

Surname	Centre Number	Candidate Number
Other Names		2



GCE AS/A level

1661/01

**APPLIED SCIENCE
UNIT 1**

P.M. FRIDAY, 11 January 2013

1½ hours

For Examiner's use only			
	Question	Max. Mark	Mark Awarded
Section A	1-10	31	
Section B	11	8	
	12	11	
	13	10	
	14	9	
	15	11	
Total		80	

ADDITIONAL MATERIALS

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

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** is included on page 19.

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1 Food firms blamed for child obesity

The food industry has come under attack during an investigation into childhood obesity by BBC Wales.

The industry is accused by some parents of deliberately manipulating children into eating high sugar or high fat products. But a manufacturers' trade group told BBC Wales' current affairs programme 'Week In Week Out' that they offer choice and that children represent a legitimate market.



- 10 Obesity is a growing problem for the NHS, costing taxpayers billions of pounds. Obesity can lead to health problems, including arthritis, heart disease and diabetes.

Some parents blame obesity on advertising

Adult obesity rates have tripled since 1982 with 19% of Britons now counted as obese and 39% overweight. But childhood obesity is also increasing rapidly with the number of obese children doubling since 1982. Around 10% of six-year-olds are obese, rising to 17% of 15-year-olds.

One mother told 'Week In Week Out' that advertising aimed at children had led to her three-year-old daughter demanding the products she saw on television. Her daughter now weighs the same as an average 10-year-old.

- 20 Her mother commented, "The problem is that she sees the cheese strings bouncing around on the TV. She doesn't see the cheese, she sees the little thing bouncing around and she wants to eat it."



Consumers

Martin Patterson, of the Food and Drink Federation, said: "Children have got money to spend, they are consumers. It would be absolutely wrong, surely, to just cut them off entirely."

There is a shortage of treatment for overweight people

'Week In Week Out' also discovered that while the number of people with obesity in Wales is rising, there is a chronic shortage of community dieticians. Cardiff and the Vale of Glamorgan has just one paediatric dietician, who has a waiting list of 15 months. Obesity surgeons are equally scarce, with just 13 working across the UK.

30 Surgery

Professor John Baxter, Professor of Surgery at the University of Wales, Swansea, said around 100 specialist surgeons are needed to tackle the problem. In Wales, he estimates 5,000 people need surgery to reduce their size. Professor Baxter is only able to perform 20 operations a year and his current waiting list is three years. "If you're morbidly obese, and you haven't started to suffer yet, you have only a one in seven chance of reaching the normal life expectancy because people die prematurely of strokes and heart attacks" says Professor Baxter.

- 40 Welsh assembly Health Minister Jane Hutt acknowledged there were serious health problems linked with obesity in Wales. She said: "Obviously I am extremely concerned and I understand this, not just in terms of people being overweight but the impact of it in terms of heart disease. We know there are huge problems and, of course, I'm concerned and I want to take this forward."

What is obesity?

Obesity is a condition where weight gain has got to the point that it poses a serious threat to health. It is measured in terms of a person's BMI which is determined by both body weight and height. BMI cut-off points have been agreed for obese and overweight adults, but for children the situation is more complex. Because a child's BMI varies with age, different cut-off points have to be used to define overweight and obese children depending on age.

Obesity and overweight are defined using BMI:

$$BMI = \frac{\text{bodyweight [kg]}}{(\text{height [m]})^2}.$$

Adults

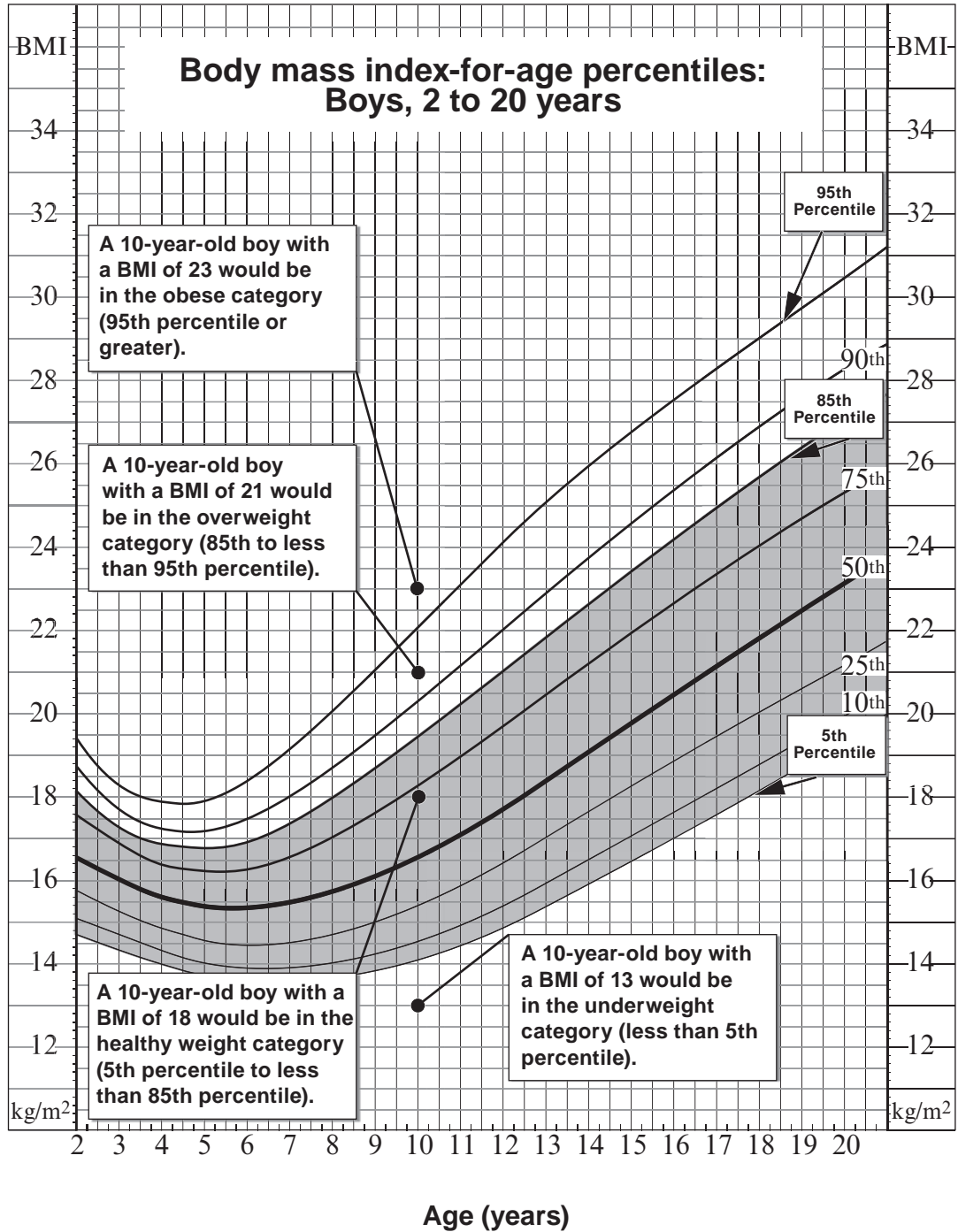
For adults, the cut off points used are: BMI <20, a person is underweight; BMI 20-25 is a healthy range; BMI 25-30 is classified as overweight; and BMI 30+ is classified as obese.

How is BMI calculated and interpreted for children and teens?

1. Calculate the BMI using the formula above
2. Review the calculated BMI-for-age percentile using a chart similar to the one opposite. Age and sex are considered for children and teens for two reasons:
 - The amount of body fat changes with age
 - The amount of body fat differs between girls and boys.
3. Find the weight status category for the calculated BMI-for-age percentile as shown in the following table. These categories are based on expert committee recommendations.

Weight Status Category	Percentile Range
Underweight	Less than the 5th percentile
Healthy weight	5th percentile to less than the 85th percentile
Overweight	85th to less than the 95th percentile
Obese	Equal to or greater than the 95th percentile

The following example shows how some sample BMI numbers would be interpreted for a 10-year-old boy.



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Obesity causes

Obesity is caused by two simple factors - an unhealthy diet (typically too rich in sugar and fats and not enough fibre and carbohydrate) and not doing enough exercise to burn off the calories consumed.

Occasionally there are other factors. For example, in a rare genetic condition called Prader-Willi syndrome there may be problems with controlling hunger. After about six months to a year, especially as the child becomes mobile, they develop an interest in food that may become an insatiable obsession. Weight gain can be rapid, leading to severe obesity that results in diabetes, strain on the heart, lungs and skeleton, and even early death.

Dietary factors

Evidence from the National Food Survey (NFS) suggests that average energy intakes in the UK have been declining since the early 1970s. Some see this as evidence that dietary factors have not contributed much to the rise in obesity. But others disagree, pointing out that the NFS does not take full account of alcoholic drinks, confectionery brought for consumption in the home and food and drink consumed outside the home over this period; it may also be subject to under-reporting. The World Health organisation expert group found 'convincing' evidence that high intake of energy dense foods is a risk factor for obesity. It also found that heavy marketing of fast foods and high intakes of sugar sweetened drinks were 'probable' risk factors and that large portion sizes was a 'possible' risk factor.

Physical activity

Changes in patterns of physical activity and the adoption of more sedentary lifestyles are also likely to be important factors behind obesity. However, as the Health Development Agency has noted, data on trends in physical activity among young people are sparse and there is little direct evidence of a rise in sedentary lifestyles.

The data that we have available reveals:

- A decline in the number of young people playing sport at school. A survey commissioned by Sport England showed that the proportion of young people spending two or more hours a week on sport in school declined from 46% in 1994 to 33% in 1999.
- A fall in the proportion of children walking to school. Since 1989/91, the proportion of primary school children walking to school has fallen from 62% to 56%, while over the same period the number being driven to school has risen from 27% to 36%.
- A decline in the proportion of children cycling to school. Just 2% of secondary pupils currently cycle to school compared with 5% in 1989/91.
- A possible rise in sedentary pastimes such as watching TV, playing computer games or accessing the internet. An Independent Television Commission survey shows that the average 4-15 year old watches approximately 2.5 hours of TV a day.

How does excess body fat impact health?

Being overweight or obese can lead to adverse metabolic effects on blood pressure, cholesterol, triglycerides and insulin resistance. Obesity can also lead to increases in certain types of cancers, especially the hormonally related and large-bowel cancers.

The non-fatal, but debilitating health problems associated with obesity include respiratory difficulties, chronic musculoskeletal problems, skin problems and infertility.

100 Obesity can lead to hypoventilation. Hypoventilation occurs when ventilation is inadequate to allow efficient gas exchange. By definition it causes an increased concentration of carbon dioxide in the blood.

The likelihood of developing Type 2 diabetes and hypertension rises steeply with increasing body size. Confined to older adults for most of the 20th century, this disease now affects obese children even before puberty. Approximately 85% of people with diabetes are Type 2, and of these, 90% are obese or overweight.

Chronic obesity can contribute significantly to osteoarthritis, a major cause of disability in adults. Other effects of obesity include:

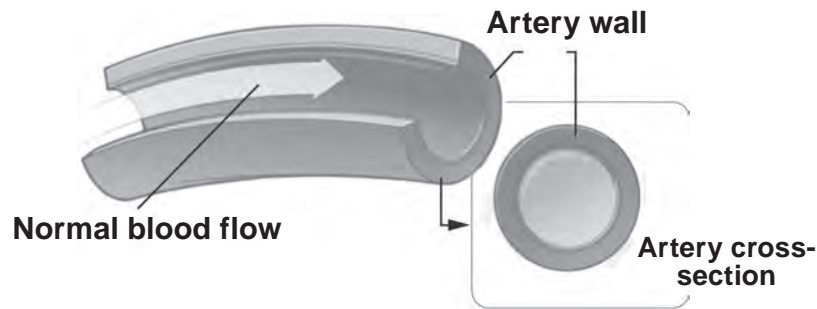
- femoral epiphysis
- benign intracranial hypertension
- 110 • gall bladder disease
- polycystic ovary syndrome
- increased risk of strokes
- hypoventilation
- psychological disorders.

Coronary heart disease

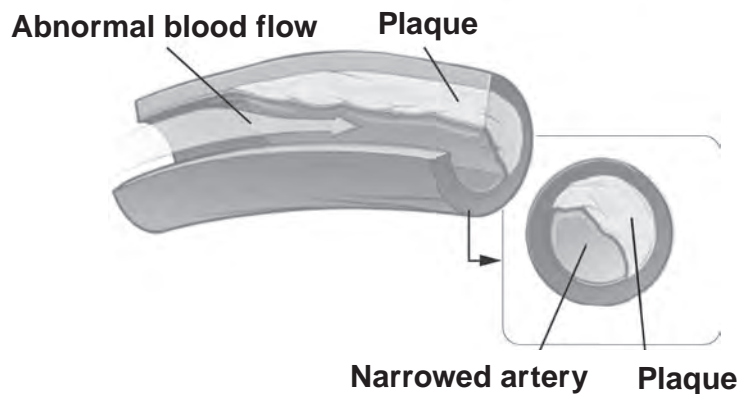
120 Coronary heart disease is the term that describes what happens when your heart's blood supply is blocked or interrupted by a build-up of fatty substances in the coronary arteries. Over time, the walls of your arteries can become furred up with fatty deposits. This process is known as atherosclerosis and the fatty deposits are called atheroma. If your coronary arteries become narrow due to a build-up of atheroma, the blood supply to your heart will be restricted. This can cause angina (chest pains).

The figure below shows a normal artery and one of a patient suffering from atherosclerosis.

A Normal artery



B Narrowing of artery



If a coronary artery becomes completely blocked, it can cause a heart attack. The medical term for a heart attack is myocardial infarction. Your risk of developing atherosclerosis is significantly increased if you are overweight or obese.

What is being done about childhood obesity?

The UK government has set out a series of initiatives to combat childhood obesity. The initiatives include:

- Compulsory nutrition standards for school lunches.
- 130 • All primary schools are expected to teach food preparation, cooking and hygiene as it forms part of the National Curriculum up to age 11.
- National school fruit scheme (NSFS), entitles all 4-6 year olds to a free piece of fruit each day.
- The government deployed 1,000 school sport coordinators by 2004 to build links between schools, develop competitive sports and after school activities, co-ordinate training of teachers and promote physically active lifestyles.
- The government is investing £750M in new opportunities funding to build/refurbish school sports facilities.
- 140 • Healthy travel to school – a School Travel Advisory Group publishes guidance for local authorities to encourage children to walk or cycle to school.

SECTION A

Answer all questions.

- 1. State what is meant by the term *obesity*. [1]

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- 2. State **three** non-fatal, but debilitating health problems associated with obesity. [3]

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- 3. BMI is used to define obesity. What term is abbreviated to BMI? [1]

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- 4. (a) Calculate the BMI of an adult male who has a mass of 105 kg and a height of 178 cm. [2]

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- (b) State which of the BMI categories this person falls into. [1]

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- (c) Assigning a BMI value to a child is difficult and cut-off points must be used to define whether a child is overweight or obese. Suggest **two** reasons why it is difficult to categorise children using BMI. [2]

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5. Obesity can lead to an increase in blood pressure.

(a) State what the following terms mean. [2]

(i) *Systolic pressure*

.....

(ii) *Diastolic pressure*

.....

(b) Obesity is one factor that can increase blood pressure. State **two** other factors that can increase blood pressure. [2]

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6. In the UK there are only 13 surgeons who specialise in weight reduction surgery. Suggest **two** reasons why the NHS has not increased this number. [2]

1.

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2.

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7. Explain how, in a person of healthy weight, the respiratory system will respond to an increase of carbon dioxide in the blood. [4]

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8. Obesity can lead to coronary heart disease. This is caused by a build up of substances on the wall of the coronary artery. (line 117)

(a) State **two** functions of the **coronary** artery. [2]

.....

(b) Over time coronary heart disease can lead to arrhythmias. Define what is meant by the term *arrhythmia*. [2]

.....

.....

(c) Complete the table to show **two** structural features of arteries and explain how they affect the function of the artery. [4]

Structural Feature	Function
1.
2.

9. Changes in patterns of physical activity are suspected to contribute to childhood obesity levels. State why this information is unreliable. [1]

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10. The UK Government has set out a series of initiatives to combat childhood obesity. Suggest **two** reasons why it is in the public interest to reduce childhood obesity. [2]

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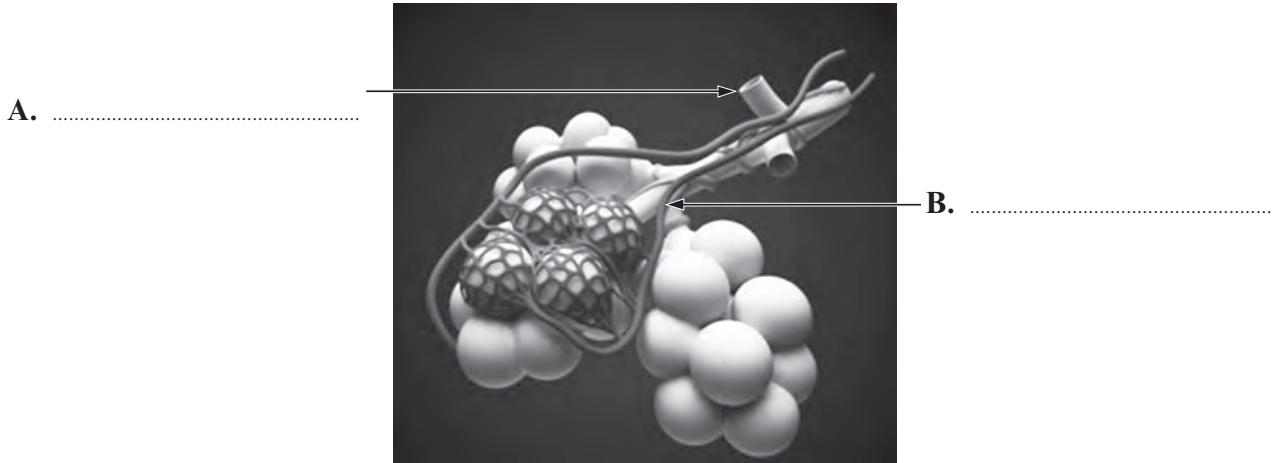
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SECTION B

Answer all questions.

11. Below is a diagram of alveoli.



(a) Label structures **A** and **B**. [2]

(b) Explain the role of surfactant in the alveoli. [2]

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.....

.....

(c) Describe **three** ways alveoli are adapted to their role as a gas exchange surface. [3]

- 1.
- 2.
- 3.

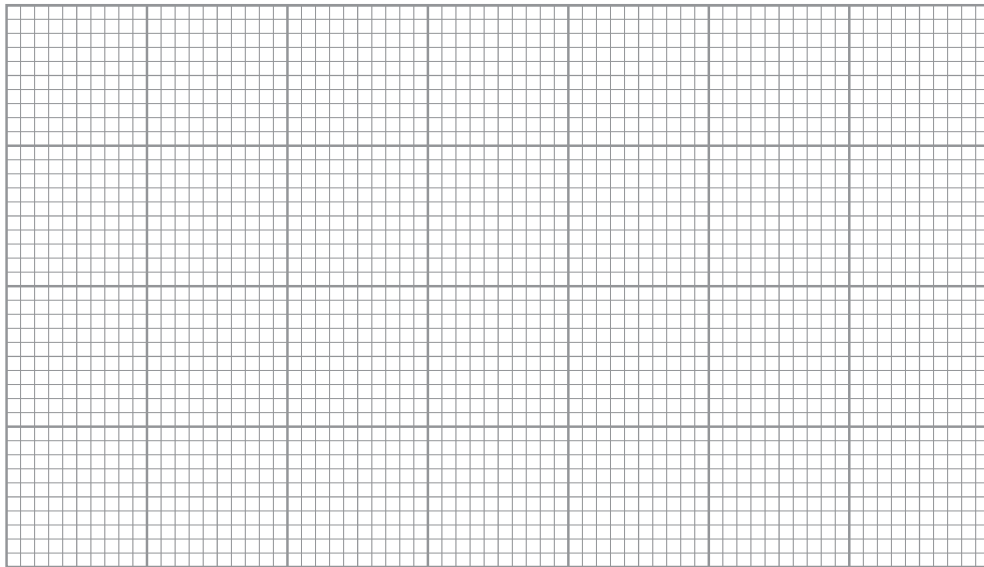
(d) State the process that allows oxygen to move out of the lungs. [1]

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12. The table below shows a person's blood glucose levels over a 24 hour period.

Time of day	07.00	09.00	11.00	13.00	15.00	17.00	19.00	21.00	23.00	01.00	03.00	05.00	07.00
Blood Glucose conc (mmol/dm ³)	4.3	6.2	4.9	7.0	5.2	4.1	6.3	5.4	5.1	4.6	4.2	4.1	4.1

(a) Use the table above to draw a chart which best displays the information. [4]



(b) State **one** reason for the peaks in blood glucose level at 09.00, 13.00 and 19.00. [1]

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(c) Explain why it is impossible to determine the gender of this person from this information. You will also need to refer to the data sheet on page 19. [1]

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(d) Glucose is a substance transported in solution by the blood. State **two** other substances transported in the blood. [2]

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(e) Complete the table below, about the blood.

[3]

Name of component	Function
Thrombocytes
.....	Transports oxygen
Leucocytes

13. Asthma is a common chronic inflammatory disease of the airways. It currently affects approximately 5.2 million people in the UK.

(a) State the name of the piece of equipment shown in the photograph below.

[1]

.....



(b) Write a standard operating procedure for this piece of equipment.

[4]

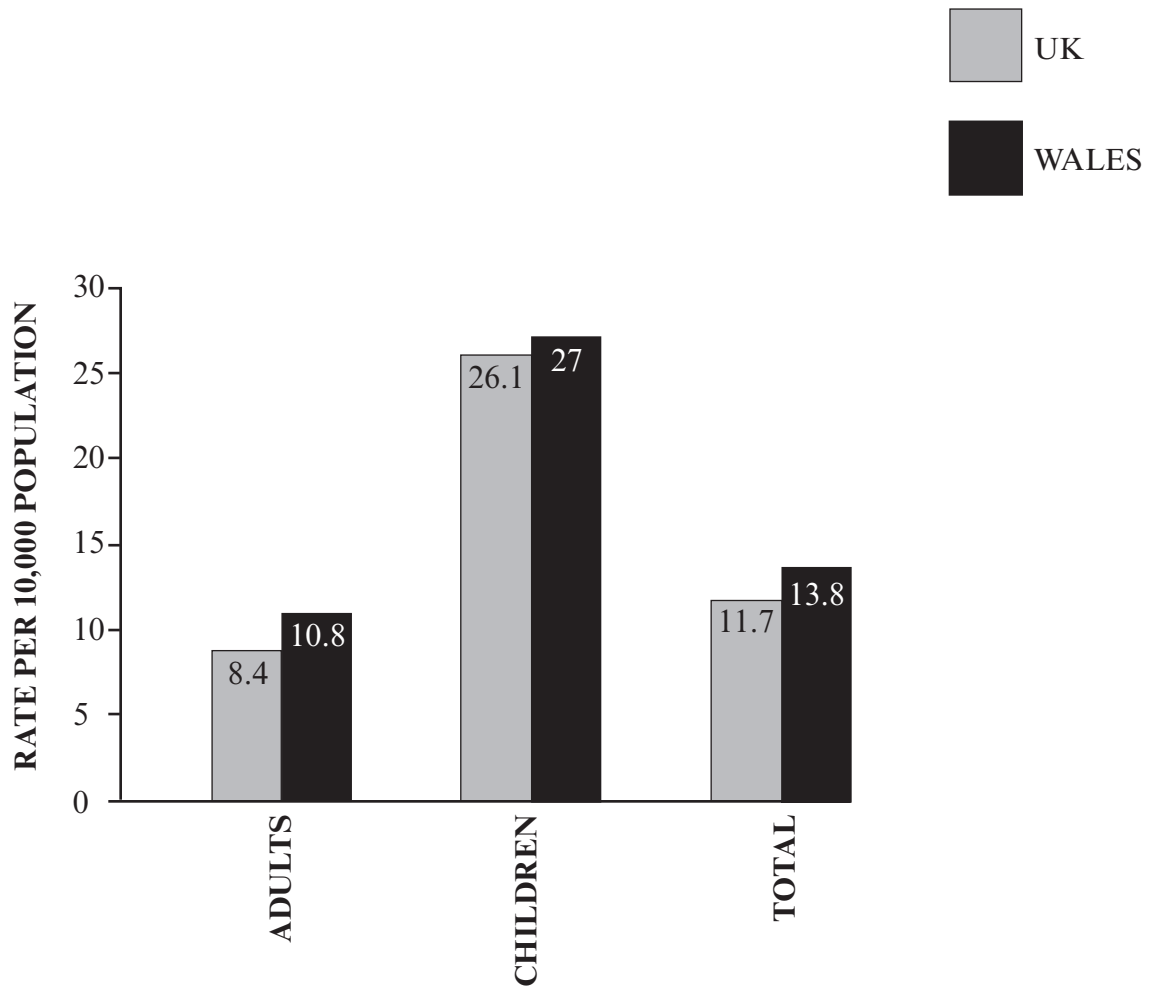
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(c) Give **three** effects of asthma on lung function.

[3]

1.
2.
3.

(d) Look at the graph below, displaying hospital admission rates for asthma.



Hospital admission rates for asthma, 2002 – UK and Wales

Suggest **two** reasons why hospital admission rates for asthma are higher for children than adults in Wales and the UK. [2]

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14. Nicola is a radiographer who operates an MRI scanner in a hospital. Before Nicola uses the scanner she has to carry out several safety checks.

(a) Several patients she sees on a particular day may present a particular problem. In **each** case explain what the problem **may** be with each patient. [3]

(i) A patient with a metallic hip joint.

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.....

(ii) An extremely agitated small child that needs a head scan.

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(iii) A pregnant woman.

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(b) State **two** advantages of MRI scans over CAT scans using X-rays. [2]

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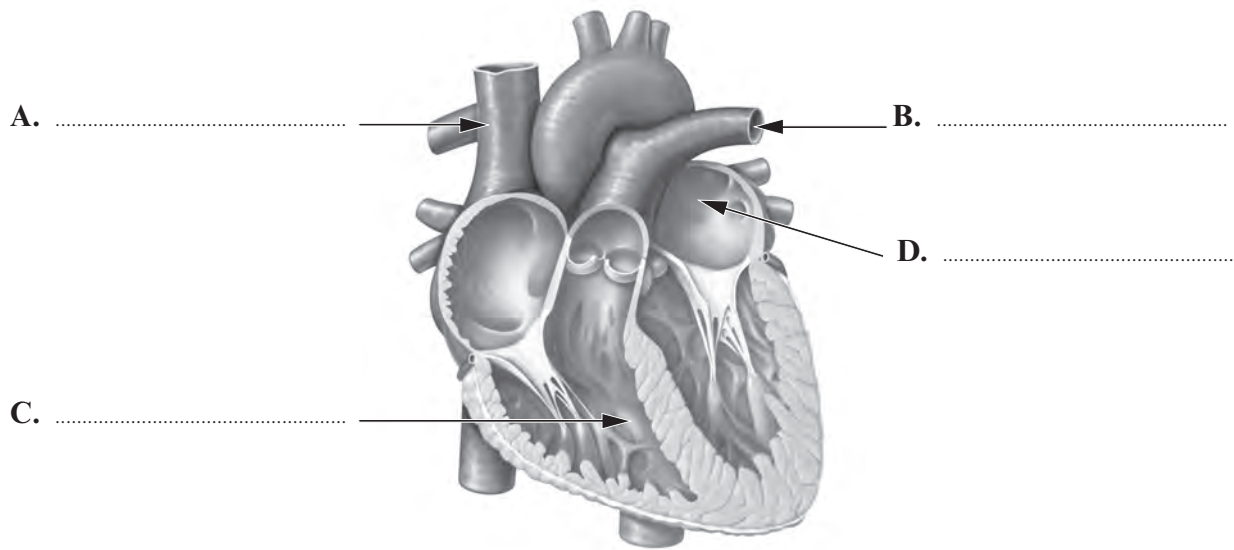
(c) Nicola also uses X-ray equipment. Give **two** precautions she must take when operating this equipment. [2]

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(d) In order to examine some organs of the body with X-rays a contrast medium is used. Explain the role of the contrast medium when taking an X-ray. [2]

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15. Below is a diagram of a cross section of the heart.



(a) On the diagram, label parts **A**, **B**, **C** and **D**. [4]

(b) Explain the role of the tricuspid valve in the heart. [3]

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(c) (i) What is meant by the term *ventricular systole*? [1]

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(ii) Why is there a delay between atrial and ventricular systole? [1]

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(d) Give **two** reasons why the left ventricle of the heart is thicker than the right ventricle. [2]

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END OF PAPER

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