



General Certificate of Secondary Education

Physics 3451/H *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)
Higher Tier 3451/H**

3451/H Q1

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

Continued

3451/H Q1

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 one 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 resistance of the lamp		1
		accept for 1 mark only the filament lamp does not obey Ohm's law	
total			9

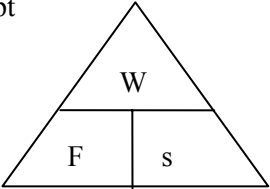
3451/H Q2

question	answers	extra information	mark
(a)	0.5		1
	hertz	accept Hz but not HZ / hz / hZ accept (waves) per second or / sec or / s or s ⁻¹ or sec ⁻¹	1
(b)	any one from: <ul style="list-style-type: none"> • any named part of the electromagnetic spectrum • S – waves / secondary waves • wave on a rope 	do not accept seismic waves / earthquake do not 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 and longitudinal gains 1 mark	1
(d)(i)	TIR shown	needs to stay inside water jet ignore number of reflections or arrow heads lines straight by eye	1
(ii)	bigger than	any indication of correct answer	1
total			7

3451/H Q3

question	answers	extra information	mark
(a)	W has only two states or is either on or off	accept discrete values only do not credit answer purely in terms of shape	1 1
(b)	any one from: • higher quality • increased carrying capacity • errors can be rectified	accept clearer do not accept easier to read ignore faster accept <u>less</u> distortion or <u>less</u> weakening of signal strength do not accept no distortion / weakening on its own accept more information can be sent or more channels	1
total			3

3451/H Q4

question	answers	extra information	mark
(a)(i)	all points plotted accurately line of best fit must be continuous	accept 1 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 not accept a straight line do not accept dot-to-dot	2 1
(ii)	4 to 6 (metres)	accept ecf from (a)(i) accept 1 mark for value taken correctly from graph at 25mph or 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> or thinking distance <u>increases</u> stopping distance / it <u>increases</u>	do not accept reaction time slower or reactions are slower do not 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
(ii)	2100	accept 2.1 kilo accept 1 mark for using 7000 N	2
(iii)	2100 (joules)	accept their (c)(ii)	1
total			14

3451/H Q5

question	answers	extra information	mark
(a)(i)	refraction		1
(ii)	it changes speed or change in density	accept it speeds up do not accept it slows down do not accept air is more dense than glass	1
(b)(i)	sound / waves <u>diffract</u> through the gap (in the wall) or over the wall or because the gate is open	do not accept reflection this only scores if first marking point is given accept for 1 mark only sound / waves go through the gap and <u>spread out</u> or 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 not accept rebounds / stops / blocks out	1
total			5

3451/H Q6

question	answers	extra information	mark
(a)	both rays brought to a focus at F on the right	do not have to be continued beyond F	1
	lines have been drawn accurately with a ruler	only credit if 1st mark credited do not 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 accurately with a ruler	only credit if 1st mark credited do not 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 or a real image can be formed on a screen or real image is (always) on the opposite side (of the lens) or 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 or a virtual / imaginary image cannot or virtual / imaginary image is (always) on the same side (of the lens) or virtual / imaginary image is (always) same way up (as the object)	may be credited from a correct diagram	1

Continued

3451/H Q6

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

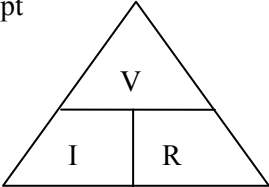
3451/H Q7

question	answers	extra information	mark															
(a)	AND (gate)	accept 'and'	1															
	OR (gate)	accept 'or'	1															
	NOT (gate)	accept 'not' or invert gate	1															
	LED or light emitting diode	accept 'led'	1															
(b)(i)	NOT (gate) and AND (gate)	both in either order or '(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 or 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															
	either 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 not accept small current is turned into a large current	1															
	or full current through electronic control system (1) may damage components / lead to overheating / electric shock (1)	annotate Q✓ Q* if answer in terms of voltage isolation / voltage/ p.d. accept QoWC mark for correct use	1															
total			10															

3451/H Q8

question	answers	extra information	mark
(a)	fusion	accept fussion do not accept any misspelling which could be interpreted as fission	1
(b)	describing forces involved forces are equal / balanced	accept radiation pressure for force	1 1
(c)(i)	(galaxies) moving away (from Earth) (quickly) or space (between Earth and the galaxies) is expanding (rapidly)	ignore wavelength do not accept planets moving away	1
(ii)	(the further the galaxy) the <u>faster</u> it is moving away from us	accept the further the galaxy the <u>faster</u> we are moving away from it	1
(d)(i)	(living) organisms produce changes to an atmosphere or atmosphere similar to earth or presence of water indicates possibility of life not caused / unlikely to be caused by other (chemical or geological) processes or atmosphere different to how it would have been with only chemical / geological changes or accounted for by photosynthesis	accept specific changes e.g. there is more oxygen accept presence of oxygen dependent on previous mark	1 1
(ii)	using radio telescopes to find meaningful / recognisable signals from space	do not accept telescopes accept pulses do not accept noise	1 1
total			9

3451/H Q9

question	answers	extra information	mark
(a)(i)	potential difference = current \times resistance	accept pd / voltage for potential difference accept $V = I \times R$ accept  provided subsequent method is correct	1
(ii)	375	an answer of 0.375 gains 2 marks accept 1 mark for correct transformation accept 1 mark for use of 0.004 A	3
(b)	straight line drawn below given line	must go through origin	1
total			5

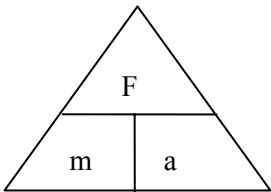
3451/H Q10

question	answers	extra information	mark
(a)(i)	(high energy) electron	accept ${}_{-1}^0\text{e}$	1
(ii)	one less neutron one more proton	both required accept it is <u>more</u> stable	1
(iii)	becomes charged / ionised	do not credit becomes negatively charged only	1
(b)	will not pass through the skull / bone	do not accept answers in terms of air, paper or metal unless qualified	1
(c)(i)	12.5		1
(ii)	increased exposure to radiation <u>from space</u> or atmosphere absorbs less of the radiation (from space) (increased risk of) cancer	accept <u>cosmic rays</u> for radiation from space accept indication of mutating cells	1 1
total			7

3451/H Q11

question	answers	extra information	mark
(a)	ions / (free) electrons gain (kinetic) energy	accept atom / particles / molecules for ion accept ions vibrate faster accept ions vibrate with a bigger amplitude accept ions vibrate more do not accept ions start to move do not credit move more	1
	(free) electrons transfer energy by collision with ions or energy transferred by collisions between vibrating ions	idea of passage from ion to ion accept atom / particles / molecules for ion	1
(b)	hot water tank jacket		1
	correct calculation shown or result of all four calculations or answers in terms of payback time with clear reference to 5 years	$20 \times 5 - 30 = 70$ or 70 25 25 50 accept for 1 mark finding saving over 5 years 100 75 100 400 or answers in terms of payback time only	2
total			5

3451/H Q12

question	answers	extra information	mark
(a)(i)	force = mass \times acceleration	accept $F = m \times a$ accept  provided subsequent method is correct accept correct transformation do not accept an equation in units	1
(ii)	5.6	accept 1 mark for correct transformation	2
(b)	forces acting against forward motion <u>increase</u> (as the athlete gets faster) (until) forces balance (acceleration is zero) or (until) force backwards = 364 N (acceleration is zero)	accept drag / air resistance / frictional forces as opposing forces ignore reference to terminal velocity	1 1
total			5

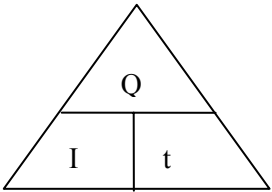
3451/H Q13

question	answers	extra information	mark
(a)	any two from: <ul style="list-style-type: none"> • do not produce pollutant gases • can produce electricity at any time • small amount of fuel gives a large amount of energy • conserves fossil fuels 	ignore answers in terms of cost accept carbon dioxide or sulphur dioxide for pollutant gases accept are reliable accept concentrated fuel	2
(b)	(high cost) of building / decommissioning	accept reference to safety / security accept high cost of waste disposal	1
(c)(i)	suitable wind strength for generation only 24% / some of the time	accept only windy 24% / some of the time accept it is not always windy	1
(ii)	any two from: <ul style="list-style-type: none"> • wind is a dilute energy source • <u>higher</u> capital / land cost • many wind farms are needed • wind farms are inefficient 	accept wind turbines for wind farm	2
total			6


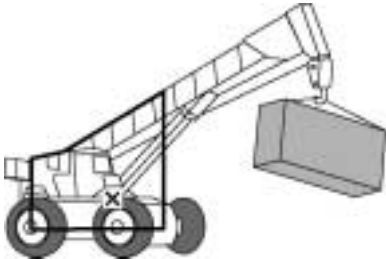
3451/H Q14

question	answers	extra information	mark
(a)(i)	(change in) gravitational potential energy = weight \times (change in) vertical height	accept $\text{gpe} = w \times h$ accept E for gpe accept $\text{gpe} = mgh$ do not accept gravity for g	1
(ii)	35 200	allow 35.2 kilo allow 1 mark for correct substitution allow 1 mark for an answer of 3520	2
(b)(i)	kinetic energy = $\frac{1}{2} \text{mass} \times \text{speed}^2$	accept velocity for speed accept $\frac{1}{2} mv^2$ do not accept $\frac{1}{2} \text{ms}^2$	1
(ii)	24	accept 1 mark for correct substitution accept 1 mark for correct transformation	3
(c)	gravitational (potential) energy and kinetic / movement energy	must be sum of the two accept gpe and ke	1
	(transferred) as elastic (potential / strain energy		1
	QoWC for linking of gravitational / kinetic / movement energy to elastic energy	annotate Q✓ Q*	1
total			10

3451/H Q15

question	answers	extra information	mark
(a)(i)	ions are free to move	accept ions carry the current	1
(ii)	electrolysis		1
(b)(i)	charge = current \times time	accept $Q = I \times t$ do not accept A for I do not accept C for Q accept  provided subsequent method is correct	1
(ii)	4 (g)	accept 1 mark for correct substitution into $Q = I \times t$, with $t = 2400$ accept 1 mark for an answer of 0.067 or 0.07	2
total			5

3451/H Q16

question	answers	extra information	mark
(a)(i)	<p>centre of X vertically below point of contact and below finger nail but above centre of metal ball</p> 	<p>accept dot or arrow with X and clear indication that this is the centre of mass</p> <p>any point on the line as shown</p>	1
(ii)	<p>either centre of mass will be (directly) beneath point of suspension</p> <p>(so) the weight of the toy does not produce/exert any turning effect</p> <p>or any slight disturbance will raise the centre of mass (1)</p> <p>which will then fall back to its original position (so the toy remains stable) (1)</p>	<p>or there is no turning effect / movement / torque</p> <p>(because) the force/weight acts at zero (perpendicular) distance from the fulcrum/pivot</p>	1 1
(b)(i)	<p>centre of X above axles but within the crane</p> 	<p>accept dot or arrow with X and clear indication that this is the centre of mass</p> <p>any point in the area shown</p>	1
(ii)	<p>centre of mass must be above wheel base / between axles</p> <p>or crane would topple over</p>		1 1

Continued

3451/H Q16

question	answers	extra information	mark
(c)(i)	turning effect = force \times perpendicular distance (between line of action and pivot / fulcrum / turning point) or turning point = force \times distance to pivot	or moment = ... do not accept just = force \times distance	1
(ii)	newton-metre(s) or Nm	accept any correct metric unit e.g. newton-centimetres accept symbols only if correct in every detail e.g. Ncm but not 'Ncms' or 'ncm' or 'N/cm' etc. Nm but not 'nM' etc.	1
(iii)	either 20(.0) or $500 \times 9 =$ (downwards) force $\times 225$ (so) (downward) force $= 500 \times 9 \div 225$ N or newton(s)	for 1 mark for 1 mark	3 1
(d)	...clockwise ... anticlockwise...	both required but allow either order and accept 'opposite' for second word	1
total			13

3451/H Q17

question	answers	extra information	mark
(a)(i)	change in momentum = force \times time	do not accept just momentum = force \times time	1
(ii)	40.5 kgm/s or kgms ⁻¹	45 \times 0.9 gains 1 mark or newton-seconds or Ns	2 1
(b)	momentum = mass \times velocity velocity = momentum \div mass velocity = 1.5 \div 0.05 velocity = 30 m/s or ms ⁻¹	correct equation stated or implied rearrange stated or implied correct substitution correct answer n.b. 1.5 \div 50 on its own gains first 2 marks	1 1 1 1 1
(c)(i)	zero		1
(ii)	any one from: <ul style="list-style-type: none"> • conservation of momentum applies • (total) momentum before explosion = (total) momentum after • there is no air (resistance) / friction / wind • that no external force acts • gravitational forces do not act • that there is no change in (total) mass 	accept gravity for gravitational forces accept no gravity	1
(iii)	down(wards) or towards the centre of the Earth		1
total			12