ST EDWARD'S

OXFORD

13+ SCHOLARSHIP EXAMINATION

2015

SCIENCE

Candidate Name

1 Hour

INSTRUCTIONS TO CANDIDATES

Write your name in the spaces at the top of this page.
Answer **all** questions.
Write your answers in the spaces provided on the question paper.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets [ ] at the end of each question or part question.
The marks allocated and the spaces provided for your answers are a good indication of the length of answers required.
A calculator may be used.

Biology	Chemistry	Physics

Total /60

%

Grade

PHYSICS

Read the passage from the BBC News website and answer the questions below:

9 February 2015 BBC News

Hey, fancy buying a straw house?

By Victoria Gill Science reporter, BBC News

The first straw houses in the UK to be offered on the open market are on sale. Though straw walls might be most readily linked to a story of pigs making questionable construction choices, the team behind these homes says the material could help to sustainably meet housing demand. The homes are the result of an engineering research project led by the University of Bath. The team says this development should move building with straw from a niche technique for the ecologically minded to the wider market.

A typical three-bedroom house would use about seven tonnes of straw. The houses, on a street of traditional brick-built homes in Bristol, are clad in brick to fit in with the surroundings. But their prefabricated walls are timber framed, filled with straw bales and encased in wooden boards.

Prof Pete Walker from the University of Bath, who led the project to develop and test this construction method, told BBC News: "I think there's a lot of misconception about using straw - stories about the three little pigs and the big bad wolf, concerns about fire resistance." As part of this EU-funded project, Prof Walker and his colleagues have systematically tested and refined the technology - including testing its structural and weight-bearing properties, and its thermal insulation. "Our testing over a number of years, and our research has demonstrated that it is a robust and safe form of construction." He added that, since straw absorbs carbon dioxide as is grows, using it as a building material actually "locks carbon into the walls" of a building.

Building with straw - the figures

- Straw is the leftover stalks from cereal crops - normally used for animal bedding
- Just under four million tonnes of this leftover straw is produced every year by UK agriculture, according to the Agricultural and Horticultural Development Board
- It takes about seven tonnes of straw to build a three-bedroom house with this pre-fabrication method
- That means there is potential to grow the material for more than half a million new homes every year in British fields.

"They're also a very efficient insulator, so they should reduce energy bills by as much as 90% compared to other houses around this site," Prof Walker added. Thermal images show how traditional brick house walls (right) lose more heat than a straw bale building.

Although these are not the first homes in the UK to be built using straw bales, they are the first to be built for any buyer on the open market.

Craig White, director of Modcell, the architectural firm involved in the project, explained: "Previously, you'd have a client in place, they knew they wanted a straw bale construction, and they would commission us to deliver that. "These are the first ones being built speculatively, for the open market," he told the BBC. "I think it's a very exciting time for this building technology. "And the more we can build out of renewable materials like straw and timber, the less carbon will be in the atmosphere, so we can reduce climate change effects."

1) How many tonnes of straw are needed for a typical 3-bedroom house? (1 mark)

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2) How many kilogrammes does your answer to Part (1) correspond to? (1 mark)

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3) Given the bulk density of wheat straw to be (on average) 100kg/m^3, what total volume does this correspond to? (3 marks)

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4) How many bales of straw are required, given that the dimensions are: width = 50cm, length = 1m, height = 50cm? (2 marks)

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5) Despite straw being partially crushed as it is turned into bales, why does it make a good insulator? (4 marks)

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6) Cotton is also a crop, with a density of 1.55g/cm3. Fibre glass is a commonly used insulator in lofts, with a density of 2.5g/cm3. Use ideas about density, conduction and convection as part of your answer to discuss why straw has not been the typical choice of insulation material to date. (6 marks)

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7) How do thermal images work? What do they measure? (2 marks)

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8) What does the colour scale on a thermograph represent? How is it chosen? (1 mark)

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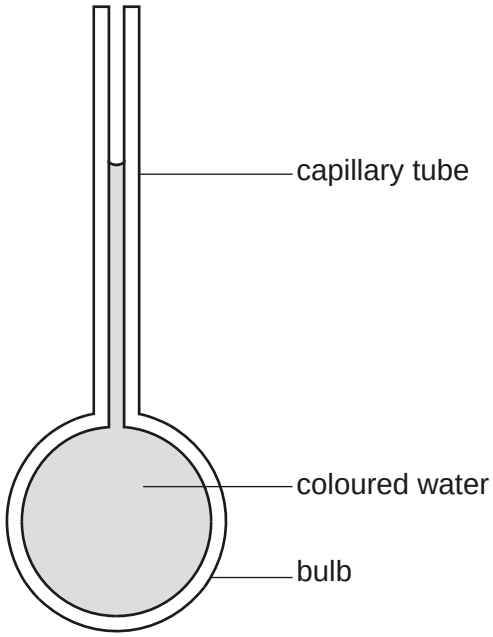
CHEMISTRY

1. You can make a simple thermometer by blowing a bulb on the end of a glass capillary tube and filling it with coloured water as shown below.



(a) When the bulb is warmed, the water rose up the tube. Can you explain why this might happen?

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(2 marks)

(b) After you have made your simple thermometer, you want to make it as accurate as possible at measuring the temperature. List some ideas of how you might do this.

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(3 marks)

2. The frames of airplanes are largely made from aluminium. What properties do you think aluminium should have to make it useful for this purpose?

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(4 marks)

3. Butane, petrol and diesel are all examples of fuels.

(a) Describe what you think a fuel is.

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(3 marks)

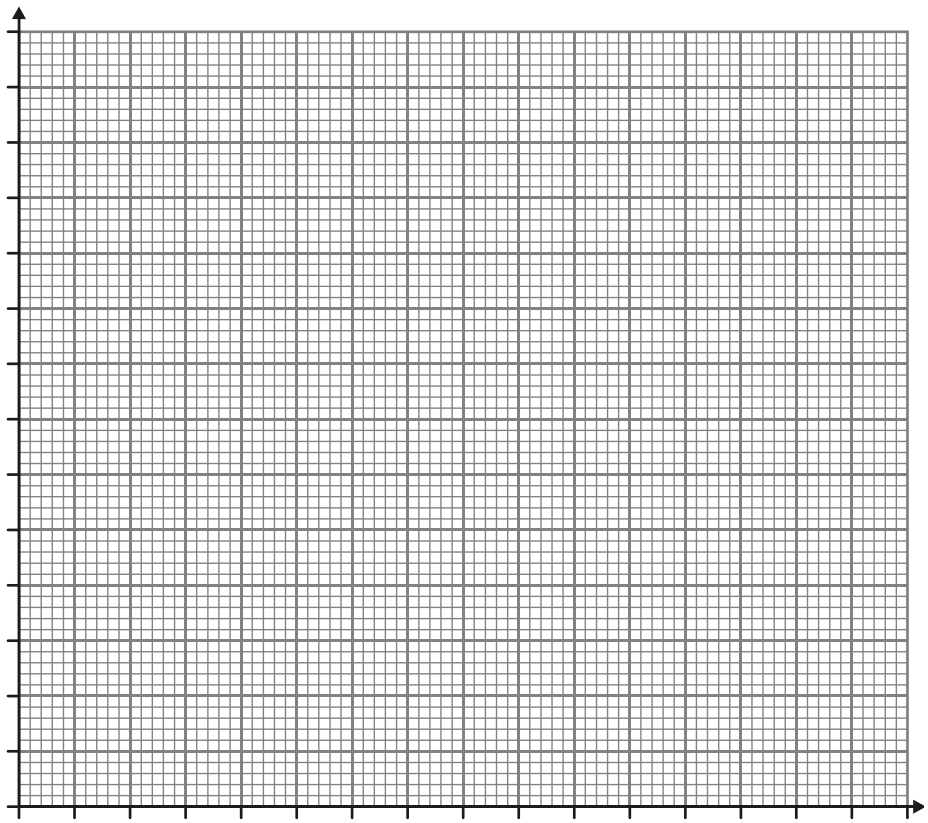
4. Six groups of pupils burned magnesium in air. The magnesium reacted with oxygen to form magnesium oxide.

They recorded the mass of magnesium used and the mass of magnesium oxide formed. Their results are shown in the table.

group	mass of magnesium (g)	mass of magnesium oxide (g)
A	3.2	5.2
B	3.8	6.5
C	4.2	7.0
D	4.9	8.6
E	5.4	8.0
F	6.1	10.7

(a) Use their results to draw a graph below. (4 marks)

□ Decide the scale for each axis. □ Plot the points.
□ Label the axes. □ Draw a line of best fit.



(b) (i) Which group's results do **not** fit the general pattern?
Give the letter.

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(1 mark)

(ii) Suggest a reason why their result might be incorrect?

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(1 mark)

(c) Use the graph to predict the mass of magnesium oxide that will be formed by burning 7.0 g of magnesium.

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(1 mark)

(d) The results show the relationship between the mass of magnesium and the mass of magnesium oxide formed.

What conclusion could you draw about this relationship?

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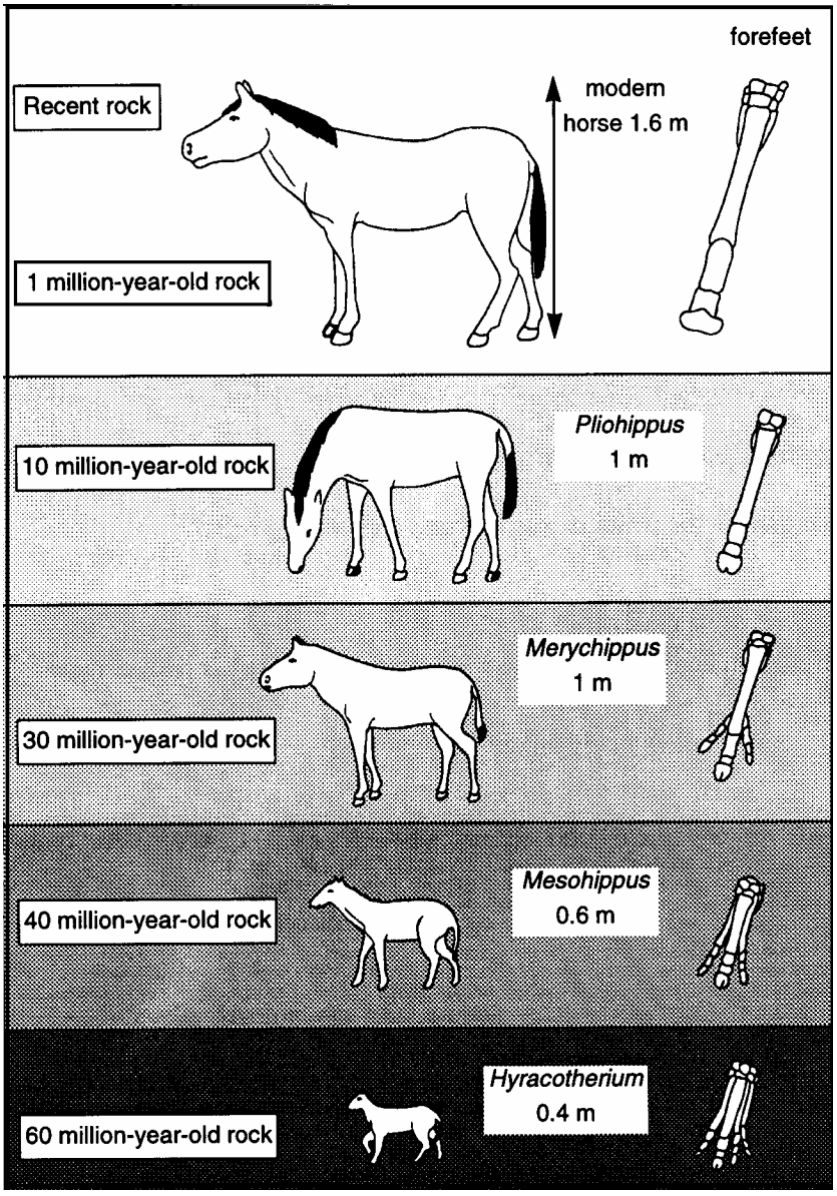
(1 mark)

BIOLOGY

1. The diagrams show fossil animals found in rocks of different ages. Scientists have used this information to work out how the modern horse evolved.



(a) *Mesohippus* became extinct over thirty million years ago. Use information from the diagrams to suggest **two** reasons why this happened.

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(2 marks)

(b) (i) How do scientists know how big these early horses were?

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(1 mark)

(ii) How do scientists know when they lived?

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(1 mark)

(c) Explain how the information in the diagrams supports the theory of evolution.

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(3 marks)

2. Earthworms are important soil organisms. When they burrow, they help to bring air into the soil as well as improving drainage. Earthworms also bury leaves in the soil. These decay making the soil more fertile. Earthworms in turn are eaten by voles, moles, foxes, badgers and birds.

New Zealand flatworm

In some parts of the United Kingdom, earthworms are being killed by New Zealand flatworms. The animals are spreading quickly and have no natural enemies. The flatworms do not make their own burrows. They only use the burrows made by the earthworms in order to attack them.

(a) Explain, as fully as you can, why it is important to control or get rid of these New Zealand flatworms in Britain.

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(4 marks)

(b) Suggest **one** possible way, giving **one** advantage and **one** disadvantage, that this New Zealand flatworm could be controlled.

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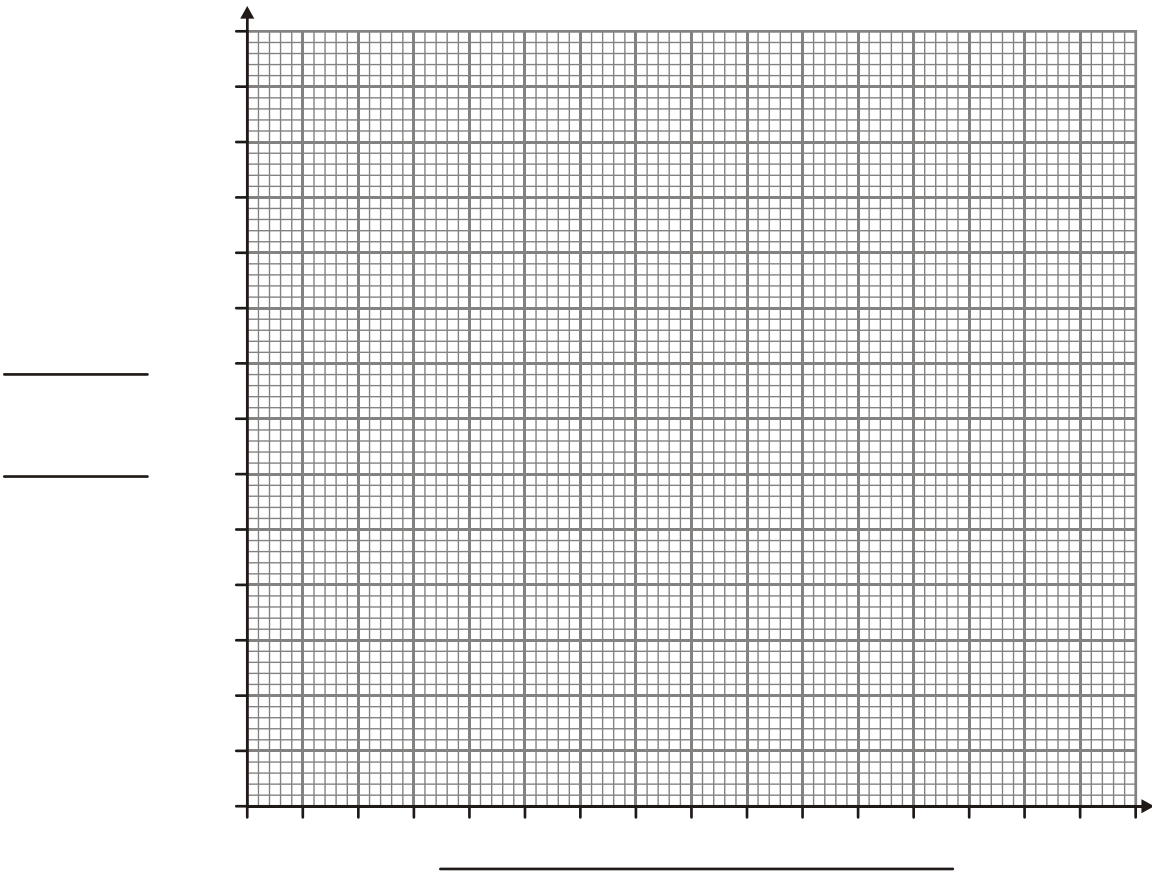
3. Neutrase is an enzyme that breaks down protein. A protein is the main reason that milk is cloudy. Six groups of students investigated the effect of neutrase concentration on the breakdown of protein in a powdered milk solution. Their table of results is below:

Concentration of neutrase (%)	**Time taken for milk to clear (seconds)**						
	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	**Average**
5	60	63	58	59	54	65	**60**
4	67	72	71	60	64	74	**68**
3	81	104	83	69	80	90	**85**
2	135	106	123	103	122	122	**119**
1	208	246	259	244	240	200	**233**

(a) Plot a graph to show the average results obtained in the investigation.

(5 marks)



(b) Describe the trend seen on the graph

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(1 mark)