



## General Certificate of Secondary Education

# Physics 3451/F *Specification B*

## Mark Scheme

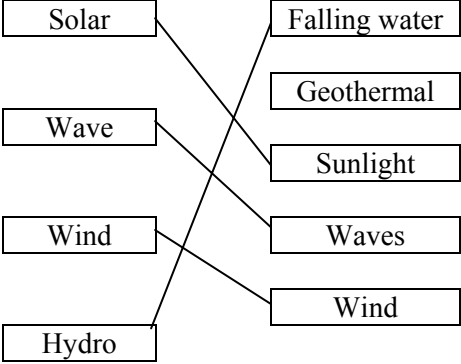
### *2006 examination – June series*

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.

**Physics (Specification B)  
Foundation Tier 3451/F**

**3451/F Q1**

question	answers	extra information	mark
(a)	<p>4 correct lines drawn</p> 	<p><b>1</b> mark for each correct line</p> <p>if more than 4 lines are drawn mark incorrect ones first. Mark only 4 lines</p>	4
(b)	4		1
(c)(i)	nuclear		1
(ii)	(natural) gas	do <b>not</b> accept natural	1
total			7

**3451/F Q2**

<b>question</b>	<b>answers</b>	<b>extra information</b>	<b>mark</b>
(a)(i)	ultra violet		1
(ii)	kill the cells	accept destroys the cells accept makes cells cancerous accept damage cells accept harms cells accept changes DNA accept cause cells to mutate accept skin cells for cells accept cause cancer do <b>not</b> accept skin for cells do <b>not</b> accept burns the cells	1
(b)(i)	the sunbed uses an alternating current (a.c.) supply		1
(ii)	10.8	accept <b>1</b> mark for correct substitution of power in W or kW <u>and</u> time in hours or seconds	2
total			5

**3451/F Q3**

question	answers	extra information	mark
(a)(i)	M		1
(ii)	K		1
(iii)	J		1
(iv)	O		1
(b)(i)	billions of years		1
(ii)	red giant	any answer in terms of explosion or supernova is <b>incorrect</b>	1
	contracts / shrinks to	incorrect reference to black hole negates <b>1</b> mark	1
	white dwarf		1
total			8

**3451/F Q4**

<b>question</b>	<b>answers</b>	<b>extra information</b>	<b>mark</b>
(a)(i)	A and C	<b>both</b> answers must be correct  in either order	1
(ii)	A and B	<b>both</b> answers must be correct  in either order	1
(iii)	same number of protons plus neutrons <b>or</b> same number of nucleons	accept number of particles in nucleus the same  do <b>not</b> accept they add up to 6 unless qualified	1
(b)(i)	any <b>two</b> from:  <ul style="list-style-type: none"> <li>• boron - 12</li> <li>• carbon - 14</li> <li>• oxygen - 15</li> <li>• lead - 209</li> </ul>	<b>both</b> required  both name <b>and</b> number must be given	1
(ii)	any <b>two</b> from:  <ul style="list-style-type: none"> <li>• boron - 11</li> <li>• carbon - 12</li> <li>• oxygen - 16</li> <li>• lead - 207</li> </ul>	<b>both</b> required  both name <b>and</b> number must be given	1
(c)	alpha		1
total			6

**3451/F Q5**

<b>question</b>	<b>answers</b>	<b>extra information</b>	<b>mark</b>
(a)	(good) insulator	accept does not conduct (electricity) accept does not conduct heat or electricity  do <b>not</b> accept does not conduct heat  outside is tough is insufficient	1
(b)	fuse		1
(c)	connect the green and yellow / earth wire	accept wires must be connected to screws	1
	swap the brown and blue wires round		1
total			4

**3451/F Q6**

<b>question</b>	<b>answers</b>	<b>extra information</b>	<b>mark</b>
(a)	fossils	answers can be in either order	1
	water		1
(b)	increased		1
(c)	radio telescope		1
total			4

**3451/F Q7**

<b>question</b>	<b>answers</b>	<b>extra information</b>	<b>mark</b>
(a)(i)	electrical		1
	kinetic	accept movement	1
(ii)	heat	answers can be in either order	1
	sound		1
(b)(i)	360	accept <b>1</b> mark for correct substitution	2
(ii)	watt		1
(c)	the stairlift is not moving the stairlift is moving at constant speed	<b>both</b> answers are required for the mark	1
total			8

**3451/F Q8**


<b>question</b>	<b>answers</b>	<b>extra information</b>	<b>mark</b>
(a)(i)	(up) further	any reference to downwards movement loses credit accept <u>with</u> more force accept motion would increase	1
	<b>or</b> (up) faster		
(ii)	down	accept the opposite way	1
		accept drop	
(b)(i)	direct current		1
(ii)	Z		1
total			4

**3451/F Q9**

question	answers	extra information	mark
(a)	level of radiation (detected) will not change	ignore reference to particles	1
	if thickness of aluminium changes	accept for <b>both</b> marks a specific example eg if the aluminium gets thicker the level of radiation detected stays the same.  accept for <b>1</b> mark gamma will pass through aluminium	1
	QoWC for 2 points in a sensible sequence		1
(b)	S W T V	all in correct order  accept <b>2</b> marks for 2 correct  accept <b>1</b> mark for 1 correct	3
total			6



## 3451/F Q10

question	answers	extra information	mark															
(a)	thermistor(s) LDR(s) switch(es) LED(s) buzzer(s) motor(s)	1 mark each or light dependent resistor(s) or light emitting diode(s)	6															
(b)(i)	<table border="1"> <thead> <tr> <th>1<sup>st</sup> input</th> <th>2<sup>nd</sup> input</th> <th>Output</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>0</td> <td><b>0</b></td> </tr> <tr> <td>1</td> <td>0</td> <td><b>0</b></td> </tr> <tr> <td>0</td> <td>1</td> <td><b>0</b></td> </tr> <tr> <td>1</td> <td>1</td> <td>1</td> </tr> </tbody> </table>	1 <sup>st</sup> input	2 <sup>nd</sup> input	Output	0	0	<b>0</b>	1	0	<b>0</b>	0	1	<b>0</b>	1	1	1	all correct	1
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(c)(i)		do <b>not</b> credit any attempt which could equally well be a poorly drawn attempt at the symbol for a cell	1															
(ii)	charge	accept 'electrons'	1															
	increases	accept 'energy' <b>or</b> gets bigger/larger	1															
total			12															

**3451/F Q11**

question	answers	extra information	mark
(a)(i)	A		1
(ii)	B		1
(iii)	mass is larger	credit if the response is clear by some other means e.g. it is ringed	1
	wire is shorter	credit if the response is clear by some other means e.g. it is ringed	1
(b)	moment		1
	distance		1
(c)(i)	1		1
(ii)	5		1
(iii)	any <b>two</b> from <ul style="list-style-type: none"> <li>• remove slotted mass(es)</li> <li>• slide (slotted) masses / weights nearer pivot</li> <li>• slide forcemeter away from the pivot</li> <li>• slide rod to the left</li> </ul>	<b>or</b> ..... to the left  <b>or</b> ..... to the right  <b>or</b> .... so that the slotted masses side is shorter <b>or</b> .... so that the forcemeter side is longer	2
(d)	centre of the rectangle	accept 2mm tolerance any direction	1
	centre of the circle	accept 2mm tolerance any direction	1
	on centre line and 10mm above base	accept 2mm tolerance any direction	1
total			13

## 3451/F Q12

question	answers	extra information	mark
(a)	0.05 (A)	ignore incorrect units if given accept 'the same' / 'the same as K' / 'the same as the other ammeter' do <b>not</b> accept 'same as the other meter'	1
(b)(i)	any <b>two</b> from: <ul style="list-style-type: none"> <li>two cells are joined + to +</li> <li>some of the cells potential difference is across the diode / ammeters / wires <b>or</b> the pd of the cells is shared by all components</li> <li>the other components have a resistance</li> <li>cells not fully charged <b>or</b> cells partially run down</li> <li>cells have an internal resistance</li> </ul>	answers in terms of current gain no marks accept one cell in the wrong way accept two cells are joined back-to-back accept two cells are joined – to – accept battery for cell do <b>not</b> accept answers in terms of all the cells or in terms of energy only accept voltage for pd do <b>not</b> accept using up pd accept a named component / components / wire has a resistance do <b>not</b> accept voltage of cells is less than 1.5 unless explained do <b>not</b> accept cells are not as powerful unless explained	2
(ii)	the diode has a (very) <u>high</u> resistance (in the reverse direction) a diode only conducts / allows current to flow in one direction	accept little / no current flows do <b>not</b> accept blocks / cuts flow	1 1

Continued

3451/F Q12

question	answers	extra information	mark
(c)	QoWC for the use of the word resistance	annotate Q✓ Q✗ accept resistant	1
	accept increase / change / decrease throughout question but a contradiction loses <b>one</b> mark with change as neutral		
	as the pd / current increases / changes	accept voltage for pd must be correctly linked to at least one of the following points accept	1
	the temperature of the filament increases / changes	lamp / bulb for filament accept filament becomes hotter	1
	increasing / changing the <b>resistance</b> of the lamp	accept for <b>1</b> mark only the filament lamp does not obey Ohm's law	1
total			9

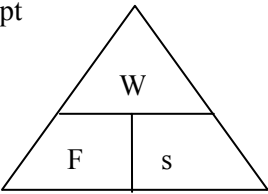
## 3451/F Q13

question	answers	extra information	mark
(a)	0.5		1
	hertz	accept Hz but <b>not</b> HZ / hz / hZ  accept (waves) per second <b>or</b> / sec <b>or</b> / s <b>or</b> s <sup>-1</sup> <b>or</b> sec <sup>-1</sup>	1
(b)	any <b>one</b> from: <ul style="list-style-type: none"> <li>any named part of the electromagnetic spectrum</li> <li>S – waves / secondary waves</li> <li>wave on a rope</li> </ul>	do <b>not</b> accept seismic waves / earthquake  do <b>not</b> accept slinky unless clearly described	1
(c)	transverse – disturbance / vibration is perpendicular to the direction of energy transfer / wave travel	accept a correctly labelled diagram	1
	longitudinal – disturbance / vibration is parallel to the direction of energy transfer / wave travel	accept a correctly labelled diagram  part explanation of the difference between transverse <b>and</b> longitudinal gains <b>1</b> mark	1
(d)(i)	TIR shown	needs to stay inside water jet  ignore number of reflections <b>or</b> arrow heads  lines straight by eye	1
(ii)	bigger than	any indication of correct answer	1
total			7

3451/F Q14

question	answers	extra information	mark
(a)	W  has only two states <b>or</b> is either on or off	accept discrete values only  do <b>not</b> credit answer purely in terms of shape	1  1
(b)	any <b>one</b> from:  <ul style="list-style-type: none"> <li>• higher quality</li> <li>• increased carrying capacity</li> <li>• errors can be rectified</li> </ul>	accept clearer  do <b>not</b> accept easier to read  ignore faster  accept <u>less</u> distortion <b>or</b> <u>less</u> weakening of signal strength  do <b>not</b> accept no distortion / weakening on its own  accept more information can be sent <b>or</b> more channels	1
total		3	

## 3451/F Q15

question	answers	extra information	mark
(a)(i)	all points plotted accurately  line of best fit must be continuous	accept <b>1</b> mark for 5 correct plots $\pm \frac{1}{2}$ small square on stopping distance  accept attempt at a reasonable curve does not need to go through 0 0 do <b>not</b> accept a straight line do <b>not</b> accept dot-to-dot	2  1
(ii)	4 to 6 (metres)	accept ecf from (a)(i) accept <b>1</b> mark for value taken correctly from graph at 25mph <b>or</b> correct method shown	2
(b)(i)	0.7 (s)	incorrect unit = 0 marks	1
(ii)	constant speed / velocity	accept (continued as) 30mph accept did not change / stayed the same accept no acceleration	1
(iii)	3.3(s)	penalise incorrect unit once only	1
(iv)	reaction time <u>increases</u> / is <u>longer</u> <b>or</b> thinking distance <u>increases</u>  stopping distance / it <u>increases</u>	do <b>not</b> accept reaction time slower <b>or</b> reactions are slower  do <b>not</b> accept travels at constant speed for longer	1 1
(c)(i)	work done = force (applied) $\times$ distance (moved)	accept $W = F \times s$ or $W = F \times d$ accept   provided subsequent method is correct	1

Continued

**3451/F Q15**

<b>question</b>	<b>answers</b>	<b>extra information</b>	<b>mark</b>
(ii) <b>E</b>	2100	accept 2.1 kilo accept <b>1</b> mark for using 7000N	2
(iii)	2100 (joules)	accept their (c)(ii)	1
total			14



## 3451/F Q16

question	answers	extra information	mark
(a)(i)	refraction		1
(ii)	it changes speed <b>or</b> change in density	accept it speeds up  do <b>not</b> accept it slows down  do <b>not</b> accept air is more dense than glass	1
(b)(i)	sound / waves <u>diffract</u>  through the gap (in the wall) <b>or</b> over the wall <b>or</b> because the gate is open	do <b>not</b> accept reflection  this only scores if first marking point is given  accept for <b>1</b> mark only sound / waves go through the gap and <u>spread out</u> <b>or</b> diagram showing wave fronts spreading out from open gates  if diagram is labelled as diffraction both marks can be scored	1  1
(ii)	less diffraction	accept no diffraction  accept gates <u>absorb</u> sound / noise / waves  accept gates <u>reflect</u> sound / noise / waves  do <b>not</b> accept rebounds / stops / blocks out	1
total			5

3451/F Q17

question	answers	extra information	mark
(a)	both rays brought to a focus at F on the right	do <b>not</b> have to be continued beyond F	1
	lines have been drawn <b>accurately</b> with a ruler	only credit if 1st mark credited do <b>not</b> credit if contradictory arrow(s) added	1
(b)	rays seem to come from a focus at G on the left and continued to the right of the lens	this mark is for the current idea of divergence	1
	lines have been drawn <b>accurately</b> with a ruler	only credit if 1st mark credited do <b>not</b> credit if contradictory arrow(s) added	1
(c)	...lens... ...image... ...object... ...image... ...object... ...lens...	lens as 1st and 6th words (1) image and object in the correct order 2nd and 3rd words (1) image and object in correct order 4th and 5th words (1)	max 3
(d)(i)	correct statement about real image real rays intersect / cross to form a real image  <b>or</b> a real image can be formed on a screen  <b>or</b> real image is (always) on the opposite side (of the lens)  <b>or</b> real image is (always) upside down (to the object)	may be credited from a correct diagram	1
	correct statement about virtual / imaginary image virtual / imaginary rays intersect / cross to form a virtual image  <b>or</b> a virtual / imaginary image cannot  <b>or</b> virtual / imaginary image is (always) on the same side (of the lens)  <b>or</b> virtual / imaginary image is (always) same way up (as the object)	may be credited from a correct diagram	1

Continued

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**3451/F Q17**

<b>question</b>	<b>answers</b>	<b>extra information</b>	<b>mark</b>
(ii)	<b>either</b> image needs to fall on / affect the film  <b>or</b> image needs to fall on / affect the light sensors / charged coupled devices (CCDs) (in a digital camera / mobile phone)  <b>or</b> image needs to cause a chemical reaction (in / on the film)		1
total			10

**3451/F Q18**

question	answers	extra information	mark															
(a)	AND (gate)	accept 'and'	1															
	OR (gate)	accept 'or'	1															
	NOT (gate)	accept 'not' <b>or</b> invert gate	1															
	LED or light emitting diode	accept 'led'	1															
(b)(i)	NOT (gate) and AND (gate)	<b>both</b> in either order <b>or</b> '(the) gates'  any additions lose the mark	1															
(ii)	<table border="1" style="display: inline-table; vertical-align: top;"> <thead> <tr> <th>Switch for fire</th> <th>Tilt switch</th> <th>Signal to relay</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>0</td> <td>...0...</td> </tr> <tr> <td>0</td> <td>1</td> <td>...0...</td> </tr> <tr> <td>1</td> <td>0</td> <td>...1...</td> </tr> <tr> <td>1</td> <td>1</td> <td>...0...</td> </tr> </tbody> </table>	Switch for fire	Tilt switch	Signal to relay	0	0	...0...	0	1	...0...	1	0	...1...	1	1	...0...	all correct  allow    off <b>or</b> no off                no on                yes off                no	1
Switch for fire	Tilt switch	Signal to relay																
0	0	...0...																
0	1	...0...																
1	0	...1...																
1	1	...0...																
(iii)	(relay) acts as / is a switch	accept implication that it works as a switch e.g. 'turns on fire'	1															
	<b>either</b> small current from the electronic / control circuit / system (1)	or 'small current through the coil (of the relay)'	1															
	large current through the output / (electric) fire (1)	do <b>not</b> accept small current is turned into a large current	1															
	<b>or</b> full current through electronic control system (1)																	
	may damage components / lead to overheating / electric shock (1)																	
<b>QoWC</b> for correct use of the scientific term 'current'	annotate Q✓ Q*  if answer in terms of voltage isolation / voltage/ p.d. accept <b>QoWC</b> mark for correct use	1																
total			10															