trend in coronary artery bypass operations. [2]

1. .....

.....

2. .....

.....

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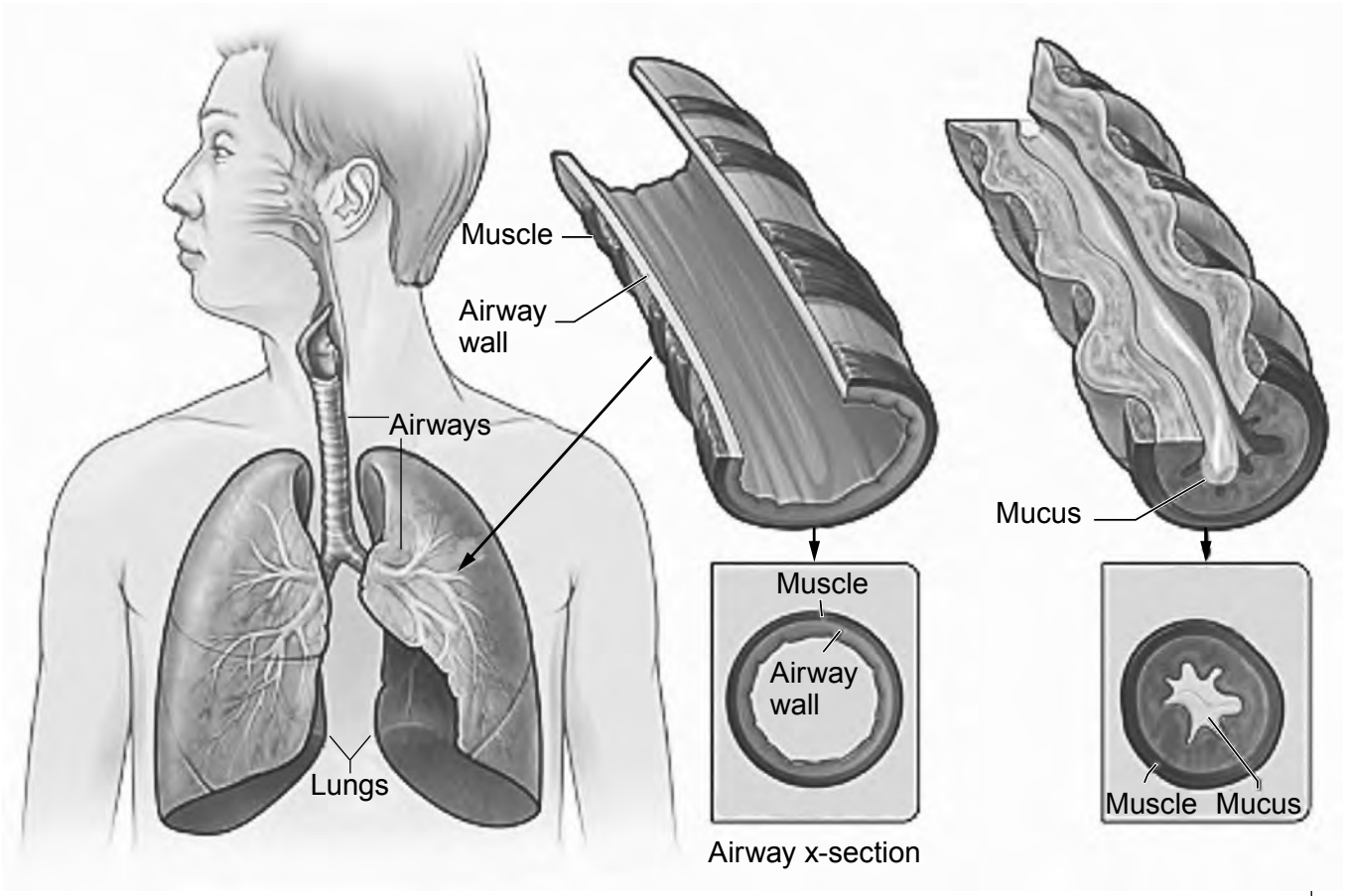
SECTION B

Answer **all** *questions*.

9. The effect of asthma is shown in the diagram below.



(a) State the name of the part of the lung shown in diagrams **B** and **C**. [1]

.....

(b) Describe the process of inspiration. [3]

.....

.....

.....

.....

.....

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(c) (i) Use the diagram and your knowledge to describe what happens in this region of the lungs during an asthma attack. [3]

.....

.....

.....

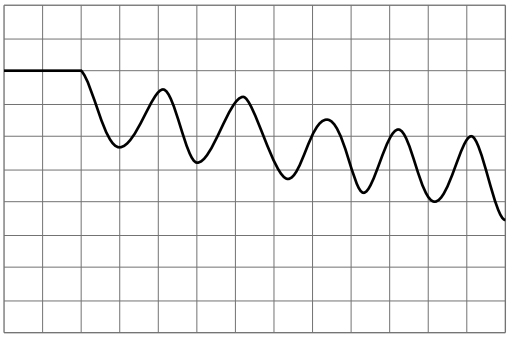
.....

(ii) State **two** symptoms of asthma that happen as a result of the events shown in the diagram. [2]

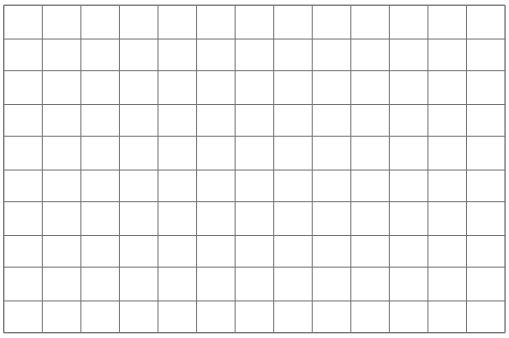
.....

.....

(d) The spirometer trace below shows normal breathing at rest in a non-asthmatic patient.



Non-asthmatic patient



Asthmatic patient

Draw, on the grid provided, the trace for an asthmatic patient. [2]

(e) (i) Describe **two** ways the drugs used to treat asthma give relief from the symptoms. [2]

1. .....

2. .....

(ii) Patients with emphysema share the same symptoms as asthma sufferers. Give **one** reason why asthma drugs cannot be used to treat emphysema. [1]

.....

.....

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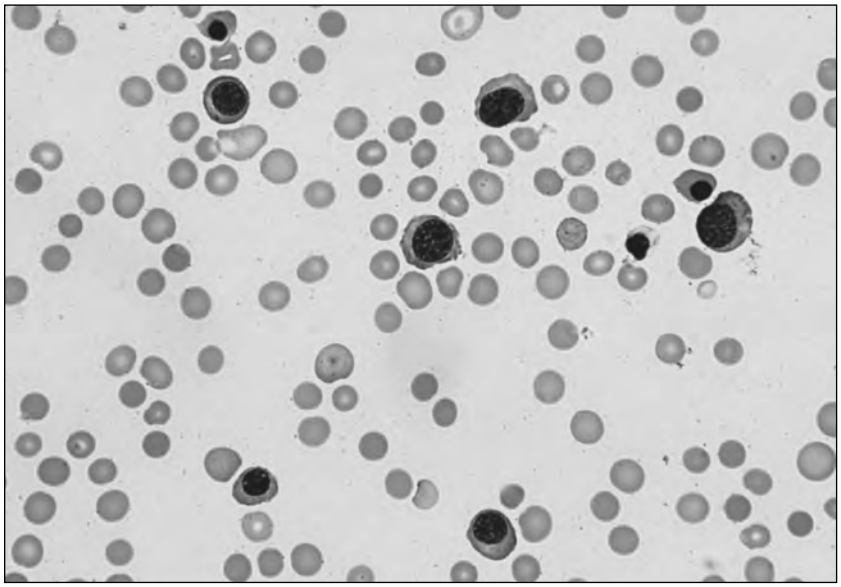
10. A blood sample was taken from an elite athlete and examined under a microscope. The micrograph is shown below.



(a) State **two** hazards associated with taking a blood sample. [1]

.....

.....

(b) (i) Label an erythrocyte and a leucocyte on the micrograph. [2]

(ii) Describe the function of the erythrocyte and leucocyte. [2]

erythrocyte: .....

leucocyte: .....

(c) Describe **two** adaptations of an erythrocyte and explain why these adaptations are important. [4]

Adaptation	Importance of the adaptation
.....	.....
.....	.....
.....	.....
.....	.....

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(d) The table below compares the mean red blood cell count of a male athlete living at sea level and after spending two months training at an altitude of 4000 metres.

Altitude (metres)	Number of red blood cells (10^{12} dm^{-3})
0	4.85
4 000	6.15

(i) Calculate the percentage increase in red blood cells after spending two months training at 4 000 metres. [2]

.....

.....

.....

(ii) Explain why having an increased number of red blood cells can enhance the athlete's performance. [2]

.....

.....

.....

.....

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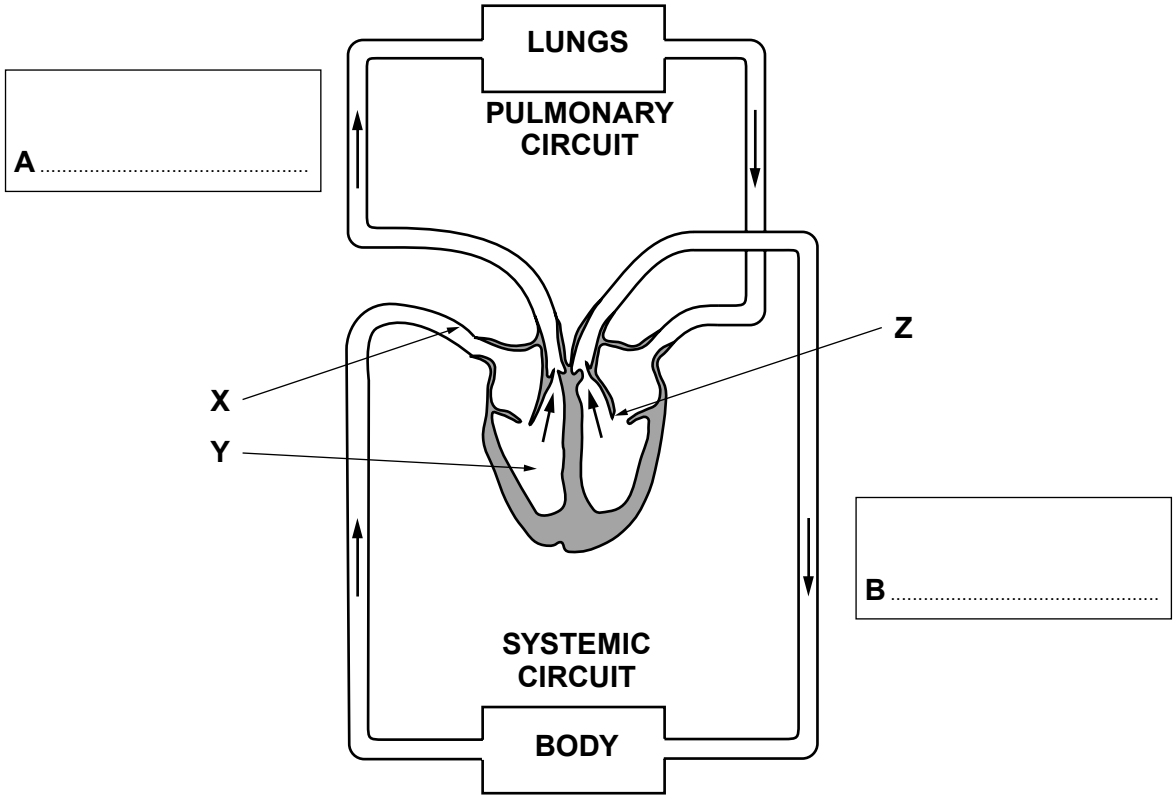
11. The diagram below shows the double circulatory system in humans.



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(a) (i) Name and explain the function of structure **X, Y** and **Z**. [6]

Structure	Name	Function
X	.....	....
Y	.....	....
Z	.....	....

(ii) Add the correct label, “oxygenated” or ”deoxygenated”, to box **A** and box **B** in the diagram of the double circulatory system. [1]

(b) (i) Give **one** reason why the human circulatory system is described as a *double circulatory system*. [1]

.....

.....

(ii) State **two** advantages of the double circulatory system in humans. [2]

.....

.....

.....

.....

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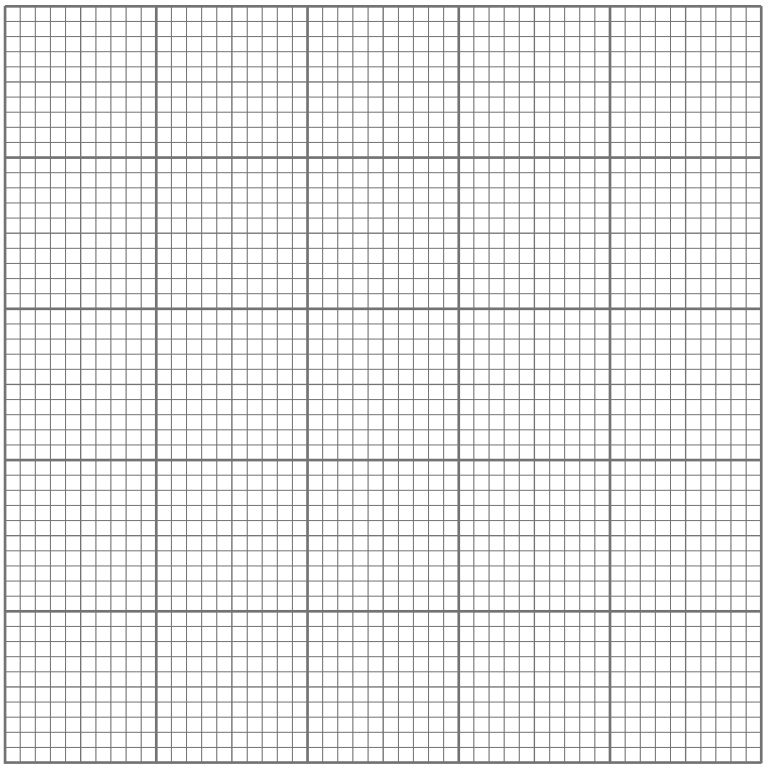
12. The table below shows the percentage of people surveyed from different socio-economic groups who smoke.

Socio-economic group	% of adults who smoke				
	2004	2006	2008	2010	2012
Managerial and professional	19	19	17	16	14
Routine and manual	35	34	31	31	30
Never worked or long-term unemployed	48	43	41	41	40

(a) Plot this data as a **line** graph on the graph paper below. [4]



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(b) (i) State which socio-economic group showed the largest decrease in smokers during the period 2004 to 2012. [1]

.....

(ii) Suggest **three** reasons for this decrease. [3]

.....

.....

.....

(c) Nicotine, present in cigarette smoke, increases heart rate. State **two** other possible causes of increased heart rate. [2]

.....

.....

(*d*) The government has voted to introduce a smoking ban in cars with children as passengers. Suggest **one** reason why there should be a smoking ban in cars and **one** reason why there should not be a smoking ban in cars. [2]

for: .....

.....

against: .....

.....

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	12 – 15 breaths per minute	12 – 15 breaths per minute
Tidal volume	400 – 500 cm^3	400 – 500 cm^3
Vital Capacity	4.8 dm^3	3.1 dm^3
Peak Flow	400 – 600 $dm^3\ min^{-1}$	400 – 600 $dm^3\ min^{-1}$
BLOOD PRESSURE		
20 years old	125/80 mmHg	123/80 mmHg
40 years old	135/85 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	140 – 180 g dm^{-3}	115 – 160 g dm^{-3}
Red Cell count	4.5 – 6.5 × 10^{12} 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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GCE AS/A level

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S15-1661-01A

APPLIED SCIENCE
UNIT 1

Pre-release Article for Examination in May 2015

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Information for Teachers

The pre-release article is intended as stimulus material in order to generate discussion. Questions will be set on the examination paper based on the information in the article and related aspects from the specification.
The article is based upon information found on various websites including:
http://www.theguardian.com/uk
http://www.nhsdirect.wales.nhs.uk/
http://www.bhf.org.uk/

No recall or terminology is required over and above that in the specification.

Candidates will be expected to have discussed and studied the article together with relevant specification content prior to the examination. However, they will not be expected to memorise any part of it as a copy will be provided in the examination paper.

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Butter and cheese are better than trans-fat margarines, says heart specialist

Butter, cheese and even red meat are not as bad for the heart as has been maintained, a cardiologist has said in a leading medical journal, adding that it is time to "bust the myth" of saturated fat.

Kate Moore, cardiology specialist at Willowdene University hospital, London, also argues that statins have been over-prescribed because of the government's obsession with lowering cholesterol in an attempt to reduce heart disease – and that the side-effects outweigh the benefits for millions of people who take them every day.

She adds that it may depend on what sort of foods the saturated fat comes from. Dairy products contain vitamin D, a lack of which has been linked to increased heart disease, and calcium and phosphorus, which may have blood pressure lowering effects. Eating processed meat has been linked to higher rates of heart disease and diabetes, but not red meat.

She tells her patients that butter and cheese – though not processed cheese – are better for them than low-fat spreads and that the odd steak will not hurt. Rather than take statins, she said, people with cardiovascular risks should eat a Mediterranean diet, rich in olive oil, fruit, vegetables, fish and nuts. She pointed to a recent study that showed that adopting a Mediterranean diet after a heart attack is three times more effective in preventing further illness than statins.

Neither Public Health England nor the British Heart Foundation agreed with Dr Moore's argument. A spokesperson from the British Heart Foundation, said: "Studies on the link between diet and disease frequently produce conflicting results because, unlike drug trials, it's difficult to undertake a properly controlled, randomised study. However, people with the highest cholesterol levels are at the highest risk of a heart attack and it's clear that lowering cholesterol, by whatever means, lowers risk."

Liz Neill, director of diet and obesity at Public Health England, said: "we recommend that no more than 11% of a person's average energy intake should come from saturated fats, as there is evidence to show increased levels of saturated fats can raise blood cholesterol levels, in turn raising the risk of cardiovascular disease."

The extract above is based upon an article that appeared in The Guardian on Wednesday 23 October 2013.

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The following information is based upon an article found on the nhsdirect.wales.nhs.uk website.

Coronary heart disease

Coronary heart disease (CHD) is the UK's biggest killer, causing around 82 000 deaths each year. About one in five men and one in eight women die from the disease. In the UK, there are an estimated 2.7 million people living with the condition and 2 million people affected by angina (the most common symptom of coronary heart disease). CHD generally affects more men than women, but from the age of 50 the chances of developing CHD are similar for men and women.

Symptoms of CHD

1. Angina

If the coronary arteries become partially blocked, it can cause chest pain (angina).

This can be a mild, uncomfortable feeling similar to indigestion. However, a severe angina attack can cause a painful feeling of heaviness or tightness, usually in the centre of the chest, which may spread to the arms, neck, jaw, back or stomach.

Angina is often triggered by physical activity or stressful situations. Symptoms usually pass in less than 10 minutes and can be relieved by resting or using a glyceryl trinitrate tablet or spray.

2. Heart attacks

If the coronary arteries become completely blocked, it can cause a heart attack (myocardial infarction). Heart attacks can cause permanent damage to the heart muscle and, if not treated straight away, can be fatal. Although symptoms can vary, the discomfort or pain of a heart attack is usually similar to that of angina, but it is often more severe. During a heart attack patients also experience the following symptoms:

- sweating
- light-headedness
- nausea
- breathlessness.

A heart attack can happen at any time, including while at rest. If heart pains last longer than 15 minutes, it may be the start of a heart attack. Unlike angina, the symptoms of a heart attack are not usually relieved using a glyceryl trinitrate tablet or spray.

3. Heart failure

Heart failure can also occur in people with CHD when the heart becomes too weak to pump blood around the body, which can cause fluid to build up in the lungs that makes it increasingly difficult to breathe. Heart failure can happen suddenly (acute heart failure) or gradually over time (chronic heart failure).

Causes of heart disease

Coronary heart disease (CHD) is usually caused by a build-up of fatty deposits on the walls of the arteries around the heart (coronary arteries). The fatty deposits, called atheroma, are made up of cholesterol and other waste substances.

The build-up of atheroma on the walls of the coronary arteries makes the arteries narrower and restricts the flow of blood to the heart (see **Figure 1**). This process is called atherosclerosis. The risk of developing atherosclerosis is significantly increased if a patient:

- smokes
- has high blood pressure (hypertension)
- has a high blood cholesterol level
- does not take regular exercise
- has diabetes.

Other risk factors for developing atherosclerosis include:

- being obese or overweight
- having a family history of CHD – the risk is increased if there is a male relative with CHD under 55 or a female relative under 65.

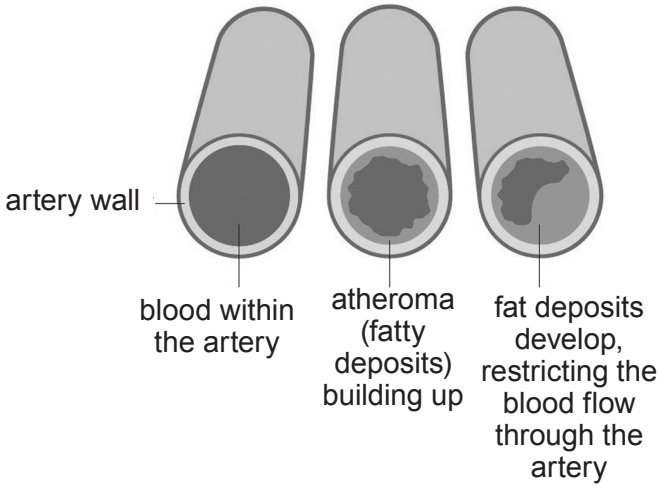

Figure 1 How atheroma builds up

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Risk factors for coronary heart disease

1. Cholesterol

Cholesterol is a fat made by the liver from the saturated fat that we eat. Cholesterol is essential for healthy cells, but if there is too much in the blood it can lead to CHD.
Cholesterol is carried in the blood stream by molecules called lipoproteins. There are several different types of lipoproteins, but two of the main ones are low-density lipoproteins (LDL) and high-density lipoproteins (HDL).

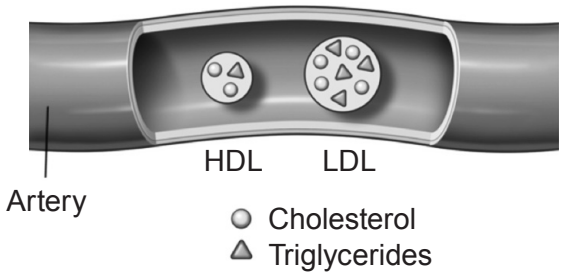

Figure 2 HDL and LDL cholesterol

LDL, often referred to as "bad cholesterol", takes cholesterol from the liver and delivers it to cells. LDL cholesterol tends to build up on the walls of the coronary arteries, increasing the risk of heart disease.
HDL, often referred to as "good cholesterol", carries cholesterol away from the cells and back to the liver, where it is broken down or passed from the body as a waste product.
In the UK, the current government recommendation is that a person should have a total blood cholesterol level of less than $5\,mmol\,dm^{-3}$, and an LDL cholesterol level of under $3\,mmol\,dm^{-3}$. This should be even lower if there are symptoms of CHD.

2. High blood pressure

High blood pressure (hypertension) puts a strain on the heart and can lead to CHD. High blood pressure is defined as a systolic pressure of 140 mmHg or more, or a diastolic pressure of 90 mmHg or more.

3. Smoking

Smoking is a major risk factor. Carbon monoxide (from the smoke) and nicotine both put a strain on the heart by making it work faster. They also increase your risk of blood clots.
Other chemicals in cigarette smoke damage the lining of your coronary arteries, leading to furring of the arteries. Smokers increase the risk of developing heart disease by 24%.

4. Thrombosis

A thrombosis is a blood clot within an artery (or a vein). If a thrombosis occurs in a coronary artery (coronary thrombosis), it will cause the artery to narrow, preventing the blood supply from reaching the heart muscle. This increases your chance of having a heart attack. Coronary thrombosis usually happens at the same place that the atherosclerosis is forming (furring of the coronary arteries).

5. Body shape

Body shape may increase the risk of CHD. The incidence of heart disease and diabetes is higher in people who are “apple-shaped” (who store fat around their abdomens) than in those who are “pear-shaped” (people with fat mostly around the hips and thighs).

Diagnosing coronary heart disease

If a doctor feels a patient is at risk of CHD, they may carry out a risk assessment. This involves asking about the patient’s medical and family history, their lifestyle and taking a blood test.

Further tests may be needed to confirm a diagnosis of CHD, including:

- an electrocardiogram (ECG)
- an X-ray
- blood tests
- echocardiogram
- a MRI scan
- a CT scan
- coronary angiography.

Treating coronary heart disease

Effective treatment of coronary heart disease (CHD) saves lives. Since 2000, there has been a 40% reduction in deaths from heart disease in people under 75. A national review of heart disease services sets out standards that define good heart disease care:

- tackling factors that increase the risk of heart disease, such as smoking, poor diet and little physical exercise
- preventing CHD in high-risk patients and, where patients have CHD, avoiding complications and tackling the progression of the disease
- rapid treatment for heart attack, including the choice of angioplasty in a specialist cardiac centre
- rapid diagnosis of heart disease and access to diagnostic tests
- rapid access and choice of treatment centre for specialised cardiac care.

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Treatment overview

1. Lifestyle changes

For those that have been diagnosed with CHD, the risk of further episodes can be reduced by making simple lifestyle changes. For example, stopping smoking after a heart attack will quickly reduce the risk of having a heart attack in the future to near that of a non-smoker. Other lifestyle changes, such as eating more healthily and doing regular exercise, will also reduce the future risk of heart disease.

2. Medicines

Many different medicines are used to treat CHD. Usually they either aim to reduce blood pressure, reduce cholesterol or widen the arteries.

(a) Antiplatelets

Antiplatelets are a type of medicine that can help reduce the risk of a heart attack by preventing the blood from clotting.

(b) Statins

If a patient has high blood cholesterol level, cholesterol-lowering medicine called statins may be prescribed. They work by blocking the formation of cholesterol and increasing the number of LDL receptors in the liver, which helps remove the LDL cholesterol from the blood. This helps slow the progression of CHD, and will make having a heart attack less likely.

(c) Beta-blockers

Beta-blockers are often used to prevent angina and treat high blood pressure. They work by blocking the effects of a particular hormone in the body, which slows down the heartbeat and improves blood flow.

(d) Nitrates

Nitrates are “vasodilators” which means they make the arteries become wider. They are available in a variety of forms, including tablets, sprays, skin patches and ointments.

3. Procedures and surgery

If the blood vessels are narrow due to a build-up of atheroma (fatty deposits), or if symptoms cannot be controlled using medication, surgery may be needed to open up or replace blocked arteries. Some of the main procedures used to treat blocked arteries are outlined on page 9 and 10.

Procedures used to treat blocked arteries

1. Coronary angioplasty

Coronary angioplasty may be a planned procedure for some people with angina, or an urgent treatment if the symptoms have become unstable. Having a coronary angiogram will determine if a patient is suitable for treatment. Coronary angioplasty can also be performed as an emergency treatment during a heart attack.

During angioplasty, a small balloon is inserted to push the fatty tissue in the narrowed artery outwards. This allows the blood to flow more easily. A metal stent (a short, wire mesh tube) is usually placed in the artery to hold it open.

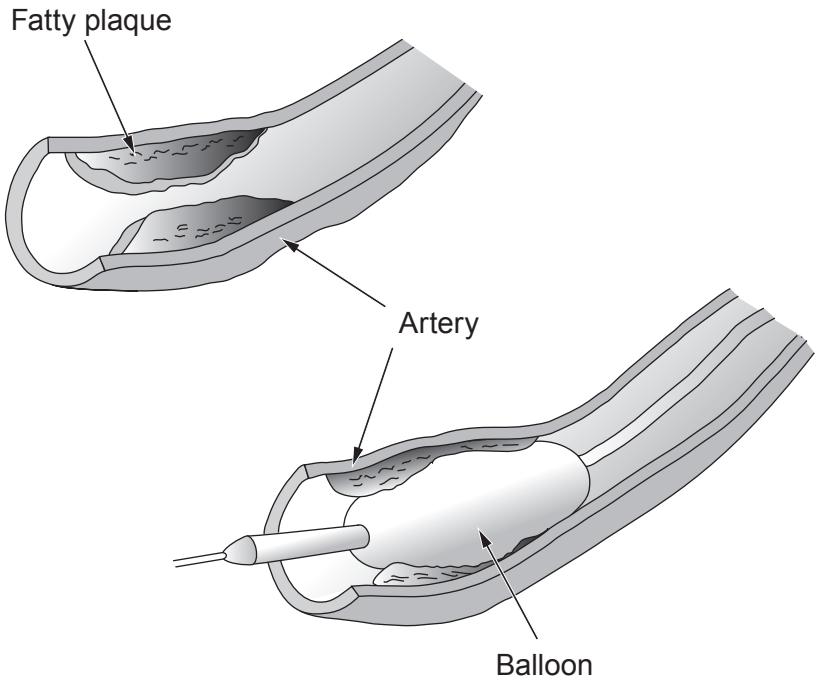

Figure 3 Coronary angioplasty

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2. Coronary artery bypass graft

Coronary artery bypass grafting is performed in patients where the arteries become narrowed or blocked. A coronary angiogram determines if a patient is suitable for treatment.
A blood vessel is inserted (grafted) between the aorta (the main artery leaving the heart) and a part of the coronary artery beyond the narrowed or blocked area. This allows the blood to bypass (get around) the narrowed sections of coronary arteries.

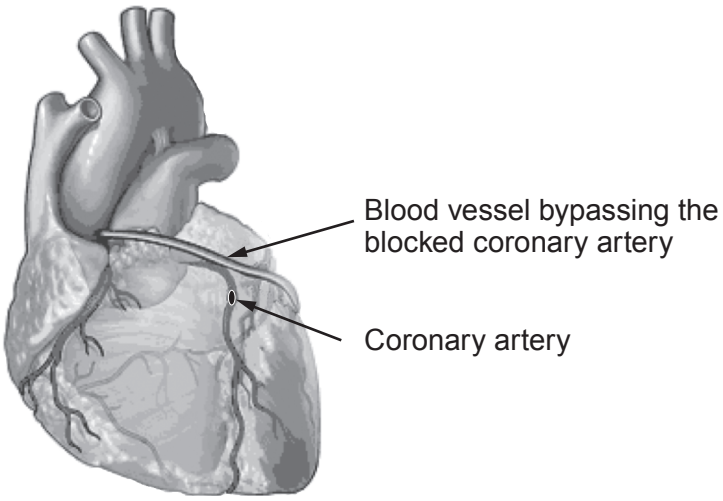
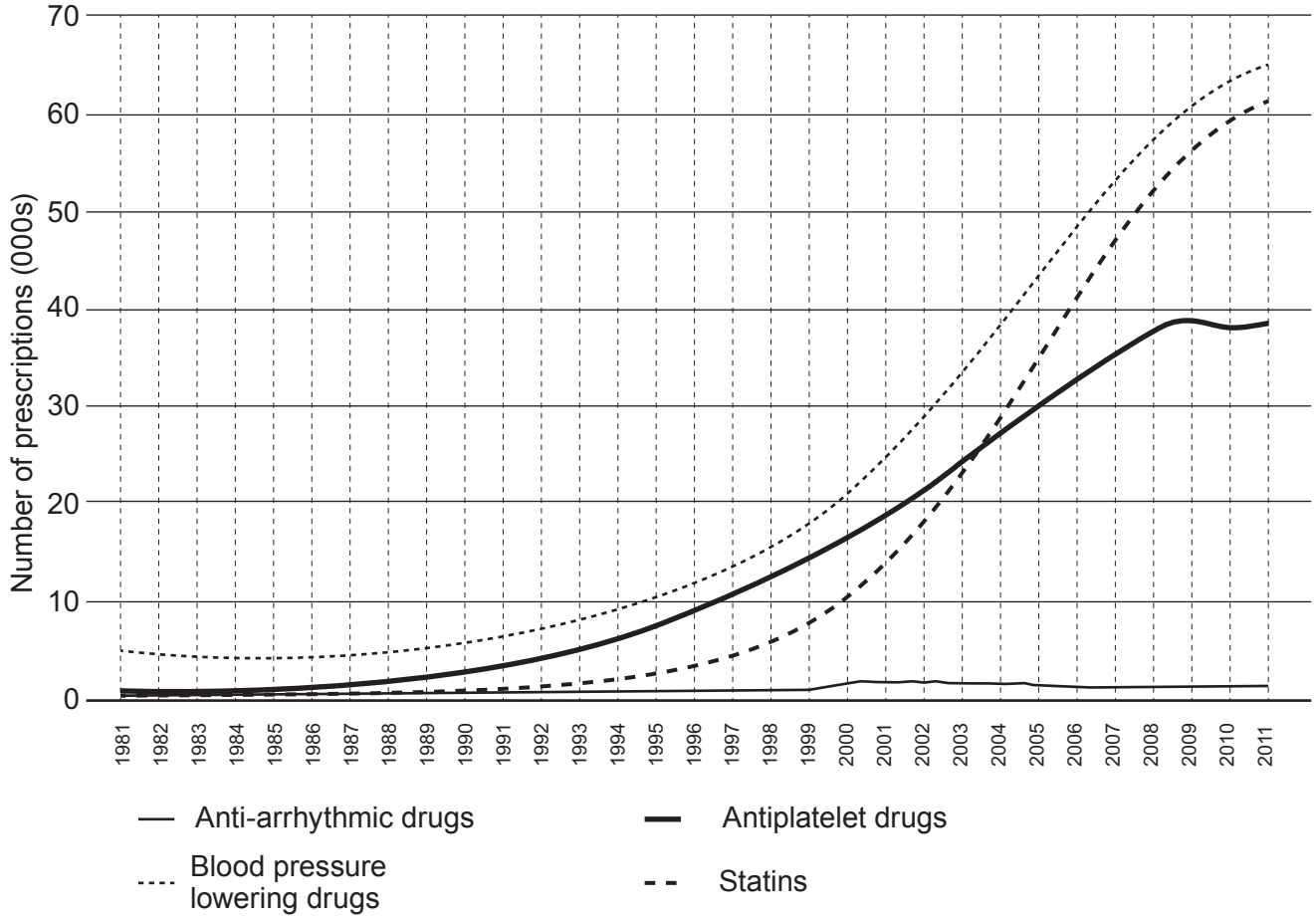


Figure 4 Coronary artery bypass

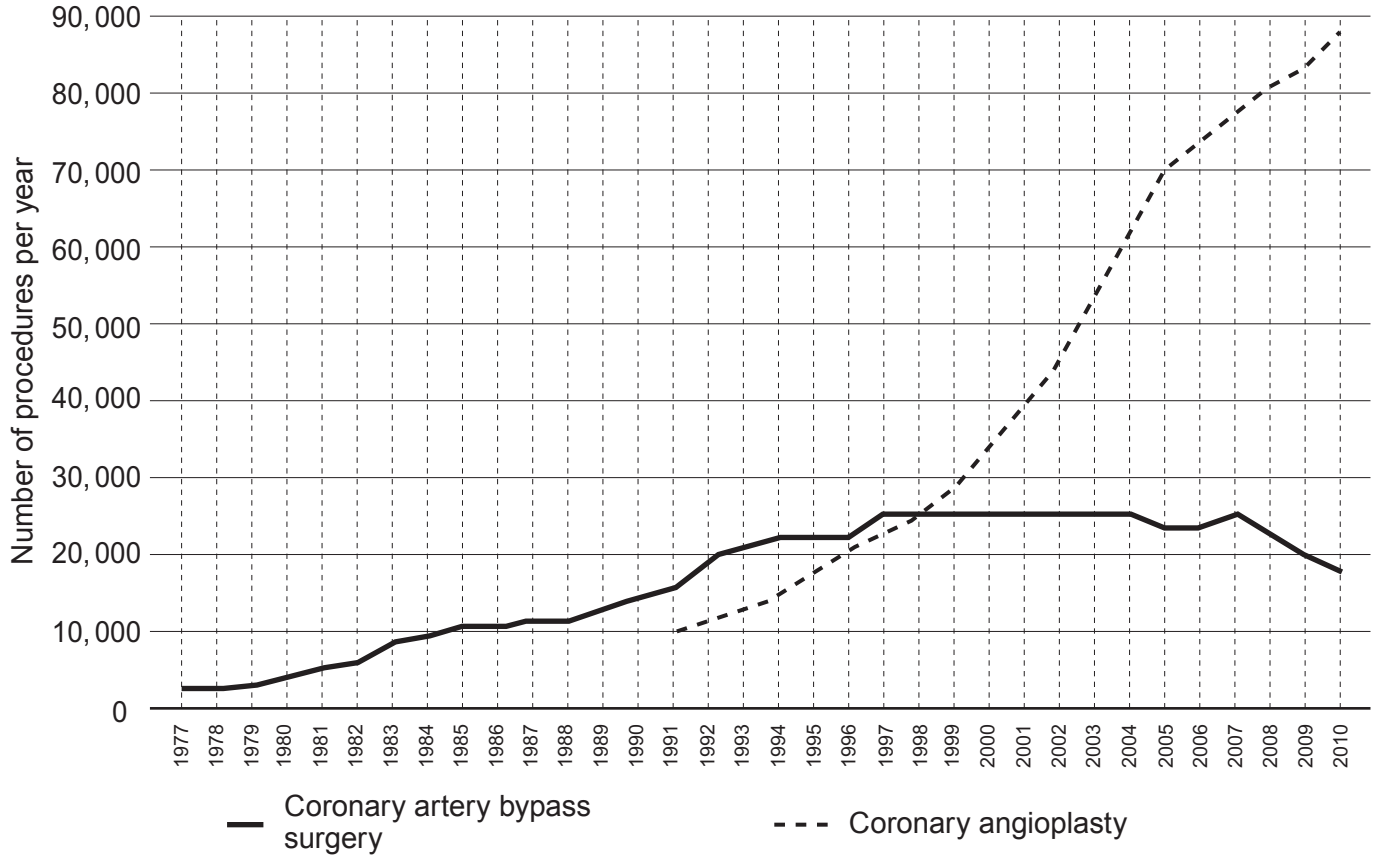
3. Heart transplant

In a small number of cases, when the heart is severely damaged and medicine is not effective, or when the heart becomes unable to adequately pump blood around the body (heart failure), a heart transplant may be needed. A heart transplant involves replacing a heart that is damaged or is not working properly with a healthy donor heart.

Graph 1 Prescriptions used in the prevention and treatment of CHD, England 1981 to 2011



Graph 2 Number of coronary artery bypass and coronary angioplasty operations per year United Kingdom 1977 to 2010



The above graphs are taken from BHF website.

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