

OXFORD CAMBRIDGE AND RSA EXAMINATIONS
GCSE

A152/01

TWENTY FIRST CENTURY SCIENCE
ADDITIONAL SCIENCE A

Modules B5 C5 P5 (Foundation Tier)

MONDAY 10 JUNE 2013: Afternoon

DURATION: 1 hour
plus your additional time allowance

MODIFIED ENLARGED

| | | | |
|-------------------------------|--|------------------------------|--|
| Candidate forename | | Candidate surname | |
|-------------------------------|--|------------------------------|--|

| | | | | | | | | | | |
|--------------------------|--|--|--|--|--|-----------------------------|--|--|--|--|
| Centre number | | | | | | Candidate number | | | | |
|--------------------------|--|--|--|--|--|-----------------------------|--|--|--|--|

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)


Calculator

READ INSTRUCTIONS OVERLEAF

INSTRUCTIONS TO CANDIDATES

- Write your name, centre number and candidate number in the boxes on the first page. 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).

INFORMATION FOR CANDIDATES

- Your quality of written communication is assessed in questions marked with a pencil ()
- The number of marks is given in brackets [] at the end of each question or part question.
- A list of physics equations is printed on pages 4–5.
- A list of qualitative tests for ions is printed on pages 6–7.
- The Periodic Table is printed on page 39.
- The total number of marks for this paper is 60.
- Any blank pages are indicated.

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TWENTY FIRST CENTURY SCIENCE EQUATIONS

USEFUL RELATIONSHIPS

THE EARTH IN THE UNIVERSE

$$\text{distance} = \text{wave speed} \times \text{time}$$

$$\text{wave speed} = \text{frequency} \times \text{wavelength}$$

SUSTAINABLE ENERGY

$$\text{energy transferred} = \text{power} \times \text{time}$$

$$\text{power} = \text{voltage} \times \text{current}$$

$$\text{efficiency} = \frac{\text{energy usefully transferred}}{\text{total energy supplied}} \times 100\%$$

EXPLAINING MOTION

$$\text{speed} = \frac{\text{distance travelled}}{\text{time taken}}$$

$$\text{acceleration} = \frac{\text{change in velocity}}{\text{time taken}}$$

$$\text{momentum} = \text{mass} \times \text{velocity}$$

$$\text{change of momentum} = \frac{\text{resultant force}}{\text{force}} \times \text{time for which it acts}$$

$$\text{work done by a force} = \text{force} \times \text{distance moved in the direction of the force}$$

$$\text{amount of energy transferred} = \text{work done}$$

$$\text{change in gravitational potential energy} = \text{weight} \times \text{vertical height difference}$$

$$\text{kinetic energy} = \frac{1}{2} \times \text{mass} \times [\text{velocity}]^2$$

ELECTRIC CIRCUITS

$$\text{power} = \text{voltage} \times \text{current}$$

$$\text{resistance} = \frac{\text{voltage}}{\text{current}}$$

$$\frac{\text{voltage across primary coil}}{\text{voltage across secondary coil}} = \frac{\text{number of turns in primary coil}}{\text{number of turns in secondary coil}}$$

RADIOACTIVE MATERIALS

$$\text{energy} = \text{mass} \times [\text{speed of light in a vacuum}]^2$$

TWENTY FIRST CENTURY SCIENCE DATA SHEET

QUALITATIVE ANALYSIS

TESTS FOR IONS WITH A POSITIVE CHARGE

| Ion | Test | Observation |
|--|------------------------------------|---|
| calcium Ca²⁺ | add dilute sodium hydroxide | a white precipitate forms; the precipitate does not dissolve in excess sodium hydroxide |
| copper Cu²⁺ | add dilute sodium hydroxide | a light blue precipitate forms; the precipitate does not dissolve in excess sodium hydroxide |
| iron(II) Fe²⁺ | add dilute sodium hydroxide | a green precipitate forms; the precipitate does not dissolve in excess sodium hydroxide |
| iron(III) Fe³⁺ | add dilute sodium hydroxide | a red-brown precipitate forms; the precipitate does not dissolve in excess sodium hydroxide |
| zinc Zn²⁺ | add dilute sodium hydroxide | a white precipitate forms; the precipitate dissolves in excess sodium hydroxide |

TESTS FOR IONS WITH A NEGATIVE CHARGE

| Ion | Test | Observation |
|--|--|---|
| carbonate CO_3^{2-} | add dilute acid | the solution effervesces; carbon dioxide gas is produced (the gas turns lime water from colourless to milky) |
| chloride Cl^- | add dilute nitric acid, then add silver nitrate | a white precipitate forms |
| bromide Br^- | add dilute nitric acid, then add silver nitrate | a cream precipitate forms |
| iodide I^- | add dilute nitric acid, then add silver nitrate | a yellow precipitate forms |
| sulfate SO_4^{2-} | add dilute acid, then add barium chloride or barium nitrate | a white precipitate forms |

Answer ALL the questions.

- 1 The Vikings dug out small amounts of impure iron from peat bogs.
This 'bog iron' contains iron oxide.**

The Vikings heated the bog iron in a charcoal fire to extract the iron.

The fire makes carbon monoxide, which reacts with the iron oxide.

- (a) There are four chemicals involved in one of the reactions in the fire.**

IRON

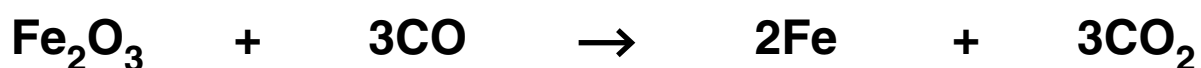
IRON OXIDE

CARBON DIOXIDE

CARBON MONOXIDE

Write the name of each chemical in the box under its formula.

One has been done for you.



**iron
oxide**

[1]

- (b) How many atoms of iron are in each formula of Fe_2O_3 ?**

Put a ring around the correct answer.

1 2 3 5 6

[1]

- (c) The relative atomic mass of carbon is 12.
The relative atomic mass of oxygen is 16.

Calculate the relative formula mass of CO.

answer = _____ [1]

- (d) The relative atomic mass of Fe is 56.
What mass of Fe is in one gram formula mass of Fe_2O_3 ?

answer = _____ g [2]

- (e) What happens to the metal oxide when it is changed into the metal?
Put a ring around the correct answer.

COMBUSTION

OXIDATION

PRECIPITATION

REDUCTION

[1]

- (f) The bog iron contains traces of aluminium oxide. Why does the carbon monoxide NOT extract the aluminium as well as the iron?
Use ideas about reactivity in your answer.

[2]

[TOTAL: 8]

2 Julie takes samples of water from a disused mine.

She adds different chemicals to the samples to see if any of them make a precipitate.

(a) What can we say about a precipitate?

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

A precipitate is

| | |
|--------------------|--------------------------|
| an element. | <input type="checkbox"/> |
| insoluble. | <input type="checkbox"/> |
| a mineral. | <input type="checkbox"/> |
| soluble. | <input type="checkbox"/> |

[1]

(b) Julie wants to know what ions are dissolved in the mine water.

(i) When she adds sodium hydroxide solution to the water a white precipitate appears.

This shows that some ions might be present.

Put rings around the ions that might be present. Use the data sheet to help you.

CARBONATE

SULFATE

CALCIUM

COPPER

IRON(II)

IRON(III)

ZINC

[1]

- (ii) She then adds more sodium hydroxide and the white precipitate disappears.
This shows Julie that only one ion is present.

Put a ring around the ion that is present.

CARBONATE

SULFATE

CALCIUM

COPPER

IRON(II)

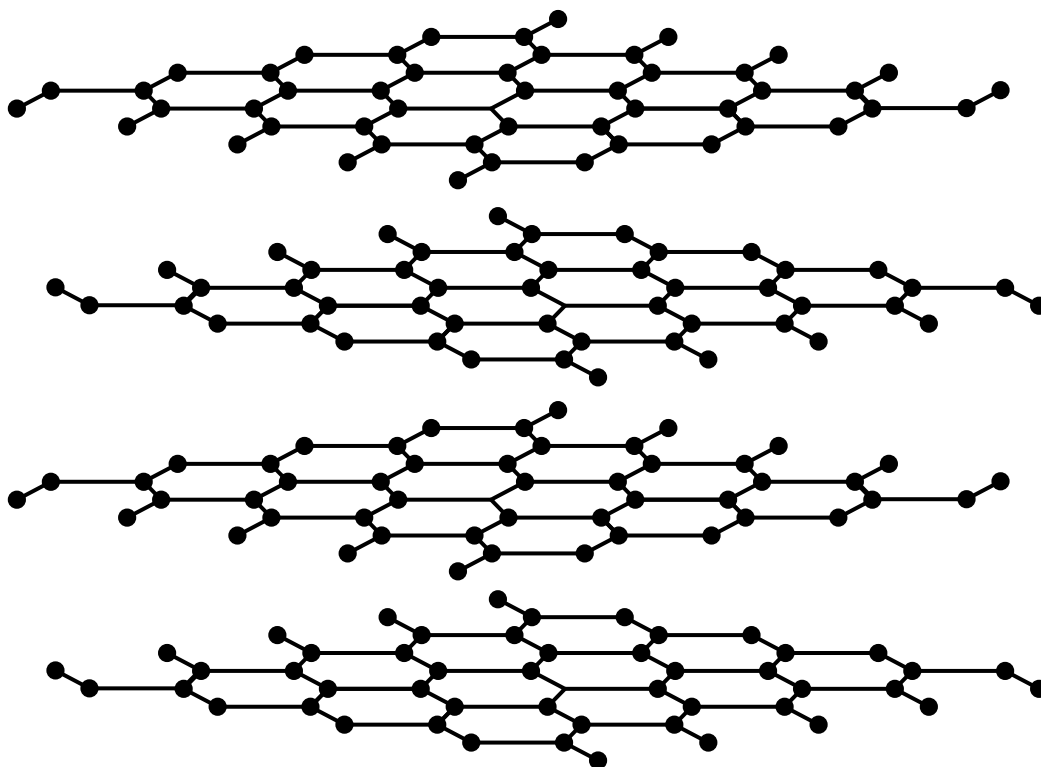
IRON(III)

ZINC

[1]

[TOTAL: 3]

3 The diagram shows the structure of graphite.



Graphite can be used as electrodes for electrolysis at high temperatures.

It is also used for lubricating moving parts in door locks and hinges.

Use ideas about the structure and properties of graphite to explain why graphite will do both these jobs.



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

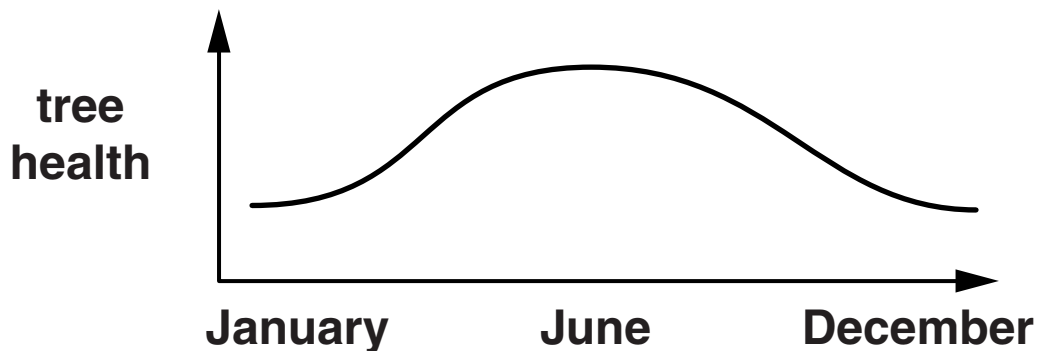
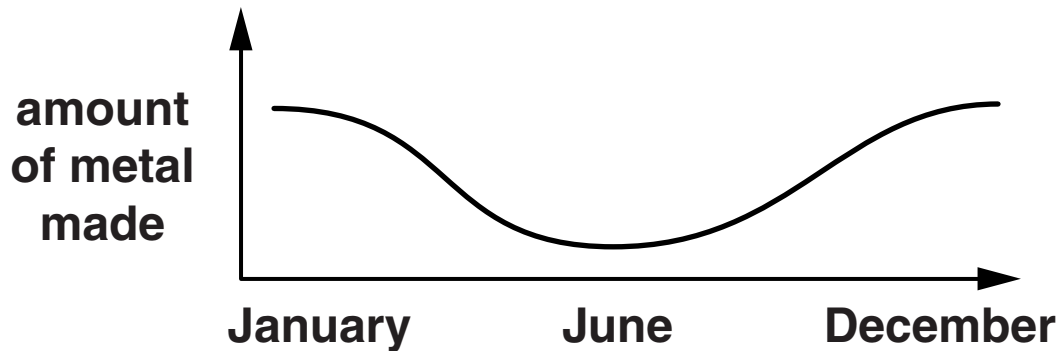
[6]

[TOTAL: 6]

4 A factory extracts metal.

The factory gives out acidic fumes of sulfur dioxide.

Scientists have been measuring how healthy the trees are in the area near the factory.



George and Maria look at the graphs.

This is what they think.

George
The factory is damaging the trees.

Maria
I'm not convinced that the factory is damaging the trees.

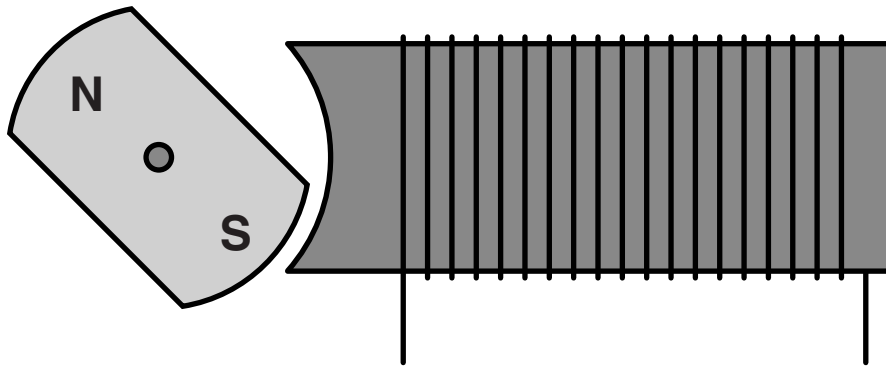
Both George and Maria could be right.

Explain why.

[3]

[TOTAL: 3]

- 5 This diagram shows part of a generator of alternating current in a power station.



The generator transfers energy from a spinning turbine into electricity.

Describe how the generator works. You may label the diagram.

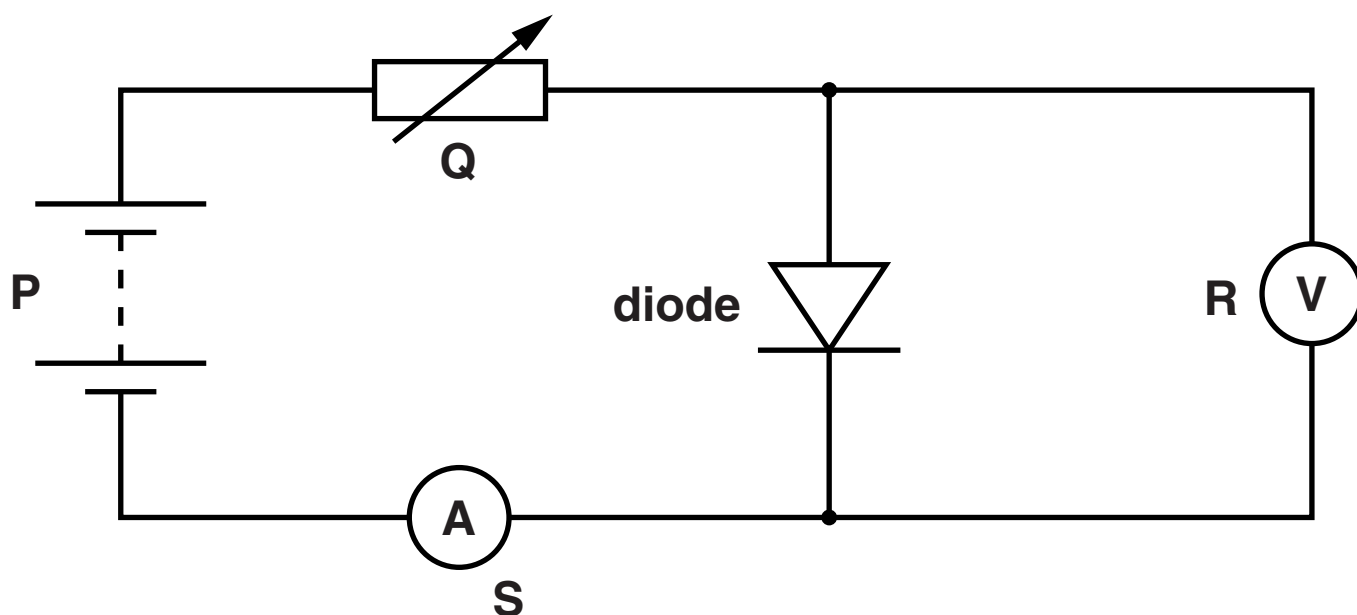


The quality of written communication will be assessed in your answer.

[6]

[TOTAL: 6]

- 6 Sally uses this circuit to investigate an electrical component called a diode.



- (a) Draw straight lines to link each labelled **COMPONENT**, P, Q, R and S, in her circuit with its **FUNCTION**. One has been done for you.

| COMPONENT | FUNCTION |
|-----------|--|
| P | measures the current in the diode |
| Q | pushes electrons around the circuit |
| R | is used to change the current in the circuit |
| S | measures the potential difference across the diode |

[2]

- (b) Sally measures the potential difference across the diode for two different currents.
Here are her results.

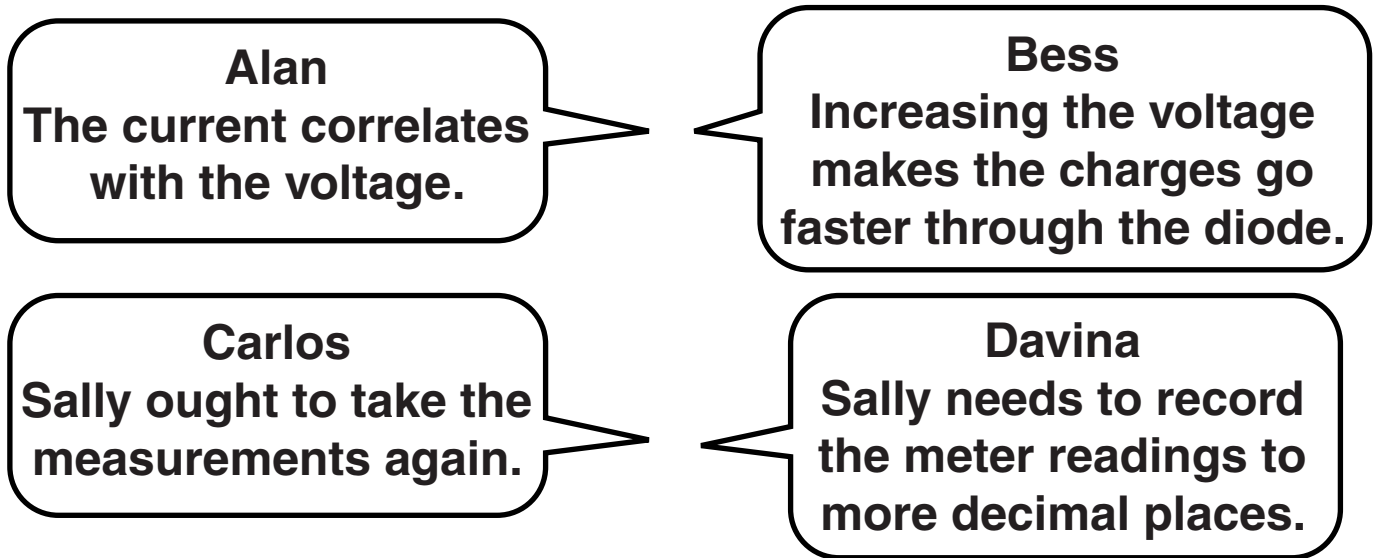
| Current in amps | Potential difference in volts |
|-----------------|-------------------------------|
| 0.12 | 0.60 |
| 0.45 | 0.90 |

What can she conclude about the effect of changing the current on the resistance of the diode?

Justify your answer. You may use calculations.

[3]

(c) Sally's friends talk about her experiment.



(i) Who suggests an EXPLANATION for Sally's results?

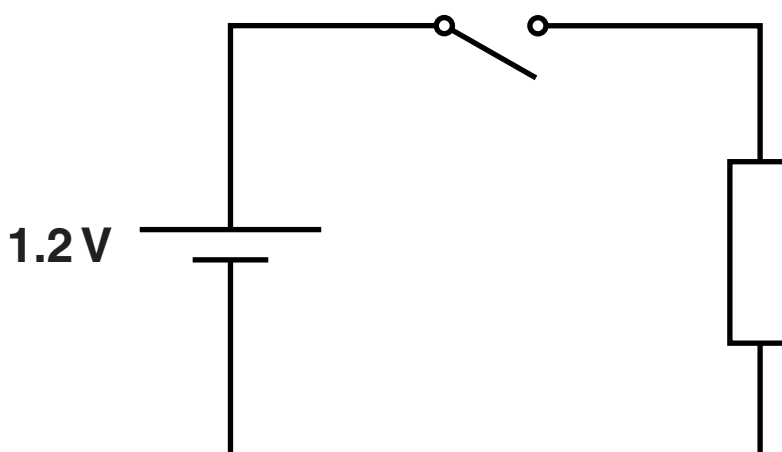
answer _____ [1]

(ii) Who talks about CHECKING Sally's data?

answer _____ [1]

[TOTAL: 7]

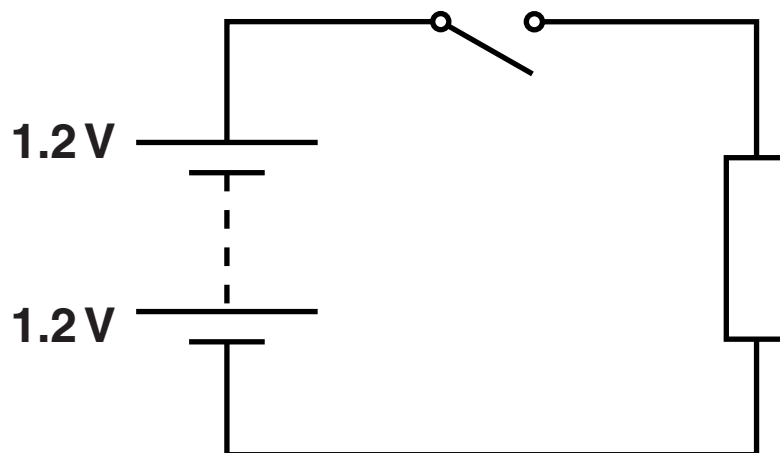
- 7 Dave keeps insects in a cage. He uses this circuit to keep them warm.



- (a) The current in the circuit is 0.2 A when the switch is closed.
Calculate the heating power of the circuit.

heating power = _____ W [1]

- (b) Dave adds an extra cell to increase the heating power of the circuit.



Complete the sentences by putting a **ring** around the correct choice.

The extra cell

DOUBLES / HALVES / DOES NOT CHANGE
the potential difference across the resistor.

The resistance of the fixed resistor

DOUBLES / HALVES / DOES NOT CHANGE.

The current in the fixed resistor

DOUBLES / HALVES / DOES NOT CHANGE.

[2]

[TOTAL: 3]

8 Electric motors are widely used in modern appliances.

(a) State the name of an appliance which contains an electric motor and describe what that motor does.

[2]

**(b) Explain how the current in an electric motor makes it spin round.
Use these words in your answer.**

COIL

FIELD

FORCE

MAGNET

[2]

[TOTAL: 4]

9 Dystrophin is a protein found in healthy muscle cells.

The gene for dystrophin is found in the nucleus.

The gene is made of DNA.

(a) Put a tick (✓) in the box next to the correct word to complete each sentence.

| | | | |
|------------------|---------------|--------------------------|-------------------------|
| DNA has a | single | <input type="checkbox"/> | helix structure. |
| | double | <input type="checkbox"/> | |
| | triple | <input type="checkbox"/> | |

Strands of DNA are made of four different bases.

| | | |
|--|-----------|--------------------------|
| The base T always pairs with the base | A. | <input type="checkbox"/> |
| | C. | <input type="checkbox"/> |
| | G. | <input type="checkbox"/> |

| | | | |
|--|----------------|--------------------------|----------------------|
| The code for dystrophin is in the | order | <input type="checkbox"/> | of the bases. |
| | pairing | <input type="checkbox"/> | |
| | shape | <input type="checkbox"/> | |

[2]

- (b) People who cannot make dystrophin have the condition called Duchenne muscular dystrophy (DMD).**

The incidence of DMD is 2.86 in 10 000 births.

One city in England has 5000 births in one year.

- (i) Calculate how many new cases of DMD can be expected in this city in this year.**

Show your working.

answer = _____ [2]

- (ii) A doctor has found a protein that she thinks is only present in people with DMD.**

**She has tested six children who have DMD.
They all have the protein.**

She concludes that the protein is a good test for DMD.

Suggest TWO ways the doctor could increase her confidence in her conclusion.

_____ [2]

[TOTAL: 6]

10 Gary studies mitosis in a plant root under his microscope.

(a) Which processes occur during mitosis?

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

number of organelles increases

☐

chromosomes are copied

☐

chromosomes separate

☐

nucleus divides

☐

number of chromosomes halves

☐

[2]

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(b) Gary counts how many cells he can see.

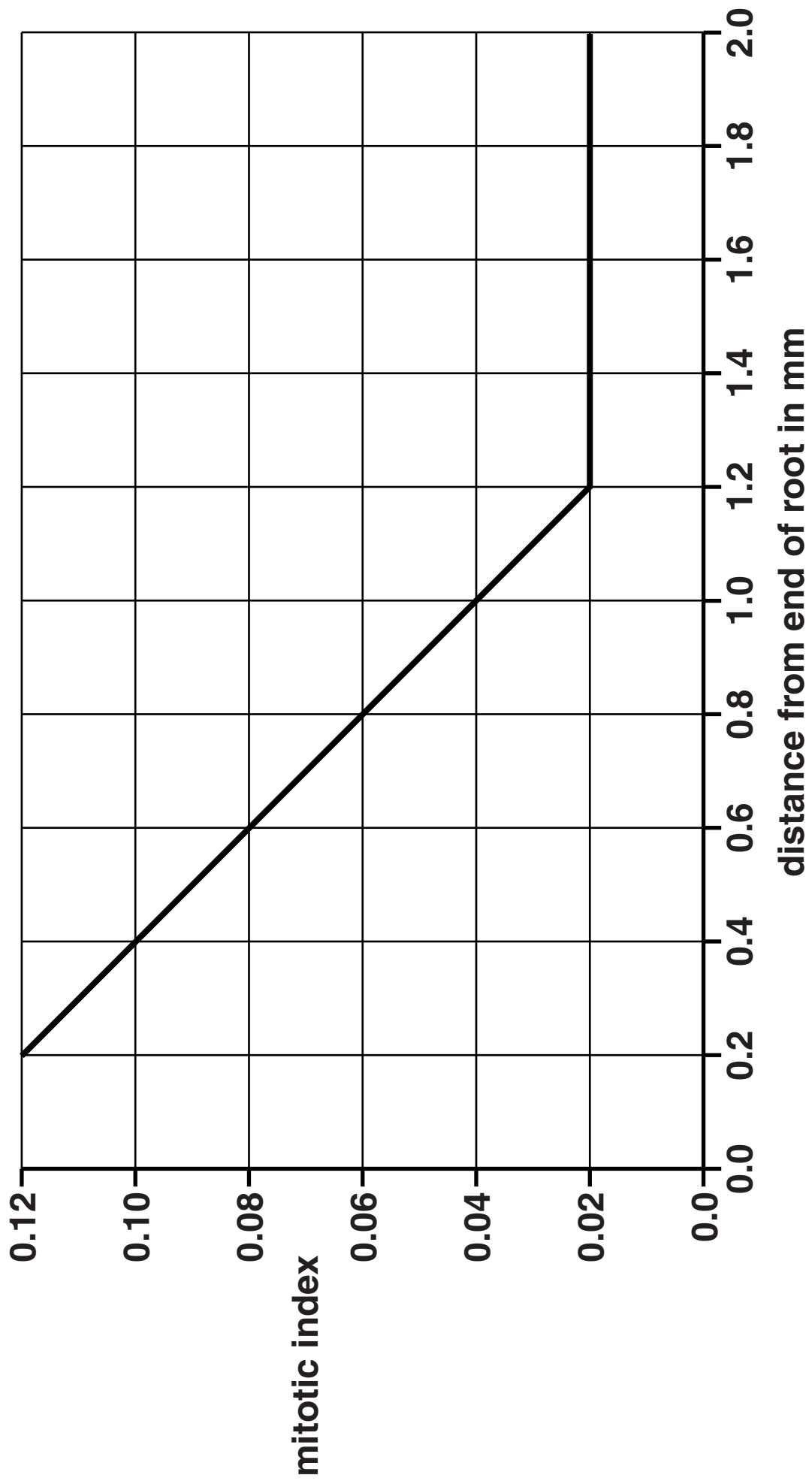
He then counts how many of these are undergoing mitosis.

He works out the mitotic index using this equation.

$$\text{mitotic index} = \frac{\text{number of cells showing mitosis}}{\text{total number of cells in view}}$$

Gary calculates the mitotic index at different distances from the end of the root.

He plots his results on the graph on page 30.



Gary looks at one section of the root through his microscope.

He sees that 16 out of 200 cells are undergoing mitosis.

(i) Calculate the mitotic index for this section.

answer = _____ [1]

(ii) Meristem tissue has a mitotic index of more than 0.1.

Is this section from the meristem?

Justify your answer.

_____ [1]

(iii) Use your answer to part (i) and Gary's graph opposite to suggest how far this section is from the end of the root.

answer = _____ [1]

[TOTAL: 5]

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11 Dutch elm disease has killed many elm trees in England.

Some elms are resistant to the disease.

Park keepers want to plant resistant elm trees to replace ones which have been killed.

They decide to use cuttings from the resistant elms, rather than using seeds.

Describe the process of using cuttings, and explain why they choose this method.



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

[6]

[TOTAL: 6]

12 This question is about stem cells.

Use words from the list to complete the sentences.

Each word may be used ONCE, MORE THAN ONCE or NOT AT ALL.

ACTIVATED

DEACTIVATED

GENES

PROTEINS

SPECIALISED

UNSPECIALISED

At the four cell stage in human embryos all of the cells are _____ .

After the eight cell stage most of the cells become _____ to form different types of tissue.

All of the cells in a person have the same _____ .

Cells in adult tissues only make some of the _____ coded for.

This means that tissue cells must have some _____ that are switched off.

[3]

[TOTAL: 3]

END OF QUESTION PAPER

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The Periodic Table of the Elements

| | | | | | | | | | | | | | | | | | |
|-------------------------------|-----------------------------|---|-------------------------------------|-------------------------------|----------------------------------|--------------------------------|-------------------------------|----------------------------------|------------------------------------|-----------------------------------|---|-----------------------------|-----------------------------|-----------------------------|-------------------------------|-------------------------------|----------------------------|
| 1 | 2 | Key | | | | | 3 | 4 | 5 | 6 | 7 | 0 | | | | | |
| 1 H hydrogen 1 | | relative atomic mass atomic symbol name atomic (proton) number | | | | | | | | | | 4 He helium 2 | | | | | |
| 7 Li lithium 3 | 9 Be beryllium 4 | | | | | | | | | | | 11 B boron 5 | 12 C carbon 6 | 14 N nitrogen 7 | 16 O oxygen 8 | 19 F fluorine 9 | 20 Ne neon 10 |
| 23 Na sodium 11 | 24 Mg magnesium 12 | | | | | | | | | | | 27 Al aluminium 13 | 28 Si silicon 14 | 31 P phosphorus 15 | 32 S sulfur 16 | 35.5 Cl chlorine 17 | 40 Ar argon 18 |
| 39 K potassium 19 | 40 Ca calcium 20 | 45 Sc scandium 21 | 48 Ti titanium 22 | 51 V vanadium 23 | 52 Cr chromium 24 | 55 Mn manganese 25 | 56 Fe iron 26 | 59 Co cobalt 27 | 59 Ni nickel 28 | 63.5 Cu copper 29 | 65 Zn zinc 30 | 70 Ga gallium 31 | 73 Ge germanium 32 | 75 As arsenic 33 | 79 Se selenium 34 | 80 Br bromine 35 | 84 Kr krypton 36 |
| 85 Rb rubidium 37 | 88 Sr strontium 38 | 89 Y yttrium 39 | 91 Zr zirconium 40 | 93 Nb niobium 41 | 96 Mo molybdenum 42 | [98] Tc technetium 43 | 101 Ru ruthenium 44 | 103 Rh rhodium 45 | 106 Pd palladium 46 | 108 Ag silver 47 | 112 Cd cadmium 48 | 115 In indium 49 | 119 Sn tin 50 | 122 Sb antimony 51 | 128 Te tellurium 52 | 127 I iodine 53 | 131 Xe xenon 54 |
| 133 Cs caesium 55 | 137 Ba barium 56 | 139 La* lanthanum 57 | 178 Hf hafnium 72 | 181 Ta tantalum 73 | 184 W tungsten 74 | 186 Re rhenium 75 | 190 Os osmium 76 | 192 Ir iridium 77 | 195 Pt platinum 78 | 197 Au gold 79 | 201 Hg mercury 80 | 204 Tl thallium 81 | 207 Pb lead 82 | 209 Bi bismuth 83 | [209] Po polonium 84 | [210] At astatine 85 | [222] Rn radon 86 |
| [223] Fr francium 87 | [226] Ra radium 88 | [227] Ac* actinium 89 | [261] Rf rutherfordium 104 | [262] Db dubnium 105 | [266] Sg seaborgium 106 | [264] Bh bohrium 107 | [277] Hs hassium 108 | [268] Mt meitnerium 109 | [271] Ds darmstadtium 110 | [272] Rg roentgenium 111 | Elements with atomic numbers 112-116 have been reported but not fully authenticated | | | | | | |

* The lanthanoids (atomic numbers 58-71) and the actinoids (atomic numbers 90-103) have been omitted.

The relative atomic masses of copper and chlorine have not been rounded to the nearest whole number.

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