RECOGNISING ACHIEVEMENT

H
A217/02

GENERAL CERTIFICATE OF SECONDARY EDUCATION
TWENTY FIRST CENTURY SCIENCE
ADDITIONAL SCIENCE A
Unit 3 Modules B6 C6 P6 (Higher Tier)
SAMPLE ASSESSMENT MATERIAL
(from 2010 onwards)

Time: 40 minutes

Candidates answer on the question paper
Additional materials (enclosed):
None

Calculators may be used.
Additional materials: Pencil
Ruler (cm/mm)

Candidate Forename		Candidate Surname	
Centre Number		Candidate Number	

INSTRUCTIONS TO CANDIDATES
- Write your name 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 you know what you have to do before starting your answer.
- Answer **all** the questions.
- Do **not** write in the bar codes.
- Do **not** write outside the box bordering each page.
- Write your answer to each question in the space provided.

INFORMATION FOR CANDIDATES
- The number of marks for each question is given in brackets [ ] at the end of each question or part question.
- The total number of marks for this paper is **42**.
- A list of physics equations is printed on page two.
- The Periodic Table is printed on the back page.

FOR EXAMINER'S USE		
Qu.	**Max.**	**Mark**
1	**4**	
2	**7**	
3	**3**	
4	**4**	
5	**5**	
6	**5**	
7	**4**	
8	**5**	
9	**5**	
TOTAL	**42**	

This document consists of **18** printed pages and **2** blank pages.

TWENTY FIRST CENTURY SCIENCE EQUATIONS

Useful Relationships

Explaining Motion

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

momentum = mass x velocity

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

work done by a force = force x distance moved by the force

change in energy = work done

change in GPE = weight x vertical height difference

kinetic energy = ½ x mass x $[\text{velocity}]^2$

Electric Circuits

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

$$\frac{\text{Voltage across primary coil}}{\text{Voltage across secondary coil}} = \frac{\text{Number of turns in primary coil}}{\text{Number of turns in secondary coil}}$$

energy transferred = power x time

power = potential difference x current

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

The Wave Model of Radiation

wave speed = frequency x wavelength

Answer **all** the questions.

1 Jane has some copper.

She uses this to make copper sulfate.

(a) Jane uses one reaction from the **first** list and one from the **second** list.

Draw **one** straight line from the correct **first** reaction to the correct **second** reaction.

first	second
copper + oxygen → copper oxide	carbon dioxide + sulfuric acid → copper sulfate
copper + oxygen → copper sulfide	copper oxide + sulfuric acid → copper sulfate
copper + sulfur → copper oxide	copper oxide + sodium hydroxide → copper sulfate

[2]

(b) The copper sulfate Jane makes is not pure.

She uses these four steps to purify the copper sulfate.

They are in the wrong order.

A drying

B filtration

C dissolving

D crystallisation

Fill in the boxes to show the right order. The first one has been done for you.

C			

[2]

[Total: 4]

2 Michael reacts magnesium with sulfuric acid.

$$Mg + H_2SO_4 \longrightarrow MgSO_4 + H_2$$

(a) Use relative atomic masses from the Periodic Table on the back page of this booklet to answer the following questions.

(i) What mass of hydrogen is produced when 24 g of magnesium react with an excess of sulfuric acid?

mass of hydrogen = ... g **[1]**

(ii) What is the relative formula mass of magnesium sulfate, $MgSO_4$?

relative formula mass = ...**[1]**

(iii) What mass of magnesium sulfate is produced when 3 g of magnesium react with an excess of sulfuric acid?

mass of magnesium sulfate = ... g **[1]**

(b) Michael works out that his reaction should produce 8 g of magnesium sulfate. In fact it only produces 2 g.

Put a ring around the percentage yield for this reaction.

16% **25%** **40%** **60%**

[1]

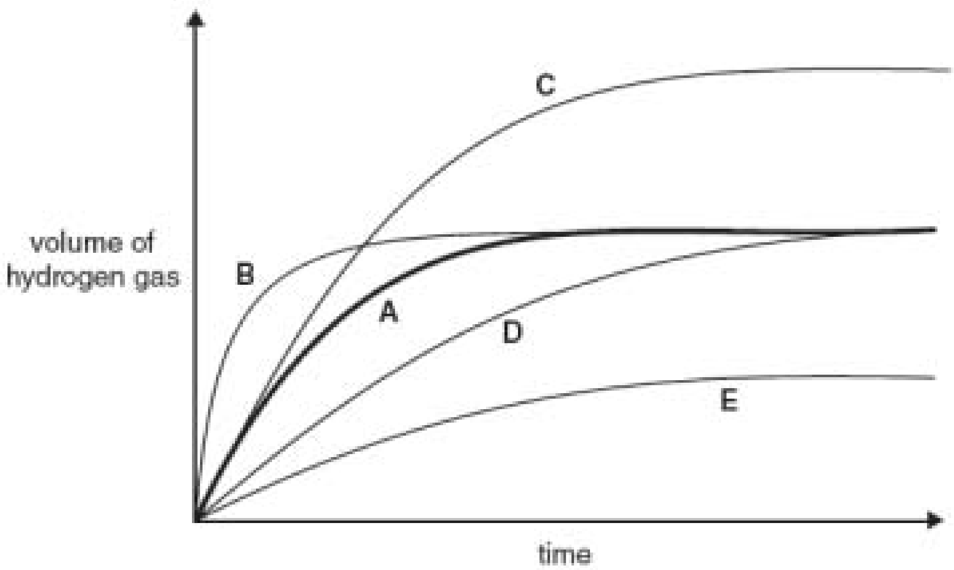
(c) Michael reacts magnesium with an excess of sulfuric acid at 20 °C.

He measures the volume of hydrogen gas given off at intervals of time.

He repeats the experiment five times, changing **one** of the conditions used each time.

He plots a graph for each reaction, **A**, **B**, **C**, **D** and **E**.

The line for Michael's first experiment at 20 °C is marked **A**.



(i) He carries out one reaction at 40 °C.

Which line, **B**, **C**, **D** or **E**, shows this reaction?

Put a ring around the correct answer.

B **C** **D** **E**

[1]

(ii) In one reaction he uses more magnesium.

Which line, **B**, **C**, **D** or **E**, shows this reaction?

Put a ring around the correct answer.

B **C** **D** **E**

[1]

(iii) In one reaction he uses the same mass of magnesium, but in larger pieces.

Which line, **B**, **C**, **D** or **E**, shows this reaction?

Put a ring around the correct answer.

B **C** **D** **E**

[1]

[Total: 7]

3 Dave reacts magnesium carbonate with hydrochloric acid.

This produces magnesium chloride, $MgCl_2$, carbon dioxide and water.

Write down a balanced symbol equation for the reaction.

$$\rightarrow$$

[3]

[Total: 3]

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Question 4 starts on page 8

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4 Jo uses a microwave oven to heat her dinner.

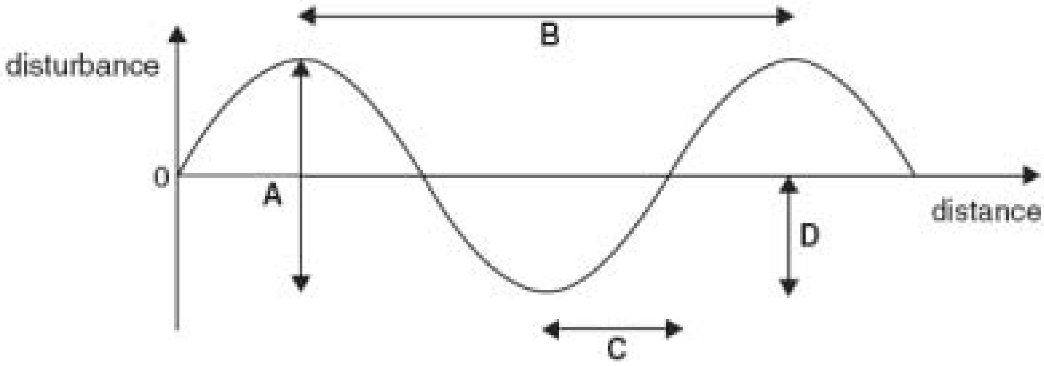
(a) These sentences are about the microwave oven.

Draw a straight line from the **start** of each sentence to its correct **end**.

start	end
The microwaves interfere ...	... by the water in the food.
The microwaves are reflected ...	... when they pass through a gap.
The microwaves are diffracted ...	... by the metal walls of the oven.
The microwaves are absorbed ...	... where they overlap with each other.

[3]

(b) This graph shows a microwave.



Which distance, **A**, **B**, **C** or **D**, is the wavelength of the microwave?

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

[Total: 4]

5 Isobel uses a remote control to adjust her TV set.

(a) The remote control uses a beam of infrared to carry information to the TV set.

Use your understanding of **photons** to describe two factors which affect the intensity of the infrared beam.

....

....

....

.... **[2]**

(b) The infrared is modulated each time that Isobel presses a button on the remote control.

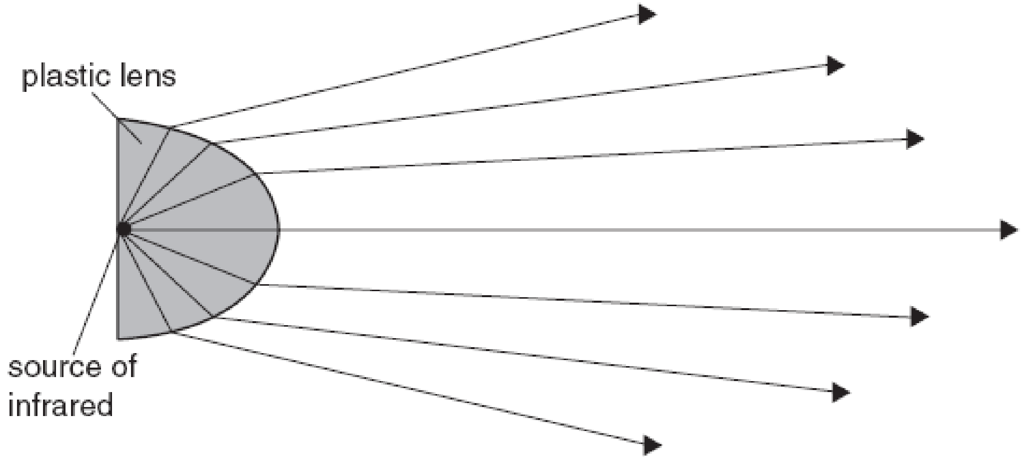
The beam is pulsed on and off in a code, with a different code for each button.

Draw a straight line from the **start** of each sentence to its correct **end**.

start	end
Each pulse represents ...	... a 0 in the code.
	... a 1 in the code.
	... information as a digital code.
The pulsed infrared beam transfers ...	... information as an analogue code.

[1]

(c) An LED is the source of the infrared in the remote control.



The LED is enclosed in a plastic lens.

(i) As the infrared leaves the plastic, most of it changes direction.

What is the name of this process?

Put a ring around the correct answer.

diffraction **reflection** **refraction** **rotation**

[1]

(ii) Which **one** of these statements explains the change of direction?

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

The infrared spreads out as it leaves the lens.	☐
The infrared rotates against the plastic as it reflects off the air.	☐
The infrared speeds up as it moves from the plastic into the air.	☐
The infrared slows down as it moves from the plastic into the air.	☐

[1]

[Total: 5]

6 Jenny is a presenter for Radio CA.

(a) Jenny sings into the microphone.

(i) The speed of sound waves in the studio is 340 m / s.

Jenny sings a note of frequency 680 Hz.

Which of these calculations gives the wavelength of her sound?

Put a ring around the correct answer.

$\dfrac{680}{340}$ **680 × 340** $\dfrac{340}{680}$ **680 + 340**

[1]

(ii) Here are some statements about sound waves.

Some of these statements are true. Some are false.

Write **T** in the box next to each **true** statement and **F** in the box next to each **false** one.

The disturbance of a sound wave …	**true** or **false**
... and its energy flow are in the same direction.	
... increases in amplitude as the sound gets louder.	
... is at right angles to the wave's direction of energy flow.	

[1]

(b) Bill listens to Jenny on his radio receiver.

Radio waves carry information about the sound in Jenny's studio to Bill's receiver.

Describe **two** different ways in which the information can be carried by the radio wave.

....

....

....

.... **[3]**

[Total: 5]

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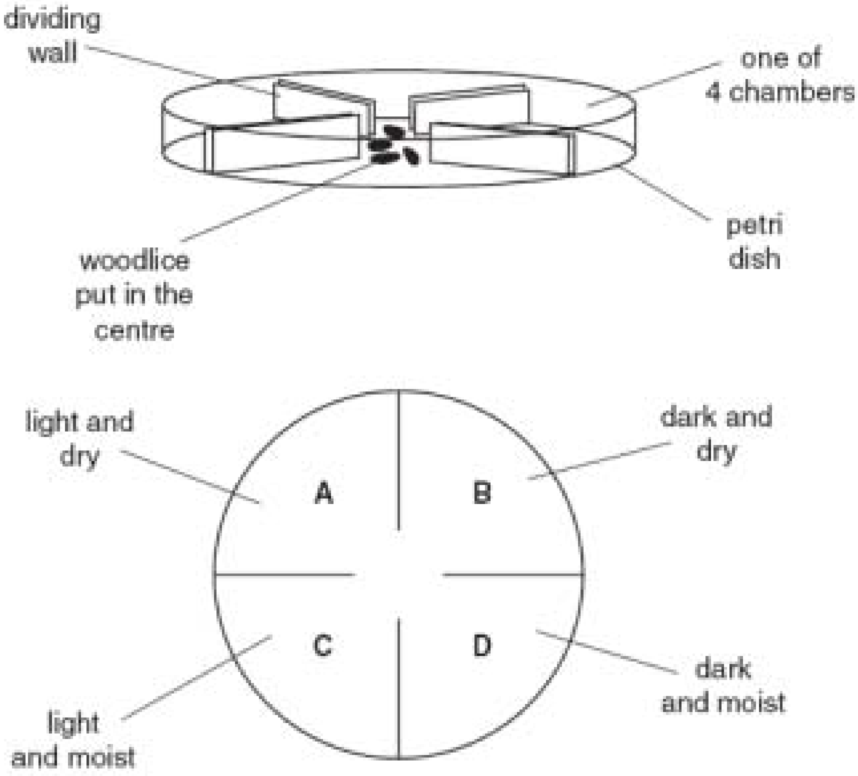
7 Charlie carries out an experiment using woodlice.

He puts 20 woodlice into the centre of a petri dish so that they can move freely into four chambers, **A**, **B**, **C** and **D**. Each chamber has different conditions.



The woodlice tend to gather in dark areas and also in moist areas.

The behaviour pattern of the woodlice is caused by simple reflex actions.

Why are simple reflex actions important for animals?

....

....

....

....

....

.... **[4]**

[Total: 4]

8 The Russian scientist Ivan Pavlov is famous for his work with learned behaviour in dogs.

His experiments included the following steps.

- A dog salivates when given food.
- A bell is rung each time the dog is fed.
- After some time, the bell is rung without giving the dog food.
- The dog salivates when it hears the bell.

(a) What is the function of each step?

Draw a straight line from each **step** to its correct **function**.

step	function
bell ringing	primary stimulus
food given	response
dog salivating	secondary stimulus

[1]

(b) Which part of the dog's brain is involved in learned behaviour patterns?

Put a ring around the correct answer.

hypothalamus **pituitary gland** **medulla** **cerebral cortex**

[1]

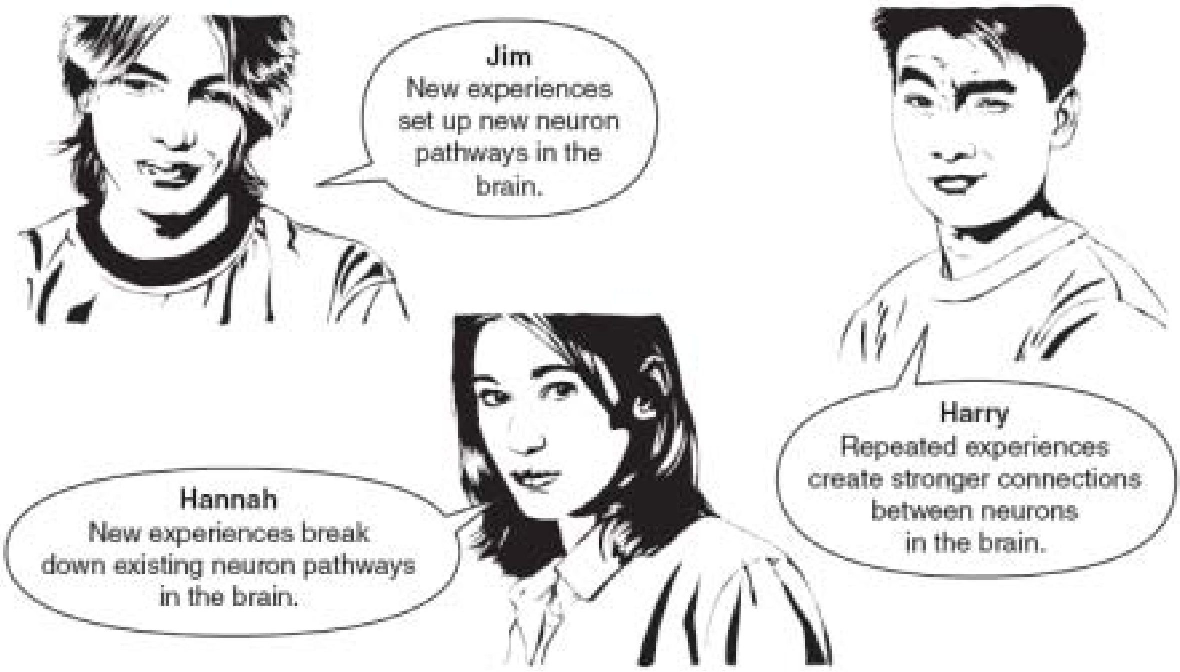
(c) Which of the following types of behaviour are learned?

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

Some bacteria can swim towards sources of food.	☐
Some birds may avoid eating caterpillars with warning colours.	☐
Houseflies fly rapidly away if they detect any sign of movement.	☐
Snails draw into their shells if they detect any sign of movement.	☐
Goldfish may swim to the front of their tank when people walk up to feed them.	☐

[2]

(d) Three friends discuss different ways of explaining what happens in the human brain when we learn.



Put a ring around the names of the **two** people with the **best** explanations.

Jim **Hannah** **Harry**

[1]

[Total: 5]

9 This question is about synapses between sensory and motor neurons.

(a) Here are the steps which take place at a synapse as an impulse passes from a sensory neuron to a motor neuron.

They are in the wrong order.

A chemical released into the synapse

B chemical diffuses across the synapse

C motor neuron transmits an impulse

D sensory neuron transmits an impulse

E chemical binds to the receptor molecules

Fill in the boxes to show the right order. The first one has been done for you.

D				

[3]

(b) The drug ecstasy blocks the removal of the synapse chemical serotonin.

How will this affect the amount of serotonin in the synapse gap between two neurons?

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

same amount of serotonin ☐

increased amount of serotonin ☐

decreased amount of serotonin ☐

[1]

(c) Synapse chemicals, like serotonin, are recognised by a specific receptor molecule found on one side of the synapse.

How does this affect the transmission of nerve impulses?

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

The strength of the nerve impulse is increased. ☐

The nerve impulses can only travel in one direction. ☐

The speed of the nerve impulse transmission is increased. ☐

[1]

[Total: 5]

END OF QUESTION PAPER

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The Periodic Table of the Elements

Key

relative atomic mass
atomic symbol
name
atomic (proton) number

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						

**** 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

RECOGNISING ACHIEVEMENT

CONFIDENTIAL

GCSE Unit

MARK SCHEME

SAMPLE ASSESSMENT MATERIAL
(from 2010 onwards)

Additional Science A (J631)
Modules B6, C6 and P6
Higher Tier

A217/02

Maximum Mark: 42

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, e.g. 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
<u>words</u>	=	underlined words must be present in answer to score a mark
ecf	=	error carried forward
AW/owtte	=	alternative wording
ORA	=	or reverse argument

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

8. Marking method for tick boxes:

Always check the additional guidance.

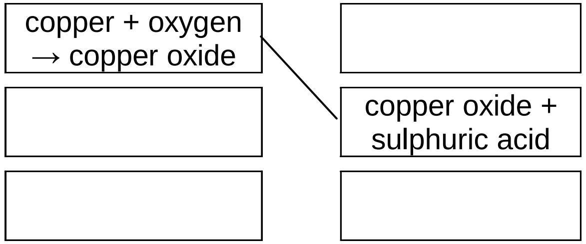
If there is a set of boxes, some of which should be ticked and others left empty, then judge the entire set of boxes.
If there is at least one tick, ignore crosses. If there are no ticks, accept clear, unambiguous indications, e.g. shading or crosses.
Credit should be given for each box correctly ticked. 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.

E.g. If a question requires candidates to identify a city in England, then in the boxes

Edinburgh	
Manchester	
Paris	
Southampton	

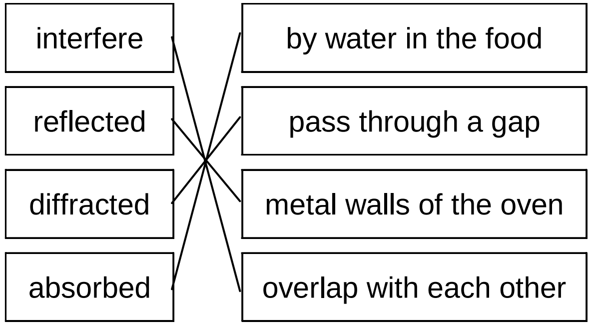
the second and fourth boxes should have ticks (or other clear indication of choice) and the first and third should be blank (or have indication of choice crossed out).

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

Question			Expected Answers	Marks	Rationale
1	**a**			2	left correct (1) right correct (1) LHS – only top box indicated, allow >1 line from the box RHS – only middle box indicated, allow >1 line to the box (Mark the boxes rather than the line)
	b		(C) | B | D | A B before D (1) D before A (1)	2	**B**etter **D**on't **A**sk!
			Total	**4**	

Question			Expected Answers	Marks	Rationale
2	**a**	**i**	2 (1)	1	
		ii	120 (1)	1	**allow** 120 g If no total given allow '24+32+64' or '24+32+4x16'
		iii	15 (1)	1	
	b		25% (1)	1	
	c	**i**	B (1)	1	
		ii	C (1)	1	
		iii	D (1)	1	
			Total	**7**	

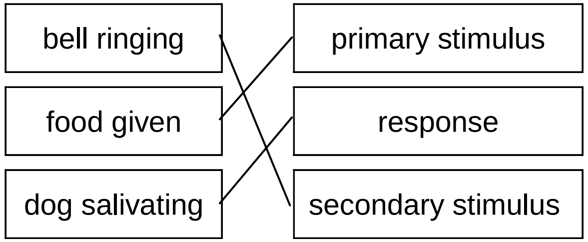
Question			Expected Answers	Marks	Rationale
3	**a**		[3 marks] The candidate shows a good understanding of the whole argument, and covers all the necessary components. The answer is expressed clearly and logically. [2 marks] The candidate shows a partial understanding of the argument and covers two of the necessary components. The answer is expressed clearly. [1 mark] The candidate shows a limited understanding of the argument and covers only one of the necessary components. The answer may not be expressed in a logical sequence.	3	Necessary components - correct symbols for reactants before the arrow (HCl, $MgCO_3$); correct symbol for products after the arrow (H_2O, CO_2, $MgCl_2$); no ecf: balanced symbol equation $2HCl + MgCO_3 = H_2O + CO_2 + MgCl_2$
			Total	**3**	

Question			Expected Answers	Marks	Rationale
4	**a**			3	4 correct (3) 3 or 2 correct (2) 1 correct (1)
	b		B (1)	1	
			Total	**4**	

Question			Expected Answers	Marks	Rationale
5	**a**		[2 marks] The candidate shows a good understanding of the argument and covers two of the necessary components. The answer is expressed clearly and logically. [1 mark] The candidate shows a partial understanding of the argument and covers one of the necessary components. The answer is expressed clearly.	2	Necessary components - number of photons per second; energy per photon; cross section of beam varies with distance;
	b		pulse represents – a 1 in the code beam transfers – a digital code	1	
	c	**i**	refraction (1)	1	
		ii	speeds up moving from plastic ✓ (1)	1	
			Total	**5**	

Question			Expected Answers	Marks	Rationale
6	a	i	340 (1) 680	1	
		ii	energy flow in same direction — T increases in amplitude — T right angles to the wave's direction — F	1	
	b	i	For answers where there is no clear hierarchical response. [3 marks] The candidate shows a good understanding of the whole argument, and covers all the necessary components. The answer is expressed clearly and logically. [2 marks] The candidate shows a partial understanding of the argument and covers two of the necessary components. The answer is expressed clearly. [1 mark] The candidate shows a limited understanding of the argument and covers only one of the necessary components. The answer is expressed clearly.	3	Necessary components – through a process called modulation; radio waves can have their frequency altered; radio waves can have their amplitude altered;
			Total	**5**	

Question			Expected Answers	Marks	Rationale
7			any four of the following, [1] each: • helps animal to survive • allows rapid response to stimuli • helps avoid predators • helps to find a mate • helps to find food	4	
			Total	**4**	

Question			Expected Answers	Marks	Rationale
8	**a**			1	all three correct for one mark
	b		cerebral cortex (1)	1	
	c		caterpillars with warning colours ✓ (1) goldfish may swim to the front ✓ (1)	2	Correct pattern [2] One mistake [1]
	d		Jim and Harry (1)	1	
			Total	**5**	

Question			Expected Answers	Marks	Rationale
9	a		(D) | A | B | E | C A before B (1) B before E (1) E before C (1)	3	
	b		increased amount of serotonin ✓ (1)	1	
	c		impulses only travel in one direction ✓ (1)	1	
			Total	**5**	

			Section total	**42**	