

**GENERAL CERTIFICATE OF SECONDARY EDUCATION  
TWENTY FIRST CENTURY SCIENCE  
SCIENCE A**

**A213/02**

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)

**Wednesday 20 January 2010  
Morning**

**Duration: 40 minutes**



Candidate Forename		Candidate Surname	
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Centre Number						Candidate Number				
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**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.

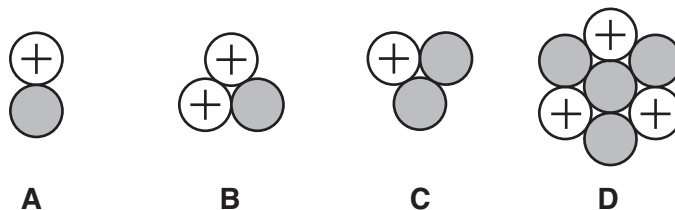
**INFORMATION FOR CANDIDATES**

- 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 **20** pages. Any blank pages are indicated.

2

Answer **all** the questions.

- 1 This diagram shows the nuclei of four different atoms.



- (a) Complete this table naming the particles found in each nucleus.

particle	name
	neutron
	.....

[1]

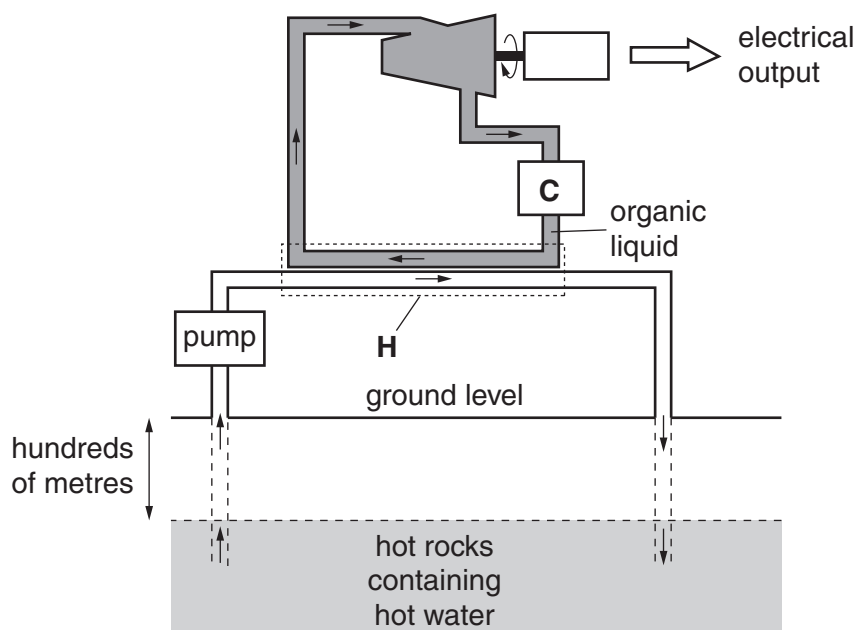
- (b) Which two of the nuclei **A**, **B**, **C** and **D** are **isotopes** (different forms of the same element)?

..... and ..... [1]

[Total: 2]

3

- 2 The diagram shows one type of geothermal power station. It gets its energy from hot rocks deep underground.



- (a) The following statements describe the energy flow in a geothermal power station.

They are **not** in the correct order.

- W** A **condenser**, **C**, turns the organic vapour back into a liquid again, ready to be recycled.
- X** The vapour turns a **turbine**, which turns a **generator**.
- Y** This water passes along pipes into a **heat exchanger**, **H**, where it boils an organic liquid.
- Z** Water is pumped from hot rocks deep underground.

Use the information in the diagram, together with your knowledge of power stations, to write the statements in the correct order.

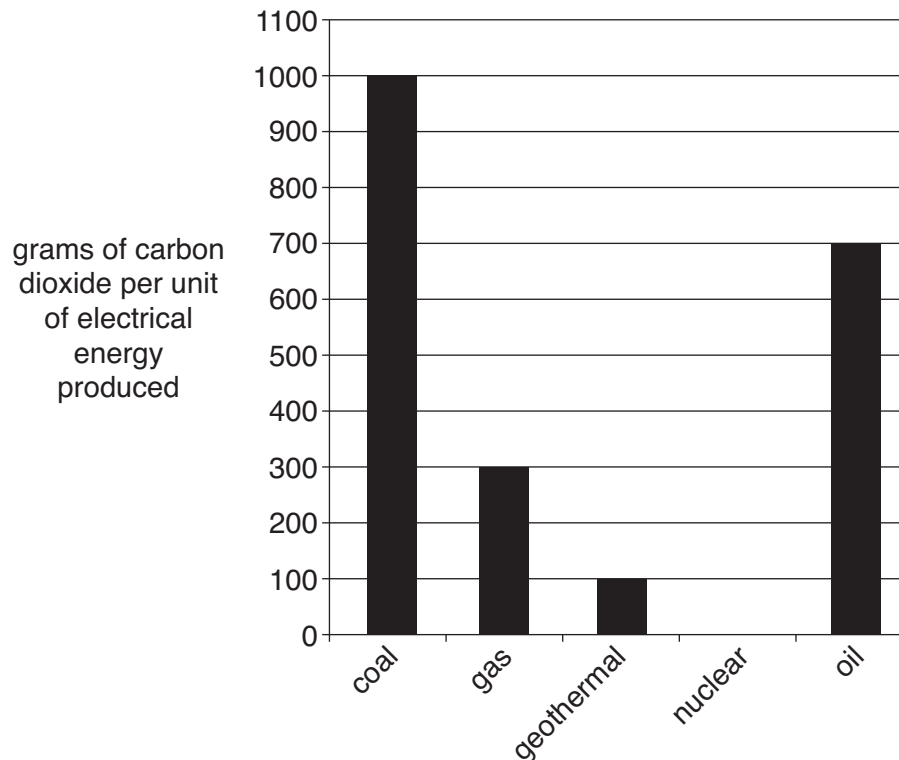
The first one has been done for you.

<b>Z</b>			
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[1]

4

- (b) A big problem with many power stations is that they give out carbon dioxide. The bar chart shows how much carbon dioxide is given off by different types of power station while they are running.



- (i) Here are some statements about the data in the bar chart.

They are **not** all correct.

Put a tick (✓) in **one** box after each statement to show whether it is **true** or **false**.

	true	false
Nuclear power stations do not produce carbon dioxide when running.	<input type="checkbox"/>	<input type="checkbox"/>
Coal power stations produce more carbon dioxide than the other types of power station, per unit of energy produced.	<input type="checkbox"/>	<input type="checkbox"/>
Using gas instead of coal saves 600 grams of carbon dioxide, per unit of energy produced.	<input type="checkbox"/>	<input type="checkbox"/>
Gas power stations produce less than half of the carbon dioxide produced by oil power stations, per unit of energy produced.	<input type="checkbox"/>	<input type="checkbox"/>

[3]

5

- (ii) The data in the bar chart do not give all the relevant information about the carbon dioxide produced by these power stations.

Which **one** of the following statements explains this?

Put a tick (✓) in the box next to the **one** correct answer.

Only three of the five energy sources are fossil fuels.

☐

Other forms of renewable energy are not included in this data.

☐

The data do not include details about building the power stations.

☐

Nuclear power stations produce radioactive waste.

☐

[1]

- (c) Nuclear power stations do not give off carbon dioxide when they are running. This is because the energy is not released by burning, but by **nuclear fission** of uranium.

Describe what happens to the uranium nucleus during nuclear fission.

.....

.....

.....

.....

.....

..... [2]

[Total: 7]

6

- 3 As part of a government plan to build new nuclear power stations, it is suggested that high level radioactive waste should be buried in disposal sites deep underground.

(a) People living near one planned disposal site have different views about these plans.

**Hilary**  
I'm against this crazy scheme. There's a chance that this waste will leak into our water supplies. The government shouldn't take any risks with the lives of our children.

**Brian**  
I don't want this dangerous radioactive waste to be stored near where I live. I'm afraid that it will make us a target for terrorist attacks.

**Eric**  
This will allow us to store waste safely. The rocks underground here have been very stable for millions of years. Radioactive waste will not leak out from stable rock formations.

**Rohit**  
I know that this plan will bring jobs into the area, and that making electricity without releasing carbon dioxide will cut down global warming. But I'm not at all happy about radioactive waste being brought here in trains and lorries. There's bound to be an accident sooner or later. I'm against this plan.

**Marion**  
I have worked in the nuclear industry as an inspector, and I know that this waste dump will be safe. The risk to workers and others is always made as small as it can be.

- (i) Which of these people talks about the ALARA principle?

Put a tick (✓) in the box next to the **one** correct answer.

Brian	<input type="checkbox"/>
Eric	<input type="checkbox"/>
Hilary	<input type="checkbox"/>
Marion	<input type="checkbox"/>
Rohit	<input type="checkbox"/>

[1]

7

- (ii) Which of these people talk about the perceived risk, but not the actual risk, of the waste dump?

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

Brian

☐

Eric

☐

Hilary

☐

Marion

☐

Rohit

☐

[1]

- (iii) Which of these people mention benefits of the waste dump?

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

Brian

☐

Eric

☐

Hilary

☐

Marion

☐

Rohit

☐

[1]

- (b) One radioactive element in the waste is plutonium-239.  
Plutonium-239 has a half-life of 24 000 years.  
A sample of plutonium-239 has an activity of 16 000 counts per second.

Calculate the activity you would expect this sample to have after 72 000 years.  
Show your working clearly.

activity = ..... counts per second [2]

[Total: 5]

Turn over

## 4 (a) Read the newspaper article.

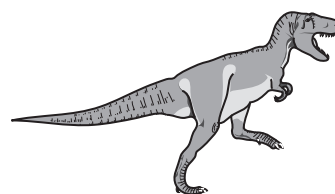
**Are birds dinosaurs?**

*Tyrannosaurus rex* (*T. rex*) is the most famous of all dinosaurs.

A 68-million-year-old fossil of a *T. rex* bone was found that still contained seven proteins.

Three of the proteins were very similar to proteins found in birds such as chickens. Two others were similar to proteins found in different animals.

Some scientists have suggested that birds evolved from dinosaurs.



The article contains a hypothesis (a scientific explanation).

(i) Write down the hypothesis from the article.

.....

..... [1]

(ii) Some observations in the article support the hypothesis.

Put **one** tick (✓) in each row to show whether the observation **increases the confidence in the hypothesis**, **decreases the confidence in the hypothesis** or **neither**.

observation	increases the confidence in the hypothesis	decreases the confidence in the hypothesis	neither
Seven proteins were extracted from a <i>T. rex</i> fossil.			
Three proteins from <i>T. rex</i> were similar to proteins found in chickens.			
Two proteins from <i>T. rex</i> were similar to proteins found in other animals.			

[1]

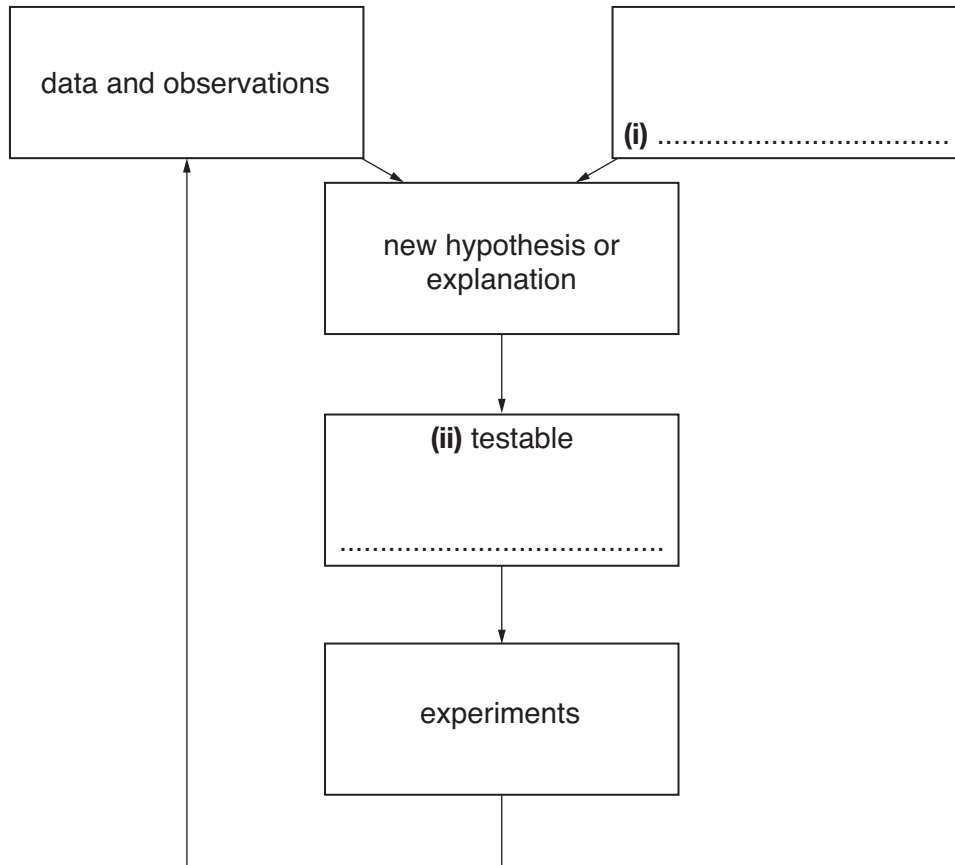


(b) Complete the flow chart which shows how science explanations change and develop.

Write the answers in the correct boxes.

(i) What is needed to produce an explanation, other than data and observations?

(ii) What does the new explanation give that can be tested by experiment?



[2]

[Total: 4]

10

- 5 (a) Over the last 100 years, grey squirrels have replaced red squirrels in all but a few places in the UK. Some scientists are worried that the red squirrel may die out in the UK.

Which of the possible changes listed could **not** cause red squirrels to die out?

Put a tick (✓) in the box next to the correct answer.

**possible changes**

indirect human activity

☐

direct human activity

☐

rapid environmental change

☐

the arrival of a new disease

☐

the extinction of a predator on the red squirrel

☐

[1]

(b) Read the newspaper article.

### Black is the new grey

Some grey squirrels produce black offspring. The black colour is caused by a change in a single gene.

In the south east of the UK, the number of grey squirrels is now falling and the number of **black squirrels** is increasing.

Female grey squirrels prefer to mate with black males. This is called sex selection.

Explain the recent increase in the number of black squirrels using ideas about natural selection.

In your answer write about:

- variation
- selection
- competition
- the effect over a number of generations.

.....

.....

.....

.....

.....

..... [4]

(c) The article states that the black colour in squirrels is caused by a change to a single gene.

(i) What are such changes to genes called?

answer ..... [1]

(ii) Some gene changes can be inherited.

To be inherited, the change must occur in one type of cell.

Which cell type is this?

answer ..... [1]

[Total : 7]

12  
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- 6 In multicellular animals, two communication systems have evolved to coordinate responses to internal and external changes.

- (a) (i) Write the name of the missing communication system in the box provided.
- (ii) Use straight lines to link each **communication system** to the correct **descriptions**.

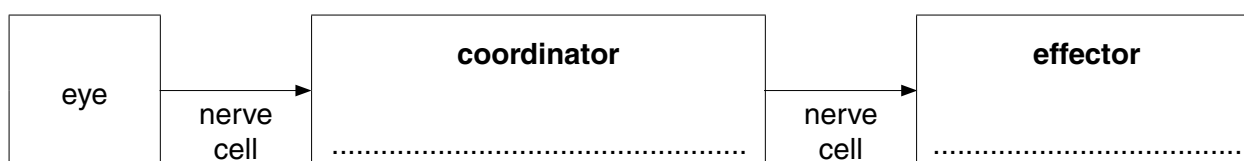
Each communication system should be joined to **two** descriptions.

communication system	description
	fast, short-lived responses
nervous	slower, longer-lasting responses
(i) .....	information transmitted by chemicals in the blood
	information transmitted by electrical impulses

[2]

- (b) During a game of football, Ryan sees the ball and responds by kicking it towards the goal.

Fill in the boxes to show the parts of Ryan's body acting as **coordinator** and **effector** in this case.



[1]

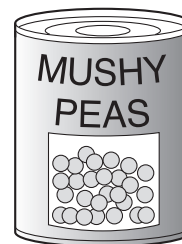
[Total: 3]

7 Read the following newspaper article.

### No colour for mushy peas

The Food Standards Agency wants six artificial colourings to be removed from food and drink. Their use is associated with hyperactive behaviour in children.

The food industry has been working on removing colourings from food, but alternative colourings for mushy peas and Turkish delight have not yet been found.



(a) Some students in a science class are discussing the newspaper article.

**Susie**

Hazardous chemicals can occur naturally in food or may be made when food is cooked.

**Chris**

Some people will not like the lack of colour and will stop buying the foods.

**Jack**

Foods look much more attractive when these colours are added and they've never affected me.

**Anwer**

I want the government to ban these colourings because they may affect children.

**Tanya**

Pesticides and fertilizers are often left on crops.

(i) Which **two** students explain why colourings are added to foods such as mushy peas?

answer ..... and ..... [1]

(ii) Who gives a reason for taking a risk?

answer ..... [1]

(iii) Which **two** students give reasons why food is never completely safe?

answer ..... and ..... [1]

15

(b) (i) Why does the Food Standards Agency want to ban some colourings?

Put a tick (✓) in the box next to the **best** answer.

All artificial additives are harmful.

☐

People will only buy foods without colourings.

☐

The colourings may make some children hyperactive.

☐

All children who eat these additives become unhealthy.

☐

[1]

(ii) Use the article to explain what is meant by the **precautionary principle**.

.....

.....

..... [1]

[Total: 5]

16

- 8 (a) (i) Organic farmers rotate crops in their fields.

What are the benefits of crop rotation?

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

The numbers of pests that eat specific plants decrease.

☐

Some crops, such as beans, put nutrients back into the soil.

☐

It allows farms to be recognised as organic.

☐

It is cheaper than growing the same crop in the same field.

☐

It increases the chances of soil erosion.

☐

[1]

- (ii) Organic farming is sustainable.

Which of the following statements about organic farming explain why it is **sustainable**?

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

Organic crops are more expensive and their yield is smaller.

☐

Organic farmers control pests with natural predators.

☐

Organic farms have smaller fields than intensive farms.

☐

Organic farms employ more people than non-organic farms of a similar size.

☐

Organic farming uses chemicals from renewable sources.

☐

[1]



- (b) The nitrogen cycle shows how nitrogen is transferred between plants, animals, the soil and the atmosphere.

The main stages in this cycle are

- nitrification
- nitrogen fixing
- denitrification.

Describe what happens at each of these stages.

.....

.....

.....

.....

.....

.....

..... [3]

[Total: 5]

- 9 Sam knows she must eat a balanced diet that includes a mixture of proteins and carbohydrates.



- (a) (i) Name the **three** different elements in **carbohydrates**.

..... and ..... and ..... [1]

- (ii) Starch is a carbohydrate.

Digestion breaks down starch to a smaller, soluble compound.

What is this compound?

answer ..... [1]

- (b) Use words from this list to complete the sentences about what happens to food in your body.

A word may be used once, more than once or not at all.

**bladder**

**carbohydrates**

**fat**

**kidney**

**liver**

**proteins**

**urea**

**urine**

Amino acids are made when our digestive system breaks down .....

Cells in our body grow by building up amino acids into .....

Excess amino acids are broken down by the .....

The breakdown of excess amino acids produces the chemical called .....

The waste leaves your body in ..... [2]

[Total: 4]

**END OF QUESTION PAPER**

**19**  
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