THIS IS A NEW SPECIFICATION

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RECOGNISING ACHIEVEMENT

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Monday 25 June 2012 – Afternoon

GCSE TWENTY FIRST CENTURY SCIENCE ADDITIONAL SCIENCE A

A152/02 Modules B5 C5 P5 (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)
- Calculator

Duration: 1 hour

A152/02

A135740612

Candidate forename		Candidate surname	

Centre number						Candidate number				

INSTRUCTIONS TO CANDIDATES

- 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

- 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 page 2.
- A list for qualitative tests for ions is printed on page 3.
- A Periodic Table is printed on the back page.
- The total number of marks for this paper is **60**.
- This document consists of **20** pages. Any blank pages are indicated.

TWENTY FIRST CENTURY SCIENCE EQUATIONS

Useful relationships

The Earth in the Universe

distance = wave speed × time

wave speed = frequency × wavelength

Sustainable energy

energy transferred = power × time

power = voltage × current

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

Explaining motion

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

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

momentum = mass × velocity

change of momentum = resultant force × time for which it acts

work done by a force = force × distance moved in the direction of the force

amount of energy transferred = work done

change in gravitational potential energy = weight × vertical height difference

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

Electric circuits

power = voltage × 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

energy = mass × [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 Ca^{2+}	add dilute sodium hydroxide	a white precipitate forms; the precipitate does not dissolve in excess sodium hydroxide
copper Cu^{2+}	add dilute sodium hydroxide	a light blue precipitate forms; the precipitate does not dissolve in excess sodium hydroxide
iron(II) Fe^{2+}	add dilute sodium hydroxide	a green precipitate forms; the precipitate does not dissolve in excess sodium hydroxide
iron(III) Fe^{3+}	add dilute sodium hydroxide	a red-brown precipitate forms; the precipitate does not dissolve in excess sodium hydroxide
zinc Zn^{2+}	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 way that atoms are held together in a substance affect its properties.

(a) Here are some properties of five substances.

Substance	Melting point	Boiling point	Electrical conductivity of solid	Hardness at room temperature
1	high	high	poor	very hard
2	high	high	good	soft
3	high	high	good	hard
4	high	high	poor	hard
5	low	low	poor	not applicable

Fill in the boxes with the numbers **1**, **2**, **3**, **4** or **5**, to show which number represents ...

... iron. ☐

... graphite. ☐

... diamond. ☐

... a compound of chlorine and oxygen. ☐

... sodium chloride crystal. ☐

[3]

(b) Nitrogen and oxygen have very low boiling points.

Explain why.

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..... **[3]**

(c) Sodium chloride solution conducts electricity when electrodes are placed in the solution.

Explain what happens.

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..... **[3]**

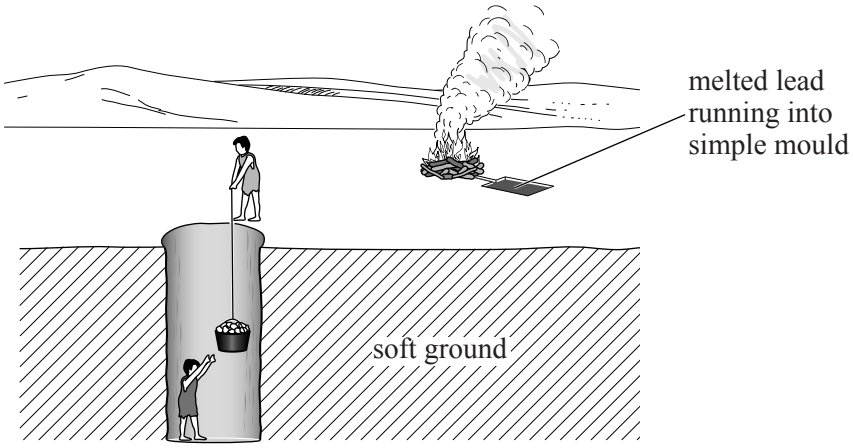
[Total: 9]

2 Read this article about lead mining.

Archaeologists have discovered a small lead mine that was used 4000 years ago.

The miners made a deep hole through soft ground until they reached the lead ore. They then dug out the ore and loaded it into baskets.

A second group of people lifted the ore out of the mine and put it into a wood fire. In the fire the ore reacted to make sulfur dioxide, carbon dioxide and melted lead. The melted lead was run into moulds and allowed to solidify.



(a) Here is some information about three of the substances involved in the process.

	Lead	**Lead ore**	**Sulfur dioxide**
Melting point in °C	327	1114	–73
Boiling point in °C	1744	1281	–10
Hazard	prolonged exposure to dust or fumes is harmful	prolonged exposure to dust or fumes is harmful	acidic gas

Use the information in the article and table above to suggest and describe at least four likely risks to people. Explain how each risk is created and who would be affected.

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

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..... **[6]**

(b) Two reactions take place when lead ore is heated in the fire.

In reaction 1, lead sulfide reacts with oxygen to make lead oxide and sulfur dioxide.

(i) Balance the equation for this reaction.

$$\square\ PbS + \square\ O_2 \rightarrow \square\ PbO + \square\ SO_2$$

[2]

(ii) In reaction 2, the oxygen is removed from the lead oxide.

What do we call a reaction in which oxygen is removed?

..... **[1]**

(iii) What is the relative formula mass of lead oxide, PbO?

Use the Periodic Table to help you.

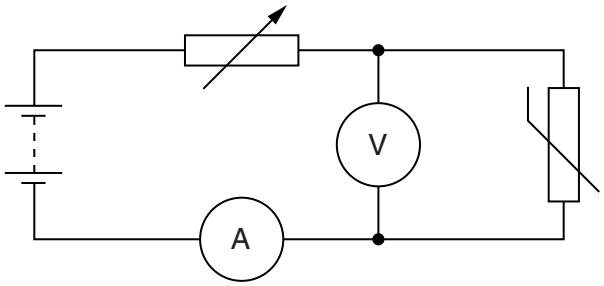
..... **[1]**

(iv) Calculate the percentage mass of Pb in the PbO.

..... **[1]**

[Total: 11]

3 Anna uses this circuit to find out how the resistance of a thermistor depends on the power delivered to it.



(a) (i) Put a (ring) around the component which allows Anna to vary the current in the circuit. **[1]**

(ii) State the property of that component which allows Anna to vary the current.

..... **[1]**

(b) Here are her results.

Power delivered in W	Resistance of thermistor in Ω
0.10	10
0.50	8.0
3.20	5.0

What is the correlation between the resistance and the power?

Use ideas about thermistors to explain the correlation.

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..... **[3]**

(c) Anna takes an extra pair of readings to provide more evidence for the correlation.

She finds that when the voltage is 3.0 V, the resistance is 6.0 Ω.

Does this support the correlation shown in the table?

Justify your answer with calculations.

..... **[2]**

[Total: 7]

4 Sanjay wants to run a low voltage lamp off the mains supply.

He decides to use a step-down transformer to reduce the mains voltage to a lower voltage supply.

(a) Describe the structure of a step-down transformer and explain how it works.

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

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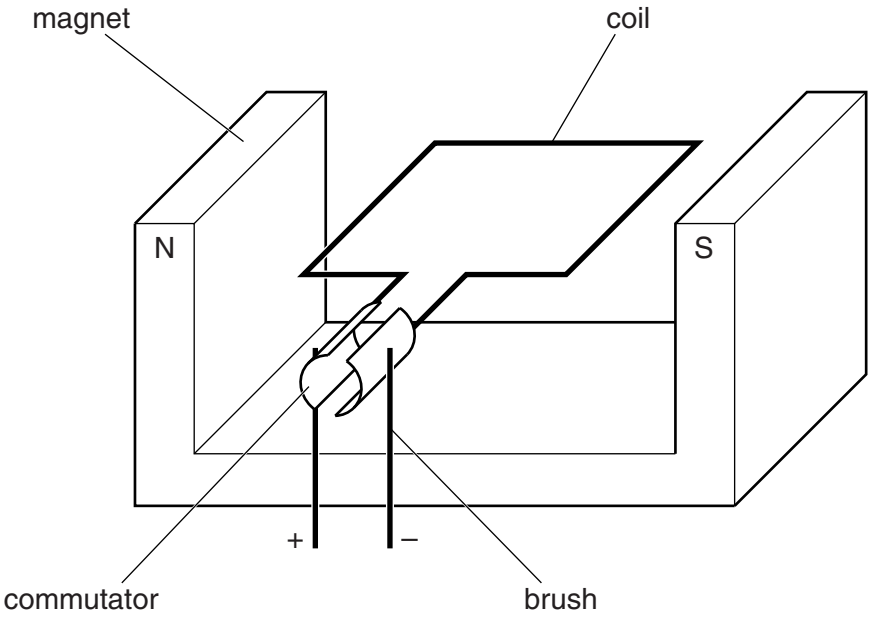
..... **[6]**

(b) Sanjay's transformer has 20 000 turns in its primary coil, but only 1000 turns in its secondary coil. Show that he can use it to run a 12 V lamp safely off the 230 V mains supply.

..... **[2]**

[Total: 8]

5 The diagram shows a simple electric motor.



Here are some statements about the simple electric motor.

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

The magnet exerts a force on all parts of the coil. ☐

The commutator converts the d.c. from the supply into a.c. for the brushes. ☐

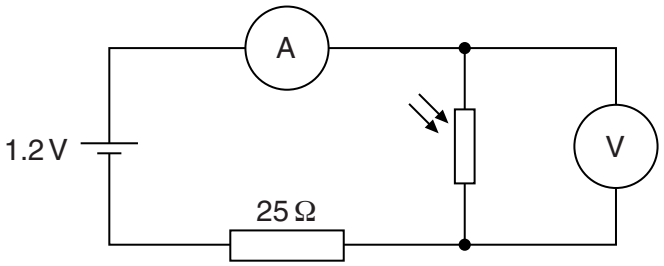
The wires next to the poles of the magnet are pushed in opposite directions. ☐

The forces on the coil are caused by the p.d. induced by its motion in the field. ☐

[1]

[Total: 1]

6 Bill assembles this circuit.



The current in the circuit depends on the lighting level of the room.

(a) At one instant the current in the ammeter is 0.04 A.

What is the reading of the voltmeter?

Put a (ring) around the correct answer.

0.20V **1.0V** **1.2V** **2.2V**

[1]

(b) Complete the sentences. Choose words from this list.

decreases **increases** **stays the same**

When the amount of light increases, the resistance of the LDR ..... .

The potential difference across the battery ..... .

The current in the battery ..... .

The potential difference across the 25 Ω resistor ..... .

[3]

[Total: 4]

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Question 7 begins on page 14

PLEASE DO NOT WRITE ON THIS PAGE

7 Scientists analysed a sample of DNA from a muscle cell.

DNA is made up of four different bases, A, T, C and G.

(a) It is found that 21% of the bases are A.

Calculate the percentage of bases that are G.

answer = ... % **[1]**

(b) The genetic code uses the four different bases.

Calculating the percentage of each base present is not enough to determine the genetic code for a particular protein.

Explain why.

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..... **[1]**

(c) Myosin is a protein which is found in muscle cells, but not in nerve cells.

Explain the processes which lead to myosin being made and why it is only produced in muscle cells.

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

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..... **[6]**

(d) A scientist claims to have found a gene that makes stronger muscles.

The stronger muscle cells have a particular protein.

He tested 23 young men who had strong muscles to find out if they had the gene.

Suggest **three** ways the scientist could improve his investigation.

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..... **[3]**

[Total: 11]

8 Mary studies the development of human embryos.

(a) Complete the table to compare two differences between the 4 cell stage and 32 cell stage.

	4 cell stage	**32 cell stage**
Difference 1		
Difference 2		

[1]

(b) Mary knows that a fertilised egg cell (zygote) develops into an embryo.

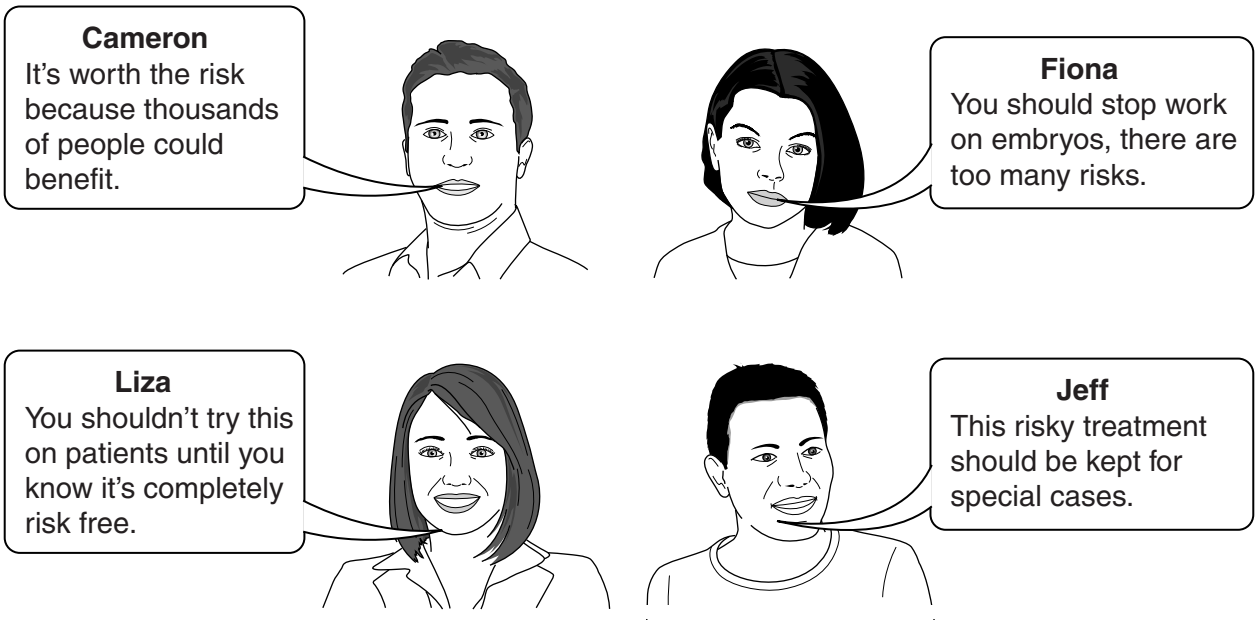
There are 46 chromosomes in the fertilised egg cell.

How many chromosomes are there in each cell of the embryo?

answer ..... **[1]**

(c) Mary hopes that her research will lead to embryonic stem cells being available to replace damaged tissues in accident victims.

Four of her friends discuss her work with her.



Which person wants something which is **not** possible to achieve?

answer ..... **[1]**

[Total: 3]

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Question 9 begins on page 18

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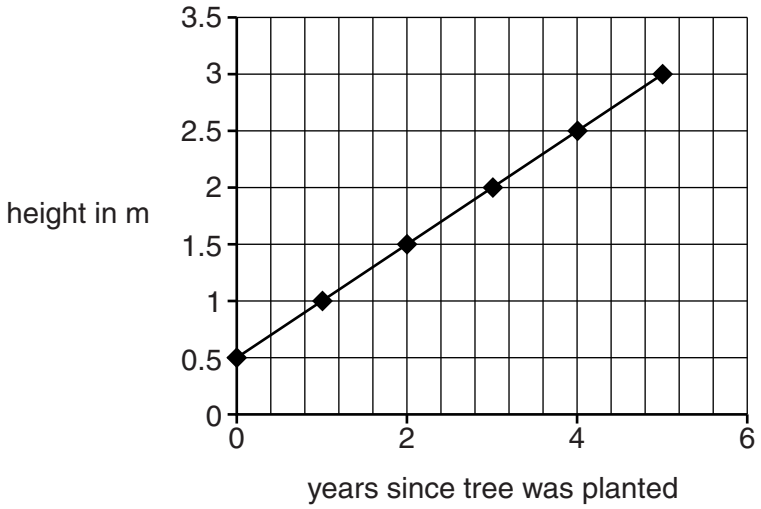
9 Tony works on a tree plantation.

Each tree is grown for forty years, then it is cut down for timber.

He records the height of one tree every year for its first five years after planting.



(a) (i) The tree is under telephone cables.

The cables are 15 m above the ground.

Tony predicts that the tree will have to be cut down 28 years after planting to avoid damaging the cables.

Explain how he made this prediction.

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..... **[2]**

(ii) Use your knowledge of plant growth to explain why this prediction may not be accurate.

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..... **[2]**

(b) Tony finds a bush growing in the plantation.

He takes a cutting of the bush to grow in his garden.

As the cutting grows it develops tissues and organs.

Explain the difference between a tissue and an organ.

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..... **[2]**

[Total: 6]

END OF QUESTION PAPER

The Periodic Table of the Elements

1	2											3	4	5	6	7	0
							1 **H** hydrogen 1										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						

Key

relative atomic mass
atomic symbol
name
atomic (proton) number

**** 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.