



ASSESSMENT and
QUALIFICATIONS
ALLIANCE

Mark scheme

June 2003

GCSE

Physics

3451

Foundation

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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

Examiners are reminded of the need to assess QoWC by the following statement appearing in the appropriate parts of the mark scheme:

The answer to this question requires ideas in good English in a sensible order with correct use of scientific terms. Quality of written communication should be considered in crediting points in the mark scheme.

The maximum marks available to a candidate whose answer is not well expressed will be (the number of marks available –1).

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.

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

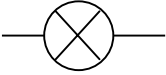
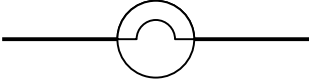
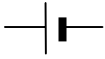
(.....) is used to indicate information which is not essential for the mark to be awarded but is included to help the examiner identify the sense of the answer required.

3.10 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.



3451/F Q1

question	answers	extra information	mark
(a)	circuit symbol for a lamp correct 	accept 	1
	circuit symbol for a cell correct 	accept any standard of drawing providing circuit would work	1
	2 lamps drawn in parallel with <u>3</u> cells	polarity of cells must be correct (+ to -) but cells may be either way around	1
(b)	4.5		1
(c)	the same as	accept any clear indication of the correct answer	1
total			5

3451/F Q2

question	answers	extra information	mark
(a)	gas		1
(b)	fuel burning stations produce electricity at any time / all the time	accept fuel available all the time	1
	wind generator can only produce when the wind is strong enough	accept it's not always windy	1
(c)	no fuel is burnt or no fuel is used or uses only energy from wind or does not emit harmful gases / soot / smoke	do not accept wind is natural / environmentally friendly / renewable answer must be in terms of wind, not negative of fuel burning specific examples of gases CO ₂ , SO ₂ , acid rain and greenhouse gases can be accepted ozone negates credit	1
total			4

3451/F Q3

question	answers	extra information	mark
(a)(i)	microwaves		1
(ii)	infra red		1
(iii)	ultrasonic		1
(b)(i)	B		1
(ii)	A		1
(c)	disturbance / vibration / movement	accept motion / force	1
	direction	do not accept energy	1
(d)	sound wave	accept any clear indication of the correct answer	1
total			8

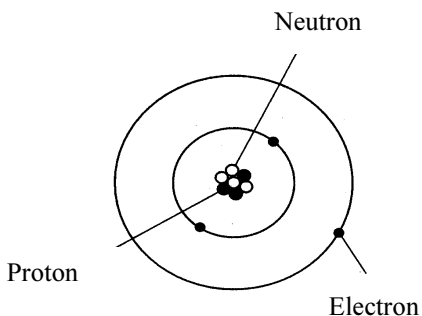
3451/F Q4

question	answers	extra information	mark
(a)(i)	heat		1
(ii)	temperature increases or (cause) convection (currents)	accept gets warmer accept gets hotter	1
(iii)	60% or 0.6	60 without % scores 1 mark 0.6 with a unit scores 1 mark 60 with incorrect unit scores 1 mark or correct substitution $\frac{120}{200}$ for 1 mark	2
(b)	street more (energy transferred as) light or less (energy transferred as) heat or useful energy output the highest	can only score this mark if first mark scored all efficiencies calculated correctly score 2 nd mark point	1 1
total			6

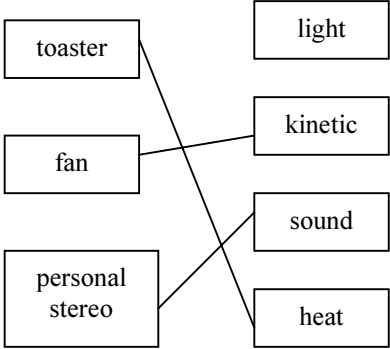
3451/F Q5

question	answers	extra information	mark
(a)	MN	accept 5.8, 8 seconds must include unit	1
(b)	LM	accept 0.8, 5.8 seconds must include unit	1
(c)(i)	0.8		1
(ii)	drinking alcohol		1
(d)	<u>straight</u> (by eye) line starting at 0.8 seconds		1
	line drawn steeper than LM starting before L	ignore lines going beyond 2 seconds but line must exceed 2.5 metres per second before terminating	1
total			6

3451/F Q6

question	answers	extra information	mark
(a)(i)	each correct label scores 1 mark		3
	 <p>The diagram shows a central nucleus composed of several protons (represented by white circles) and neutrons (represented by black circles). Two concentric circles represent electron shells. Three electrons (represented by small black dots) are shown orbiting the nucleus. Labels with lines pointing to specific particles are: 'Neutron' pointing to a black dot in the nucleus, 'Proton' pointing to a white dot in the nucleus, and 'Electron' pointing to a black dot on the outer shell.</p>		
(ii)	neutron		1
(iii)	7		1
	number of protons and neutrons or number of nucleons or number of particles in the nucleus	accept number of particles in the centre only if first answer = 7	1
(b)(i)	50 ± 5		1
(ii)	50 ± 5	accept their (b)(i)	1
(iii)	less	accept any way of indicating the correct answer	1
total			9

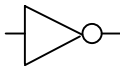

3451/F Q7

question	answers	extra information	mark
(a)	<p>each correct line scores 1 mark</p> 	<p>if more than 3 lines are drawn mark incorrect ones first, to a maximum of 3 lines</p>	3
(b)	toaster	accept 1.2 kW	1
(c)(i)	400		1
(ii)	£24 or 2400p	<p>full credit for their (c)(i) × 6p</p> <p>for full credit the correct numerical answer must have the correct unit</p> <p>an answer of 24 or 2400 with no unit or the incorrect unit scores 1 mark</p> <p>(c)(i) × 6 incorrectly evaluated scores 1 mark</p>	2
(d)	6	<p>allow 6000 for 1 mark</p> <p>allow 3 × 2 for 1 mark</p>	2
total			9

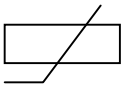
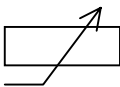
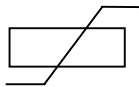
3451/F Q8

question	answers	extra information	mark
(a)(i)	point where the rays cross	do not credit if ambiguous	1
(ii)	converging (lens)	do not accept convex	1
(b)(i)	point where the rays appear to diverge from	this should appear to be within 10mm in front of the back of the arrows on the approximate centre line need not be accurately constructed using a ruler	1
(ii)	diverging (lens)	do not accept concave	1
(c)	converging film smaller than nearer to	accept any clear indication of the correct response e.g. ticking, ringing, writing in after a mistake	1 1 1 1
(d)(i)	(image) bigger than object / enlarge	accept just 'made bigger'	1
(ii)	it / real image can be put on a screen or real image on the opposite side of the lens to the object	accept 'not an imaginary or virtual image' assume 'it' refers to a real image do not credit 'it can be seen'	1
(e)	either (the converging lens is) thick in the middle thin(ner) at the edge or (both) sides bend outwards (1) in the middle (1) or one side bends in the middle (1) more than the other side bends inwards (in the middle) (1)	<u>thickest</u> in the middle gains 2 marks convex gains 2 marks suitable diagrams gains 2 marks	1 1
total			12

3451/F Q9

question	answers	extra information	mark
(a)(i)	off off on	all correct	1
(ii)	AND (gate)	accept and (gate)	1
(iii)	on on on	all correct	1
(iv)	OR (gate)	accept or (gate)	1
(b)(i)	1 0 or 0 1 0 1 1 0	do not credit on / off responses	1
(ii)		accept mirror image accept  accept with either or both parts shaded accept line through as shading	1
(c)	0 0 0 1 1 1 1 1	accept off for 0 and on for 1 throughout both correct both correct both correct both correct	1 1 1 1

3451/F Q9 continued

<p>(d)(i)</p>	 <p>accept mirror image or inverted</p> <p>do not credit</p>  <p>or</p>  <p>or similar</p>	<p>1</p>
<p>(ii)</p>	<p>resistance decreases / increases / changes</p> <p>current (through it) increases / decreases / changes</p> <p>or</p> <p>temperature changes / increases / decreases (1)</p> <p>resistance changes / decreases / increases (1)</p> <p>(NTC thermistor)</p> <p>both marks independent but must be compatible to score 2 marks</p> <p>accept ‘voltage across it decreases’ for 2 marks but only if it is made clear that this refers to a thermistor in series</p>	<p>1</p> <p>1</p>
<p>total</p>		<p>13</p>

3451/F Q10

question	answers	extra information	mark
(a)(i)	friction	accept any way of indicating the correct answer	1
(ii)	gravity	accept any way of indicating the correct answer	1
(b)(i)	accelerates or <u>speed</u> / velocity increases	accept faster <u>and</u> faster (1 mark) do not accept faster pace / falls faster or suggestions of a greater but constant speed	1
	downwards / falls	accept towards the Earth / ground this may score in part (b)(ii) if it does not score here and there is no contradiction between the two parts	1
(ii)	constant speed / velocity or terminal velocity / speed or zero acceleration	stays in the same place negates credit	1
total			5

3451/F Q11

question	answers	extra information	mark
(a)(i)	X – mantle		1
	Y – <u>inner</u> core	do not accept solid core	1
(ii)	different to the crust or contains a lot of (heavy) metals	accept iron and nickel for metals	1
	<u>higher</u> (average) density or denser	density higher than 5500 (kg/m ³) gets 2 marks	1
(b)	animals were able to move from one continent to the other		1
	(when bridge broke) animals evolved differently	accept animals adapted differently	1
(c)(i)	earthquakes occur at the boundary between plates or earthquakes occur where plates push against each other		1
	there are no plate <u>boundaries</u> running through Britain	accept Britain is not near the edge of a plate	1
(ii)	convection currents (in the mantle) or heat released by (natural) radioactive processes		1
total			9

3451/F Q12

question	answers	extra information	mark
(a)(i)	outside the Earth or not from the Earth	accept alien accept life from / on another planet / space accept our planet for Earth	1
(ii)	radio telescope(s)	do not accept telescopes do not accept satellite dishes do not accept radio receivers or transmitters	1
(b)(i)	galaxies	do not accept stars	1
(ii)	any one from: the pulses were regular pulses from space are usually random (scientists) thought technology had been used to produce the pulses neutron stars were unknown signals from a single point	accept signals / beats for pulses accept noise for random pulses idea of regular but not continuous	1
(iii)	neutron star is (the matter / mass) left behind after a star / red giant explodes (as a super nova)	accept after a super nova (explosion) neutron star causing super nova gets no credit	1 1
(c)(i)	carried on the balloon / equipment	accept carried by a rocket / aircraft / satellite birds negates credit	1
(ii)	on comets or meteors	accept meteorites / shooting stars accept returning space craft accept solar wind ignore asteroids accept ufo do not accept solar flares do not accept satellites	1
total			8

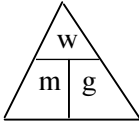
3451/F Q13

question	answers	extra information	mark
(a)	silver is a (good) reflector of <u>heat</u> (radiation) or silver reflects the heat (radiation)	fact heat = infra red ignore references to light accept shiny for silver good radiator negates the mark ignore references to good conductor do not accept bounce back	1
	less heat is lost through the board or more heat is retained by the shirt	explanation accept both sides of shirt heated reflects heat back up gets 1 mark only ignore mention of friction	1
(b)	metal soleplate	accept soleplate / bottom / metal do not accept outside / case	1
(c)	plastic or rubber	accept any named plastic do not accept wood	1
	it is a (good) insulator or it is a poor conductor	ignore mention of heat if in conjunction with electricity	1
(d)	Quality of written communication <i>The answer to this question requires ideas in good English in a sensible order with correct use of scientific terms. Quality of written communication should be considered in crediting points in the mark scheme.</i>	<i>Maximum of 2 marks if ideas not well expressed.</i>	
	pulls iron bolt down or attracts the iron bolt or moves bolt out of plunger	answers in terms of charges attracting or repelling gain no credit	1
	plunger pushed / moved to the right (by spring) or plunger released		1
	push switch opens / goes to off / goes to right	accept circuit is broken for maximum credit the points must follow a logical sequence 3 correct points but incorrect sequence scores 2 marks only ignore reset action	1
total			8

3451/F Q14

question	answers	extra information	mark
(a)(i)	any one from: the ground the air radon (gas) building materials buildings rocks / granite food cosmic <u>rays</u> or solar <u>rays</u> X-rays nuclear weapons testing nuclear power stations / accidents	do not accept mobile phones accept from outer space accept sun but not sunlight accept medical uses	1
(ii)	2	allow $\frac{1200}{60 \times 10}$ or $\frac{1200}{600}$ or 120 for 1 mark	2
(b)	alpha: the count rate is (greatly) reduced by the card or the card absorbs alphas <u>but not betas</u> beta: the count rate is (greatly) reduced by the metal or the thin metal absorbs alphas <u>and</u> betas or the thin metal absorbs all of the radiation (from the source) gamma: would pass through the thin metal but count rate is background or no radiation passing through or a higher reading would be recorded or to reduce the count to 2 would require <u>much more</u> than 3 mm of metal	answers must be comparative accept converse answers throughout accept paper for the card accept aluminium for the metal accept aluminium for the metal accept lead / aluminium for the metal	1 1 1
total			6

3451/F Q15

question	answers	extra information	mark
(a)(i)	weight = mass \times g.f.s.	accept $w = m \times g$ accept gravity for gfs accept  provided subsequent use of Δ correct do not accept $N = kg \times N/kg$	1
(ii)	675	75 \times 9 for 1 mark	2
(iii)	g.(f.s.) is higher (on Earth than Venus)	accept gravity for g.f.s. do not accept g.f.s. is lower unless answer states on Venus	1
(iv)	orbit time for Jupiter is <u>longer</u> / longest (than for the other planets)	do not give any credit for an answer that includes a comparison of diameter or a comparison of g.f.s.	1
(b)	Quality of written communication <i>The answer to this question requires ideas in good English in a sensible order with correct use of scientific terms. Quality of written communication should be considered in crediting points in the mark scheme.</i> any two from: dust <u>and</u> gas or remnants of a super nova pulled together by (force of) <u>gravity</u> nuclear fusion starts	<i>Maximum of 1 mark if ideas not well expressed.</i> accept hydrogen for dust and gas do not accept hydrogen burns although candidates may include more detail these points are essential to score the credit	2
total			7

3451/F Q16

question	answers	extra information	mark
(a)(i)	upright with the contacts at the bottom and still in place and unbent	no need for labels but incorrect label(s) cancel the mark accept a freehand drawing no need for details such as correct dimensions	1
	one blob of mercury touching <u>both</u> contacts	do not award mark if contacts bent to touch	1
(b)(i)	(X is a) battery	do not credit cell accept (set of) cells accept power supply do not accept power pack	1
	(Y is a) LED	or light emitting diode	1
(ii)	longer (time)	do not accept 'slower time'	1
(iii)	any two from: current less (so) rate of flow of charge less or less coulombs per second (so) discharge is slower	do not accept current slower accept capacitor has charge for longer or charge lasts longer or (so total of) electrons take longer to travel round circuit	2
(c)	4200	translation correct (= 4000) but percentage addition incorrect gains 1 mark translation incorrect but 5% addition is correct gains 1 mark accept 422.1 or 42.2 or 6.3 for 1 mark	2
	ohms or Ω	4.2 kilohms or 4.2 k Ω gains all 3 marks	1
total			10

3451/F Q17

question	answers	extra information	mark
(a)	point at which its mass (seems to) act or point at which gravity (seems to) act	accept ...its weight acts accept correct statements if the intent is clear e.g. ... if suspended, the centre of gravity will be directly under the point of suspension e.g. ... (if the object is symmetrical), the centre of gravity is on the or an axis (of symmetry) do not credit just 'it is a point'	1
(b)	Quality of written communication <i>The answer to this question requires good English in a sensible order with correct use of scientific terms. Quality of written communication should be considered in crediting points in the mark scheme.</i> any five from: clamp (steel) rod (horizontally) hang plastic / sheet by rod through (one) hole hang plumb line from rod mark ends of plumb line on the sheet and use the ruler to draw a straight line repeat with other hole centre of mass is where the lines cross check by balancing at this point	<i>maximum of 4 marks if ideas not well expressed</i> no marks if method quite unworkable <i>maximum of 3 marks if no 'repeat with other hole'</i>	5
(c)(i)	(turning) effect or moment force distance	all three correct accept weight accept length	1
(ii)	17.6 Nm or newton metre(s)	allow 44×0.4 or 0.4×44 for 1 mark do not accept N/m or N/cm 1760 Ncm gains all 3 marks	2 1
total			10