

GCSE 2004

June Series



Mark Scheme

Physics Specification B *3451/H*

Mark schemes are prepared by the Principal Examiner and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation meeting attended by all examiners and is the scheme which was used by them in this examination. The standardisation meeting ensures that the mark scheme covers the candidates' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for the standardisation meeting each examiner analyses a number of candidates' scripts: alternative answers not already covered by the mark scheme are discussed at the meeting and legislated for. If, after this meeting, examiners encounter unusual answers which have not been discussed at the meeting they are required to refer these to the Principal Examiner.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of candidates' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

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Dr Michael Cresswell Director General

GCSE PHYSICS

INFORMATION FOR EXAMINERS

1. General

The mark scheme for each question shows:

- the marks available for each part of the question;
- the total marks available for the question;
- the typical answer or answers which are expected;
- extra information to help the Examiner make his or her judgement and help to delineate what is acceptable or not worthy of credit or, in discursive answers, to give an overview of the area in which a mark or marks may be awarded.

The extra information is aligned to the appropriate answer in the left-hand part of the mark scheme and should only be applied to that item in the mark scheme.

At the beginning of a part of a question a reminder may be given, for example:
where consequential marking needs to be considered in a calculation;
or the answer may be on the diagram or at a different place on the script.

In general the right hand side of the mark scheme is there to provide those extra details which confuse the main part of the mark scheme yet may be helpful in ensuring that marking is straightforward and consistent.

2. Emboldening

2.1 In a list of acceptable answers where more than one mark is available ‘any **two** from’ is used, with the number of marks emboldened. Each of the following lines is a potential mark.

2.2 A bold **and** is used to indicate that both parts of the answer are required to award the mark.

2.3 Alternative answers acceptable for a mark are indicated by the use of **or**. (Different terms in the mark scheme are shown by a / ; e.g. allow smooth / free movement.)

3. Marking points

3.1 Marking of Quality of Written Communication

Where *Quality of written communication* appears in the mark scheme, one mark is to be awarded for either of the following points:

- Using correct scientific terms
- Correct sequencing or linking of ideas or points

The mark scheme will specify which of the points is to be awarded in a particular question. A QoWC mark can be awarded for a scientific answer, even if it is not accurate. It cannot be awarded for a nonsensical or non-scientific answer.

On the script, the QoWC tick should be identified by a ‘q’ written next to it.

3.2 Marking of lists

This applies to questions requiring a set number of responses, but for which candidates have provided extra responses. The general principle to be followed in such a situation is that ‘right + wrong = wrong’.

Each error/contradiction negates each correct response. So, if the number of error/contradictions equals or exceeds the number of marks available for the question, no marks can be awarded.

However, responses considered to be neutral (indicated as * in example 1) are not penalised.

Example 1: What is the pH of an acidic solution? (1 mark)

Candidate	Response	Marks awarded
1	4,8	0
2	green, 5	0
3	red*, 5	1
4	red*, 8	0

Example 2: Name two planets in the solar system. (2 marks)

Candidate	Response	Marks awarded
1	Pluto, Mars, Moon	1
2	Pluto, Sun, Mars, Moon	0

3.3 Use of chemical symbols/formulae

If a candidate writes a chemical symbol/formula instead of a required chemical name, full credit can be given if the symbol/formula is correct and if, in the context of the question, such action is appropriate.

3.4 The marking of quantitative relationships

Full credit can be given for a correct quantitative relationship expressed in:

- named units;
- physical quantities;
- standard symbols;
- a combination of physical quantities and units.

No credit can be given for any quantitative relationship expressed in terms of:

- a combination of physical quantities, units and symbols;
- a diagram, e.g. the ohm's law triangle, unless the rest of the answer shows clearly that the candidate understands the relationships involved.

3.5 Marking procedure for calculations

3.5.1 Full marks can be given for a correct numerical answer, as shown in the column 'answers', without any working shown. However:

- if the answer is incorrect, mark(s) can be gained by correct substitution/working and this is shown in the 'extra information' column;
- if the answer is correct, but an incorrect relationship is written in the working, then no marks can be awarded (see 3.5.2).

3.5.2 Where calculations are based on incorrectly recalled relationships, neither the incorrectly recalled relationship, nor the resulting calculation based on the incorrect relationship, will be credited.

3.6 Interpretation of 'it'

Answers using the word 'it' should be given credit only if it is clear that the 'it' refers to the correct subject.

3.7 Errors carried forward

There should be no error carried forward from a previous answer which has been based on wrong science. Any error in the answers to a structured question should be penalised once only.

Examples

- (a) A candidate who calculates average speed using $\text{speed} = \text{time}/\text{distance}$ **and** then proceeds to use this incorrect answer to calculate an acceleration based on the correct quantitative relationship should be given credit for the use of the correct acceleration relationship but none for either numerical answer.
- (b) A candidate who incorrectly calculates average speed using $\text{speed} = \text{distance}/\text{time}$ and then proceeds to use this incorrect value to calculate an acceleration based on the correct quantitative relationship, should be given credit for the use of both correct quantitative relationships **and** for the correct substitution and use of the incorrect value in the calculation of the rate of acceleration.

Papers should be constructed in such a way that the number of times errors can be carried forward are kept to a minimum. Allowances for errors carried forward are most likely to be restricted to calculation questions and should be shown by the abbreviation e.c.f. in the marking scheme.

3.8 Phonetic spelling

The phonetic spelling of correct scientific terminology should be credited **unless** there is a possible confusion with another technical term.

3.9 Brackets

(.....) is used to indicate information which is not essential for the mark to be awarded but is included to help the examiner identify the sense of the answer required.

3.10 Interpretation of marginal points

There will be times when the answer is almost, but not quite, correct. Some examiners would award a mark while others would not. In any one script, an attempt should be made to balance these nearly correct answers by giving the mark on some occasions but not on others. If this is not done, the marking would end up being too lenient or too harsh.

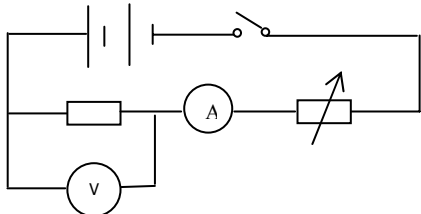

3.11 Unexpected Correct Answers not in the Mark Scheme

The Examiner should use professional judgement to award credit where a candidate has given an unexpected correct answer which is not covered by the mark scheme. The Examiner should consult with the Team Leader to confirm the judgement. The Team Leader should pass this answer on to the Principal Examiner with a view to informing all examiners.



**GCSE Physics
Higher Tier 3451/H**

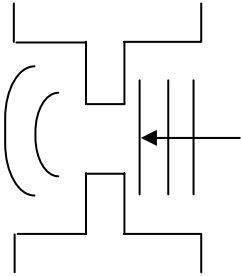
3451H Q1

question	answers	extra information	mark
(a)	all symbols correct	 <p>accept push switch symbol switch may be open or closed any lines through symbols = 0 marks</p>	1
	correct circuit drawn voltmeter must be across resistor only	<p>polarity of cells not relevant provided they are joined correctly two cells are required in the diagram ignore the order of the components allow small gaps in circuit</p> <p>omission of any component = 0 marks</p>	1
(b)(i)	potential difference = current \times resistance	<p>accept voltage or p.d. for potential difference</p> <p>accept $V = I \times R$</p> <p>accept  provided</p> <p>subsequent use correct</p> <p>do not accept C for current</p>	1
(ii)	2	<p>allow 1 mark for correct substitution wrong working loses both marks</p>	2
(iii)	straight line drawn <u>through the origin</u>	judge by eye	1
	straight line passes through $I = 0.4$, $V =$ their (b)(ii) / 2 and 0.0	<p>this mark may be awarded if all points shown including these points are correct even if no line is drawn N.B. a curve scores 0 marks</p>	1 dep
(c)	temperature <u>increases</u>	<p>accept filament lamp / it gets <u>hotter</u> allow heat for temperature</p>	1
total			8

3451H Q2

question	answers	extra information	mark
(a)(i)	gamma rays	accept gamma accept correct symbol	1
(ii)	infra red	accept IR	1
(b)	ultraviolet <u>absorbed</u> by ink (energy) given out as light	accept glows / luminous accept for both marks the ink is fluorescent do not accept answers in terms of uv being reflected	1 1
(c)	any two from: <ul style="list-style-type: none"> • UV can damage / kill / ionise / alter (normal) cells • change DNA structure or mutate • (normal) cells may become cancerous 	do not accept attacks cells or burns skin accept may cause (skin) cancer accept abnormal cell multiplication	2
(d)(i)	microwaves and infra red	both answers needed in either order do not accept heat for IR	1
(ii)	0.9	allow 1 mark for the <u>correct</u> use of 1.8 (kW) ($1.8 \times \frac{1}{2}$ or 1.8×30) i.e. adding the correct 2 power values	2
total			9

3451H Q3

question	answers	extra information	mark
(a)(i)	any one from: <ul style="list-style-type: none"> • (doctors) to see inside a patients body or endoscope • telephone <u>cables</u> • optical fibre / fibre optic lamps or (artificial) Christmas trees • data transfer or internet connection 	accept keyhole surgery do not accept flex or wires for cable accept decorative / ornamental lighting accept any feasible practical suggestion for taking light to a difficult to access place do not accept lighting unqualified do not accept lamp unqualified do not accept communications unless clarified	1
(ii)	(incident) ray angle greater than critical angle <u>total internal reflection</u> occurs	either order accept (incident) ray greater than 42° accept TIR do not accept just description of TIR	1 1
(b)(i)	waves shown diffracting in the correct direction 	ignore wavelength	1
(ii)	diffraction	accept diffract / diffracted	1
total		5	

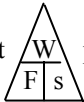
3451H Q4

question	answers	extra information	mark
(a)	Y and Z they have the same number of protons or same atomic number	accept they have the same number of electrons or same number of protons and electrons allow only different in number of neutrons N.B. independent marks	1 1
(b)	Quality of written communication A – alpha particle passes straight through the empty space of the atom or it is a long way from the nucleus B – alpha particle <u>deflected</u> / <u>repelled</u> / <u>repulsed</u> by the (positive) <u>nucleus</u> C – alpha particle heading straight for the <u>nucleus</u> is <u>deflected</u> / <u>repelled</u> / <u>repulsed</u> backwards	for correct use of terms underlined in B or C Q ✓ Q X describes 3 tracks correctly for 2 marks describes 2 or 1 track correctly for 1 mark do not accept hits the nucleus do not accept answers referring to refraction do not accept answers in terms of reflected backwards unless qualified in terms of repulsion mention of difference in charge on nucleus negates that track	1 max 2
total			5

3451H Q5

question	answers	extra information	mark
(a)(i)	accelerating	accept getting faster accept speed / velocity increasing	1
(ii)	acceleration <u>increases</u>	accept velocity / speed increases <u>more</u> rapidly do not accept velocity / speed increases	1
(b)(i)	acceleration = $\frac{\text{change in velocity}}{\text{time (taken)}}$	accept $a = \frac{v - u}{t}$ or $a = \frac{v_1 - v_2}{t}$ do not accept velocity for change in velocity do not accept change in speed do not accept $a = \frac{v}{t}$	1
(ii)	15	allow 1 mark for an answer of 900 or for <u>correct</u> use of 540 seconds	2
(iii)	velocity includes direction	accept velocity is a vector (quantity) accept converse answer	1
(c)	force of gravity (between <u>shuttle</u> and Earth) plus correct orbital speed (makes <u>shuttle</u> move in a curve)	accept gravitational pull if used correctly accept forward motion or constant speed for orbital speed accept it is travelling fast enough accept for 2 marks the force of gravity provides the <u>centripetal</u> force	1 1
(d)	black is a good emitter of radiation or to limit the temperature rise inside the shuttle	accept heat for radiation accept the tiles are good insulation do not accept black absorbs heat on its own do not accept tiles are heat proof	1
total			9

3451H Q6

question	answers	extra information	mark
(a)(i)	work (done) = force (applied) × distance (moved)	accept $W = F \times s$ or $W = F \times d$ accept  provided subsequent method is correct	1
(ii)	240 000 joules	allow 1 mark for correct substitution or correct use of 1200 (N) accept J do not accept j / Nm	2 1
(b)	800 (watts)	accept 0.8 kW accept their (a)(ii) ÷ 300 correctly evaluated for 2 marks allow 1 mark for correct substitution (a)(ii) ÷ 5 correctly evaluated for 1 mark	2
(c)(i)	any one from: • needs to raise the chair / lift • lifting more than one chair • energy transfer to the surroundings correctly qualified	allow lifting more than 2 people implication of a heavier weight accept loss for transfer do not accept motor inefficient do not accept motor gets hot do not accept friction unless the location is specified as external to the motor	1
(ii)	electrical potential	accept electric both answers required for the mark	1
total			8

3451H Q7

	answers	extra information	mark
(a)	relay (normally open) (switch)	each mark is independent	1
	... switch on a (larger) current (in another circuit) or switch on a higher voltage circuit	do not accept switch on another circuit or smaller / equal current	1
	light emitting diode / LED	do not credit LDR	1
	... in one / direct / certain direction or from left to right	or when the cathode is connected to the negative terminal / side or when the left-hand side is connected to the positive terminal / side do not credit just '... is big enough' do not accept 'positive direction'	1
	AND gate	accept 'and' gate	1
	... (both) inputs are on / high / 1 or current flows in both inputs	do not accept numerical values unless expanded	1
(b)	Quality of written communication	If in a sensible order which clearly indicates advantages or disadvantages, including answers in the form of a table or as bullet points Q ✓ Q X	1
	any three from: <ul style="list-style-type: none"> • advantage of mobile phones • drawback of mobile phones • benefit of the Internet • drawback of the Internet 	e.g. more convenient for service engineers e.g. calls can be received away from base e.g. privacy can be more easily invaded e.g. drivers can be distracted e.g. microwaves / radio waves can / may cause damage to the brain e.g. access to educational material e.g. some material is salacious e.g. spam (on external e-mail) these are examples candidates may be credited for a variety of responses	3
total			10

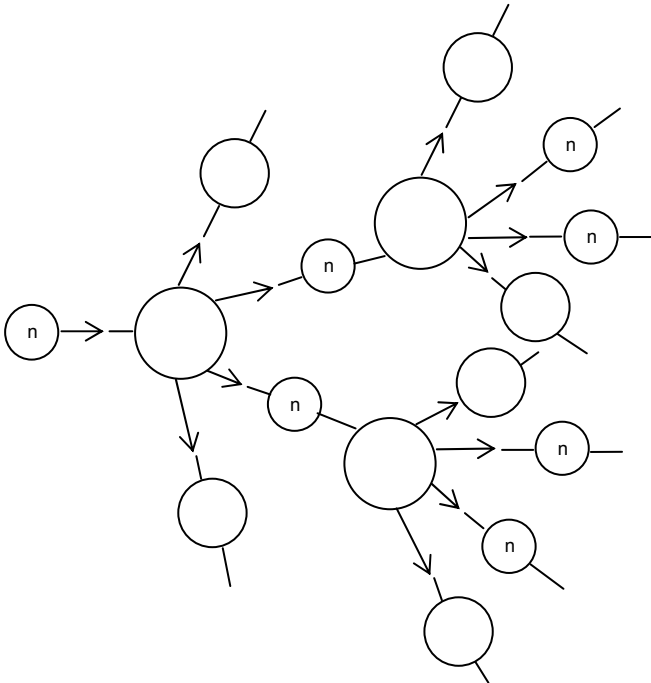
3451H Q8

	answers	extra information	mark
(a)(i)	current		1
(ii)	resistance decreases	accept 'the flow of electrons / current (through it) increases' for 1 mark do not credit just '... it will get warmer'	1 1
(b)		all pairs correct one pair correct for 1 mark	2
(c)(i)	potential divider	accept voltage divider	1
(ii)	4 (volts)	$6 \times \frac{30}{45}$ for 1 mark	2
(iii)	across the new resistor...(will) increase across R ₂ ... (will) decrease	N.B. independent marks	1 1
total			10

3451H Q9

question	answers	extra information	mark
(a)	<p>Quality of written communication</p> <p>A – B constant <u>speed</u></p> <p>B – C (has accelerated) to a higher (constant) <u>speed</u></p> <p>C – D goes back to original / lower (constant) <u>speed</u></p>	<p>for correct use of term speed in all correct examples Q ✓ Q X</p> <p>describes all 3 sections correctly for 2 marks describes 2 or 1 section correctly for 1 mark</p> <p>do not accept pace for speed</p> <p>allow for 1 mark, initial and final (constant) speeds are the same accept velocity for speed ignore reference to direction</p>	<p>1</p> <p>max 2</p>
(b)	62.5	<p>allow answer to 2 s.f.</p> <p>allow 1 mark for drawing a correct triangle or for using two correct pairs of coordinates</p> <p>allow 1 mark for correct use of y/x</p> <p>ignore units</p>	3
total			6

3451H Q10

question	answers	extra information	mark
(a)(i)	(large) <u>nucleus</u> hit by a neutron splits into (smaller) nuclei and neutron(s) (+ energy)		1 1
(ii)	additional neutrons collide with nuclei causing further fission	<p>allow full credit for a correct labelled diagram accept 2 or more neutrons given out at each fission reaction</p> <p>diagram shows 3 discernible sizes, with smaller nuclei and neutrons at same stage</p> 	1
(b)	cost of (building and) de-commissioning is very high or cost of building is <u>higher</u>	<p>accept a correct description of de-commissioning</p> <p>accept high cost to keep the power station safe / secure accept high cost of reprocessing / storage of nuclear waste</p>	1

continued:

3451H Q10 continued

question	answers	extra information	mark
(c)	less pollution from transport carrying the fuel	accept coal produces more pollutant gases accept correct named gases accept more radiation pollution from coal than nuclear accept more waste from coal than nuclear do not accept any reference to burning uranium do not accept answers in terms of global warming or acid rain unless developed	1
total			5

3451H Q11

question	answers	extra information	mark
(a)(i)	rotating coil cuts through <u>magnetic field</u>	accept relative movement between coil and <u>magnetic field</u>	1
	voltage <u>induced</u> across coil	accept current <u>induced</u> in coil do not accept voltage <u>induced</u> through coil	1
		any reference to current being put into coil negates these 2 marking points	
	slip rings rotate / turn with the coil	accept slip rings allow coil to rotate without tangling	1
	brushes connect slip rings to circuit	accept allow (induced) current to flow	1
(ii)	rotate the coil twice as fast	accept for 1 mark, rotate the coil faster any suggested change to the design of the generator negates 1 mark unless justified in terms of amplitude and frequency	2
(b)	<u>transformers</u> only work with a.c.	accept converse	1
	<u>transformers</u> used to reduce current along power lines or <u>transformers</u> increase voltage across power lines	do not accept general statements e.g. step up / step down voltage accept converse	1
	less energy wasted (as heat) (along power lines) or power loss along the lines is reduced	accept increases efficiency (of energy / power transmission) accept converse	1
total			9


3451H Q12

question	answers	extra information	mark
(a)	any two from: <ul style="list-style-type: none"> • nuclei / atoms of light elements fuse • each (fusion) reaction releases energy / heat / light • lots of reactions occur 	accept hydrogen or helium for light elements accept join for fuse accept for 1 mark, by nuclear fusion answers about fission negates a mark	2
(b)	presence of nuclei of the heaviest / heavy / heavier elements	accept atom for nuclei	1
(c)(i)	(matter / mass) with such a high density / strong gravitational (field)		1
	electromagnetic radiation / light is pulled in	accept nothing can escape do not accept answers in terms of an empty void	1
(ii)	X-rays	accept e-m radiation / e-m waves	1
(d)	longer wavelength waves or light moved towards red end of spectrum		1
	(galaxy) moving <u>away</u> from the Earth or space is expanding or the galaxy and Earth are moving apart	accept us for Earth do not accept galaxies expanding	1
(e)	big bang		1
total			9

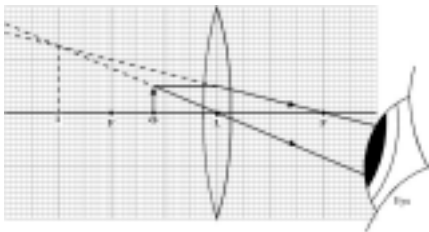
3451H Q13

question	answers	extra information	mark
(a)(i)	power = potential difference \times current	accept voltage for potential difference accept $P = V \times I$ or correct transposition accept $\begin{array}{c} P \\ \hline V I \end{array}$ provided subsequent method correct	1
(ii)	8	allow 1 mark for correct substitution or transformation or an answer 2.67 / 2.7	2
(b)(i)	$\frac{\text{voltage across primary}}{\text{voltage across secondary}} = \frac{\text{number of turns on primary}}{\text{number of turns on secondary}}$	accept input for primary accept output for secondary accept $\frac{V_p}{V_s} = \frac{N_p}{N_s}$ accept $\frac{V_1}{V_2} = \frac{N_1}{N_2}$ or correct transposition	1
(ii)	60	allow 1 mark for correct transformation	2
total			6

3451H Q14

question	answers	extra information	mark
(a)	plates are moving <u>away</u> from each other	do not accept plates being forced apart	1
	fractures are filled by magma / basalt / igneous rock	do not accept mantle or lava	1
(b)	magnetic reversal patterns in oceanic crust	accept in form of diagram accept floor or bed for crust accept sea for oceanic reference to charged rock scores 0 marks	1
(c)(i)	wave speed = frequency \times wavelength	accept $v = f \times \lambda$ accept  provided subsequent method correct	1
(ii)	0.5	allow 1 mark for an answer of 0.0005 or for 12 or 12000 obtained from graph or for correct transformation standard form must be expressed correctly	2
total			6

3451H Q15

	answers	extra information	mark
(a)(i)	converging / convex / biconvex		1
(ii)	focal (points) or foci	accept focuses or focus (point)	1
(iii)	(principal) axis		1
(iv)	 <p>all lines drawn with a ruler for full marks</p> <p>no ruler, penalise 1 mark from first four</p> <p>last mark can still be awarded</p> <p>double refraction drawn could get 4 out of 5 marks</p>	<p>ray that continues from the top of the object through L to the eye</p> <p>horizontal ray from the top of the object, refracted by the lens and continued through F on the r.h.s. to the eye</p> <p>back projections of these rays (shown as dotted lines)</p> <p>image 25 mm high at 61 mm left of L (tolerance 1 mm \pm vertically, 2 mm \pm horizontally)</p> <p>at least one arrow shown on real ray and towards the eye but do not credit if contradicted by other arrow(s)</p>	<p>1</p> <p>1</p> <p>1</p> <p>1</p> <p>1</p>
(v)	formed where imaginary rays intersect / cross or not formed by real rays	<p>accept (virtual image) is imaginary</p> <p>accept cannot be put on screen</p> <p>do not credit just ‘... is not real’</p>	1
(b)	<p>(the image) needs to fall on film / sensors / LDRs / CCDs</p> <p>either</p> <p>to cause a (chemical) reaction or to be digitalised</p> <p>object (should be) on the far side of F / the focus (from the lens)</p> <p>or</p> <p>object should be more than twice the distance / 2F (from the lens)</p> <p style="text-align: right;">(2 marks)</p>	<p>accept just ‘charged couples’</p> <p>do not credit ‘... solar cells’</p> <p>do not accept virtual image cannot be stored</p> <p>for credit response must be appropriate to camera type</p> <p>or ... more than the focal length (away from the lens)</p> <p>allow ‘beyond the focus’</p> <p>or ... more than twice the focal length (away from the lens)</p> <p style="text-align: right;">(2 marks)</p>	<p>1</p> <p>1</p> <p>1</p>
total			12

3451H Q16

	answers	extra information	mark
(a)(i)	momentum = mass × velocity	accept ... × speed or any transposed version	1
(ii)	11.2 to 11.3	0.75 × 15 for 1 mark	2
	kg m/s down(wards) or Ns down(ward)	n.b. both unit and direction required for this mark	1
(iii)	11.2 to 11.3	accept same numerical answer as part (a)(ii) accept answer without any unit or with the same unit as in part (a)(ii), even if incorrect, but any other unit cancels the mark	1
(iv)	force = $\frac{\text{change in momentum}}{\text{time}}$	accept transposed version	1
(v)	112 to 113 or numerical value from (a)(ii) × 10	11.25 ÷ 0.1 or (a)(ii) ÷ 0.1 for 1 mark	2
	newton(s)	or N accept Newton(s) do not credit 'Ns' or n	1
(b)	(the user will experience a) <u>large</u> change in momentum	do not credit just '... momentum changes'	1
	(but) seat belt increases the time for this to occur or seat belt stops you hitting something which would stop you quickly	do not credit just '... stops you hitting the windscreen etc.'	1
	(so) the force on the user is less	} depends on previous response re momentum or continued movement	1
	(so) less chance of (serious / fatal) injury		1
total			13

3451H Q17

question	answers	extra information	mark
(a)(i)	nucleus / neutron	do not accept shells or orbits	1
(ii)	neutron changes to a proton or number of neutrons goes down 1 and the number of protons goes up by 1	do not accept becomes positive	1
(b)(i)	photographic film / paper	accept X-ray film	1
(ii)	(when developed) the film is darker	must have a comparison	1
(iii)	to prevent them receiving / being exposed to too much radiation or so they know how much radiation they have been exposed to	accept if he gets too much radiation there may be something wrong with the plant any statement making reference to a need for preventive or corrective action gains 1 mark an isolated statement of fact of the effect of radiation gains 0 marks	1
total			5