Version 1.0: 0906

ASSESSMENT and QUALIFICATIONS ALLIANCE

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:		2
	• two cells are joined + to +	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	
	• some of the cells potential difference is across the diode / ammeters / wires **or** the pd of the cells is shared by all components	accept voltage for pd do **not** accept using up pd	
	• the other components have a resistance	accept a named component / components / wire has a resistance	
	• cells not fully charged **or** cells partially run down	do **not** accept voltage of cells is less than 1.5 unless explained do **not** accept cells are not as powerful unless explained	
	• cells have an internal resistance		
(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	accept for **1** mark only the filament lamp does not obey Ohm's law	1
total			9

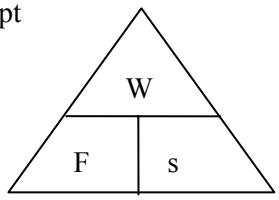
3451/H Q2

question	answers	extra information	mark
(a)	0.5		1
	hertz	accept Hz but **not** HZ / hz / hZ	1
		accept (waves) per second **or** / sec **or** / s **or** s^{-1} **or** sec^{-1}	
(b)	any **one** from:		1
	• any named part of the electromagnetic spectrum		
	• S – waves / secondary waves	do **not** accept seismic waves / earthquake	
	• wave on a rope	do **not** accept slinky unless clearly described	
(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	1
		part explanation of the difference between transverse **and** longitudinal gains **1** mark	
(d)(i)	TIR shown	needs to stay inside water jet	1
		ignore number of reflections **or** arrow heads	
		lines straight by eye	
(ii)	bigger than	any indication of correct answer	1
total			7

3451/H Q3

question	answers	extra information	mark
(a)	W		1
	has only two states **or** is either on or off	accept discrete values only do **not** credit answer purely in terms of shape	1
(b)	any **one** from:		1
	• higher quality	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	
	• increased carrying capacity	accept more information can be sent **or** more channels	
	• errors can be rectified		
total			3

3451/H Q4

question	answers	extra information	mark
(a)(i)	all points plotted accurately	accept **1** mark for 5 correct plots ± ½ small square on stopping distance	2
	line of best fit must be continuous	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	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 increases / is longer **or** thinking distance increases	do **not** accept reaction time slower **or** reactions are slower	1
	stopping distance / it increases	do **not** accept travels at constant speed for longer	1
(c)(i)	work done = force (applied) × distance (moved)	accept W = F × s or W = F × 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

<table>
<tr><th>question</th><th>answers</th><th>extra information</th><th>mark</th></tr>
<tr><td>(a)</td><td>AND (gate)

OR (gate)

NOT (gate)

LED or light emitting diode</td><td>accept ‘and’

accept ‘or’

accept ‘not’ or invert gate

accept ‘led’</td><td>1

1

1

1</td></tr>
<tr><td>(b)(i)</td><td>NOT (gate) and AND (gate)</td><td>both in either order or ‘(the) gates’

any additions lose the mark</td><td>1</td></tr>
<tr><td>(ii)</td><td><table><tr><th>Switch for fire</th><th>Tilt switch</th><th>Signal to relay</th></tr><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></table></td><td>all correct

allow off or no
off no
on yes
off no</td><td>1</td></tr>
<tr><td>(iii)</td><td>(relay) acts as / is a switch

either
small current from the electronic / control circuit / system (1)

large current through the output / (electric) fire (1)

or

full current through electronic control system (1)

may damage components / lead to overheating / electric shock (1)

QoWC for correct use of the scientific term ‘current’</td><td>accept implication that it works as a switch e.g. ‘turns on fire’

or ‘small current through the coil (of the relay)’

do not accept small current is turned into a large current

annotate Q✓ Q×

if answer in terms of voltage isolation / voltage/ p.d. accept QoWC mark for correct use</td><td>1

1

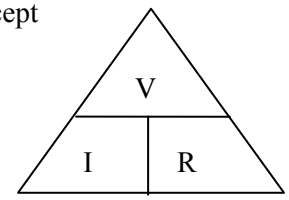
1

1</td></tr>
<tr><td>total</td><td></td><td></td><td>10</td></tr>
</table>

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 × resistance	accept pd / voltage for potential difference accept V = I × 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

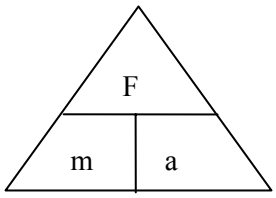
3451/H Q10

question	answers	extra information	mark
(a)(i)	(high energy) electron	accept $^{-1}_{0}$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)	accept <u>cosmic</u> <u>rays</u> for radiation from space	1
	(increased risk of) cancer	accept indication of mutating cells	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 × acceleration	accept F = m × 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

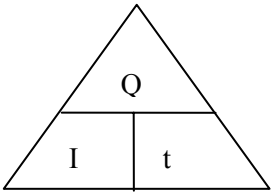
3451/H Q13

question	answers	extra information	mark
(a)	any **two** from: • 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: • wind is a dilute energy source • higher 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 × (change in) vertical height	accept gpe = w × h accept E for gpe accept 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 = $\frac{1}{2}$ mass × speed^2	accept velocity for speed accept $\frac{1}{2}mv^2$ do **not** accept $\frac{1}{2}ms^2$	1
(ii)	24	accept **1** mark for correct substitution accept **1** mark for correct transformation	3
(c)	gravitational (potential) energy **and** kinetic / movement energy (transferred) as elastic (potential / strain energy QoWC for linking of gravitational / kinetic / movement energy to elastic energy	must be sum of the two accept gpe and ke annotate Q✓ Q×	1 1 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 × time	accept Q = I × 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 × 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)	centre of X vertically below point of contact and below finger nail but above centre of metal ball 	accept dot or arrow with X and clear indication that this is the centre of mass any point on the line as shown	1
(ii)	**either** centre of mass will be (directly) beneath point of suspension (so) the weight of the toy does not produce/exert any turning effect **or** any slight disturbance will raise the centre of mass (1) which will then fall back to its original position (so the toy remains stable) (1)	**or** there is no turning effect / movement / torque (because) the force/weight acts at zero (perpendicular) distance from the fulcrum/pivot	1 1
(b)(i)	centre of X above axles but within the crane 	accept dot or arrow with X and clear indication that this is the centre of mass any point in the area shown	1
(ii)	centre of mass must be above wheel base / between axles or crane would topple over		1 1

Continued

3451/H Q16

question	answers	extra information	mark
(c)(i)	turning effect = force × perpendicular distance (between line of action and pivot / fulcrum / turning point) or turning point = force × distance to pivot	**or** moment = … do **not** accept just …… = force × 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 × 9 = (downwards) force × 225 (so) (downward) force = 500 × 9 ÷ 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 × time	do **not** accept just momentum = force × time	1
(ii)	40.5 kgm/s or $kgms^{-1}$	45×0.9 gains 1 mark or newton-seconds or Ns	2 1
(b)	momentum = mass × velocity velocity = momentum ÷ mass velocity = 1.5 ÷ 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 ÷ 50 on its own gains first 2 marks	1 1 1 1 1
(c)(i)	zero		1
(ii)	any **one** from: • 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