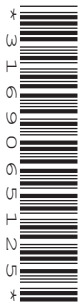




Friday 6 June 2014 – Afternoon

LEVEL 2 CAMBRIDGE NATIONAL IN SCIENCE

R072/02 How scientific ideas have developed



Candidates answer on the Question Paper.
A calculator may be used for this paper.

OCR supplied materials:

- Insert (R072/02/I – inserted)

Other materials required:

- Pencil
- Ruler (cm/mm)

Duration: 1 hour



Candidate forename		Candidate surname	
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Centre number						Candidate number				
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INSTRUCTIONS TO CANDIDATES

- The Insert will be found inside this document.
- Write your name, centre number and candidate number in the boxes above. Please write clearly and in capital letters.
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Answer **all** the questions.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Write your answer to each question in the space provided. Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).
- Do **not** write in the bar codes.

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 **60**.
- Your quality of written communication is assessed in questions marked with a pencil (✎).
- This document consists of **12** pages. Any blank pages are indicated.

Answer **all** the questions.

1 This question refers to the article, **Reaction Times** in the Insert.

(a) The patellar reflex (knee jerk) has several stages.

These stages and some incorrect stages are listed below.

A	Hammer hits the knee cap
B	Hammer stretches the tendon
C	Motor neuron carries impulse to muscle
D	Motor neuron carries impulse to spinal cord
E	Muscle contracts, moving the lower leg
F	Patient sits with the leg relaxed
G	Sensory neuron carries impulse to muscle
H	Sensory neuron carries impulse to spinal cord

Choose the correct stages for the patellar reflex and put them into the correct order.
The first has been done for you.

F				
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[3]

(b) Sue is a sprinter. Her time for 100 m is more than a second slower than her boyfriend's time. Together they look at **Graph 1** in the article. Sue says that this explains the difference between them.

Use the data in the graph to explain why her boyfriend does not agree.

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..... [2]

(c) (i) Look at **Table 1** (reproduced from the article).

	Distance before the ruler was caught in cm				
Ali	25	30	30	25	25
Charlie	45	40	40	35	40
Phil	92.1	81.3	44.5	43.2	36.4

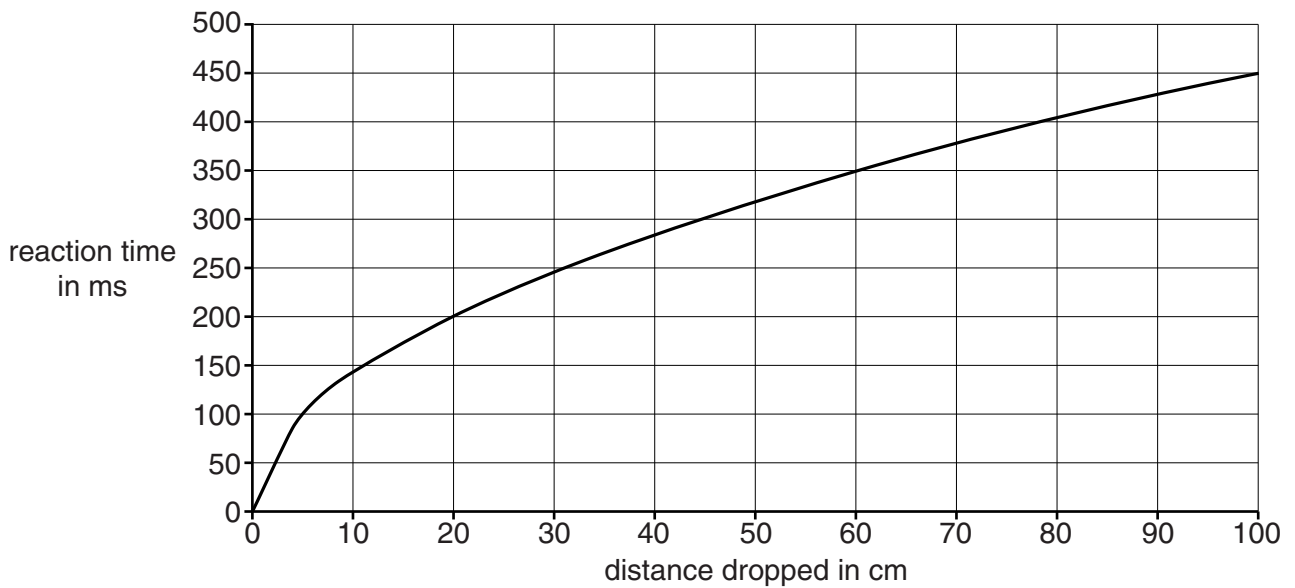
Table 1

What is the **mean** distance that the ruler fell before Charlie caught it?

Show your working.

..... cm [2]

This graph shows the relationship between the distance the ruler drops and reaction time.



(ii) Use this graph to find Charlie's mean reaction time.

..... ms [1]

(iii) Explain why Phil's results might be more precise but less reliable than Ali's and Charlie's.

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 [2]

(d) Explain why **complex** reaction times are generally slower than the **simple** reaction times and have more mistakes.

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..... [1]

(e) Look at **Table 3** and **Graph 2** in the article.

(i) Why was **Group A** included in the investigation?

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..... [1]



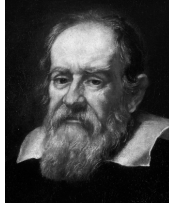


(ii) Use the data to explain why it is not safe to drive a car after using alcohol or drugs like temazepam.

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..... [3]

[Total: 15]

2 Human understanding of the universe has changed over the last 4000 years.

(a) For each theory, put a tick (✓) in the column for each of the people who believed this. Each row may have one or more than one tick.

Theory	Ancient Greeks 	Copernicus 	Galileo 	Newton 	Hubble 
Earth is the centre of the universe (Geocentric)					
Galaxies move away from us					
Moon orbits the Earth					
The Earth moves because of gravity					

[4]

(b) Suggest **two** scientific developments which have allowed modern scientists to improve earlier theories about the universe.

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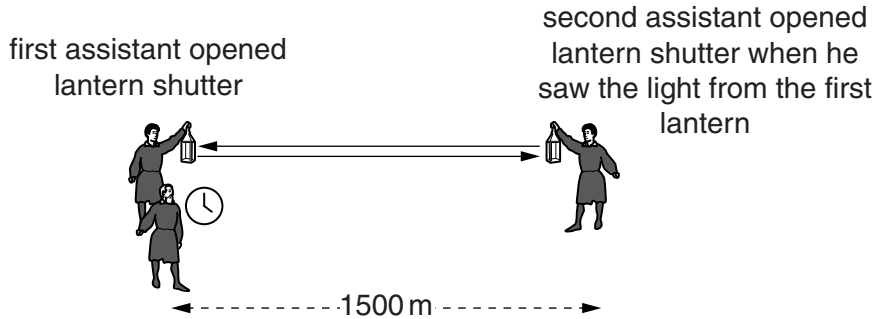
..... [2]

(c) Galileo tried to work out how fast light travels.

He had two assistants standing on hills.

The first person shone a lantern towards the second.

As soon as the second person saw the light he shone his own lantern.



Galileo measured the time between the opening of the first lantern shutter and observation of light from the second lantern.

Assuming that light travels at 300 000 km/s, show that Galileo would have to measure a time of less than 1 ms in this experiment.

[2]

(d) Two other scientists, called Fizeau and Foucault, redesigned Galileo's experiment. They used machines with wheels and mirrors instead of people with lanterns. They managed to measure the speed of light more accurately.

Suggest why this experiment was more accurate than Galileo's.

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..... [2]

- (e) At about this time, James Clerk Maxwell suggested that there were many different types of electromagnetic radiation. He knew about light but predicted the existence of radio waves.

Why is it important that his theory could be used to predict the existence of radio waves?

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..... [2]

- (f) Many people were involved in developing radio as a means of communication. Draw a straight line to link each person with their contribution to the development of radio.

Person	Contribution
Hertz	First to send radio waves beyond the horizon
Marconi	First to send and receive radio waves
Morse	Invented a digital code

[2]

- (g) Data can be sent as binary digits (bits).

- (i) List **all** the possible values for a single bit.

..... [1]

- (ii) A broadband connection advert offers “up to 100 Megabits per second”.

How many bytes of data may be received each second?

Show your working.

.....bytes [2]

[Total: 17]

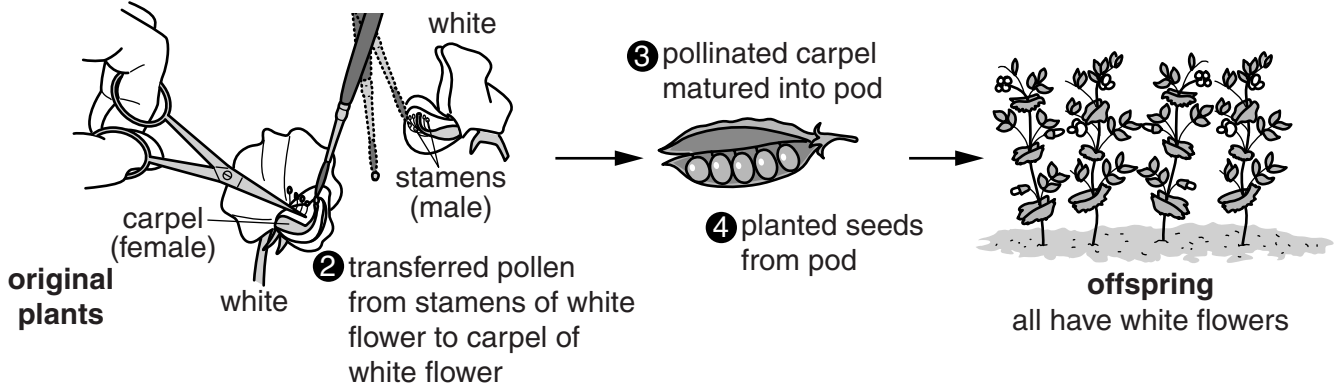
3 Gregor Mendel studied the characteristics of pea plants.

Some of his pea plants had white flowers and some had purple flowers.

Experiment 1

When he took pollen from a white flower and used it to fertilise another white flower, the seeds always grew into plants with white flowers.

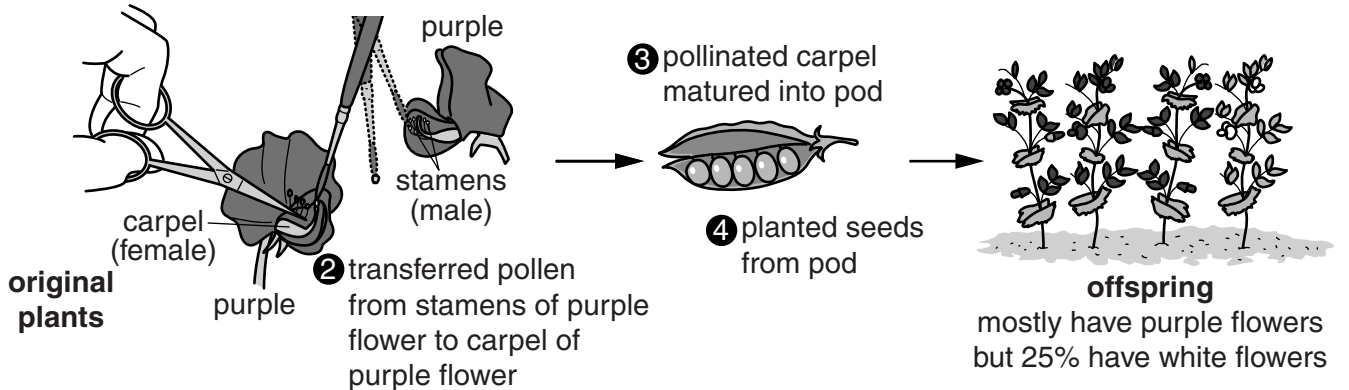
- ① removed stamens from white flower



Experiment 2


When he took pollen from a purple flower and used it to fertilise another similar purple flower, most of the seeds grew into plants with purple flowers, but 25% of the seeds grew into plants with white flowers.

- ① removed stamens from purple flower



Mendel invented a model to explain how these results are obtained.

- (a) Explain how the colour of a flower is inherited and why the two types of plant crosses produce either all white offspring or a mixture of purple and white offspring.

 The quality of written communication will be assessed in your answer.

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- (b) Many years after Mendel published his work, another scientist published a paper suggesting that the results that Mendel reported were "too perfect" to have been obtained in a real experiment.

Mendel is dead, so he cannot be asked if he had "cheated".

What could you do to check if Mendel had "cheated"?

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..... [2]

[Total: 8]

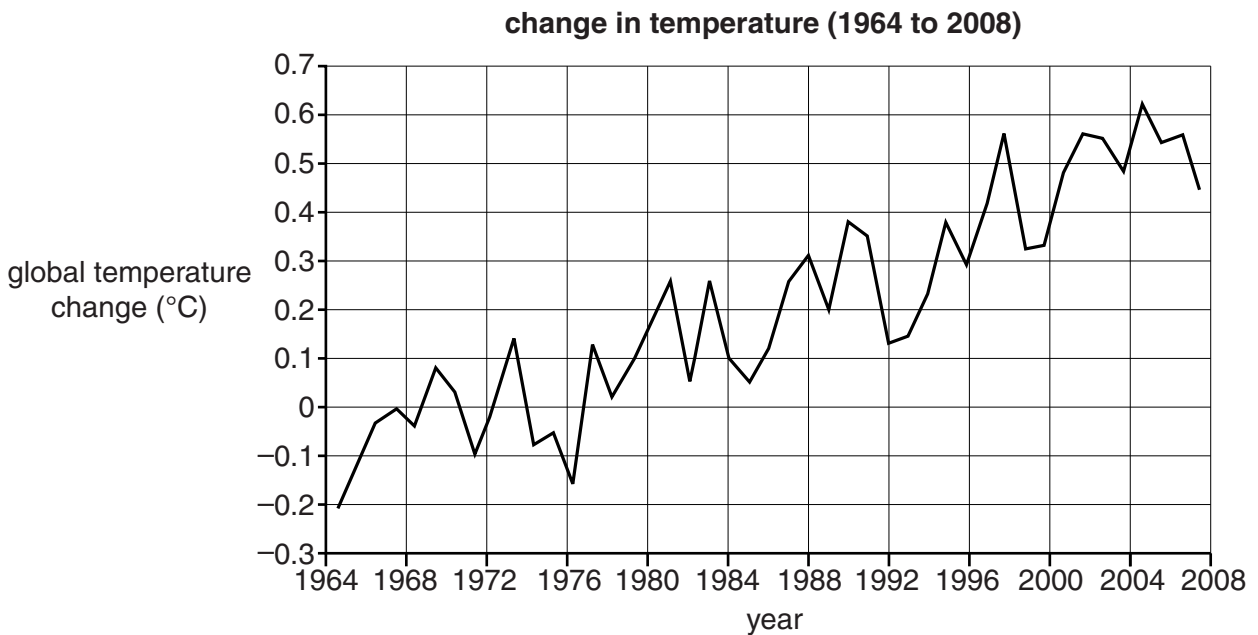
4 The amount of carbon dioxide in the atmosphere has changed over the last 50 years.

Year	1960	1970	1980	1990	2000	2010
Atmospheric carbon dioxide in parts per million (ppm)	316	325	338	354	369	388

(a) Calculate the percentage change in the carbon dioxide level from 1960 to 2010.

..... [2]

(b) During this time, the global temperatures have also changed.

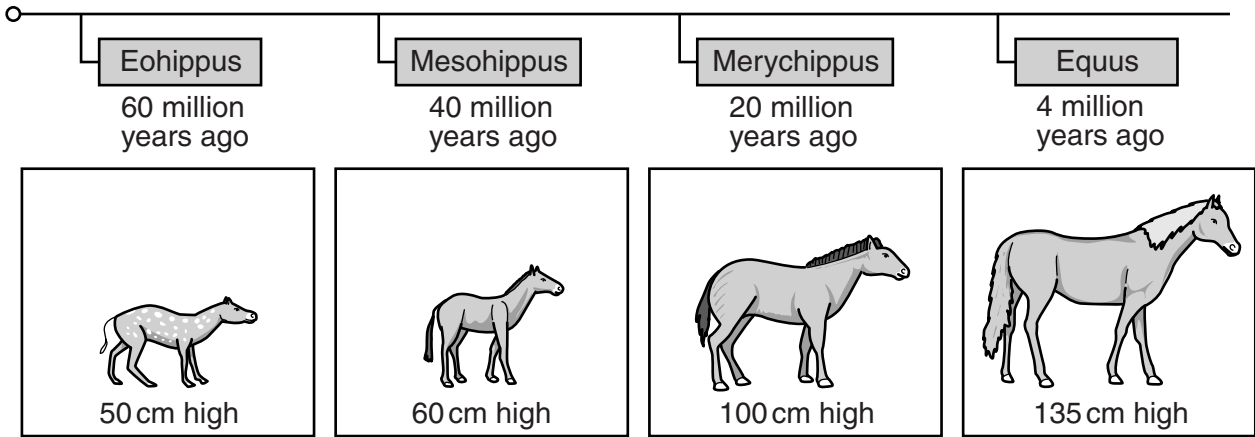


Describe the way that global temperature has changed.

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 [2]

5 The horse has evolved over many years.



(a) Explain the processes that took place as Eohippus evolved into Equus.

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(b) Modern racehorses have been bred from Equus. Explain how a racehorse breeder would breed a successful racehorse.

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

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..... [4]

[Total: 8]

END OF QUESTION PAPER



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