ASSESSMENT and QUALIFICATIONS ALLIANCE

Mark scheme June 2003

GCSE

Physics

3451

Higher

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Registered address: Addleshaw Booth & Co., Sovereign House, PO Box 8, Sovereign Street, Leeds LS1 1HQ
Kathleen Tattersall: *Director General*

INFORMATION FOR EXAMINERS

1. General

The mark scheme for each question shows:

- the marks available for each part of the question;
- the total marks available for the question;
- the typical answer or answers which are expected;
- extra information to help the Examiner make his or her judgement and help to delineate what is acceptable or not worthy of credit or, in discursive answers, to give an overview of the area in which a mark or marks may be awarded.

The extra information is aligned to the appropriate answer in the left-hand part of the mark scheme and should only be applied to that item in the mark scheme.

At the beginning of a part of a question a reminder may be given, for example:
where consequential marking needs to be considered in a calculation;
or the answer may be on the diagram or at a different place on the script.

In general the right hand side of the mark scheme is there to provide those extra details which confuse the main part of the mark scheme yet may be helpful in ensuring that marking is straightforward and consistent.

2. Emboldening

2.1 In a list of acceptable answers where more than one mark is available 'any **two** from' is used, with the number of marks emboldened. Each of the following lines is a potential mark.

2.2 A bold **and** is used to indicate that both parts of the answer are required to award the mark.

2.3 Alternative answers acceptable for a mark are indicated by the use of **or**. (Different terms in the mark scheme are shown by a / ; e.g. allow smooth / free movement.)

3. Marking points

3.1 Marking of Quality of Written Communication

Examiners are reminded of the need to assess QoWC by the following statement appearing in the appropriate parts of the mark scheme:

The answer to this question requires ideas in good English in a sensible order with correct use of scientific terms. Quality of written communication should be considered in crediting points in the mark scheme.

The maximum marks available to a candidate whose answer is not well expressed will be (the number of marks available –1).

3.2 Marking of lists

This applies to questions requiring a set number of responses, but for which candidates have provided extra responses. The general principle to be followed in such a situation is that 'right + wrong = wrong'.

Each error/contradiction negates each correct response. So, if the number of error/contradictions equals or exceeds the number of marks available for the question, no marks can be awarded.

However, responses considered to be neutral (indicated as * in example 1) are not penalised.

Example 1: What is the pH of an acidic solution? (1 mark)

Candidate	Response	Marks awarded
1	4,8	0
2	green, 5	0
3	red*, 5	1
4	red*, 8	0

Example 2: Name two planets in the solar system. (2 marks)

Candidate	Response	Marks awarded
1	Pluto, Mars, Moon	1
2	Pluto, Sun, Mars, Moon	0

3.3 Use of chemical symbols/formulae

If a candidate writes a chemical symbol/formula instead of a required chemical name, full credit can be given if the symbol/formula is correct and if, in the context of the question, such action is appropriate.

3.4 The marking of quantitative relationships

Full credit can be given for a correct quantitative relationship expressed in:

- named units;
- physical quantities;
- standard symbols;
- a combination of physical quantities and units.

No credit can be given for any quantitative relationship expressed in terms of:

- a combination of physical quantities, units and symbols;
- a diagram, e.g. the ohm's law triangle, unless the rest of the answer shows clearly that the candidate understands the relationships involved.

3.5 Marking procedure for calculations

3.5.1 Full marks can be given for a correct numerical answer, as shown in the column 'answers', without any working shown. However, if the answer is incorrect, mark(s) can be gained by correct substitution/working and this is shown in the 'extra information' column.

3.5.2 Where calculations are based on incorrectly recalled relationships, neither the incorrectly recalled relationship, nor the resulting calculation based on the incorrect relationship, will be credited.

3.6 Interpretation of 'it'

Answers using the word 'it' should be given credit only if it is clear that the 'it' refers to the correct subject.

3.7 Errors carried forward

There should be no error carried forward from a previous answer which has been based on wrong science. Any error in the answers to a structured question should be penalised once only.

Examples

(a) A candidate who calculates average speed using speed = time/distance **and** then proceeds to use this incorrect answer to calculate an acceleration based on the correct quantitative relationship should be given credit for the use of the correct acceleration relationship but none for either numerical answer.

(b) A candidate who incorrectly calculates average speed using speed = distance/time and then proceeds to use this incorrect value to calculate an acceleration based on the correct quantitative relationship, should be given credit for the use of both correct quantitative relationships **and** for the correct substitution and use of the incorrect value in the calculation of the rate of acceleration.

Papers should be constructed in such a way that the number of times errors can be carried forward are kept to a minimum. Allowances for errors carried forward are most likely to be restricted to calculation questions and should be shown by the abbreviation e.c.f. in the marking scheme.

3.8 Phonetic spelling

The phonetic spelling of correct scientific terminology should be credited **unless** there is a possible confusion with another technical term.

3.9 Brackets

(…..) is used to indicate information which is not essential for the mark to be awarded but is included to help the examiner identify the sense of the answer required.

3.10 Unexpected Correct Answers not in the Mark Scheme

The Examiner should use professional judgement to award credit where a candidate has given an unexpected correct answer which is not covered by the mark scheme. The Examiner should consult with the Team Leader to confirm the judgement. The Team Leader should pass this answer on to the Principal Examiner with a view to informing all examiners.

3451/H Q1

question	answers	extra information	mark
(a)(i)	outside the Earth **or** not from the Earth	accept alien accept life from / on another planet / space accept our planet for Earth	1
(ii)	radio telescope(s)	do **not** accept telescopes do **not** accept satellite dishes do **not** accept radio receivers **or** transmitters	1
(b)(i)	galaxies	do **not** accept stars	1
(ii)	any **one** from: the pulses were regular pulses from space are usually random (scientists) thought technology had been used to produce the pulses neutron stars were unknown signals from a single point	 accept signals / beats for pulses accept noise for random pulses idea of regular but not continuous	1
(iii)	neutron star is (the matter / mass) left behind after a star / red giant explodes (as a super nova)	 accept after a super nova (explosion) neutron star causing super nova gets no credit	1 1
(c)(i)	carried on the balloon / equipment	accept carried by a rocket / aircraft / satellite birds negates credit	1
(ii)	on comets or meteors	accept meteorites / shooting stars accept returning space craft accept solar wind ignore asteroids accept ufo do **not** accept solar flares do **not** accept satellites	1
total			8

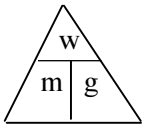
3451/H Q2

question	answers	extra information	mark
(a)	silver is a (good) reflector of heat (radiation) **or** silver reflects the heat (radiation)	fact heat = infra red ignore references to light accept shiny for silver good radiator negates the mark ignore references to good conductor do **not** accept bounce back	1
	less heat is lost through the board **or** more heat is retained by the shirt	explanation accept both sides of shirt heated reflects heat back up gets **1** mark only ignore mention of friction	1
(b)	metal soleplate	accept soleplate / bottom / metal do **not** accept outside / case	1
(c)	plastic **or** rubber	accept any named plastic do **not** accept wood	1
	it is a (good) insulator **or** it is a poor conductor	ignore mention of heat if in conjunction with electricity	1
(d)	**Quality of written communication** *The answer to this question requires ideas in good English in a sensible order with correct use of scientific terms. Quality of written communication should be considered in crediting points in the mark scheme.*	*Maximum of **2** marks if ideas not well expressed.*	
	pulls iron bolt down **or** attracts the iron bolt **or** moves bolt out of plunger	answers in terms of charges attracting or repelling gain no credit	1
	plunger pushed / moved to the right (by spring) **or** plunger released		1
	push switch opens / goes to off / goes to right	accept circuit is broken for maximum credit the points must follow a logical sequence 3 correct points but incorrect sequence scores **2** marks only ignore reset action	1
total			8

3451/H Q3

question	answers	extra information	mark
(a)(i)	any **one** from:		1
	the ground	do **not** accept mobile phones	
	the air		
	radon (gas)		
	building materials		
	buildings		
	rocks / granite		
	food		
	cosmic <u>rays</u> **or** solar <u>rays</u>	accept from outer space accept sun but **not** sunlight	
	X-rays	accept medical uses	
	nuclear weapons testing		
	nuclear power stations / accidents		
(ii)	2	allow $\frac{1200}{60\times10}$ **or** $\frac{1200}{600}$ **or** 120 for **1** mark	2
(b)		answers must be comparative accept converse answers throughout	
	alpha: the count rate is (greatly) reduced by the card **or** the card absorbs alphas <u>but not betas</u>	accept paper for the card	1
	beta: the count rate is (greatly) reduced by the metal **or** the thin metal absorbs alphas <u>and</u> betas **or** the thin metal absorbs all of the radiation (from the source)	accept aluminium for the metal	1
	gamma: would pass through the thin metal but count rate is background **or** no radiation passing through **or** a higher reading would be recorded **or** to reduce the count to 2 would require <u>much more</u> than 3 mm of metal	accept aluminium for the metal accept lead / aluminium for the metal	1
total			6

3451/H Q4

question	answers	extra information	mark
(a)(i)	weight = mass × g.f.s.	accept w = m × g accept gravity for gfs accept  provided subsequent use of Δ correct do **not** accept N = kg × N/kg	1
(ii)	675	75 × 9 for **1** mark	2
(iii)	g.(f.s.) is higher (on Earth than Venus)	accept gravity for g.f.s. do **not** accept g.f.s. is lower unless answer states on Venus	1
(iv)	orbit time for Jupiter is <u>longer</u> / longest (than for the other planets)	do **not** give any credit for an answer that includes a comparison of diameter **or** a comparison of g.f.s.	1
(b)	**Quality of written communication** *The answer to this question requires ideas in good English in a sensible order with correct use of scientific terms. Quality of written communication should be considered in crediting points in the mark scheme.* any **two** from: dust <u>and</u> gas **or** remnants of a super nova pulled together by (force of) <u>gravity</u> nuclear fusion starts	*Maximum of **1** mark if ideas not well expressed.* accept hydrogen for dust and gas do **not** accept hydrogen burns although candidates may include more detail these points are essential to score the credit	2
total			7

3451/H Q5

question	answers	extra information	mark
(a)(i)	upright with the contacts at the bottom and still in place and unbent	no need for labels but incorrect label(s) cancel the mark accept a freehand drawing no need for details such as correct dimensions	1
	one blob of mercury touching <u>both</u> contacts	do **not** award mark if contacts bent to touch	1
(b)(i)	(X is a) battery	do **not** credit cell accept (set of) cells accept power supply do **not** accept power pack	1
	(Y is a) LED	**or** light emitting diode	1
(ii)	longer (time)	do **not** accept 'slower time'	1
(iii)	any **two** from: current less (so) rate of flow of charge less **or** less coulombs per second (so) discharge is slower	 do **not** accept current slower accept capacitor has charge for longer **or** charge lasts longer **or** (so total of) electrons take longer to travel round circuit	2
(c)	4200	 translation correct (= 4000) but percentage addition incorrect gains **1** mark translation incorrect but 5% addition is correct gains **1** mark accept 422.1 **or** 42.2 **or** 6.3 for **1** mark	2
	ohms **or** Ω	 4.2 kilohms **or** 4.2 kΩ gains all **3** marks	1
total			10

3451/H Q6

question	answers	extra information	mark
(a)	point at which its mass (seems to) act **or** point at which gravity (seems to) act	accept …its weight acts accept correct statements if the intent is clear e.g. … if suspended, the centre of gravity will be directly under the point of suspension e.g. … (if the object is symmetrical), the centre of gravity is on the **or** an axis (of symmetry) do **not** credit just 'it is a point'	1
(b)	**Quality of written communication** *The answer to this question requires good English in a sensible order with correct use of scientific terms. Quality of written communication should be considered in crediting points in the mark scheme.* any **five** from: clamp (steel) rod (horizontally) hang plastic / sheet by rod through (one) hole hang plumb line from rod mark ends of plumb line on the sheet and use the ruler to draw a straight line repeat with other hole centre of mass is where the lines cross check by balancing at this point	*maximum of **4** marks if ideas not well expressed* **no** marks if method quite unworkable maximum of **3** marks if no 'repeat with other hole'	5
(c)(i)	(turning) effect **or** moment force distance	all three correct accept weight accept length	1
(ii)	17.6 Nm **or** newton metre(s)	allow 44 × 0.4 **or** 0.4 × 44 for **1** mark do **not** accept N/m **or** N/cm 1760 Ncm gains all **3** marks	2 1
total			10

3451/H Q7

question	answers	extra information	mark
(a)(i)	X – mantle		1
	Y – inner core	do **not** accept solid core	1
(ii)	different to the crust **or** contains a lot of (heavy) metals	accept iron and nickel for metals	1
	higher (average) density **or** denser	density higher than 5500 (kg/m^3) gets **2** marks	1
(b)	animals were able to move from one continent to the other		1
	(when bridge broke) animals evolved differently	accept animals adapted differently	1
(c)(i)	earthquakes occur at the boundary between plates **or** earthquakes occur where plates push against each other		1
	there are no plate boundaries running through Britain	accept Britain is not near the edge of a plate	1
(ii)	convection currents (in the mantle) **or** heat released by (natural) radioactive processes		1
total			9

3451/H Q8

question	answers	extra information	mark
(a)(i)	potential difference = current × resistance	accept voltage **or** pd for potential difference accept V = I × R accept correct transformation do **not** accept V = C × R do **not** accept V = A × R accept  provided subsequent use of Δ correct do **not** accept an equation expressed in units	1
(ii)	46	credit correct transformation for **1** mark allow **1** mark for use of 11.5 V **or** division of final resistance by 20 a final answer of 920 gains **2** marks only	3
	ohm(s)	accept symbol Ω do **not** accept Ωs unit / symbol mark can be awarded in (iii) provided unit / symbol is omitted in (ii)	1
(iii)	920 (ohms) **or** their (a)(ii) × 20		1
(b)	as temperature increases, resistance increases	accept hotter for temperature increase do **not** accept a reference to resistance only i.e. it / resistance goes up	1
total			7

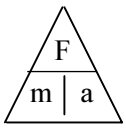
3451/H Q9

question	answers	extra information	mark
(a)(i)	analogue – amplitude and / or frequency vary continuously	accept sine wave	1
	digital – a series of off and on pulses **or** have only two values		1
		allow full credit for a correct diagram of each signal	
(ii)	signals (weaken and) need amplifying **or** when signals are amplified		1
	analogue – any **one** from:		1
	noise / random additions are amplified		
	different frequencies weaken different amounts, amplification increases this difference		
	digital – any **one** from:		1
	changes shape of pulses but not the pattern of pulses and spaces		
	noise is low amplitude and treated as off / 0 / ignored		
	electronic circuits remove the noise		
(iii)	always above the same point on Earth **or** same point in sky	do **not** accept always stays above the equator ignore reference to 24 hour rotation	1
	(transmitting and receiving) dishes do not need to keep changing direction		1
(b)(i)	(partly) reflected when they hit a (boundary between two) different media or substance or tissue	accept named substances do **not** accept bounce back	1
	time taken for reflected wave (to return) is used to produce the image		1

3451/H Q9 continued

(ii)	any **one** from: cleaning a delicate mechanism / jewellery do **not** accept cleaning welding plastics cutting textiles mixing emulsion paints sonar motion sensors (in burglar alarms) do **not** accept burglar alarms removing dental plaque industrial quality control breaking up kidney stones treating injuries	1
total		10

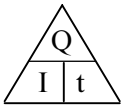
3451/H Q10

question	answers	extra information	mark
(a)	concentration / tiredness / drugs / alcohol	accept any reasonable factor that could affect a driver's reactions do **not** accept speed or any physical condition unrelated to the driver	1
(b)	31.25	credit for **1** mark correct attempt to calculate the area under the slope **or** for using the equation distance = <u>average</u> velocity (speed) × time credit for **1** mark use of correct velocity change (12.5) <u>and</u> correct time (5) **or** answer of 62.5	3
(c)	2.5	credit for **1** mark triangle drawn on slope **or** correct equation **or** two correct pairs of coordinates credit for **1** mark use of correct velocity change (12.5) and correct time (5) accept time = between 4.8 and 5.2 if used in (b) do not accept an attempt using one pair of coordinates taken from the slope	3
	metres / second / second **or** metres / second squared **or** m/s^2 **or** ms^{-2}		1
(d)(i)	force = mass × acceleration	accept correct transformation accept F = m × a accept  provided subsequent use of Δ is correct do **not** accept an equation in units	1
(ii)	2250	credit their (c) × 900 for 2 marks credit **1** mark for correct substitution	2
total			11

3451/H Q11

question	answers	extra information	mark
(a)	ions / 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 move faster	1
	(free) electrons transfer energy by collision with ions **or** energy transferred by collisions between vibrating ions		1
(b)	move faster **or** take up more space	do **not** accept start to move / vibrate	1
	(warmer) water expands **or** becomes less dense (than cooler water)	do **not** accept answers in terms of particles expanding	1
	warm water rises (through colder water) **or** colder water falls to take its place		1
(c)	transfer of energy by waves / infrared (radiation)	accept rays for waves do **not** accept transfer of energy by electromagnetic waves ignore reference to heat	1
total			6

3451/H Q12

question	answers	extra information	mark
(a)	positively charged - attracted towards the negative spoon / electrode **or** (each) silver atom has lost one / its (outer) electron	both the polarity and reason are required for the mark accept movement	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 use of the Δ is correct	1
(ii)	900 coulombs **or** C	15 scores **1** mark only	2 1
(iii)	4.0(g)	accept 4	1
total			6

3451/H Q13

question	answers	extra information	mark
(a)(i)	kinetic energy = $\frac{1}{2}$ × mass × speed^2	accept ke = $\frac{1}{2}$ mv^2 do **not** accept KE = $\frac{1}{2}$ ms^2	1
(ii)	13	allow **1** mark for correct substitution or transformation	2
(b)	PE at A maximum PE at B minimum PE at C just less than **or** = to A	if B is at the top of the curve - **no** marks do **not** accept wavy lines **or** very non-symmetrical accept straight lines or curves	1
	difference between A and B is 5000 to 5200		1
total			5

3451/H Q14

question	answers	extra information	mark
(a)(i)	two protons and two neutrons **or** the nucleus of a helium atom		1
(ii)	different numbers of neutrons **or** one has (3) more or less neutrons than the other	accept different mass (numbers) if give a number as a difference it must be 3	1
(iii)	technetium (99) or none	if polonium or hydrogen chosen gets **0** marks	1
	any **two** from:		2
	gamma rays less dangerous inside the body	do **not** accept gamma rays are less dangerous	
	gamma radiation less likely to be absorbed by cells **or** gamma rays do not ionise cells		
	gamma rays can penetrate the body (to be detected externally)		
	short half-life so safe levels inside body soon reached	first 3 points valid if either technetium or iridium or none is given	
	half-life long enough to obtain measurements		
	half-life short enough not to cause long term damage	last 3 points valid if either technetium or uranium or none is given	
(b)	2200 ± 200	allow **1** mark for attempted use of 70% on the graph	2
total			7

3451/H Q15

question	answers	extra information	mark
(a)(i)	OR (gate)	accept or (gate)	1
(ii)	thermistor	accept (thermal) resistor accept semi-conductor temperature sensor	1
(iii)	capacitor	accept condenser	1
(b)(i)	off **or** low **or** 0 **or** decreased		1
	on **or** high **or** 1	do **not** accept increased accept off / low / 0 if input given as on / high / 1	1
	transistor		1
	relay		1
	(security) light	accept <u>output</u> device do **not** accept alarm	1
(ii)	any **two** from:		2
	protects the <u>transistor</u> (from damage)	do **not** credit just 'protection' **or** 'prevents damage'	
	when the relay is switched off		
	<u>induced</u> emf / voltage / current at switch off		
	(due to) collapse of field (around relay)		
	(because) it acts as a buffer		
(iii)	(so that) it does not short (circuit) the relay		1
(iv)	reverse (the positions of) the LDR and the variable resistor / rheostat	do **not** credit … and the resistor	1
	remove the NOT gate **or** remove the inverter **or** do not have the NOT gate or inverter in series (with the resistor) **or** add another NOT gate next to the NOT gate	accept not gate	1
total			13

3451/H Q16

question	answers	extra information	mark
(a)(i)	momentum = mass × velocity (change in) (change in)	accept … speed	1
(ii)	9000	1500 × 6 for **1** mark but **not** from incorrect equation	2
	kilogram metre(s) per second **or** kg m/s		1
(iii)	**either** 7.5 (m/s) **or** change in momentum of car B = change in momentum of car A (1) 9000 = 1200 × v (1) **or** error carried forward from part (ii)	or v = 9000 ÷ 1200 (1) **examples** 5 (m/s) if 6000 offered in (ii) (3) 12.5(m/s) if 15000 offered in (ii) (3)	3
(b)	each point for or against (1) with example / explanation / amplification (1) **examples** • deter antisocial behaviour • (but) deter activity which is not illegal but is (potentially) embarrassing • if broadcast / made public • deterrent to (potential) criminals • (and) provide evidence of any crimes which do occur • (but) they just displace criminal / antisocial behaviour • to places where there are no cameras • make (law-abiding) people feel more secure • less fencing is needed • images / pictures (may be) of poor quality • not satisfactory for identification (in court) • inefficient when weather affects visibility	up to a maximum of 5 maximum **4** marks if the discussion is entirely one-sided do **not** credit any cost point do **not** credit any unqualified point, e.g. fences are better, **or** muddled / repetitive thinking	max 5
total			12