OCR
RECOGNISING ACHIEVEMENT

H

GENERAL CERTIFICATE OF SECONDARY EDUCATION

TWENTY FIRST CENTURY SCIENCE

A213/02

SCIENCE A

Unit 3: Modules B3 C3 P3
(Higher Tier)

Candidates answer on the question paper
A calculator may be used for this paper

OCR Supplied Materials:
None

Other Materials Required:
- Pencil
- Ruler (cm/mm)

Monday 22 June 2009
Morning

Duration: 40 minutes

A213302

OCE/11111

Candidate Forename		Candidate Surname	

Centre Number						Candidate Number				

INSTRUCTIONS TO CANDIDATES

- Write your name clearly in capital letters, your Centre Number and Candidate Number in the boxes above.
- Use black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure that you know what you have to do before starting your answer.
- Answer **all** the questions.
- Do **not** write in the bar codes.
- Write your answer to each question in the space provided, however additional paper may be used if necessary.

INFORMATION FOR CANDIDATES

- The number of marks is given in brackets **[ ]** at the end of each question or part question.
- The total number of marks for this paper is **42**.
- This document consists of **24** pages. Any blank pages are indicated.

Answer **all** the questions.

1 This question is about making good use of as much energy as possible from the primary fuel used in power stations.

(a) A modern gas-fired power station has two sets of turbines.

The hot exhaust gases produced by burning the fuel go directly through the first set of turbines, producing electrical energy.

When they leave the turbines, the exhaust gases are still very hot, and turn water into steam. This steam turns a second set of turbines.

Condensers turn the steam back into water to be used again.

(i) The different stages in this power station are listed below. They are not in the right order.

A fuel burns

B electrical energy is generated

C steam is cooled

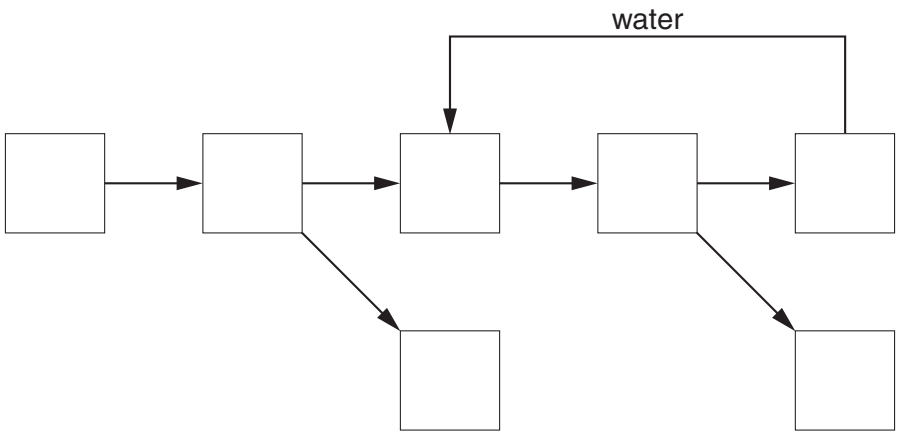
D steam turns turbines

E exhaust gases boil water

F exhaust gases turn turbines

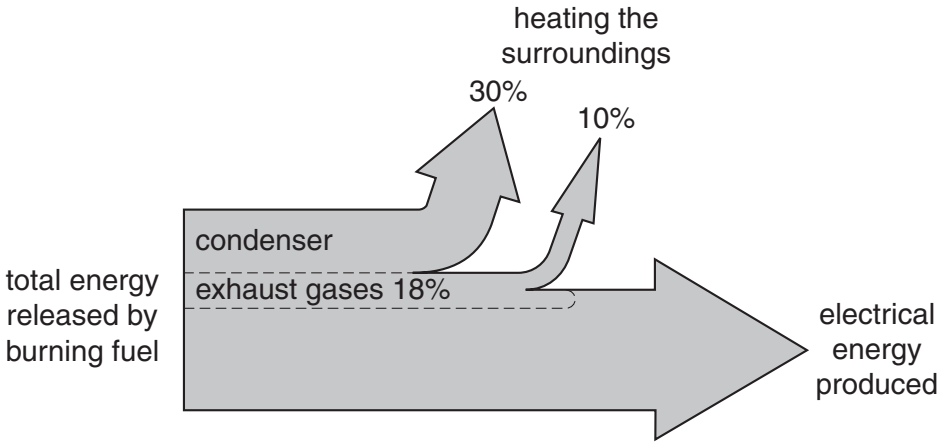
Use the letters **A**, **B**, **C**, **D**, **E** and **F** to label this flow chart.

Each box should have one letter. Each letter may be used once, more than once or not at all.



[3]

(ii) The diagram shows the efficiency of this power station.



Here are a number of statements about this energy-flow diagram.

The statements are **not** all correct.

Put a tick (✓) in the box next to **each** correct statement.

The power station is more than 50% efficient. ☐

Power stations make the environment warmer. ☐

60% of the energy released by burning fuel is wasted. ☐

18% of the energy released is wasted in the exhaust gases. ☐

Some of the energy in the exhaust gases produces electrical energy. ☐

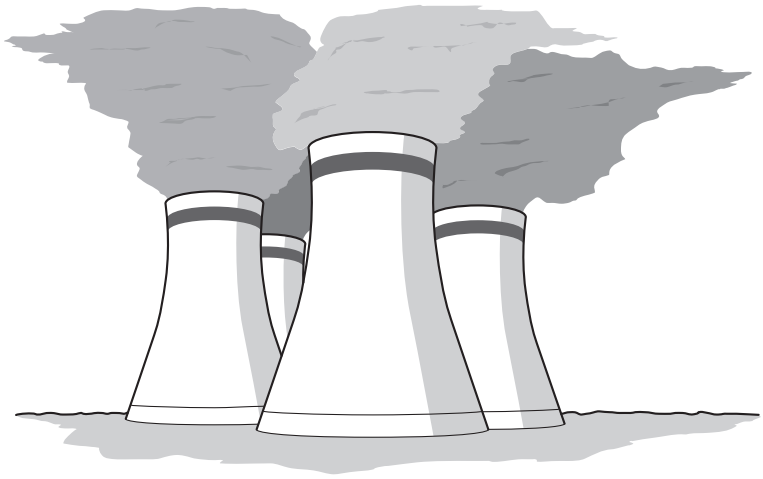
[2]

(b) Read this press release from an environmental group.

Combined Heat and Power (CHP)

UK power stations throw away the same amount of energy as is needed to provide hot water and heating for every building in the UK.

How does this happen? Well, generating electricity produces huge amounts of 'waste' energy, which is lost by our power stations – for example, heating water into the steam which goes up the cooling towers.



If power stations are built near towns or on industrial sites, this energy can be captured and supplied to heat homes and businesses or used in industrial processes.

This technology exists and is used in other countries. It's called Combined Heat and Power (or CHP), and CHP plants can be up to two-and-a-half times as efficient as the power stations we use at the moment. The old-fashioned power stations we presently use are, on average, only 38% efficient.

On a small number of industrial sites in the UK, there's enough CHP potential to provide the same electricity generating capacity as the whole of the proposed new generation of nuclear reactors combined.

(i) What is the maximum efficiency of a CHP plant?

Put a (ring) around the correct answer.

38% **60%** **62%** **95%** **100%**

[1]

(ii) Four different people have read the press release about CHP power stations.

Anne
They are going to have to put in a lot of pipes to carry the heat from the power station to all the houses.

Milan
We won't need so many power stations if they use CHP, as less energy is wasted.

Richard
If everyone just turned down the temperature of their central heating by 2 degrees, it would save plenty of energy.

Penny
If power stations were more efficient we would not need to burn so much fuel. That's bound to be good for the environment.

Which of these people mention an advantage of CHP?

Put ticks (✓) in the boxes next to the **two** correct names.

Anne ☐

Milan ☐

Penny ☐

Richard ☐

[1]

[Total: 7]

2 This question is about using gamma radiation to preserve soft fruit. This is done in the USA, but not in Britain.

Strawberries can be preserved with gamma radiation.

This kills microorganisms on the fruit. Provided that other microorganisms have no chance to get on to the irradiated fruit, the fruit cannot go bad.

(a) Here are 4 sentences that describe this procedure.

They are in the wrong order.

A The strawberries are taken away from the radiation source.

B The strawberries are put near a source of gamma radiation.

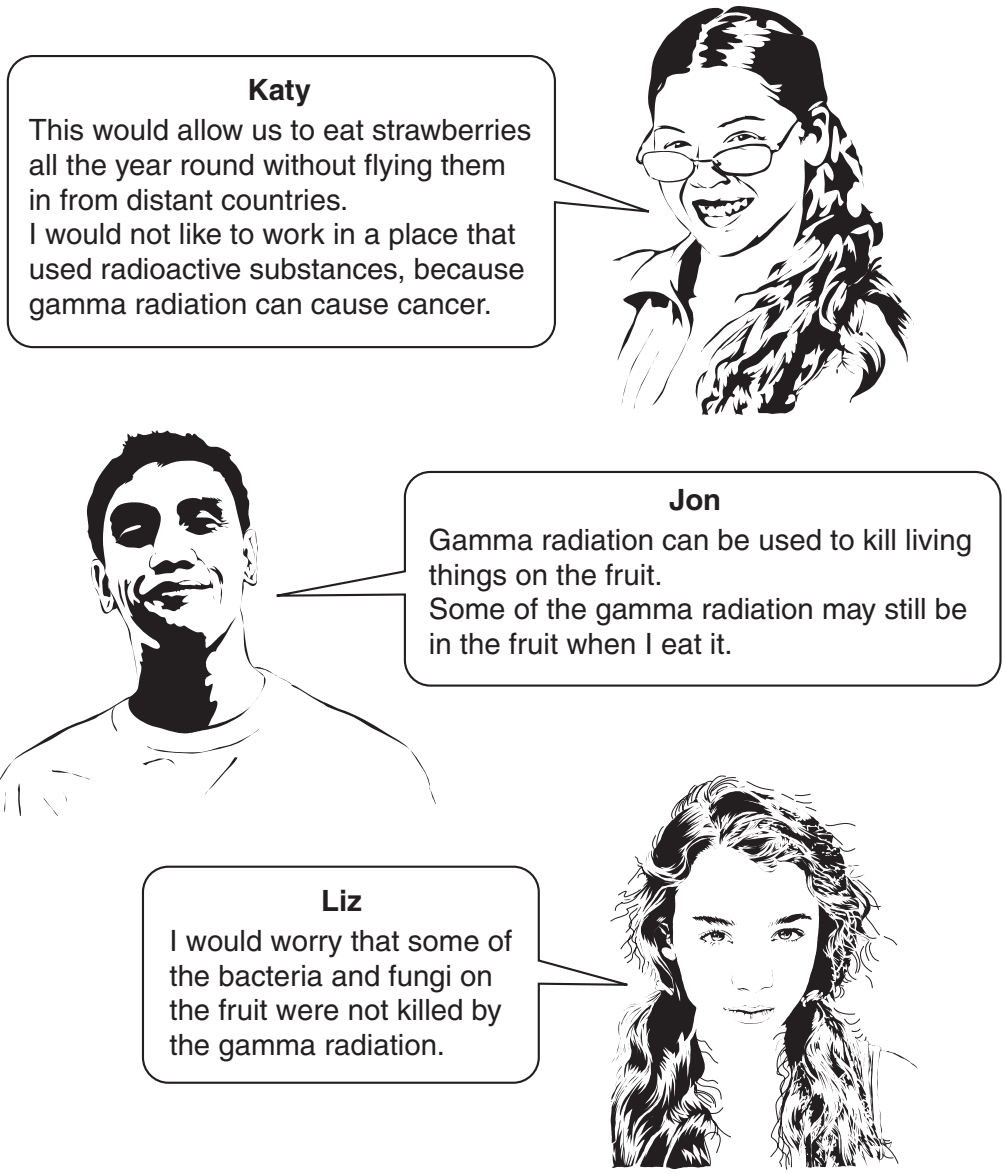
C The container of strawberries is put into an airtight plastic bag.

D The strawberries stay there for long enough to kill all bacteria and fungi.

Fill in the boxes to show the correct order.

[1]

(b) Katy, Jon and Liz are discussing whether or not preserving strawberries with gamma radiation should be done in the UK.



For each of the following questions, put ticks (✓) in the boxes to indicate the correct people.

The questions may have one, two or three ticks.

		Katy	Jon	Liz
(i)	Which people state an advantage of preserving fruit in this way?	☐	☐	☐
(ii)	Which people are not happy about eating fruit preserved in this way?	☐	☐	☐
(iii)	Which **one** person says something about gamma radiation which is not true?	☐	☐	☐

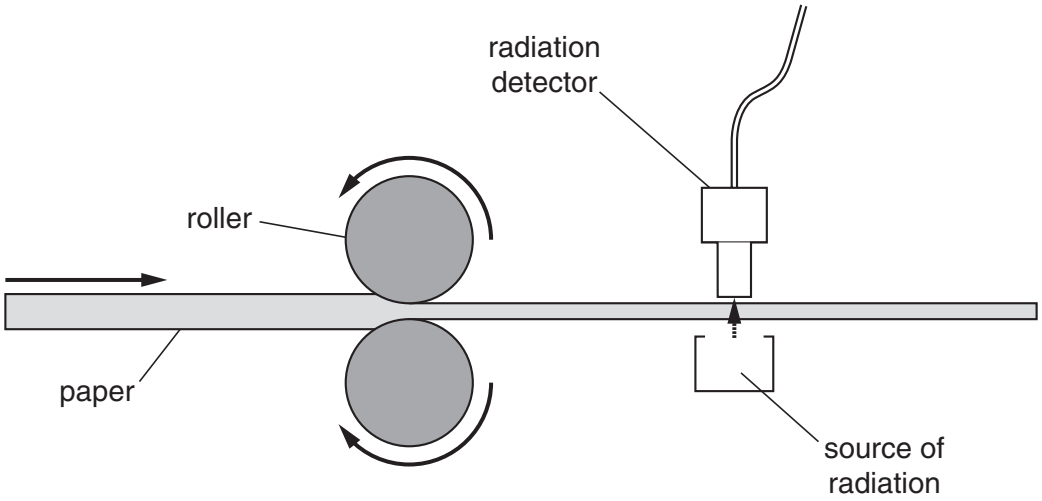
[3]

[Total: 4]

3 When paper is made, it is squeezed into thin sheets by passing it between two rollers.

The paper must be of the same thickness all the time.

The paper thickness can be tested with radiation, as the diagram shows.



(a) The radiation used is one of the types emitted by radioactive materials.

Finish the sentences below by using the appropriate scientific words.

Choose from this list.

alpha

beta

gamma

infrared

ultraviolet

X-ray

…… radiation from radioactive materials is stopped completely by a thin sheet of paper.

…… radiation from radioactive materials is very penetrating, so it is not absorbed by paper at all. This means that the radiation detector would give the same reading for thin paper as for thick paper.

Therefore …… radiation is used to check the thickness of the paper.

If the paper is too thin, the radiation count will increase.

[1]

(b) Here are some statements about the risk from radiation to people who work in the paper factory.

The statements are all correct.

A People who work near a radioactive source are exposed to radiation.

B A radiation dose from the radioactive source can make cells cancerous.

C Government regulations put an upper limit on the dose a worker is allowed to receive.

D The risk to the workers is reduced as far as possible while still allowing this paper tester to be used.

E People working near any radioactive source must have regular checks to measure the dose they have received.

(i) Which **one** of the statements **A**, **B**, **C**, **D** or **E** is the best example of the ALARA principle?

statement ..... **[1]**

(ii) Many people are very nervous about working with radioactive materials.

Which **two** of the statements **A**, **B**, **C**, **D** or **E**, taken together, explain how people who work with radioactive materials are protected?

statements ..... and ..... **[1]**

[Total: 3]

4 Read this article from a website.

Kids aren't doing enough exercise

A recent study looked at physical exercise in 11-year-olds. Only one in forty meets the national target of an hour of physical exercise a day. 95% of boys and 99.6% of girls did not meet the target.

Scientists studied the physical activity levels of more than 5500 children for two years.

"It's a worrying fact that children and young people aren't doing enough exercise" said an advisor from Diabetes UK. "If we don't put the emphasis back on exercise and healthy lifestyle, children and young people in the UK may face a lifetime of ill health."

"The increase of type 2 diabetes in children is linked to rising levels of obesity. The increase in obesity is caused by lack of exercise and diets that are high in fat, salt and sugar. Both type 2 diabetes and obesity are risk factors for heart disease.

(a) Which **two** statements, when put together, explain why lack of exercise is a risk factor for diabetes?

Put a tick (✓) in the box next to each of the **two** correct answers.

People who do not exercise can become overweight. ☐

More girls than boys have diabetes. ☐

There is a risk of developing diabetes when a child is 11 years old. ☐

Obesity is a risk factor for type 2 diabetes. ☐

Boys exercise more than girls. ☐

[2]

(b) Insulin controls the level of sugar in the blood.

It allows sugar molecules in the blood to move into the cells, where they can be used for energy.

Put ticks (✓) in the boxes next to the **two** possible **causes** of type 2 diabetes.

There is not enough sugar in the blood.	☐
The pancreas makes too much insulin.	☐
There is too much sugar in the urine.	☐
The cells do not respond to insulin.	☐
The pancreas does not make enough insulin.	☐

[2]

(c) The article discusses health effects for children who do not exercise and also have a poor diet.

Put a tick (✓) in the box next to each statement about these children to show whether it is true or false.

	true	**false**
They are more likely to develop type 2 diabetes.	☐	☐
They are certain to develop type 2 diabetes.	☐	☐
They can reduce their chance of developing type 2 diabetes by getting more exercise.	☐	☐
They are more likely to develop type 2 diabetes and heart disease.	☐	☐

[1]

[Total: 5]

5 **(a)** Read this guide to healthy eating.

Acrylamide is a chemical found in large amounts in starchy foods that have been cooked at high temperatures. These foods include crisps, chips and bread.

Acrylamide causes cancer in animals and so may also harm people's health in the same way. However, the Food Standards Agency (FSA) has not set a limit for acrylamide in food.

You do not need to change your diet or the way in which you cook your food – but you should continue to eat a healthy, balanced diet.

Remember that food, especially meat, needs to be cooked properly to destroy the bacteria that cause food poisoning.

The FSA has **not** advised the government to put a limit on acrylamides in food.

Put a tick (✓) in the box next to the **best** explanation for this.

The FSA was not set up to protect people's health. ☐

The benefit of a balanced diet containing cooked starches outweighs the risk. ☐

Acrylamide is harmless when levels are kept low. ☐

Nothing can ever be completely safe. ☐

[1]

(b) Foods from crops may contain chemicals that are harmful to health.

Draw a straight line from each **harmful chemical** to the **reason it is in the food**.

One has been done for you.

harmful chemical	reason it is in the food
aflatoxins made by mould growing on food	the way the crop is farmed
pesticides and herbicides left on crops after spraying	the way the crop is stored
toxins present inside the food	starch is cooked at high temperatures
acrylamides in the food	the crop plant itself produces poisonous chemicals

[2]

[Total: 3]

6 Bert is an organic farmer.

He does not use artificial fertilizer on his farm.

(a) (i) What methods might Bert use to maintain the fertility of his soil?

Put ticks (✓) in the boxes next to the **two** correct answers.

He puts manure on his fields.	☐
He grows crops in small fields.	☐
He encourages wildlife on his farm.	☐
He grows different crops in his fields each year.	☐
He uses pesticide on his crops.	☐

[2]

(ii) Bert needs to replace elements that are lost from the soil.

Draw straight lines to join the boxes to make **one** sentence describing what happens if he does not replace these elements.

	… need carbon dioxide and water …	… which are removed when crops are harvested …	
	or	or	
Crops that grow …	… need carbon dioxide and oxygen …	… which are removed by bacteria …	… so the land becomes infertile.
	or	or	
	… need nitrogen, potassium and phosphorus …	… which are lost when dead leaves fall off …	

[2]

(b) In developing countries, the use of artificial fertilizer is increasing.

Which **two** of the following statements, when put together, explain this?

Put ticks (✓) in the boxes next to the **two** correct answers.

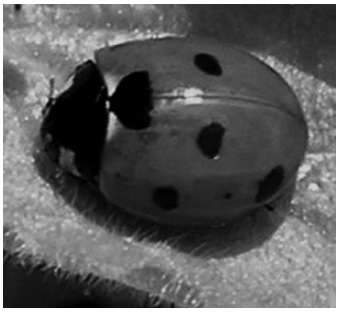
Developing countries cannot afford to import artificial fertilizers.	☐
There may be food shortages in developing countries.	☐
There is less information about organic farming.	☐
Farmers are only interested in making a profit on their land.	☐
Artificial fertilizers give higher crop yields than organic farming.	☐
Farms using artificial fertilizer need fewer workers than organic farms.	☐

[2]

[Total: 6]

7 Read the newspaper article.

British ladybirds lose out to Harlequins



native British ladybird

Harlequin ladybird

In September 2004 the Asian Harlequin ladybird arrived in Essex.

In three years, Harlequin ladybirds have spread across the whole of England.

90% of ladybirds in London parks are now Harlequins, not native British ladybirds.

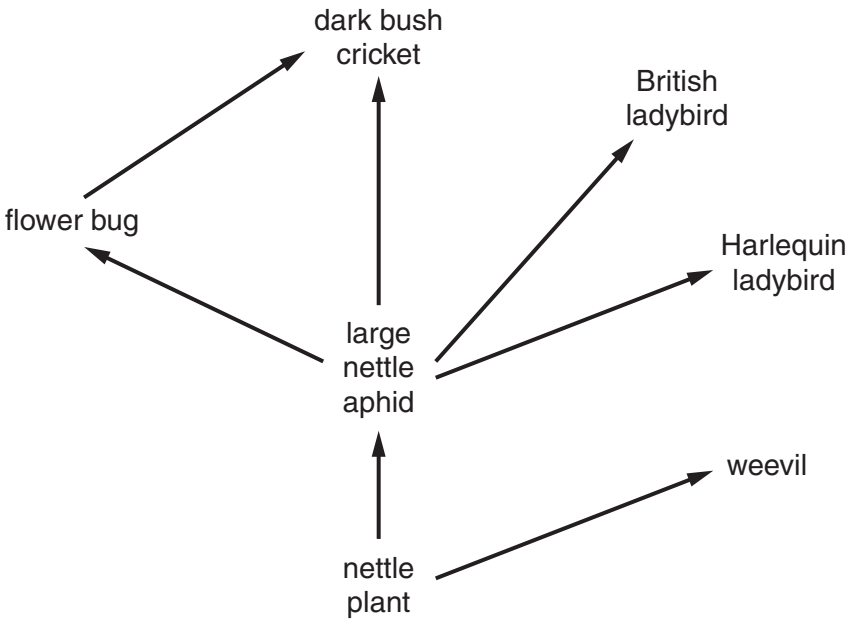
(a) Harlequin ladybirds and British ladybirds both feed on the same types of insects.

Write down the term scientists use to describe the struggle between two species for a limited resource in a habitat.

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

(b) There are **parasitic wasps** which feed only on British ladybirds.

(i) Add these parasitic wasps to the food web. **[1]**



Some scientists think that Harlequin ladybirds will replace British ladybirds in the UK because both feed on the same types of insects.

What effect would this have on other species of insects?

Finish the sentences by using the words or phrases in the list.

decrease **increase** **stay the same**

(ii) The population of the parasitic wasps will …… . **[1]**

(iii) If the population of large nettle aphids decreases, the population of weevils will …… . **[1]**

[Total: 4]

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8 Read this article on puffins.

Disastrous decline of puffins

1 The biggest colony of puffins in Britain is in trouble.

2 Thousands of puffin chicks have failed to hatch or have starved to death.

3 There has been a two degree rise in ocean temperatures.

4 Some scientists claim this has driven sand eels, the puffins' favourite food, to move to cooler waters so the puffins don't have enough food.

5 Puffins have been seen trying to feed their chicks on pipefish.

6 Other scientists think the deaths are due to unusually bad storms.

(a) Write down the numbers of the sentences that report data (observations or measurements).

sentences ..... **[1]**

(b) **(i)** Write down the numbers of the sentences that contain explanations for the fall in the numbers of puffin chicks.

sentences ..... **[1]**

(ii) Sentence 5 is accounted for by one of the explanations.

Write down the number of the sentence which contains this explanation.

sentence ..... **[1]**

[Total: 3]

9 Read the article on butterflies.

Male butterfly shows evolution at work

The tropical blue moon butterfly is attacked by parasitic bacteria.

The bacteria are passed down from the mother and kill male embryos before they hatch.

Six years ago, males made up only 1% of the blue moon butterfly population.

However, by 2006 the butterflies had evolved a gene to suppress the bacteria and males were up to about 40% of the population.

(a) Scientists say this change in the percentage of male butterflies is an example of natural selection.

Put a tick (✓) in the box next to the statement below which gives the **best** reason for this.

	reason
A new species has been produced by the change.	☐
A new type of disease has affected the butterflies.	☐
The percentage of males with the suppressor gene has increased over generations.	☐
The change in DNA has increased the amount of variation in the butterfly population.	☐

[1]

(b) Charles Darwin explained that evolution was caused by natural selection. Another scientist called Jean-Baptiste Lamarck had a different explanation for evolution.

Some statements from Lamarck's explanation are given below.

Some of these statements would also fit into Darwin's theory of natural selection.

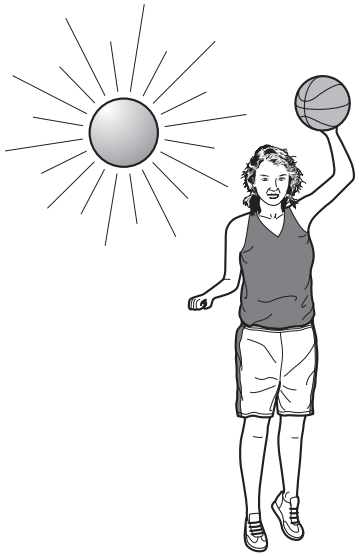
Put a tick (✓) in the box next to **each** statement from Lamarck's explanation which would also fit into Darwin's theory.

statements from Lamarck's explanation	
Life on Earth started with simple living things.	☐
Fossils provide evidence for evolutionary change.	☐
Simple living things get more complicated with each successive generation.	☐
Over a long period of time species can change into new species.	☐
Changes acquired during an individual's lifetime are passed on to the next generation.	☐

[2]

[Total: 3]

10 Helen is playing basketball on a hot, sunny day.



Her muscles are contracting and her body temperature starts to increase.

This starts a control mechanism.

Her sweat glands begin to release more sweat.

This helps her to maintain a normal body temperature.

(a) Helen's body is trying to maintain a constant internal environment.

Write down the name for maintaining a constant internal environment.

.....

[1]

(b) The table shows some steps in **this** control mechanism in Helen.

Put a tick (✓) in the box next to the **one** row that shows the correct **stimulus**, **effector** and **response**.

stimulus	effector	response	
playing basketball	muscles	an increase in body temperature	
a decrease in body temperature	muscles	muscle contraction	
an increase in blood temperature	sweat glands	sweating	
the Sun	sweat glands	sweating	

[1]

(c) In any control mechanism the stimulus needs to be detected.

Write down the name for cells that detect a stimulus.

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

(d) It is dangerous if Helen's body temperature is different from normal for too long.

Helen's body has two different communication systems that are involved in control mechanisms.

These systems use nerves or hormones.

One of these systems is used in this case.

Put a tick (✓) in the box next to the correct explanation for the system that is used.

Her body uses hormones for a rapid response that does not last for too long.	☐
Her body uses nerves for a rapid response that continues for a long time.	☐
Her body uses hormones for a slow response that lasts for a long time.	☐
Her body uses nerves for a rapid response that does not last for too long.	☐

[1]

[Total: 4]

END OF QUESTION PAPER

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