OCR
RECOGNISING ACHIEVEMENT

SPECIMEN F

GENERAL CERTIFICATE OF SECONDARY EDUCATION

TWENTY FIRST CENTURY SCIENCE

ADDITIONAL SCIENCE A

A153/01

Unit A153: 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 clearly in capital letters, your Centre Number and Candidate Number in the boxes above.
- Use black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure that you know what you have to do before starting your answer.
- Answer **all** the questions.
- Write your answer to each question in the space provided, however additional paper may be used if necessary.

INFORMATION FOR CANDIDATES

- A list of physics equations is printed on page **2**.
- The Periodic Table is printed on the back page.
- Your quality of written communication is assessed in questions marked with a pencil (✎).
- The number of marks for each question is given in brackets **[ ]** at the end of the question or part question.
- The total number of marks for this paper is **60**.
- This document consists of **20** pages. Any blank pages are indicated.

For Examiner's Use		
	Max	**Mark**
1	**3**	
2	**4**	
3	**4**	
4	**6**	
5	**3**	
6	**5**	
7	**2**	
8	**7**	
9	**6**	
10	**3**	
11	**2**	
12	**3**	
13	**6**	
14	**3**	
15	**3**	
TOTAL	**60**	

TWENTY FIRST CENTURY SCIENCE DATA SHEET

Useful relationships

The Earth in the Universe

distance = wave speed x time

wave speed = frequency x wavelength

Sustainable energy

energy transferred = power x time

power = voltage x 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 x velocity

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

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

amount of energy transferred = work done

change in gravitational potential energy = weight x vertical height difference

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

Electric circuits

power = voltage x current

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

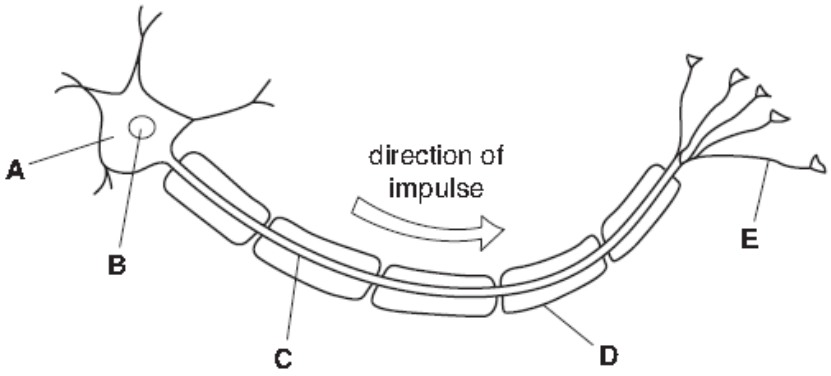
$$\frac{\text{voltage across primary coil}}{\text{voltage across secondary coil}} = \frac{\text{number of turns in primary coil}}{\text{number of turns in secondary coil}}$$

Radioactive materials

energy = mass x [speed of light in a vacuum]^2

Answer **all** the questions.

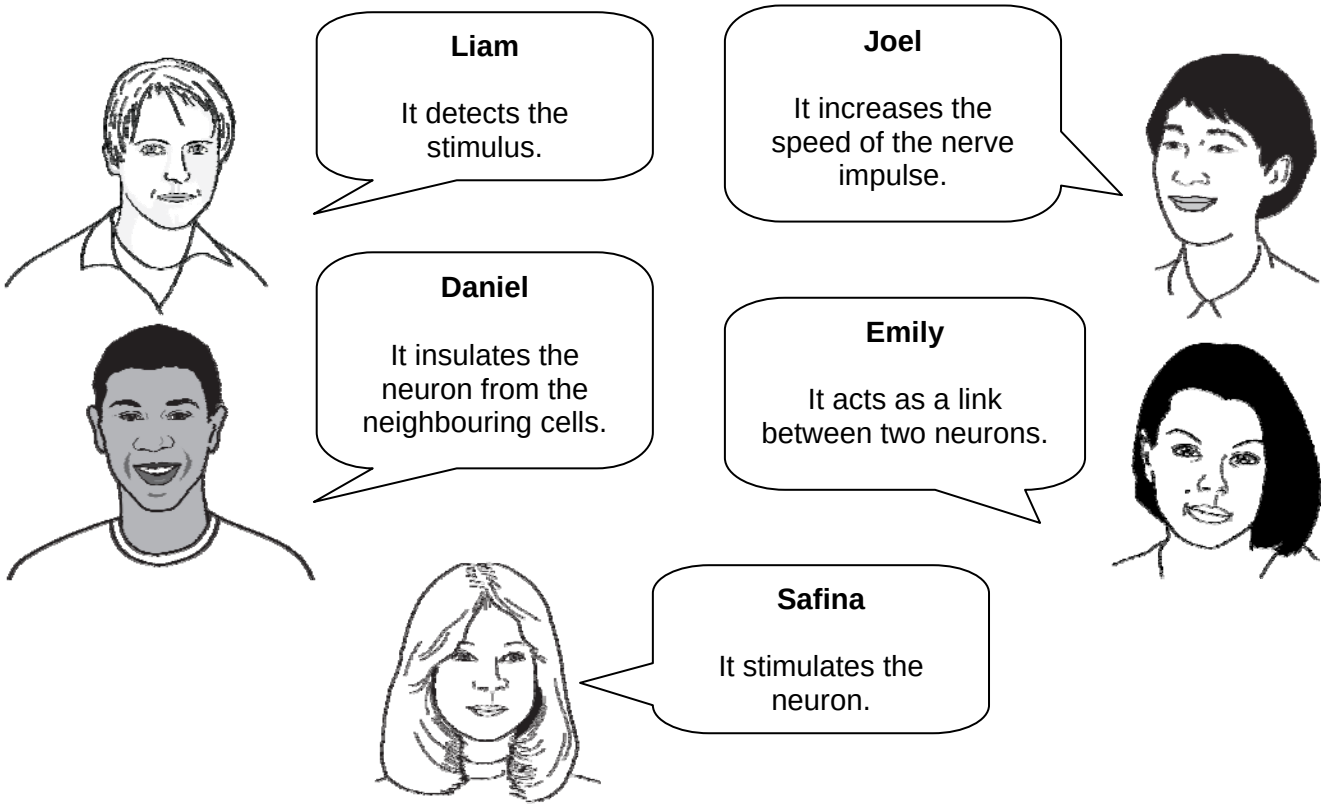
1 The human nervous system contains neurons.



(a) Which part, **A**, **B**, **C**, **D**, or **E**, is the fatty sheath?

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

(b) The fatty sheath has two functions. Some friends discuss what they think these functions are.



Which **two** people give correct answers?

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

[Total: 3]

2 Some of our knowledge of how the nervous system works is based on experiments with animals.

People have different opinions about animal experiments.

Describe arguments **for** and arguments **against** animal experiments.

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.....

..... **[4]**

[Total: 4]

3 Brian walks out of the cinema into bright sunshine.

The bright light dazzles his eyes, and at first he cannot see properly.

Then, his eyes adjust as his pupils get smaller. This is the pupil reflex.

(a) Draw straight lines to join each **component** to the correct **part of the reflex**.

component	part of the reflex
muscle cells in iris	processor
light sensitive cells in retina	effector
central nervous system	receptor

[2]

(b) Newborn babies have some reflexes that disappear after time.

Write down two newborn reflexes.

1 .....

2 .....

[2]

[Total: 4]

4 The human nervous system is made up of the central nervous system (CNS) and the peripheral nervous system (PNS).

Outline the structures and organs that make up each of these parts, and

- explain what the CNS and PNS do
- suggest why it is more difficult for scientists to understand how the CNS works compared to the PNS.

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

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

[Total: 6]

5 Animals such as woodlice respond to changes in their environment.

Kieron does some experiments to test how woodlice react to light.

He prepares a tank for them, half of which is lit brightly with a lamp, and half of which he keeps dark and shaded.

He puts 20 woodlice into the tank and notes down how many are in each half of the tank after 20 minutes.

He repeats the experiment six times with different woodlice.

	number of woodlice						
	test 1	**test 2**	**test 3**	**test 4**	**test 5**	**test 6**	**mean**
light	17	9	7	3	5	2	
dark	3	11	13	17	15	18	

(a) Complete the table by calculating the mean number of woodlice in each area after 20 minutes. Record the mean for each group in the empty box, rounding your answers to the nearest whole number.

[1]

(b) Comment on what the mean values tell you about how woodlice react to light, and suggest why it is an advantage to woodlice to have this reflex.

.....

.....

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

[Total: 3]

6 John knows that there is more than one type of salt.

He makes some salts using different reactants.

(a) Draw a straight line to link each set of **reactants** to the **salt formed**.

reactants	salt formed
sodium hydroxide and hydrochloric acid	magnesium chloride
magnesium hydroxide and hydrochloric acid	sodium chloride
magnesium oxide and sulfuric acid	magnesium sulfate

[2]

(b) The salt that John makes is dissolved in a flask of water.

Solid impurities are in the bottom of the flask.

Explain how he could make clean, dry crystals of his salt.

.....

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.....

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

[Total: 5]

7 This question is about solids and liquids.

(a) Which of these chemicals will be a **solid** at room temperature and pressure?

Put a (ring) around the correct answer.

hydrochloric acid **carbon dioxide** **hydrogen** **citric acid**

[1]

(b) Baking powder contains small grains of a solid acid and small grains of a solid alkali.

The acid in baking powder does not react with the alkali until water is added.

What does the water do to the **acid**?

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

Water makes the acid disappear. ☐

Water lets the acid dissolve and produce H^+ (aq) ions. ☐

Water lets the acid dissolve and produce OH^- (aq) ions. ☐

Water makes the acid more concentrated. ☐

[1]

[Total: 2]

8 Bobby reacts small pieces of magnesium with acid. The reaction produces a gas.

Bobby collects the gas in an upturned container filled with water.

The gas displaces an equal volume of water from the container.

When all of the magnesium has reacted, 35 cm^3 of gas has been produced.

(a) Bobby has the following pieces of apparatus in the laboratory.

50 cm^3 beaker

100 cm^3 beaker

500 cm^3 beaker

25 cm^3 measuring cylinder

50 cm^3 measuring cylinder

100 cm^3 measuring cylinder

Which of these pieces of apparatus should Bobby have used to collect and measure the gas?

Explain your choice.

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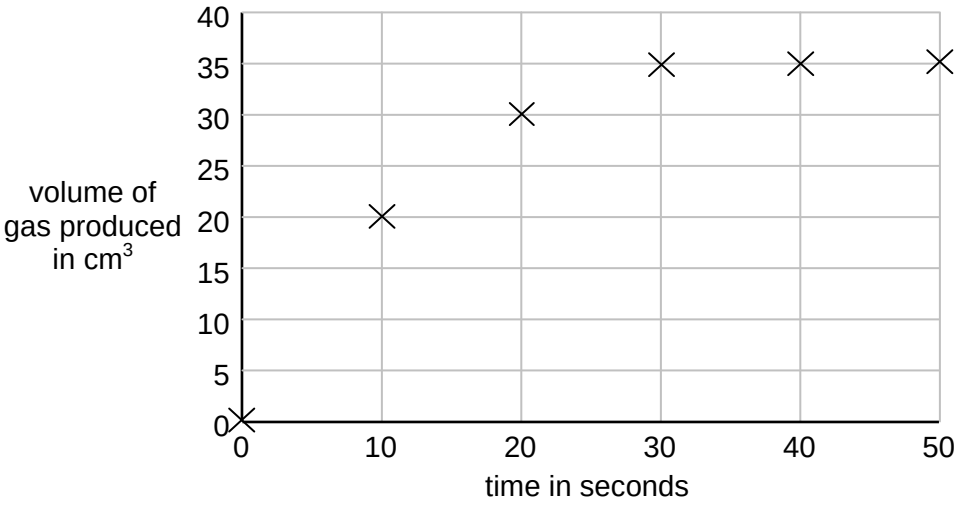
.....

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

(b) Bobby measured the amount of gas given off every 10 seconds.

He plotted these data on a piece of graph paper.



Bobby calculates what the rate of reaction was at different times during the experiment.

He does this by calculating how much gas was produced per second.

Prove that the rate of reaction was fastest during the first ten seconds of the experiment.

[2]

(c) Bobby does the experiment a further four times.

Each time he makes **one** change to the way he does the experiment.

experiment	volume of gas collected after 10 s, in cm^3	volume of gas collected after 30 s, in cm^3	volume of gas collected after 50 s, in cm^3
original experiment	20	35	35
experiment **A**	35	40	40
experiment **B**	30	35	35
experiment **C**	20	30	35
experiment **D**	25	35	35

In which experiment did Bobby use a larger mass of magnesium pieces?

Explain your answer.

.....

.....

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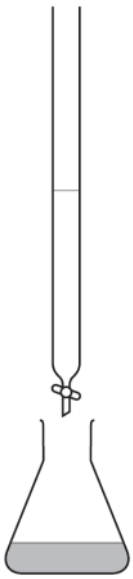
..... **[3]**

[Total: 7]

9 Mary carries out an acid / alkali titration.

She puts 25.0 cm^3 of alkali solution in a conical flask and does a rough titration.



Mary then does an accurate titration.

What are the main stages in carrying out an accurate titration? Include any readings Mary should take.

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

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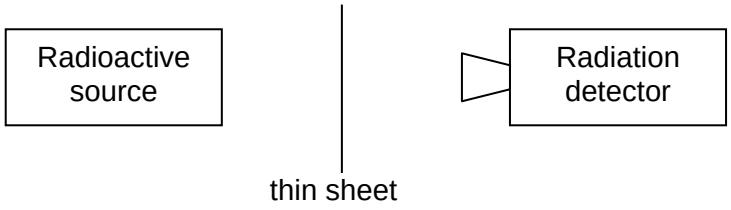
..... **[6]**

[Total: 6]

10 Gordon wants to know whether a thin sheet is made of paper or gold foil.

He places a radioactive source on one side of the sheet. On the other side of the sheet a detector measures the amount of radiation that is received.



Which would be the best type of radiation to use?

Justify your answer.

.....

.....

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

[Total: 3]

11 The annual dose **limit** for a worker in a nuclear power station is higher than for a member of the public.

(a) Why might it be acceptable for workers in the power station to receive a higher dose than members of the public?

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

Members of the public are not exposed to as much radiation. ☐

Nuclear power provides us with energy. This is worth the small risk to the workers. ☐

Workers in a nuclear power station are used to a higher dose. ☐

[1]

(b) What precautions could be taken to sensibly reduce the risk to the workers in a nuclear power station?

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

Not allow the workers to bring any visitors to the power station. ☐

Reduce the number of workers. ☐

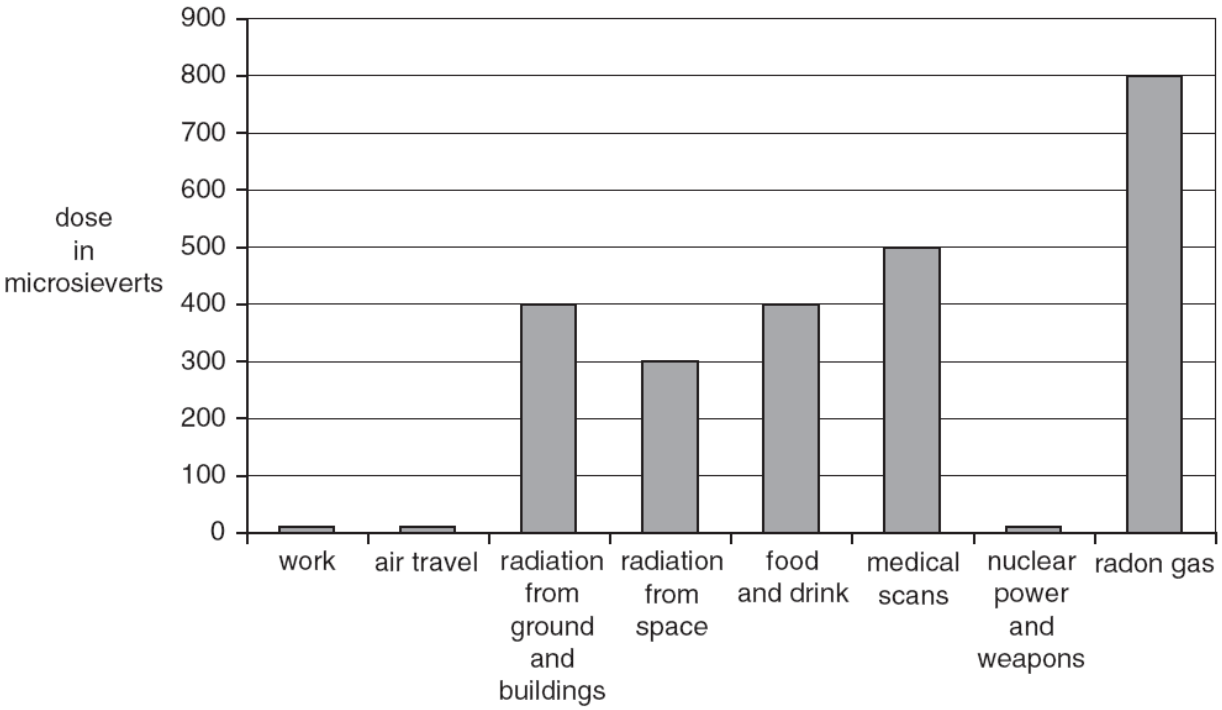
Provide food for the workers that has been sterilised by irradiation. ☐

Use shielding to reduce the level of radiation. ☐

[1]

[Total: 2]

12 The bar chart shows the typical yearly radiation dose for a person in Britain from different sources.



(a) What would be the total radiation dose a typical person in Britain would get from the ground and buildings, and medical scans in a year?

Put a (ring) around the correct answer. All values are in microsieverts.

100 **400** **500** **900**

[1]

(b) The total for all sources is 2430 microsieverts.

Which of the following statements are correct conclusions **from the bar chart**?

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

Not everyone will have medical scans. ☐

Radon gas provides more than half the total dose. ☐

The fraction of dose received from nuclear power stations is very small. ☐

The dose from radon gas will be different in different parts of Britain. ☐

The dose from food and drink is less than a quarter of the total dose. ☐

[2]

[Total: 3]

13 A nuclear reactor produces radioactive materials for use in hospitals. The radioactive materials are used to treat patients.

Identify the different types of radioactive waste generated by the production and use of these radioactive materials and describe how the waste should be dealt with.

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

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

[Total: 6]

14 Hospitals use a generator containing a radioactive substance called Mo – 99 to make an isotope called Tc – 99 m.

Mo – 99 has a half life of 66 hours.

Tc – 99 m has a half life of 6 hours.

The technician tests a sample from the generator to find out what it contains.

He measures its activity at four different times.

Here are the results.

time of measurement	activity of sample in Bq
06:00h	5200
12:00h	2600
18:00h	1300
24:00h	650

What does the sample contain? Use data from the table to justify your answer.

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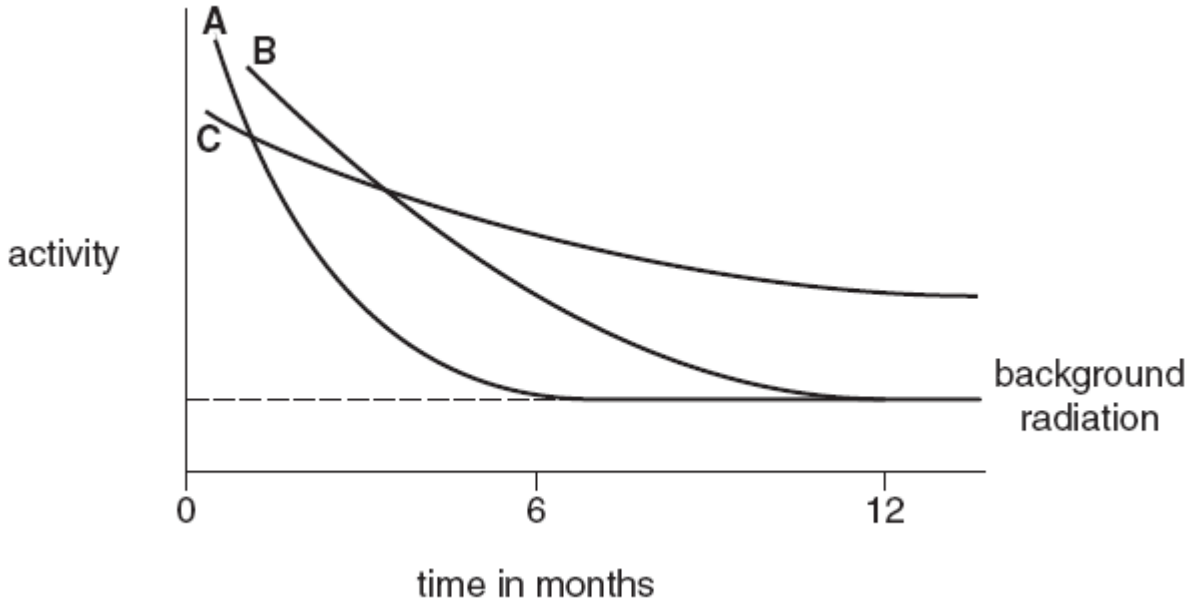
..... **[3]**

[Total: 3]

15 Different radioactive sources are used in hospitals for different purposes.

The graph shows the activity over time of three different radioactive sources.



(a) Which radioactive source has the shortest half-life **A**, **B** or **C**? ……..

[1]

(b) Which has the most activity after 12 months **A**, **B** or **C**? ……..

[1]

(c) Which source is likely to be a long term storage problem **A**, **B** or **C**? ……..

[1]

[Total: 3]

[Paper Total: 60]

END OF QUESTION PAPER

Periodic Table

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.***

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SPECIMEN F

GENERAL CERTIFICATE OF SECONDARY EDUCATION

TWENTY FIRST CENTURY SCIENCE

A153/01

ADDITIONAL SCIENCE A

Unit A153: Modules B6, C6, P6 (Foundation Tier)

MARK SCHEME

Duration: 1 hour

MAXIMUM MARK 60

This document consists of 16 pages

Guidance for Examiners

Additional guidance within any mark scheme takes precedence over the following guidance.

1. Mark strictly to the mark scheme.

2. Make no deductions for wrong work after an acceptable answer unless the mark scheme says otherwise.

3. Accept any clear, unambiguous response which is correct, eg mis-spellings if phonetically correct (but check additional guidance).

4. Abbreviations, annotations and conventions used in the detailed mark scheme:

/	=	alternative and acceptable answers for the same marking point
(1)	=	separates marking points
not/reject	=	answers which are not worthy of credit
ignore	=	statements which are irrelevant - applies to neutral answers
allow/accept	=	answers that can be accepted
(words)	=	words which are not essential to gain credit
words	=	underlined words must be present in answer to score a mark
ecf	=	error carried forward
AW/owtte	=	alternative wording
ORA	=	or reverse argument

Eg mark scheme shows 'work done in lifting / (change in) gravitational potential energy' (1)
work done = 0 marks
work done lifting = 1 mark
change in potential energy = 0 marks
gravitational potential energy = 1 mark

5. Annotations:
The following annotations are available on SCORIS.

✓	=	correct response
✗	=	incorrect response
bod	=	benefit of the doubt
nbod	=	benefit of the doubt **not** given
ECF	=	error carried forward
^	=	information omitted
I	=	ignore
R	=	reject

6. If a candidate alters his/her response, examiners should accept the alteration.

7. Crossed out answers should be considered only if no other response has been made. When marking crossed out responses, accept correct answers which are clear and unambiguous.
Eg
For a one mark question, where ticks in boxes 3 and 4 are required for the mark:

Put ticks (✓) in the two correct boxes.	Put ticks (✓) in the two correct boxes.	Put ticks (✓) in the two correct boxes.
☐	☐	☒
☐	☐	☒
✓	☒	✓
☒	☒	✓
☐	☐	☐
This would be worth 0 marks.	This would be worth one mark.	This would be worth one mark.

8. The list principle:
If a list of responses greater than the number requested is given, work through the list from the beginning. Award one mark for each correct response, ignore any neutral response, and deduct one mark for any incorrect response, eg one which has an error of science. If the number of incorrect responses is equal to or greater than the number of correct responses, no marks are awarded. A neutral response is correct but irrelevant to the question.

9. Marking method for tick boxes:
Always check the additional guidance.
If there is a set of boxes, some of which should be ticked and others left empty, then judge the entire set of boxes.
If there is at least one tick, ignore crosses. If there are no ticks, accept clear, unambiguous indications, eg shading or crosses.
Credit should be given for each box correctly ticked. If more boxes are ticked than there are correct answers, then deduct one mark for each additional tick. Candidates cannot score less than zero marks.
Eg If a question requires candidates to identify a city in England, then in the boxes

Edinburgh	
Manchester	
Paris	
Southampton	

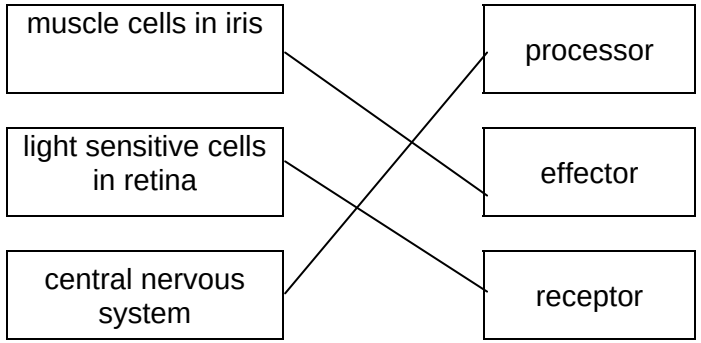
the second and fourth boxes should have ticks (or other clear indication of choice) and the first and third should be blank (or have indication of choice crossed out).

Edinburgh			✓			✓	✓	✓	✓	
Manchester	✓	×	✓	✓	✓				✓	
Paris				✓	✓		✓	✓	✓	
Southampton	✓	×		✓		✓	✓		✓	
Score:	2	2	1	1	1	1	0	0	0	NR

10. Three questions in this paper are marked using a Level of Response (LoR) mark scheme with embedded assessment of the Quality of Written Communication (QWC). When marking with a Level of Response mark scheme:
    - Read the question in the question paper, and then the list of relevant points in the 'Additional guidance' column of the mark scheme, to familiarise yourself with the expected science. The relevant points are not to be taken as marking points, but as a summary of the relevant science from the specification.
    - Read the level descriptors in the 'Expected answers' column of the mark scheme, starting with Level 3 and working down, to familiarise yourself with the expected levels of response.
    - *For a general correlation between quality of science and QWC*: determine the level based upon which level descriptor best describes the answer; you may award either the higher or lower mark within the level depending on the quality of the science and/or the QWC.
    - *For high-level science but very poor QWC*: the candidate will be limited to Level 2 by the bad QWC no matter how good the science is; if the QWC is so bad that it prevents communication of the science the candidate cannot score above Level 1.
    - *For very poor or totally irrelevant science but perfect QWC*: credit cannot be awarded for QWC alone, no matter how perfect it is; if the science is very poor the candidate will be limited to Level 1; if there is insufficient or no relevant science the answer will be Level 0.

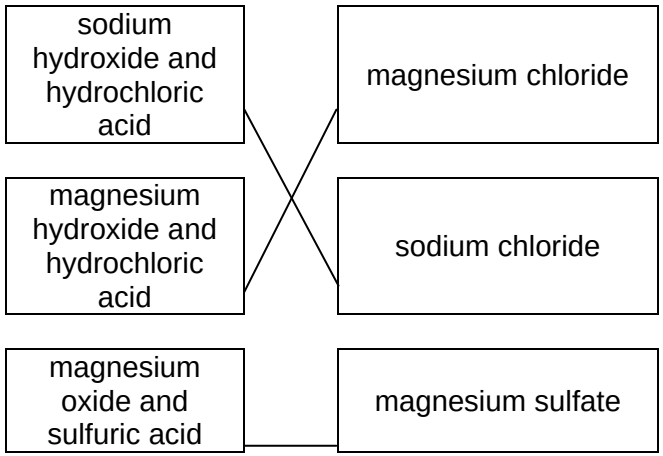
Question			Expected answers	Marks	Additional guidance
1	(a)		**D**	[1]	
	(b)		Daniel Joel	[2]	**accept** answers in either order
			Total	[3]	

2			**any four from:** *against:* **any two from:** it is wrong it is cruel / hurts them playing God / religious objection animals cannot give consent *in support:* **any two from:** it helps to discover new or useful information many people benefit, only a few animals are harmed / benefits outweigh costs it is better than testing on models / simulations cheaper than tests on humans	[4]	a maximum of 3 marking points can be credited for each of the 'against' or 'for' sections **ignore** 'better than testing on humans', unless explained
			Total	[4]	

Question			Expected answers	Marks	Additional guidance
3	(a)			[2]	
	(b)		**any two from:** stepping grasping sucking	[2]	**accept** 'suckling' for sucking
			Total	[4]	

Question			Expected Answers	Marks	Additional Guidance
4			**[Level 3]** Answer correctly names all parts of CNS and PNS, and clearly describes what the CNS and PNS do. Location and structure of CNS are clearly linked to the difficulties in studying it. All information in the answer is relevant, clear, organised and presented in a structured and coherent format. Specialist terms are used appropriately. Few, if any, errors in grammar, punctuation and spelling. (5 – 6 marks) **[Level 2]** Answer considers components and roles at a high level but only for **one** of the parts (CNS **or** PNS, but not both) **OR** Answer considers both parts (CNS and PNS) but omits details and/or technical terms. There is some mention of the difficulty in understanding how the CNS works eg less accessible than PNS, very complicated. For the most part the information is relevant and presented in a structured and coherent format. Specialist terms are used for the most part appropriately. There are occasional errors in grammar, punctuation and spelling. (3 – 4 marks) **[Level 1]** Answer names or describes components, but omits or confuses roles. Little or no effort is made to describe the difficulties of understanding the CNS. Answer may be simplistic. There may be limited use of specialist terms. Errors of grammar, punctuation and spelling prevent communication of the science. (1 – 2 marks) **[Level 0]** Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	**[6]**	**relevant points include:** *CNS* • comprises brain and spinal cord • processes signals from sensory neurons • links sensory neurons to motor neurons (via relay neurons) *PNS* • comprises sensory and motor neurons • sensory neurons , transmit/communicate/deliver , signals/impulses from receptors (to CNS) • **accept** skin/eyes/ears/taste buds/nose etc. instead of the word “receptors” but award 5 marks max. • motor neurons , transmit / communicate / deliver , signals/impulses from CNS to effectors • motor neurons stimulate effectors • **accept** named types of effectors (eg muscles, endocrine glands) instead of the word “effectors”
			Total	**[6]**	

Question			Expected Answers	Marks	Additional Guidance
5	(a)		light mean = 7 dark mean = 13	[1]	**accept** light = 5 if the outlier (test 1) is rejected **accept** dark = 15 if the outlier (test 1) is rejected
	(b)		woodlice prefer the dark which helps them avoid predators	[2]	**accept** this helps them stay cool / prevents drying out
			Total	[3]	

6	(a)			[2]	3 lines correct = 2 marks 1 or 2 lines correct = 1 marks
	(b)		filter the contents of the flask / pour through filter paper then crystallise the salt by evaporating the water and finally dry the crystals in an oven/desiccator	[3]	for full marks the explanation must be expressed in a logical and coherent order
			Total	[5]	

Question			Expected answers	Marks	Additional guidance
7	(a)		**citric acid**	[1]	
	(b)		Water lets the acid dissolve and produce H^+ ions ✓	[1]	
			Total	[2]	

Question			Expected answers	Marks	Additional guidance
8	(a)		he should use the 50 cm^3 measuring cylinder because it is big enough to hold 35 cm^3 of gas but will be more accurate than the 100 cm^3 cylinder and all of the beakers	[2]	for full marks the explanation must link the choice of apparatus to accuracy of measurement
	(b)		rate between 0 and 10 s = 20 ÷ 10 = 2 cm^3/s rate between 10 and 20 s = 10 ÷ 10 = 1 cm^3/s rate between 20 and 30 s = 5 ÷ 10 = 0.5 cm^3/s rate between 30 and 50 s = 0	[2]	units are not required for the marks, but if units are given they must be correct if no calculations are shown, **credit** "the line is steepest between 0 and 10 s" for 1 mark max.
	(c)		experiment **A** because a larger mass of magnesium pieces will give a higher rate of reaction, so more gas will have been produced by 10s and a larger mass of reactant will produce a greater volume of product/gas/hydrogen	[3]	for full marks the explanation must be expressed in a logical and coherent order
			Total	[7]	

Question			Expected answers	Marks	Additional guidance
9			**[Level 3]** Discusses all the major stages in the titration, including the measurements to be taken. All information in the answer is relevant, clear, organised and presented in a structured and coherent format. Specialist terms are used appropriately. Few, if any, errors in grammar, punctuation and spelling. (5 – 6 marks) **[Level 2]** Aspects are missing, but the candidate is clearly familiar with titration as a procedure and raises at least one aspect which affects the accuracy. For the most part the information is relevant and presented in a structured and coherent format. Specialist terms are used for the most part appropriately. There are occasional errors in grammar, punctuation and spelling. (3 – 4 marks) **[Level 1]** There is some evidence that the candidate recognises a titration as a procedure. Answer may be simplistic. There may be limited use of specialist terms. Errors of grammar, punctuation and spelling prevent communication of the science. (1 – 2 marks) **[Level 0]** Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	**[6]**	**relevant points include:** • put the acid in the burette • add an indicator to the alkali in the flask • take the burette reading before you start adding the acid • add the acid in small amounts at a time • as you approach the rough titration add the acid more slowly and swirl the flask between each addition • stop adding the acid when you see the first permanent colour change • take the burette reading at the end
			Total	**[6]**	

Question			Expected answers	Marks	Additional guidance
10			beta radiation because alpha radiation would be stopped by paper and gold foil / would not be sufficiently penetrating and gamma radiation would not be stopped by either / will penetrate both **OR** beta radiation because it will pass through/penetrate paper but will be stopped by/will not penetrate gold foil	[3]	
			Total	[3]	

Question			Expected answers	Marks	Additional guidance
11	(a)		Nuclear power provides us with energy … ☐ ✓ ☐	[1]	
	(b)		Use shielding to reduce the level … ☐ ☐ ☐ ✓	[1]	
			Total	[2]	

Question			Expected answers	Marks	Additional guidance
12	(a)		**900**	**[1]**	
	(b)		☐ ☐ The fraction of dose received … ✓ ☐ The dose from food and drink … ✓	**[2]**	correct pattern for (2) one mistake for (1)
			Total	**[3]**	

Question			Expected answers	Marks	Additional guidance
13			**[Level 3]** Evaluates production and use of the radioactive materials, and correctly identifies sources for all three types of waste. Suggests how to dispose of them safely. Will give a valid reason why waste needs to be stored carefully. All information in the answer is relevant, clear, organised and presented in a structured and coherent format. Specialist terms are used appropriately. Few, if any, errors in grammar, punctuation and spelling. (5 – 6 marks) **[Level 2]** Evaluates production and/or use of the radioactive materials, and correctly identifies sources for at least two types of waste, perhaps omitting some important details. For the most part the information is relevant and presented in a structured and coherent format. Specialist terms are used for the most part appropriately. There are occasional errors in grammar, punctuation and spelling. (3 – 4 marks) **[Level 1]** Refers to at least one type of waste and a valid disposal method for it. May not give a reason for the need for careful disposal. Answer may be simplistic. There may be limited use of specialist terms. Errors of grammar, punctuation and spelling prevent communication of the science. (1 – 2 marks) **[Level 0]** Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	**[6]**	**relevant points include:** • high level <u>only</u> produced in reactor • high level waste is very radioactive • so is stored in ponds of water • until it becomes intermediate waste / less radioactive • hospital produces mostly intermediate • intermediate waste is encased in concrete / glass • and stored in metal drums • under guard / in secure conditions • low level produced at both hospital and reactor • low level waste is put in landfill • with waterproof linings • to keep radioactivity out of ground water • all radioactive waste is harmful / cancerous • becoming less harmful as time goes on **accept** descriptions of type / source of waste instead of names eg nuclear power station giving high level waste. **accept** references to underground burial for intermediate waste
			Total	**[6]**	

Question			Expected answers	Marks	Additional guidance
14			Tc-99 m because activity drops a lot in the time Mo-99 would hardly change in the time	[3]	**accept** 2600 is half of 5200 for (1) **accept** 1300 is half of 2600 and 650 is half of 1300 for (1) **accept** half life is 6 hours **accept** cannot say whether Mo is present, as sample only tested for 24 hours (1)
			Total	[3]	

Question			Expected answers	Marks	Additional guidance
15	(a)		**A**	[1]	
	(b)		**C**	[1]	
	(c)		**C**	[1]	
			Total	[3]	

Assessment Objectives (AO) Grid

(includes quality of written communication ✎)

Question	AO1	AO2	AO3	Total
1(a)	1			**1**
1(b)	2			**2**
2		4		**4**
3(a)	1	1		**2**
3(b)	2			**2**
4✎	3	3		**6**
5(a)		1		**1**
5(b)		1	1	**2**
6(a)	2			**2**
6(b)	3			**3**
7(a)	1			**1**
7(b)	1			**1**
8(a)			2	**2**
8(b)		2		**2**
8(c)		2	1	**3**
9✎	6			**6**
10		3		**3**
11(a)		1		**1**
11(b)		1		**1**
12(a)		1		**1**
12(b)			2	**2**
13✎	3	2	1	**6**
14			3	**3**
15(a)		1		**1**
15(b)		1		**1**
15(c)		1		**1**
Totals	**25**	**25**	**10**	**60**