



# General Certificate of Secondary Education

## Physics 3451/H *Specification B*

# Mark Scheme

## *2005 examination – June series*

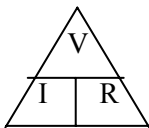
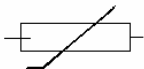
Mark schemes are prepared by the Principal Examiner and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation meeting attended by all examiners and is the scheme which was used by them in this examination. 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)(i)	$A_1 = 0.5$	ignore any units	1
	$A_4 = 0.5$	allow 1 mark for $A_1 = A_4 \neq 0.5$	1
(ii)	the resistance of <b>P</b> is more than $20 \Omega$		1
	a smaller current goes through P / $A_2$ (than $20 \Omega$ )	dependent on getting 1 <sup>st</sup> mark correct accept converse	1
(b)(i)	potential difference = current $\times$ resistance	accept pd / voltage for potential difference accept $V = I \times R$ , correct symbols and correct case only accept volts = amps $\times$ ohms accept <div style="text-align: center;">  </div> provided subsequent method is correct allow combination of physical quantities and named units allow voltage = $I \times R$	1
(ii)	6	allow 1 mark for correct substitution	2
(iii)	6	accept their (b)(ii)	1
(c)	<u>thermistor</u> or 	accept correct circuit symbol allow phonetic spelling	1
	<u>resistance</u> goes down (as temperature of thermistor goes up)	do <b>not</b> accept changes for goes down do <b>not</b> accept an answer in terms of current only answers in terms of other components are incorrect	1
total			10

**3415H Q2**

question	answers	extra information	mark
(a)(i)	larger the distance, greater the time	accept 'they are proportional' accept converse	1
(ii)	any value between 6 and 9 years inclusive		1
(b)(i)	carbon dioxide		1
(ii)	(Venus) has <u>higher</u> temperature (than Mercury)	accept has the <u>highest</u> temperature accept Venus is <u>hotter</u> / <u>hottest</u>  do <b>not</b> accept has a high / very high temperature	1
	(Venus) further from the Sun than Mercury	accept 'Venus is not the closest planet to the Sun'  answer in terms of greenhouse effect only, scores <b>0</b> marks	1
total			5

**3451/H Q3**

question	answers	extra information	mark
(a)(i)	20		1
(ii)	convection		1
(iii)	fit draughtproof strips	accept lay carpet accept fit curtains accept close doors / windows / curtains accept any reasonable suggestion for reducing a draught 'double glazing' alone is insufficient	1
(b)	air is (a good) insulator <b>or</b> air is a poor conductor	accept air cavity / 'it' for air	1
	reducing heat transfer by <u>conduction</u>	accept stops for reduces ignore convection do <b>not</b> accept radiation do <b>not</b> accept answers in terms of heat being trapped	1
(c)(i)	most cost effective	accept it is cheaper or <u>lowest</u> cost accept shortest payback time accept in terms of reducing heat loss by the largest amount do <b>not</b> accept it is easier ignore most heat is lost through the roof	1
(ii)	4		1
total			7

## 3451/H Q4

question	answers	extra information	mark
(a)(i)	<u>constant</u> speed	do <b>not</b> accept normal speed do <b>not</b> accept it is stopped / stationary	1
	in a straight line	accept any appropriate reference to a direction	1
		constant velocity gains <b>2</b> marks 'not accelerating' gains <b>2</b> marks	
		terminal velocity alone gets <b>1</b> mark	
(ii)	goes down owtte	accept motorbike (it) slows down	1
(b)(i)	20 (m/s)	ignore incorrect units	1
(ii)	acceleration = $\frac{\text{change in velocity}}{\text{time (taken)}}$	do <b>not</b> accept velocity for change in velocity accept change in speed accept $a = \frac{v-u}{t}$ <b>or</b> $a = \frac{v_1 - v_2}{t}$ <b>or</b> $a = \frac{\Delta v}{t}$ do <b>not</b> accept $a = \frac{v}{t}$	1
(iii)	4 <b>or</b> their (b)(i) $\div 5$	allow <b>1</b> mark for correct substitution	2
	m/s <sup>2</sup>	m/s/s <b>or</b> ms <sup>-2</sup> <b>or</b> metres per second squared <b>or</b> metres per second per second	1
(c)	vehicle may skid / slide	loss of control / brakes lock / wheels lock accept greater stopping distance <b>or</b> difficult to stop	1
	due to reduced friction (between tyre(s) and road)	accept due to less grip do <b>not</b> accept <u>no</u> friction	1

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**3451/H Q4 cont...**

(d)	<p>any <b>three</b> from:</p> <ul style="list-style-type: none"> <li>• <u>increased</u> speed</li> <li>• <u>reduced</u> braking force</li> <li>• <u>slower</u> (driver) reactions</li> <li>• <u>poor</u> vehicle maintenance</li> <li>• <u>increased</u> mass / weight of vehicle</li> <li>• <u>poor</u> road surface</li> <li>• <u>more</u> streamlined</li> </ul>	<p>do <b>not</b> accept night time / poor vision</p> <p>N.B. specific answers may <b>each</b> gain credit eg tiredness (1), drinking alcohol (1), using drugs (1), driver distracted (1) etc</p> <p>specific examples may <b>each</b> gain credit eg worn brakes or worn tyres etc</p> <p>accept large mass / weight of vehicle</p> <p>if candidates give three answers that affect stopping distance but not specific to <u>increase</u> award <b>1</b> mark only</p>	3
total			13

## 3451/H Q5

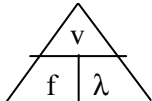
question	answers	extra information	mark
(a)(i)	arrow from centre of the ball <b>and</b> at right angles to the string <b>and</b> in the correct direction	arrow should point to the student's belt accept free-hand 'straight' line do <b>not</b> accept curved line	1
(ii)	increase increase increase	accept 'be stronger / bigger' accept 'be stronger / bigger' accept 'be stronger / bigger'	1 1 1
(b)	speed velocity direction	all <b>three</b> correct  any two correct for <b>1</b> mark otherwise <b>0</b> marks	2
(c)(i)	centripetal	accept 'centripedal' and other minor misspellings do <b>not</b> accept anything which could be 'centrifugal'	1
(ii)	gravity	accept 'weight' accept 'force of attraction due to mass(es) (of the Moon and the Earth)'	1
(iii)	electron(s)		1
(iv)	electrostatic	accept 'electrical' do <b>not</b> accept just 'centripetal'	1
total			10

## 3451/H Q6

question	answers	extra information	mark
(a)(i)	<b>X</b> at the centre of the lifebelt	measuring from the centre of <b>X</b> , allow 2 mm tolerance in any direction	1
(ii)	any <b>two</b> from:  below the point of suspension  at the centre (of the lifebelt)  (because) the lifebelt / it is symmetrical	if X is on vertical line below the hanger (but not at centre) can gain the first point only  accept '(vertically) below <b>Y</b> '  accept 'in the middle'  <b>or</b> (because) the mass / weight is evenly distributed	2
(b)	Nm <b>or</b> newton metre(s)  750	accept Newton metre(s) do <b>not</b> accept any ambiguity in the symbol ie NM, nM or nm  (moment) = force $\times$ (perpendicular) distance (between line of action and pivot) <b>or</b> (moment) = $500 \times 1.5$ gains <b>1</b> mark	1  2
(c)	<b>Quality of written communication:</b>  any <b>three</b> connected points from:  low(er) <u>centre of mass / gravity</u>  (more) <u>stable</u>  less likely to fall over  the <u>turning effect / moment</u> (of the weight of case) is less  so the pull on her arm is less	for <b>2</b> of the underlined terms used in the correct context  <b>or</b> <u>centre of mass / gravity</u> will be close(r) to the wheels / axle / ground  <b>or</b> less <u>unstable</u>  accept 'less likely to overturn' do <b>not</b> accept 'will not fall over'  <b>or</b> so less effort is needed to hold the case ignore references to pulling the case	1  3
total			10



## 3451/H Q7

question	answers	extra information	mark
(a)	any <b>two</b> from: <ul style="list-style-type: none"> <li><b>amplitude</b> decreasing</li> <li><b>wavelength</b> increasing</li> <li><b>frequency</b> decreasing</li> </ul> <p><b>Quality of written communication</b></p>	<p>accept siren / sound getting quieter do <b>not</b> accept sound decreases</p> <p>accept pitch decreasing ignore reference to transverse wave ignore reference to speed</p> <p>contradictory statements within each point lose the mark</p> <p>all emboldened terms in candidate's answer used correctly</p>	<p>2</p> <p>1</p>
(b)(i)	ultrasound <b>or</b> ultrasonic		1
(ii)	wave speed = frequency $\times$ wavelength	<p>accept speed / velocity for wave speed</p> <p>accept <math>v = f \times \lambda</math> do <b>not</b> accept w for <math>\lambda</math> do <b>not</b> accept s for v</p> <p>accept </p> <p>provided subsequent calculation shows a correct method</p>	1
(iii)	339.2 <b>or</b> 340 <b>or</b> 339	<p>allow <b>1</b> mark for using 212 000 allow <b>1</b> mark for correct substitution</p> <p>an answer of 0.3392 <b>or</b> 0.34 <b>or</b> 0.339 gains <b>1</b> mark only award full credit for a correct numerical answer with the unit changed to km/s</p>	3
total			8

**3451/H Q8**

question	answers	extra information	mark
(a)	converted into helium	accept helium created accept converted into heavier elements accept used up in nuclear fusion / to produce energy do <b>not</b> accept any reference to burning	1
(b)	turns / expands into a <u>red giant</u>	contradictions negate mark	1
	contracts <b>and</b> explodes <b>or</b> becomes a supernova		1
	may form a (dense) <u>neutron star</u> <b>or</b> (if enough mass shrinks to) form a <u>black hole</u>	accept forms a neutron star and (then) a black hole	1
	<b>Quality of written communication</b>	correct points must be in sequence	1
(c)(i)	supernova <b>or</b> remains of an earlier star	ignore super nebula	1
(ii)	younger <b>or</b> not formed at the time of the Big Bang		1
total			7

## 3451/H Q9

question	answers	extra information	mark
(a)(i)	both lose <u>2</u> protons and ( <u>2</u> ) neutrons	accept changes by 2 protons and 2 neutrons	1
(ii)	different number of protons (in the nucleus)	accept different atomic number do <b>not</b> accept different number of protons and neutrons or different mass number ignore electrons	1
(iii)	gamma involves no change in the number of protons (in the nucleus) <b>or</b> gamma is a wave (not a particle)	do <b>not</b> accept number of neutrons and / or protons ignore electrons	1
(b)(i)	water because  for all energy values the thickness of water needed to absorb (90% of) the radiation is more than the other materials	both material <b>and</b> reason required  accept thickness of water required is always more than the other materials	1
(ii)	6	allow <b>1</b> mark for obtaining both correct values 72 <b>and</b> 12 from graph allow <b>1</b> mark for incorrect values 71 and / or 11 from graph evaluated correctly	2

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**3451/H Q9 cont...**

(c)	<p>any <b>three</b> from:</p> <ul style="list-style-type: none"> <li>• <u>most</u> (alpha) particles passed <u>undeflected</u> / <u>straight through</u> the gold</li> <li>• suggesting most of the atom is empty (space)</li> <li>• a <u>few</u> (alpha) particles <u>scattered</u> / <u>deflected</u> through (very) <u>large</u> angles</li> <li>• suggesting a concentrated / small nucleus</li> <li>• nucleus is positive because it <u>repels</u> the positive (alpha) particles</li> </ul> <p>may be scored on annotated diagram provided not negated elsewhere</p> <p>accept repelled do <b>not</b> accept reflected / rebound / bounce back</p> <p>no reference to experiment, maximum <b>1</b> mark</p>	3
total		9

## 3451/H Q10

question	answers	extra information	mark
(a)(i)	infra red <b>or</b> ir		1
(ii)	a series of <u>on and off</u> pulses <b>or</b> a signal having only two values	accept a diagram accept starts and stops  like 1 0	1
(b)	signals pick up <u>noise</u> / <u>interference</u> which is also <u>amplified</u>	must be clear noise <b>or</b> interference amplified	1
	different frequencies weaken different amounts	accept distorts signal	1
	more amplification increases the difference in amplitude between different frequencies	accept answers in terms of the more amplifications, the less like the original signal	1
(c)	<u>absorbed</u> by water / fat / oil molecules (in cells)	accept causes <u>increase</u> in vibrations of oil / fat / water molecules / particles	1
	cells damaged by the <u>heat</u> released	accept cell killed by the heat released or (enzymes denatured by heat released) accept for <b>1</b> mark 'heats up water (in cells)' ignore reference to cancer	1
total			7

**3451/H Q11**

question	answers	extra information	mark
(a)	electrons / negative charges are <u>repelled</u>	do <b>not</b> accept converse implied movement of 'positive charges' negates the mark	1
(b)(i)	energy (transferred) = potential difference $\times$ charge	accept pd or voltage for potential difference  accept $E = V \times Q$ accept $W = V \times Q$  accept   provided subsequent method correct	1
(ii)	21 600 000 000 <b>or</b> $2.16 \times 10^{10}$	accept 21 600 000 <u>kilojoules</u> for <b>both</b> marks  allow <b>1</b> mark for an answer of 21 600 000 joules	2
(c)	copper is a <u>good</u> (electrical) conductor <b>or</b> copper has a low resistance  provides path for electrons / electricity / lightning <u>to</u> earth / ground / metal plate	accept allows electrons / electricity to flow easily ignore heat  do <b>not</b> accept in terms of heat / energy do <b>not</b> accept attracts lightning unless explained	1  1
total			6



**3451/H Q13**

question	answers	extra information	mark
(a)(i)	$\text{gpe} = \text{weight} \times \text{height}$	accept $E_p = mgh$ accept $pe = mgh$	1
(ii)	1200	accept values using 9.8 (1) allow <b>1</b> mark for correct substitution	2
(b)(i)	120	accept $\frac{\text{their (a)(ii)} \times 6}{60}$	1
(ii)	300	allow $b(i) \div 0.4$ for both marks allow <b>1</b> mark for correct transformation	2
total			6



## 3451/H Q14

question	answers	extra information	mark
(a)(i)	<p><b>either</b> the momentum in a particular direction after (the collision) is the same as the momentum in that direction before (the collision) (2)</p> <p><b>or</b> <u>total</u> momentum after (the collision) equals the <u>total</u> momentum before (the collision) (2)</p>	<p>accept 'momentum before equals momentum after' for <b>1</b> mark</p> <p>accept 'momentum before equals momentum after' for <b>1</b> mark</p>	2
(ii)	<p>explosion(s)</p> <p><b>or</b> (action of a) rocket (motor(s))</p> <p><b>or</b> (action of a) jet (engine)</p> <p><b>or</b> firing a gun</p>	accept any other activity in which things move apart as a result of the release of internal energy eg throwing a ball	1
(iii)	<p>momentum = mass <math>\times</math> velocity</p> <p><b>or</b> any correctly transposed version</p>	<p>accept momentum = mass <math>\times</math> speed</p> <p>accept <math>p = mv</math></p> <p>do <b>not</b> accept momentum = <math>ms</math> or <math>M = mv</math></p>	1
(iv)	<p>0.8</p> <p>m/s</p> <p>to the right</p>	<p>if answer 0.8 not given, any <b>two</b> for (1) each:</p> <p>momentum of <b>X</b> = <math>0.2 \times 1.2</math></p> <p>= momentum of <b>X and Y</b> after impact</p> <p>= <math>0.3 \times v</math> <b>or</b> = <math>(0.1 + 0.2) \times v</math></p>	<p>3</p> <p>1</p> <p>1</p>
(v)	<p>any <b>one</b> from:</p> <p>conservation of momentum (applies)</p> <p>no external forces</p> <p>friction is negligible / insignificant</p> <p>no friction</p> <p>no air resistance</p>	do <b>not</b> accept just 'no (other) forces act'	1

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**3451/H Q14 cont...**

(b)	force = (change in) momentum $\div$ time    or any correctly transposed version	1
	4000 <b>or</b> 4 kilonewtons                      dependent on correct or no equation force = $5 \div 0.00125$ gains <b>1</b> mark	2
total		13

## 3451/H Q15

question	answers	extra information	mark
(a)	• heat released from (natural) radioactive decay		1
	• causes <u>convection</u> (currents) in the mantle / underneath the crust	do <b>not</b> accept in the magma	1
(b)	• (oceanic plate) pushed down	must be clear which plates are referred to accept 'moves under' if supported by correct reference to density	1
	or • (oceanic plate) subducted		1
	• (oceanic plate) (partially) melts		1
	• magma rises through the (continental) crust / plate / part of Ecuador	do <b>not</b> accept answers in terms of fold mountains etc	1
(c)(i)	earthquakes / tremors / mining / p(rietary) waves / s(econdary) waves / tectonic plate movement	accept sensible alternatives for underground activity	1
(ii)	any <b>two</b> from: • difficult to get inside volcano crater safely • changes in ground level difficult to see / measure • changes to sulphur dioxide levels difficult to measure • limited research • seismic activity (may be) limited before eruption	accept difficult to get near to volcano safely  accept changes may be sudden  accept any sensible suggestion related to the difficulty or safety of obtaining relevant measurements	2
(d)(i)	kinetic energy = $\frac{1}{2} \times \text{mass} \times \text{speed}^2$	accept velocity for speed accept $\text{KE} = \frac{1}{2} mv^2$	1
(ii)	32 000	accept 32 kJ	1
(e)(i)	$\frac{1}{4}$	accept 0.25 or 25%	1
(ii)	2600	if answer to (e)(i) is $\frac{1}{2}$ then accept 1300	1
total			12