

Surname						Other Names					
Centre Number						Candidate Number					
Candidate Signature											

For Examiner's Use

General Certificate of Secondary Education
June 2007

APPLIED SCIENCE (DOUBLE AWARD)
Unit 2 Science for the Needs of Society
Higher Tier

APSC/2H
H



Wednesday 13 June 2007 9.00 am to 10.30 am

For this paper you must have:

- a ruler.

You may use a calculator.

Time allowed: 1 hour 30 minutes

Instructions

- Use blue or black ink or ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- Answer the questions in the spaces provided.
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information

- The maximum mark for this paper is 90.
- The marks for questions are shown in brackets.
- You are reminded of the need for good English and clear presentation in your answers.

For Examiner's Use			
Question	Mark	Question	Mark
1		4	
2		5	
3		6	
		7	
		8	
		9	
Total (Column 1) →			
Total (Column 2) →			
TOTAL			
Examiner's Initials			

Answer **all** questions in the spaces provided.

- 1 A sports scientist is studying the reaction times of an athlete.



He hopes to help the athlete to react quickly when the starting gun is fired.

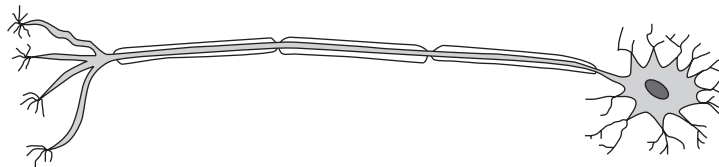
An athlete's reaction time will depend on how quickly the following actions take place:

- receptor cells in the athlete's body detect a stimulus
- a message passes along neurones to the athlete's brain
- a message is sent to the athlete's leg muscles
- the athlete's leg muscles contract.

- (a) Where in the athlete's body are the receptor cells that detect the stimulus when the gun is fired?

.....
(1 mark)

- (b) The diagram below shows a neurone (nerve cell).



- (i) Name **two** parts of a nerve cell that are also found in other animal cells.

1

2

(2 marks)

- (ii) How does the structure of the nerve cell help it to carry out its function?

.....

.....

.....

.....

(2 marks)

- (c) Muscle cells need to be supplied with energy to make them contract.

Explain how muscle cells obtain energy.

.....

.....

.....

.....

(2 marks)

- (d) Adrenaline is a hormone that improves reaction times.

Adrenaline is produced in the adrenal gland.

- (i) How is adrenaline transported to other parts of the body to improve reaction times?

.....

.....

(1 mark)

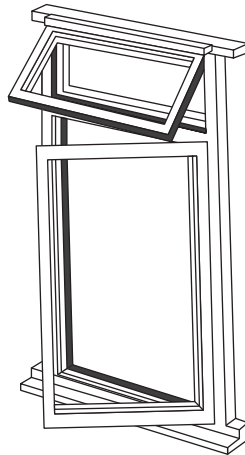
- (ii) Name **one** other hormone that is produced in the body and name the organ that produces this hormone.

Name of hormone

Name of organ

(2 marks)

- 2 A builder was asked to recommend the materials for making the window frames for a new house.



He suggested four possible choices.

They are listed in order of cost.

The most expensive is at the top of the list.

- Hardwood frame – double glazed
 - Hardwood frame – single glazed
 - PVC frame – double glazed
 - PVC frame – single glazed
- (a) Apart from the cost, give **two** disadvantages of using a traditional material such as wood for building.

- 1
-
- 2
-

(2 marks)

- (b) The sections of PVC used to make the window frames are reinforced with steel plate.

- (i) Why does the PVC frame need to be reinforced with steel?

Explain your answer.

.....

.....

.....

.....

(2 marks)

- (ii) Explain why this reinforced polymer could be classified as a composite.

.....

.....

(1 mark)

- (c) The glass used to make the single-glazed and double-glazed units is made by heating together a mixture of materials.

Name **two** of the materials in the mixture that is heated to make glass.

1

2

(2 marks)

- (d) The builder recommended double glazing. He said:

“Although double glazing is more expensive than single glazing, it will pay for itself by reducing fuel bills.”

Explain the advice given by the builder.

.....

.....

.....

.....

(2 marks)

- 3 Speed cameras are mounted by the side of the road to detect and photograph speeding vehicles.

Some cameras are triggered by sensors in the road surface.

Photograph of a speed camera is not reproduced here due to third-party copyright restrictions.

The camera takes two photographs, half a second apart, as the vehicle passes over markers painted on the road a fixed distance apart. When the images are compared, they show the registration marks of the vehicles and information about the speed. Speeding drivers are usually punished with a fine and with penalty points on their driving licence.

- (a) How is the information from the camera used to calculate speed?

.....
.....

(1 mark)

- (b) There will be fewer serious accidents if vehicles are made to travel more slowly.

There are fewer accidents because slower vehicles have a shorter stopping distance.

Give **two** other factors that affect the stopping distance of a vehicle.

1
.....

2
.....

(2 marks)

- (c) Inexperienced drivers and drunken driving cause accidents on the roads.

Describe how we try to reduce the number of accidents caused by these problems.

Inexperienced drivers

.....

Drunken driving

.....

(2 marks)

- (d) A road traffic engineer was asked by the residents of a busy street to check the speed of vehicles passing their homes. The residents were worried that some of the vehicles were going faster than the speed limit of 30 miles per hour (13.4 metres per second).

The engineer recorded the time taken for the vehicles to pass between two posts that he positioned 50 metres apart.

The results of some of his measurements are recorded in the table below.

Vehicle	Time taken in seconds	Calculated speed in m/s
Blue Vauxhall	4.1	12
Red BMW	3.3	

Use a calculation to show whether the red BMW was going faster than the speed limit of 13.4 metres per second.

Show your working.

.....

.....

..... m/s
(2 marks)

- (e) The engineer noticed that the frequency of the sound waves from the vehicles changed as they moved away from him.

Describe the change in the frequency of the sound waves.

.....

.....

(1 mark)

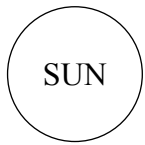
4 Environmental scientists study the composition of the Earth's atmosphere.

They can learn more about how the atmosphere developed on Earth by comparing it with the atmosphere on other planets in the Solar System.

Planet	Average surface temperature in °C	Composition of the atmosphere
Earth	10	Mostly nitrogen and oxygen with small amounts of carbon dioxide and argon
Jupiter	−150	Mostly hydrogen and helium with small amounts of CH ₄ and NH ₃
Venus	450	Mostly carbon dioxide with small amounts of nitrogen
Mars	−50	Mostly carbon dioxide with small amounts of nitrogen and argon

Use the information in the table to help you to answer the questions that follow.

- (a) Arrange the four planets in order of their distance from the sun.

(1 mark)

- (b) Name the gases that are present in small amounts in the atmosphere of Jupiter.

.....

.....

(2 marks)

- (c) Two billion years ago the composition of the Earth's atmosphere was very different.

There were much larger quantities of carbon dioxide and hardly any oxygen.

Explain why the composition of the Earth's atmosphere changed.

.....

.....

.....

.....

.....

.....

(3 marks)

- (d) An environmental scientist was asked about global warming. This is what she said:

“The combustion of fossil fuels produces greenhouse gases and this is changing the composition of the atmosphere. An extreme example of global warming can be found on Venus, and the same effect may cause problems on Earth in the future. The only solution is to reduce our dependence on fossil fuels. We can do this by developing renewable energy resources.”

- (i) Why did the environmental scientist describe Venus as an extreme example of global warming?

.....

.....

.....

.....

(2 marks)

- (ii) Name **one** renewable energy resource, and explain why it cannot meet all our energy needs in the future.

.....

.....

.....

.....

(2 marks)

- (iii) Apart from developing renewable energy resources, suggest **one** other way to reduce our dependence on fossil fuels in the future.

.....

.....

(1 mark)

5 Tuberculosis (TB) is an infectious disease.

Some of the reasons why tuberculosis became less common in the UK are listed below.

- The use of streptomycin
- BCG vaccinations
- The use of radiography for early detection of the disease
- Better knowledge about how the disease is spread

Health workers are concerned that infection with TB is now becoming more common again.

- (a) Streptomycin is a drug that kills bacteria.

What name is given to this type of drug?

.....
(1 mark)

- (b) BCG vaccinations prevent infection by TB.

Explain how vaccination protects us from infection.

.....
.....
.....
.....
.....
.....
(3 marks)

- (c) Describe **one** other way in which we prevent the spread of TB.

.....
.....
(1 mark)

- (d) TB infects the lungs.

Explain how radiography can lead to early detection of the disease.

.....

.....

.....

.....

(2 marks)

- (e) Suggest **two** reasons why some infectious diseases are becoming more common.

1

.....

2

.....

(2 marks)

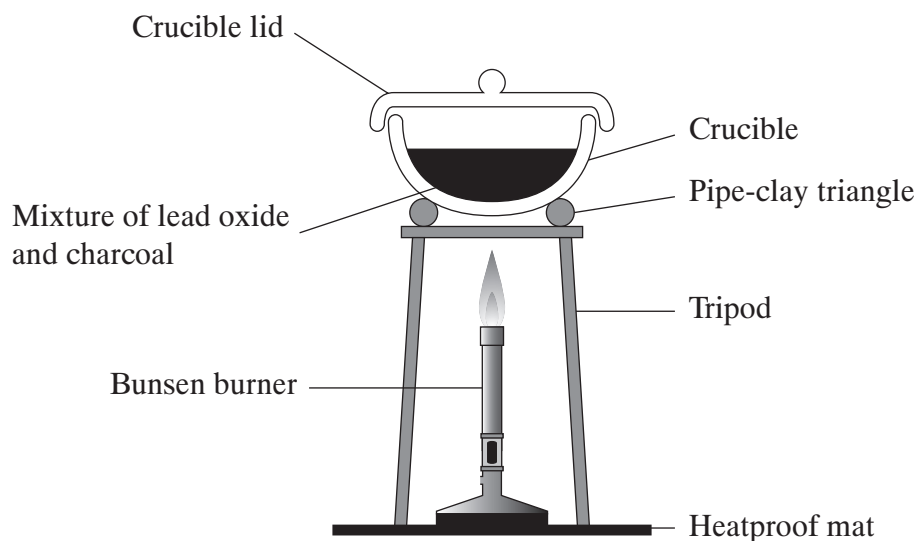
9

Turn over for the next question

Turn over ►

- 6 Lead is used in the construction industry and in the electronics industry.

Lead can be extracted from lead ore (PbO) in the laboratory.



The mixture of lead ore and charcoal is heated in a crucible.

- (a) The crucible is made from a ceramic material.

What property of a ceramic makes it a good choice for making the crucible?

.....
(1 mark)

- (b) Charcoal (carbon) acts as a reducing agent in this reaction.

- (i) Complete the word equation for the reaction.

lead oxide + carbon $\rightarrow$ +
(1 mark)

- (ii) Write a balanced symbol equation for the reaction.

.....
(2 marks)

- (iii) How does the charcoal reduce the lead oxide?

.....
.....
(1 mark)

- (c) Lead is used in the construction industry.

- (i) Give **one** use of lead in the construction industry.

.....
(1 mark)

(ii) Give **two** properties of lead that make it suitable for this use.

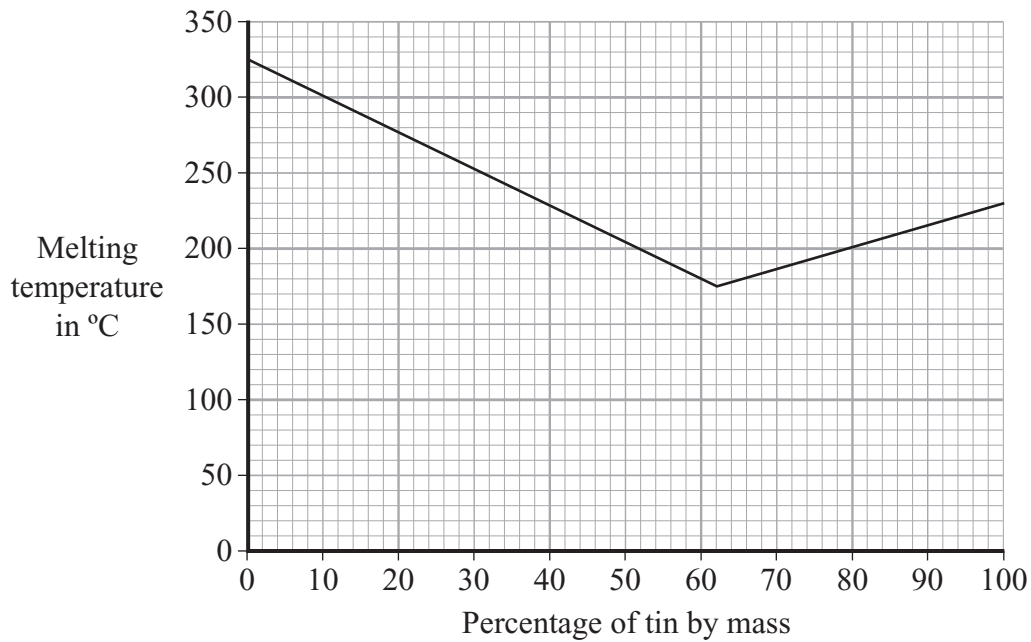
1

2

(2 marks)

(d) Solder, an alloy of lead and tin, is used in the electronics industry.

The graph shows how the melting point of solder depends on its composition.



Use the graph to help you to answer the questions that follow.

(i) What is the percentage of lead in solder with the lowest melting temperature?

.....

(1 mark)

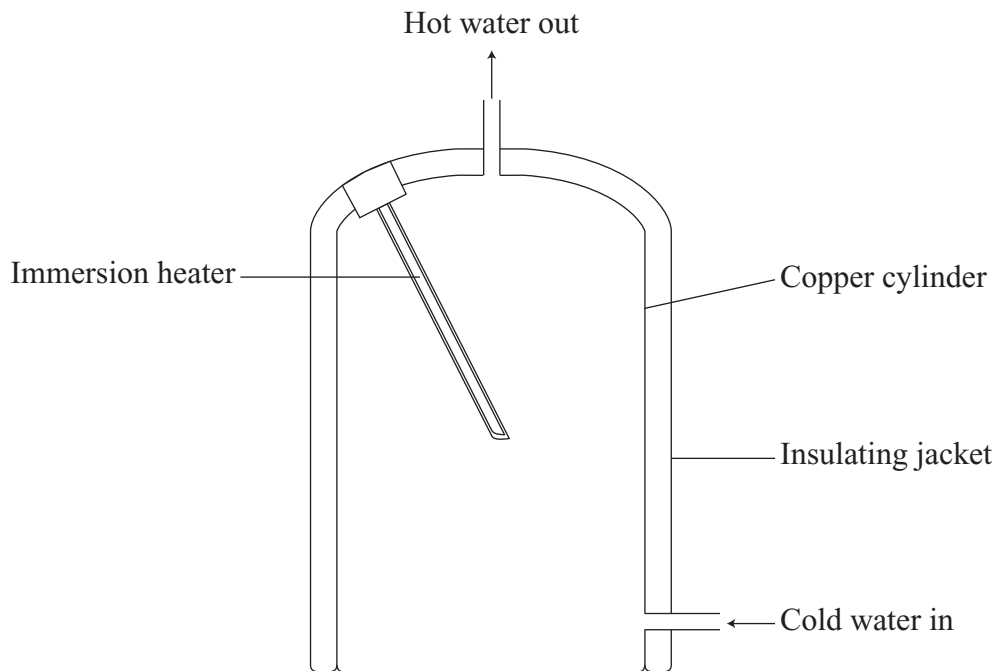
(ii) Describe how to make 250 g of solder that has a melting temperature of 210°C.

.....

(2 marks)

- 7 An electrician was asked to install a new electrical immersion heater.

He installed an immersion heater with a power of 2700 watts (2.7 kilowatts).



- (a) The electricity is supplied to the heater with a potential difference of 230 volts.

Calculate the current flowing through the heater in amps.

.....

 amps
 (3 marks)

- (b) The electrical circuit will include a fuse to protect the immersion heater circuit from overheating.

- (i) Suggest the correct size of fuse for this circuit.

.....
 (1 mark)

(ii) Explain how the fuse will protect the circuit.

.....

.....

.....

.....

(2 marks)

(c) The hot water cylinder is fitted with an insulating jacket to reduce heat loss.

A student carried out an experiment in the laboratory to find out if a jacket filled with foam would be a better insulator than a jacket filled with glass fibre.

Describe how the student would carry out this experiment.

You may use a labelled diagram as part of your description.

.....

.....

.....

.....

.....

.....

.....

.....

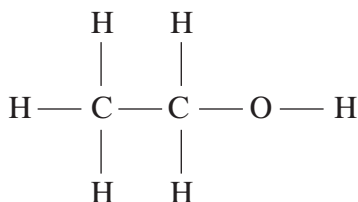
(4 marks)

8 Alcohol (ethanol) is used as a recreational drug.



Health workers know the effects of this drug so that they are able to give good advice to their patients about the short-term and long-term effects of drinking too much ethanol.

- (a) The structure of a molecule of ethanol and some information about its properties are given below.



Molecular formula	$\text{C}_2\text{H}_5\text{OH}$
Melting point in $^{\circ}\text{C}$	-117
Boiling point in $^{\circ}\text{C}$	78
Solubility	Very soluble in water

- (i) Name the type of chemical bonding in ethanol.

.....
(1 mark)

- (ii) Explain why ethanol has a low boiling point.

.....

 (2 marks)

- (b) The amount of ethanol in some alcoholic drinks is given below.

Alcoholic drink	Percentage ethanol
Beer	4%
Alcopop	5%
Wine	12%
Vodka	40%

- (i) Wine and beer are manufactured by growing a particular microorganism in sugar solution.

Give the name of this process and name the type of microorganism.

Name of process

Type of microorganism
(2 marks)

- (ii) Vodka is manufactured by separating ethanol from a mixture of ethanol and water.

Name this process.

.....
(1 mark)

- (iii) Use the data in part (a) to explain how a mixture of ethanol and water can be separated.

.....
.....
(1 mark)

- (c) Health workers are concerned that many young people are drinking too much alcohol.

Give **two** reasons why health workers advise their patients to drink less alcohol.

1
.....
2
.....

(2 marks)

9 Electromagnetic radiation has many uses.

(a) Give **one** use for each type of electromagnetic radiation listed below.

One has been done for you.

Type of radiation	Use
Gamma rays	Radiotherapy
Radio waves	
Microwaves	
Infrared	

(3 marks)

(b) The use of the type of electromagnetic radiation depends on the frequency of the waves.

The approximate frequency of each type of radiation is given in the table.

Type of radiation	Frequency in billions of hertz (Hz)
Infrared	30 000
Microwaves	300
Light waves	300 000
Radio waves	3
Ultraviolet	3 000 000

(i) What is meant by the frequency of the radiation?

.....

.....

(2 marks)

- (ii) The wavelength of electromagnetic radiation can be calculated from the frequency.

Use the equation and the data given below to calculate the wavelength of a radio wave in metres.

$$\text{frequency (Hz)} \times \text{wavelength (m)} = \text{speed of light (m/s)}$$

- frequency of radio wave = 3×10^9 Hz
- speed of light = 3×10^8 m/s

.....
.....

..... metres
(2 marks)

- (c) Gamma rays are used in radiotherapy.

- (i) What is radiotherapy?

.....
.....
(1 mark)

- (ii) Why are gamma rays the most dangerous form of electromagnetic radiation?

.....
.....
(1 mark)

Question 9 continues on the next page

Turn over ►

(d) Gamma radiation is produced by the decay of radioactive elements.

(i) Name **two** other types of radiation produced by the decay of radioactive elements.

1

2

(2 marks)

(ii) Radium-223 is a radioactive element used in radiotherapy.

When radium-223 decays it produces radon-219.

Use the information in the table to explain what happens to the structure of an atom of radium-223 when it produces radon-219.

Radioactive element	Mass number	Atomic number
Radium-223	223	88
Radon-219	219	86

.....

.....

.....

.....

(2 marks)

END OF QUESTIONS

ACKNOWLEDGEMENT OF PUBLISHERS AND COPYRIGHT-HOLDERS

Question 3 Photograph © EMPICS.

Copyright © 2007 AQA and its licensors. All rights reserved.

G/J21581/Jun07/APSC/2H