

THIS IS A NEW SPECIFICATION

**F****Thursday 13 June 2013 – Morning****GCSE TWENTY FIRST CENTURY SCIENCE
ADDITIONAL SCIENCE A****A153/01** Modules B6 C6 P6 (Foundation 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)

Duration: 1 hour

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.
- The 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**

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

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

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

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

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

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

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

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

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

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

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

Electric circuits

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

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

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

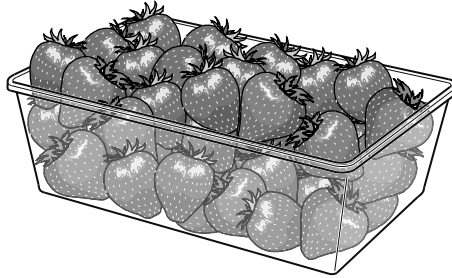
Radioactive materials

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

3

Answer **all** the questions.

- 1 Some countries allow soft fruit to be sterilised by radiation so that it has a much longer shelf-life in the shops.



Food is sterilised by radiation in a processing centre without harming the people who work there.

Describe how food is sterilised by radiation. Include safety aspects.



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

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..... [6]

[Total: 6]

4

2 Technetium is often used as a radioactive tracer in hospitals.

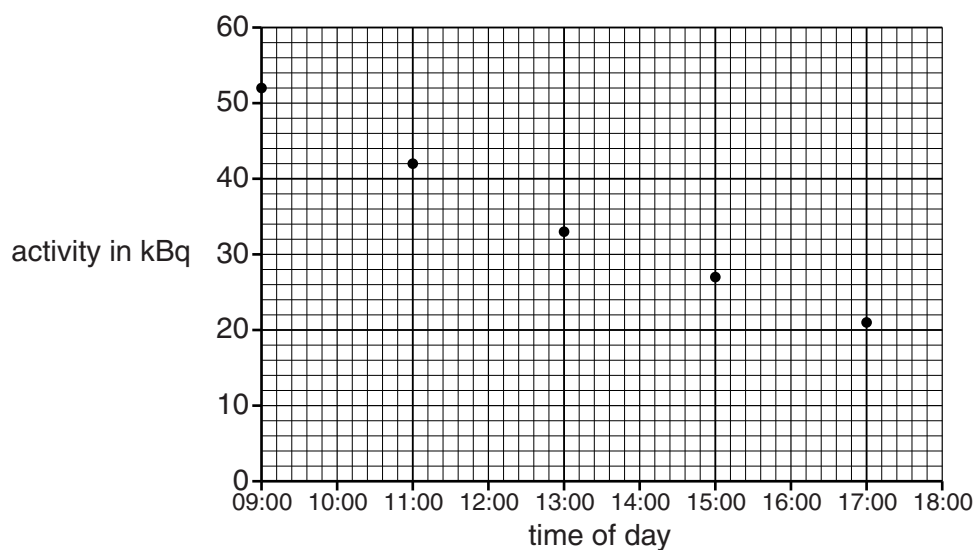
(a) Technetium comes from the radioactive decay of molybdenum.

It is important that the technetium is **not** contaminated with molybdenum.

Marie tests the purity of a sample of technetium.

She measures the activity of the sample at five different times.

Marie plots her results on a graph.



Marie uses this graph and the data in the table to make a conclusion.

Material	Half-life in hours
molybdenum	67
technetium	6

Marie concludes that the sample contains no molybdenum.

Is she correct? Justify your answer.

.....

.....

.....

.....

..... [3]

5

- (b) Technetium is injected into patients to act as a tracer. This has both risks and benefits for the patients, workers and visitors at the hospital.

- (i) Who at the hospital benefits **most** from the use of technetium?

Choose from the patients, the workers or the visitors.

Give a reason for your answer.

.....

 [2]

- (ii) Who at the hospital is **least** at risk from the use of technetium?

Choose from the patients, the workers or the visitors.

Give a reason for your answer.

.....

 [2]

- (iii) There are regulations about the use of technetium in hospitals.

Who decides the regulations?

Put a ring around the correct answer.

the doctors

the Government

the manufacturers

the patients

[1]

[Total: 8]

- 3 Your level of background radiation depends on where you live.

Region of UK	Background radiation dose mSv per year
East Anglia	0.5
Cornwall	8
London	2

- (a) Adele lives in London for 40 years.

- (i) Calculate her total background radiation dose over 40 years.

total radiation dose = mSv [1]

- (ii) Her chance of getting cancer from background radiation in those 40 years is 4 in 1000.

Adele thinks that her risk of getting cancer is proportional to her dose from the background radiation.

Suppose she lived in Cornwall instead of London.

What would her chance of getting cancer be using this idea?

Put a ring around the correct answer.

1 in 1000

4 in 1000

8 in 1000

16 in 1000

[1]

- (b) Why does exposure to background radiation increase her risk of getting cancer?

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

all radiation is reflected by her skin

☐

radiation breaks molecules into ions

☐

radiation only kills cells

☐

radiation passes straight through her

☐

[1]

7

- (c) Bert is a radiographer at a hospital in Cumbria where the background radiation dose is 3 mSv per year.

The **total** allowed radiation dose for a radiographer is 20 mSv per year.

How much radiation dose, in mSv, is Bert allowed to receive from his work in a year?

Put a **ring** around the correct answer.

3 17 20 23

[1]

[Total: 4]

- 4 Uranium-235 is a nuclear fuel. It is used to make electricity in nuclear power stations.

Complete the sentences about an atom of uranium-235.

Choose words from this list.

electrons

neutrons

protons

At the centre of each atom is a nucleus which contains and

The rest of the atom contains

[2]

[Total: 2]

5 Jenny has a stroke.

This is caused by a blood vessel in her brain becoming blocked.

Part of her brain is damaged.

She loses the ability to speak.

Jenny learns to speak again with practice.

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

The damaged part of her brain can be identified by an

IRM	
MIR	
MRI	

scan.

The damaged part of her brain is the

cortex.	
hypothalamus.	
pituitary.	

She can speak again because of the formation of new

spinal cord tissue.	
muscle fibres.	
neuron pathways.	

[2]

(b) As part of her treatment, Jenny has to memorise some words.

To help her remember the words, Jenny puts them into a pattern.

What else could Jenny do to help her remember the words?

.....

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

- (c) Scientists develop a new treatment for people who have had a stroke.

They discuss whether the new treatment should replace the existing treatment.

Brian The new treatment is cheaper than the existing one so it should be used.		Charlie We should not use the new treatment until we know it is 100% safe.
Dawn The new treatment has some side effects, but we should still use it because it works better than the existing treatment.		Erica We should allow people to choose which treatment they have.

- (i) Which scientist argues that the right thing to do is the one which leads to the best outcome for most people involved?

answer [1]

- (ii) Which scientist argues that it is right to do some things even if there are consequences?

answer [1]

[Total: 5]

10

- 6 Terry measures the speed of impulses travelling along different neurons.

He obtains these results.

Diameter of neuron in μm	Length of neuron in cm	Speed of impulse in m/s
2	12	12
6	3	36
10	5	60
14	15	84
18	10	108

- (a) Which are correct conclusions from the data?

Put ticks (✓) in the boxes next to the **two** correct conclusions.

As the diameter of the neuron increases, the speed of the impulse increases.

☐

As the diameter of the neuron increases, the speed of the impulse decreases.

☐

As the length of the neuron increases, the speed of the impulse increases.

☐

As the length of the neuron increases, the speed of the impulse decreases.

☐

There is a correlation between diameter and length.

☐

There is a correlation between diameter and speed.

☐

There is a correlation between length and speed.

☐

[2]

- (b) All the neurons Terry tested had fatty sheaths.

He then tests a neuron which does **not** have a fatty sheath.

It is $10\mu\text{m}$ in diameter and 5 cm long.

Predict the speed of impulse in this neuron.

Explain your answer.

.....

..... [2]

[Total: 4]

7 Kate is surprised by a camera flash.

She blinks.

This is an example of a simple reflex.

(a) Describe what happens in Kate's nervous system to make her blink.



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

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..... [6]

(b) Kate tests her reactions using a reaction timer on her computer.

She presses a button as soon as she sees a dot appear on the screen.

She gets these results.

	Test 1	Test 2	Test 3	Test 4	Test 5
Reaction time in ms	0.77	0.60	0.75	0.59	0.84

Kate concludes that her reaction time improves with practice.

Explain why Kate's conclusion is wrong.

.....

.....

..... [1]

[Total: 7]

Turn over

8 Simple animals rely on reflex actions for most of their behaviour.

(a) Write down **one** way that reflex actions help a simple animal to survive.

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

(b) Other animals can be conditioned.

Pigs on a farm are always fed from a yellow bucket.

Eventually, the pigs salivate every time they see the yellow bucket, even if there is no food in it.

Explain why this is an example of conditioning.

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

[Total: 4]

9 Mark is doing a titration with hydrochloric acid and sodium hydroxide.

(a) Sodium hydroxide is an alkali.

Name **one** other alkali.

.....

[1]

(b) Mark tries to write a word equation for the reaction.

He has several attempts.

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

acid + alkali + salt → water

☐

acid + alkali → salt + water

☐

acid → alkali + salt + water

☐

acid → alkali + salt → water

☐

[1]

(c) Which salt is made when nitric acid reacts with sodium hydroxide?

Put a **ring** around the correct answer.

sodium chloride

sodium hydrate

sodium nitrate

sodium oxide

[1]

(d) In his experiment Mark slowly adds acid to the alkali.

He measures the pH as it changes.

What can he use to measure the pH as it changes?

Suggest **two** different methods.

1

2

[2]

(e) Mark knows that one type of ion is made by all acids when they dissolve in water.

Put a **ring** around the formula of this ion.

H⁺

H⁻

OH⁺

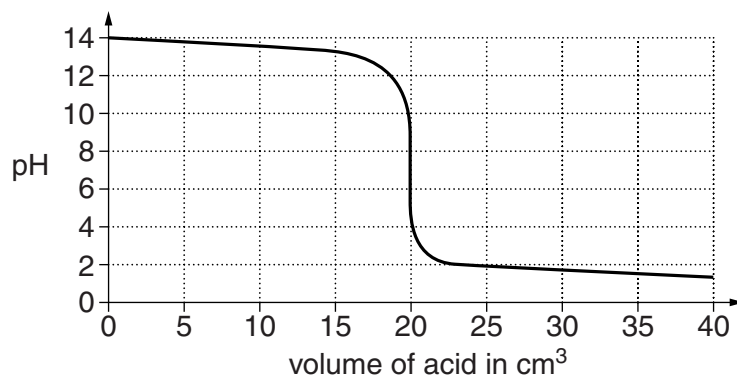
OH⁻

[1]

14

(f) Mark adds acid to 25 cm³ of alkali.

He draws a graph of the change in pH during his titration.



(i) Describe what happens to the pH during this titration.

Include numbers in your answer.

.....

.....

.....

..... [3]

(ii) Look at the graph.

When all of the alkali has reacted the pH = 7.

What volume of acid is needed to react with the alkali? [1]

(iii) What happens to the alkali as it reacts?

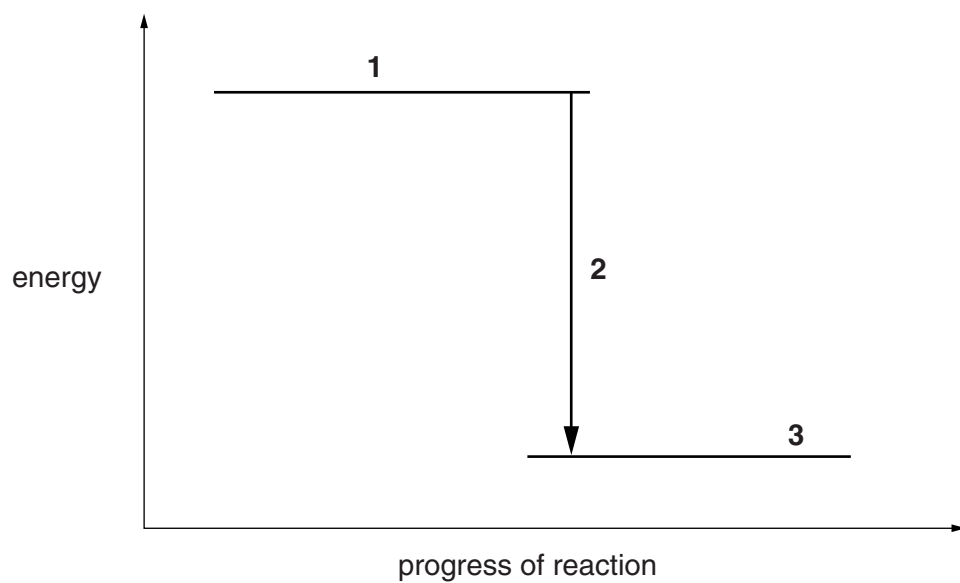
Put a tick (✓) in the box next to the correct answer.

The alkali is	neutralised.	☐
	oxidised.	☐
	recycled.	☐
	removed.	☐

[1]

15

(g) Mark draws an energy level diagram for the reaction.



Mark labels the diagram.

What should he write at points **1**, **2** and **3** to show what this diagram tells you about the reaction?

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

[Total: 14]



..... [6]

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The Periodic Table of the Elements

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1	2	Key										3	4	5	6	7	0						
		relative atomic mass atomic symbol name atomic (proton) number																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												

* 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.