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ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Secondary Education

Physics 3451/H
Specification B

Mark Scheme

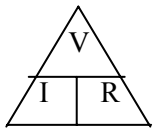
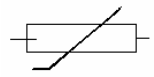
2005 examination - June series

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 **P** is more than 20 Ω		1
	a smaller current goes through P / A_2 (than 20 Ω)	dependent on getting 1st mark correct accept converse	1
(b)(i)	potential difference = current × resistance	accept pd / voltage for potential difference accept V = I × R, correct symbols and correct case only accept volts = amps × ohms accept  provided subsequent method is correct allow combination of physical quantities and named units allow voltage = I × R	1
(ii)	6	allow **1** mark for correct substitution	2
(iii)	6	accept their (b)(ii)	1
(c)	thermistor or 	accept correct circuit symbol allow phonetic spelling	1
	resistance goes down (as temperature of thermistor goes up)	do **not** accept changes for goes down do **not** 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 high**er** temperature (than Mercury)	accept has the high**est** temperature accept Venus is hotter / hottest do **not** 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 **0** 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 **or** 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 **not** accept radiation do **not** accept answers in terms of heat being trapped	1
(c)(i)	most cost effective	accept it is cheaper or low<u>est</u> cost accept shortest payback time accept in terms of reducing heat loss by the largest amount do **not** 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 **not** accept normal speed do **not** accept it is stopped / stationary	1
	in a straight line	accept any appropriate reference to a direction constant velocity gains **2** marks 'not accelerating' gains **2** marks terminal velocity alone gets **1** mark	1
(ii)	goes down owtte	accept motorbike (it) slows down	1
(b)(i)	20 (m/s)	ignore incorrect units	1
(ii)	acceleration = <u>change in velocity</u> time (taken)	do **not** accept velocity for change in velocity accept change in speed accept $a = \frac{v-u}{t}$ **or** $a = \frac{v_1 - v_2}{t}$ **or** a = $\frac{\Delta v}{t}$ do **not** accept $a = \frac{v}{t}$	1
(iii)	4 **or** their (b)(i) ÷ 5	allow **1** mark for correct substitution	2
	m/s^2	m/s/s **or** ms^{-2} **or** metres per second squared **or** metres per second per second	1
(c)	vehicle may skid / slide	loss of control / brakes lock / wheels lock accept greater stopping distance **or** difficult to stop	1
	due to reduced friction (between tyre(s) and road)	accept due to less grip do **not** accept <u>no</u> friction	1

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3451/H Q4 cont…

(d)	any **three** from: • <u>increased</u> speed • <u>reduced</u> braking force • <u>slower</u> (driver) reactions • <u>poor</u> vehicle maintenance • <u>increased</u> mass / weight of vehicle • <u>poor</u> road surface • <u>more</u> streamlined	do **not** accept night time / poor vision N.B. specific answers may **each** gain credit eg tiredness (1), drinking alcohol (1), using drugs (1), driver distracted (1) etc specific examples may **each** gain credit eg worn brakes or worn tyres etc accept large mass / weight of vehicle if candidates give three answers that affect stopping distance but not specific to <u>increase</u> award **1** mark only	3
total			13

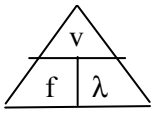
3451/H Q5

question	answers	extra information	mark
(a)(i)	arrow from centre of the ball **and** at right angles to the string **and** in the correct direction	arrow should point to the student's belt accept free-hand 'straight' line do **not** 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 **three** correct any two correct for **1** mark otherwise **0** marks	2
(c)(i)	centripetal	accept 'centripedal' and other minor misspellings do **not** 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 **not** accept just 'centripetal'	1
total			10

3451/H Q6

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

3451/H Q7

question	answers	extra information	mark
(a)	any **two** from: • **amplitude** decreasing • **wavelength** increasing • **frequency** decreasing **Quality of written communication**	accept siren / sound getting quieter do **not** accept sound decreases accept pitch decreasing ignore reference to transverse wave ignore reference to speed contradictory statements within each point lose the mark all emboldened terms in candidate's answer used correctly	2 1
(b)(i)	ultrasound **or** ultrasonic		1
(ii)	wave speed = frequency × wavelength	accept speed / velocity for wave speed accept v = f × λ do **not** accept w for λ do **not** accept s for v accept  provided subsequent calculation shows a correct method	1
(iii)	339.2 **or** 340 **or** 339	allow **1** mark for using 212 000 allow **1** mark for correct substitution an answer of 0.3392 **or** 0.34 **or** 0.339 gains **1** mark only award full credit for a correct numerical answer with the unit changed to km/s	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 **not** accept any reference to burning	1
(b)	turns / expands into a red giant	contradictions negate mark	1
	contracts **and** explodes **or** becomes a supernova		1
	may form a (dense) neutron star **or** (if enough mass shrinks to) form a black hole	accept forms a neutron star and (then) a black hole	1
	Quality of written communication	correct points must be in sequence	1
(c)(i)	supernova **or** remains of an earlier star	ignore super nebula	1
(ii)	younger **or** not formed at the time of the Big Bang		1
total			7

3451/H Q9

question	answers	extra information	mark
(a)(i)	both lose 2 protons and (2) neutrons	accept changes by 2 protons and 2 neutrons	1
(ii)	different number of protons (in the nucleus)	accept different atomic number do **not** 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) **or** gamma is a wave (not a particle)	do **not** 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 **and** reason required accept thickness of water required is always more than the other materials	1
(ii)	6	allow **1** mark for obtaining both correct values 72 **and** 12 from graph allow **1** mark for incorrect values 71 and / or 11 from graph evaluated correctly	2

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3451/H Q9 cont…

(c)	any **three** from: • most (alpha) particles passed undeflected / straight through the gold • suggesting most of the atom is empty (space) • a few (alpha) particles scattered / deflected through (very) large angles • suggesting a concentrated / small nucleus • nucleus is positive because it repels the positive (alpha) particles	may be scored on annotated diagram provided not negated elsewhere accept repelled do **not** accept reflected / rebound / bounce back no reference to experiment, maximum **1** mark	3
total			9

3451/H Q10

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

3451/H Q12

question	answers	extra information	mark
(a)(i)	6.25 / 6.1 to 6.4	accept range 6.1 to 6.4	1
(ii)	4.5 / 4.2 to 4.8	accept any response in the range 4.2 to 4.8	1
(b)(i)	thermistor … variable resistor **or** thermistor … rheostat	**both** in the correct order are required	1
(ii)	potential divider **or** voltage divider **or** input sensor(s)		1
(iii)	(will) increase(s)		1
(iv)	(as temperature increases) resistance across thermistor decreases / falls (so) the potential difference across the thermistor falls (and the voltage across the variable resistor increases / rises)	 accept voltage do **not** accept 'voltage flows across…'	1 1
(c)	fridge / freezer / air conditioner / fan	accept any appliance which will reduce the temperature do **not** accept 'thermostat' **not** just buzzer / warning light	1
(d)(i)	transistor relay		1 1
(ii)	any **one** from: • in series with (fixed) resistor • between (fixed) resistor and transistor • between A-B junction and (fixed) resistor to switch on heating when it gets cold	 accept 'next to (fixed) resistor' do **not** accept 'near to (fixed) resistor' and other vague responses any appropriate <u>description</u> but both action **and** condition required eg 'to switch on warning (light / bell) when the temperature falls'	1 1
total			12

3451/H Q13

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

3451/H Q14

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

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3451/H Q14 cont…

(b)	force = (change in) momentum ÷ time	or any correctly transposed version	1
	4000 **or** 4 kilonewtons	dependent on correct or no equation force = 5 ÷ 0.00125 gains **1** mark	2
total			13

3451/H Q15

question	answers	extra information	mark
(a)	• heat released from (natural) radioactive decay • causes convection (currents) in the mantle / underneath the crust	 do **not** accept in the magma	1 1
(b)	• (oceanic plate) pushed down **or** (oceanic plate) subducted • (oceanic plate) (partially) melts • magma rises through the (continental) crust / plate / part of Ecuador	must be clear which plates are referred to accept 'moves under' if supported by correct reference to density do **not** accept answers in terms of fold mountains etc	1 1 1
(c)(i)	earthquakes / tremors / mining / p(rimary) waves / s(econdary) waves / tectonic plate movement	accept sensible alternatives for underground activity	1
(ii)	any **two** 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 = $\frac{1}{2} \times$ mass $\times$ speed^2	accept velocity for speed accept 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