

**Level 1/2 Cambridge National Certificate in
 SCIENCE**

R072/02

R072: How scientific ideas have developed (Level 2)

Candidates answer on the question paper

OCR Supplied Materials:

- Case study (inserted)

Other Materials Required:

- Pencil, ruler
- Calculator

Duration: 1 hour

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.
- Write your answer to each question in the space provided, however additional paper may be used if necessary.

INFORMATION FOR CANDIDATES

- Your quality of written communication is assessed in questions marked with a pencil (✎).
- The number of marks for each question is given in brackets [] at the end of each question or part question.
- The total number of marks for this paper is **60**.
- This document consists of **16** pages. Any blank pages are indicated.

Answer **all** questions.

This question is based on the case study 'Sweet foods, obesity and diabetes'.

1 (a) Frances worries about her risk of contracting diabetes.

By calculating her BMI from the data below, assess her risk. Show your working.

age = 42 years

mass = 84 kg

height = 1.6 m

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[3]

(b) Look at the graph showing **relative risk for Type 2 diabetes**.

The graph shows data for women in the age range 30-55.

Explain why it may be difficult to obtain accurate obesity data for the general population.

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[3]

(c) This question is about possible links between fructose and obesity.

(i) The article describes a study of rats carried out by one group of researchers.

Their conclusion was 'fructose may make you think that you are hungry even when you do not need to eat'.

Suggest two reasons why some other scientists are not convinced by this conclusion.

1.

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2.

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[1]

(ii) The article suggests that there may be **another** link between fructose and obesity.

What is the suggested link, and what evidence would need to be collected to support the link?

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[3]

(d) The Food Standards Agency has set an Acceptable Daily Intake (ADI) for aspartame.

Michael has sugar-free drinks containing aspartame.

How can he use the ADI to decide how many drinks he can safely consume each day?

 One mark will be for a clear ordered answer.

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[3]

- (e) Until the 1920s, the only way of treating someone with diabetes was to control the amount of sugar in their diet.

Explain how modern treatment methods using insulin can be used to treat people with diabetes.

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[2]

2 A group of students is discussing global warming.

Andrew
The amount of carbon dioxide in the atmosphere has decreased in the past 200 years.

Gemma
There will be more flooding in the future.

Kate
We can grow crops in this country that wouldn't grow here 50 years ago.

Tom
Burning down forests increases the amount of carbon dioxide in the atmosphere.

Mike
How can there be global warming? My dad told me that 1976 was the hottest summer he remembers.

(a) Which **two** people are talking about possible consequences of global warming?

answer and [2]

(b) Which **one** person has identified a correlation?

answer [1]

(c) Carbon dioxide is a greenhouse gas that can also be found in the atmosphere.

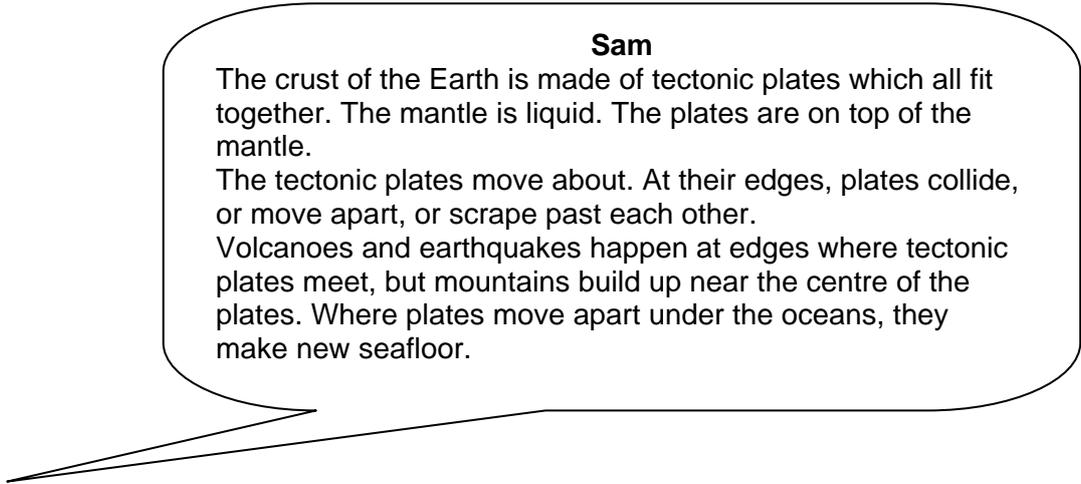
Name **two** other greenhouse gases that can also be found in the atmosphere.

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[2]

3 Sam has been watching a TV programme on continental drift.

He is trying to explain it to his friend Jo, but he has forgotten some of the information in the programme.



(a) Sam has made two mistakes as he describes continental drift. Write down and then correct each mistake in the spaces below.

First Mistake.....

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First Correction.....

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Second Mistake.....

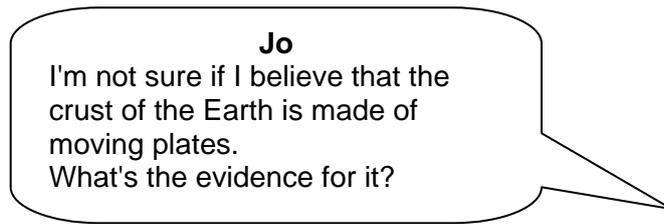
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Second Correction.....

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[2]

(b) Jo needs to be convinced of these ideas about continental drift.



Here are some scientific observations.

Put a tick (✓) in the box next to each statement which provides evidence for continental drift.

The Earth has a hot core of molten iron.

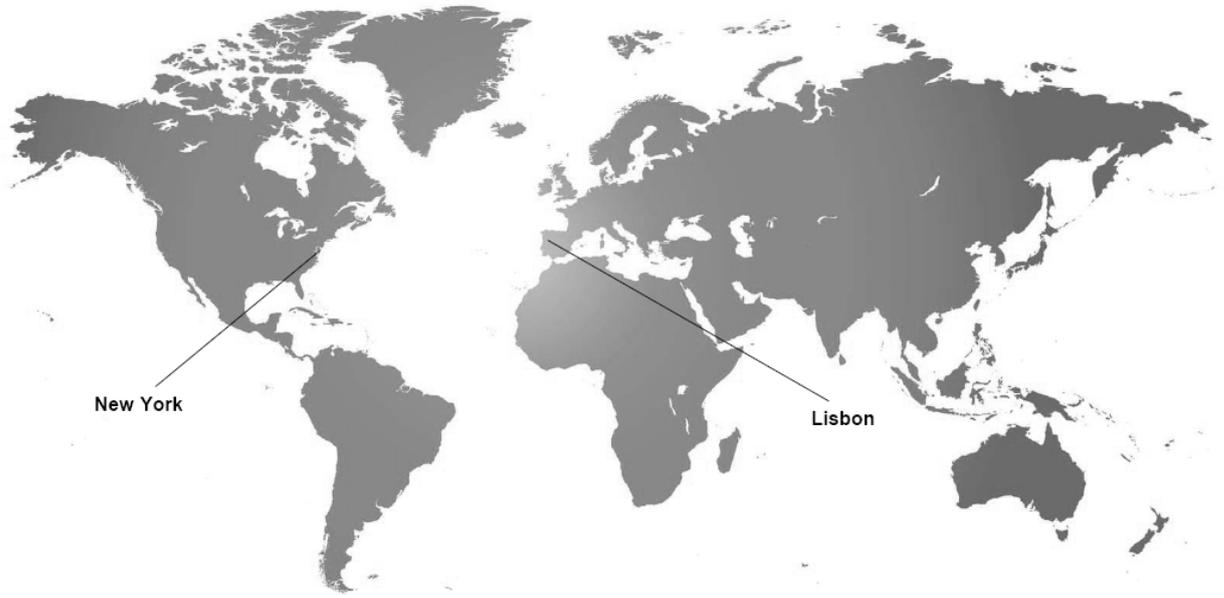
Rocks of the ocean floor are magnetised by the Earth's field.

There are ridges of solidified magma near the centre of many oceans.

Volcanoes are common in coasts along the edges of the Pacific ocean.

[1]

(c) This question is about modern evidence for continental drift.



York and Lisbon are seaside cities on opposite sides of the Atlantic Ocean.

The shortest distance between them along the surface of the Earth is 5400 kilometres.

GPS measurements show that the two cities are moving apart at a rate of about 25 mm per year.

This is explained by seafloor spreading of the Atlantic Ocean.

(i) Use the information to estimate the age of the Atlantic Ocean. Show your working.

age = _____ million years [3]

(ii) The youngest fossils under New York which match those under Lisbon are about 165 million years old.

Suggest a reason why this is not the same as your estimate of the age of the Atlantic Ocean.

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[1]

4 Giraffes feed on tree leaves.

Giraffes have evolved from ancestors which had shorter necks.

Scientists have proposed explanations of how this may have happened.

(a) One of the first explanations was suggested by Lamarck.

Lamarck imagined that over generations the habit of continually reaching for the higher leaves produced a lengthening of the neck.

Few scientists now agree with Lamarck's idea.

Put a tick (✓) in the box next to the statement which best explains why.

There will be variation in any population.

Only genetic variation can be passed on.

The environment can be a cause of variation.

Some variations make it more likely an individual will survive.

[1]

(b) Charles Darwin made many observations of plants and animals during his voyage around the world.

Darwin developed a new theory to explain how evolution happened.

Explain why Darwin developed a new theory.

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[1]

(c) Many people disagreed with Darwin's new theory.

Scientists can use predictions to test a theory.

Suggest reasons why Darwin's theory is hard to test.

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[2]

- (d) Scientists have used Darwin's theory to produce two alternative explanations for the evolution of the giraffe's long neck.

Explanation A:

- when there was little food, giraffes with longer necks survived as they competed for food
- they passed on their characteristics
- over many generations, the neck length of giraffes increased

Explanation B:

- male giraffes with longer and stronger necks competed better for female mates
- they passed on their characteristics
- over many generations, the neck length of giraffes increased

Some observations about giraffes are given in the table.

For each **observation**, decide if it best supports **explanation A** or **explanation B**.

Put ticks (✓) in the correct boxes.

observation	explanation A	explanation B
Only giraffes can reach the high leaves on trees.		
Male giraffes are up to 1 metre taller than females.		
Dead male giraffes with damaged neck bones have been found.		
In drought conditions, when food is scarce, giraffes generally feed on low shrubs.		

[3]

5 Selina is running in a marathon. This makes her sweat a lot.



(a) Sweating is one way that the body maintains a constant temperature.
Why is a constant temperature important?

Put a tick (✓) in the boxes next to the **two** best answers.

Enzymes are made of carbohydrate.

Enzymes slow down chemical reactions in cells.

Enzymes work best at an optimum temperature.

Enzymes are destroyed at low temperatures.

Enzymes can stop working at high temperatures.

[2]

(b) Blood vessels supplying capillaries in the skin are also important in maintaining a constant temperature.

The sentences show changes that happen as the body becomes overheated.

Put a **ring** around the **correct** word to complete each sentence.

As the body gets hotter, the blood vessels supplying the capillaries in the skin ...

- constrict dilate move inwards move outwards**

The blood flow through the capillaries ...

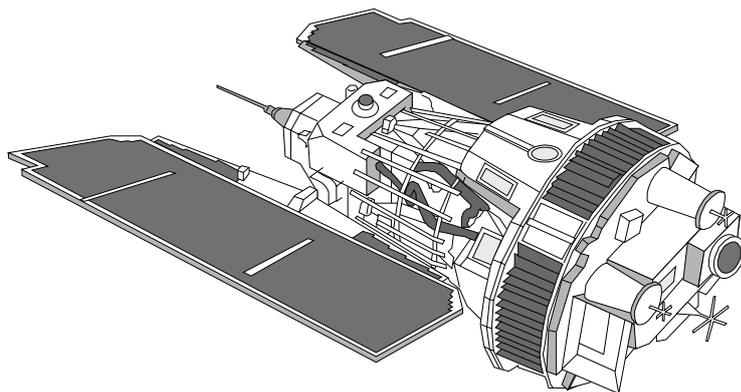
- decreases increases remains constant stops**

Energy loss from the skin ...

- decreases increases remains constant stops**

[3]

6 Albert is an astronomer.



He uses a new type of telescope in orbit around the Earth.

It can make images of stars using infra-red radiation.

(a) What is the advantage of using the new type of telescope to study a star?

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[1]

(b) Albert does not work on his own. He is part of a large team of astronomers.

Explain the scientific advantages of Albert working with a team of other astronomers.

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[2]

(c) Albert and his team make a new discovery about some stars.

They decide to share this discovery with other scientists.

(i) They submit an article for publication in a scientific journal.

Explain what the editor of the journal does with the article.

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[3]

(ii) Suggest why it is good for the progress of science that Albert and his team publish his discoveries.

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[1]

7 Suzy is an astronomy student. She investigates the motion of four different galaxies in one night.

For each galaxy, she measures:

- how fast it is moving away from Earth
- how far away it is from Earth

Here are her results.

galaxy	speed away from Earth (km/s)	distance from Earth (millions of light-years)
A	80	2.5
B	550	27
C	420	18
D	260	7.5

(a) Describe the pattern in Suzy's results.

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..... [1]

(b) Suzy was using a method first developed by Edwin Hubble (1889-1953).

How did Hubble measure the speed of the galaxies?

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..... [1]

(c) Edwin Hubble suggested the idea that the universe is expanding in the 1920s.

Hubble's idea was controversial when he first suggested it.

The majority of scientists now accept that we inhabit an expanding universe which started in a big bang.

Explain why most scientists now accept this idea.

 *The quality of written communication will be assessed in your answer to this question.*

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[6]

**Level 1/2 Cambridge National Certificate in
SCIENCE**

R072/02

R072: How scientific ideas have developed (Level 2)

MARK SCHEME

Duration: 1 hour

MAXIMUM MARK 60

Question		Expected Answers	Marks	Additional Guidance
1	(a)	BMI = $84/1.6^2$; = 32.8; EITHER Frances is obese OR relative risk is 40;	[3]	ecf on incorrect value of BMI
	(b)	any three of the following for [1] each: sample taken; which may not be representative of the whole population; obese people reluctant to participate in sampling; so sample is unrepresentative of the whole population; BMI is not a direct measure of obesity; so people with high BMIs are not necessarily obese; same BMI has different obesity rating associated at different ages;	[3]	could be bias for regional/social/ethnicity/lifestyle variation accept muscle can give high BMI one reason, clearly linked to why population data may be inaccurate, for 2 marks.
	(c) (i)	(it was carried out) on rats / not on humans; timescale too short;	[1]	both points needed
	(ii)	reduced ability to 'burn fat'; idea that data needed for obesity of groups of people eating sucrose and fructose;	[3]	allow 'use fat' e.g. obesity data (or data on amount of fat, or amount of fat 'burned') for two groups eating equal amounts of fructose and glucose
	(d)	reference to 40 (mg/kg); Use of 40 mg(/kg) together with EITHER body weight OR contents of a drink can; QWC: A clear ordered answer - A logical sequence of at least two statements, clearly understood on first reading;	[3]	
	(e)	(regular) injections of insulin after meals; (and so) allow excess glucose/sugar in blood to be stored in the liver/muscles;	[2]	points must be coherently linked to gain full marks
Total			[15]	

Question		Expected Answers	Marks	Additional Guidance
2	(a)	Kate; Gemma;	[2]	
	(b)	Tom	[1]	
	(c)	methane; water vapour	[2]	accept ozone; nitrous oxide; CFCs;
Total			[5]	

3	(a)	<p>first mistake -the mantle is liquid correction the mantle is a (viscous/plastic) solid [1]</p> <p>second mistake -Mountains build up near the centre of the plates correction – mountains build up near plate boundaries [1]</p>	[2]	<p>mistakes in either order</p> <p>correction must match the error</p>
	(b)	ridges of solidified magma volcanoes are common in coasts;	[1]	both required
	(c) (i)	<p>25 mm is 0.025 m, 5400 km is 5,400,000 m; use of $time = distance / speed / 5.400.000$ divided by 0.025;</p> <p>time = 216 million years;</p>	[3]	<p>1 mark for correct conversion of data to common units 1 mark for use of formula or showing division 1 mark for correct calculation</p> <p>allow 3 marks for correct answer allow ecf on correct calculation with incorrectly converted data</p>
	(ii)	rate of seafloor spreading may have been quicker in the past;	[1]	other scientifically correct explanations accepted
Total			[7]	

Question		Expected Answers	Marks	Additional Guidance
4	(a)	Only genetic variation can be passed on.	[1]	
	(b)	Darwin's observations could not be explained by existing theories	[1]	
	(c)	any two of the following for [1] each: evolution takes many generations for effects to be seen / takes a long time to test; natural variation in each generation produces many changes; not all changes are beneficial; environmental factors will influence natural selection;	[2]	
	(d)	Only giraffes reach high leaves on trees. A Male giraffes are up to 1 metre taller than females. B Dead male giraffes with damaged neck bones have been found. B In drought conditions, when food is scarce, giraffes generally feed on low shrubs. B	[3]	only one box should be indicated in each row; all four boxes correct scores 3 marks; three boxes correct scores 2 marks; two boxes correct scores 1 mark; one box correct scores 0 marks; all boxes indicated scores 0 marks;
Total			[7]	

5	(a)	Enzymes work best at an optimum temperature; Enzymes can stop working at high temperatures;	[2]	
	(b)	dilate; increases; increases;	[3]	
Total			[5]	

Question		Expected Answers	Marks	Additional Guidance
6	(a)	new data can be collected about the star;	[1]	
	(b)	any one of the following: <ul style="list-style-type: none"> they will discuss the observations/data/design of experiments; they bring different skills/expertise/experience to the team; linked with one of: <ul style="list-style-type: none"> design of experiments/quality of data produced will benefit from different skills/experience development of explanations will benefit from different scientific understanding; 	[2]	Reason given must be coherently linked to the benefits for the design of experiments, the quality of the data or the nature of the explanations for full marks to be awarded.
	(c) (i)	the paper is sent to other scientists; (so that they can) check his results/conclusions; (and) the paper is only published if they agree (that it is good science);	[3]	Action taken by editor must be coherently linked to the peer review process for full marks to be awarded.
	(ii)	so that other teams can replicate his data/offer different conclusions	[1]	
Total			[7]	

7	(a)	as distance from Earth increases, speed away from Earth increases	[1]	
	(b)	red-shift	[1]	allow description of using spectrum of light if red-shift not mentioned

Question	Expected Answers	Marks	Additional Guidance
7  (c)	<p>Level 3 Clear linkage demonstrated between evidence and confidence in the explanation. Shows detailed understanding of both evidence and scientific process. Quality of written communication does not impede communication of the science at this level. [5 – 6 marks]</p> <p>Level 2 Shows some understanding of both evidence and explanation but does not show the relationship between the two. Quality of written communication partly impedes communication of the science at this level. [3 – 4 marks]</p> <p>Level 1 Mentions some points from evidence and explanation. Answer may be simplistic. Quality of written communication impedes communication of the science at this level. [1 – 2 marks]</p> <p>0 marks = no response, or no response worthy of credit.</p>	[6]	<p>Relevant points include:</p> <p>Explanation</p> <ul style="list-style-type: none"> • more than one set of evidence points to an expanding Universe • more accurate / repeated measurements since 1920s confirm Hubble's results • cosmic microwave background predicted based on Hubble, prediction shown to be true • confidence increases when results support hypotheses <p>Evidence:</p> <p>Red shift</p> <ul style="list-style-type: none"> • light from galaxies is red-shifted • implying motion away from us • with speed increasing with distance <p>Microwave background</p> <ul style="list-style-type: none"> • random microwaves from all directions • from light released as atoms formed • when universe was hotter and smaller
	Total	[8]	

Question	Expected Answers	Marks	Additional Guidance
8 	<p>Level 3 Uses the data to comprehensively support the idea that the gene for pink is recessive. Provides a clear account of inheritance to explain why the next generation of plants should all be pink. Quality of written communication does not impede communication of the science at this level. [5 – 6 marks]</p> <p>Level 2 Uses idea of dominant and recessive genes to explain how removing all blue flowers in one generation could leave only pink flowers in the next. Any analysis of data is superficial. Quality of written communication partly impedes communication of the science at this level. [3 – 4 marks]</p> <p>Level 1 Uses ideas of dominant and recessive genes to explain how plants in a generation can have different colours. No attempt to use data in the table at more than superficial level. Answer may be simplistic. Quality of written communication impedes communication of the science at this level. [1 – 2 marks]</p> <p>0 marks = no response, or no response worthy of credit.</p>	[6]	<p>Relevant points include:</p> <p>Analysis of data</p> <ul style="list-style-type: none"> • gene for colour has two alleles (pink or blue) • if pink recessive, then blue is dominant • so two pink alleles for a pink flower • and one or no pink alleles for blue flower • if alleles evenly spread in population, then 1 in 4 (25%) of plants should have pink flowers • consistent with data in table • 11 pink out of 50 is 22% <p>Inheritance</p> <ul style="list-style-type: none"> • seeds get one allele from each parent • all blue plants have one or two dominant genes • destroying blue plants removes these genes • so all seeds have two pink genes • so next generation of plants will all be pink • any blue plants will disprove Ted's hypothesis
	Total	[6]	

Learning Outcome (LO) Grid

Question		LO1	LO2	LO3	LO4	Total
1	(a)			3		3
1	(b)		2	1		3
1	(c) (i)		1			1
1	(c) (ii)			3		3
1	(d) 			2	1	3
1	(e)	2				2
2	(a)	2				2
2	(b)			1		1
2	(c)	2				2
3	(a)	2				2
3	(b)		1			1
3	(c) (i)			3		3
3	(c) (ii)			1		1
4	(a)	1				1
4	(b)		1			1
4	(c)	2				2
4	(d)		3			3
5	(a)	2				2
5	(b)	3				3
6	(a)		1			1
6	(b)		2			2
6	(c) (i)		3			3
6	(c) (ii)		1			1
7	(a)			1		1
7	(b)	1				1
7	(c) 	3	1		2	6
8 		3		1	2	6
Total		23	16	16	5	60