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RECOGNISING ACHIEVEMENT

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ADVANCED SUBSIDIARY GCE AS 3888

PHYSICS B (ADVANCING PHYSICS)

Second Edition (post-Tomlinson Enquiry statistics)

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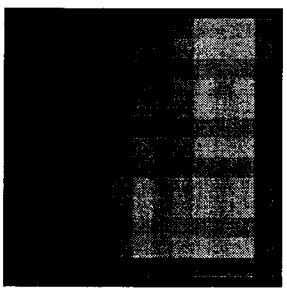
MARK SCHEME FOR THE UNITS

JUNE 2002

AS/A2



3888/7888/MS/02

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This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which marks were awarded by Examiners. It does not indicate the details of the discussions which took place at an Examiners' meeting before marking commenced.

All Examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes should be read in conjunction with the published question papers and the Report on the Examination.

OCR will not enter into any discussion or correspondence in connection with this mark scheme.

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Advanced Subsidiary GCE/Advanced GCE Physics B (Advancing Physics) 3888/7888
June 2002 Assessment Session

This specification was re-graded following the Tomlinson enquiry into A Level standards. Therefore, these thresholds and statistics were revisited in October 2002. Thresholds and statistics which have changed are marked in bold.

Unit Threshold Marks

Unit		Maximum Mark	a	b	c	d	e	u
2860	Raw	90	69	63	57	51	46	0
	UMS	100	80	70	60	50	40	0
2861	Raw	90	64	57	50	43	36	0
	UMS	110	88	77	66	55	44	0
2862	Raw	120	97	**85**	**73**	**62**	**51**	0
	UMS	90	72	63	54	45	36	0
2863 Option A	Raw	127	97	**87**	**77**	**67**	**58**	0
	UMS	100	80	70	60	50	40	0
2863 Option B	Raw	127	97	**85**	**74**	**63**	**52**	0
	UMS	100	80	70	60	50	40	0
2864 Option A	Raw	119	90	81	**72**	**63**	**54**	0
	UMS	110	88	77	66	55	44	0
2865	Raw	90	66	**59**	**52**	**46**	**40**	0
	UMS	90	72	63	54	45	36	0

Specification Aggregation Results

Overall threshold marks in UMS (i.e. after conversion of raw marks to uniform marks)

	Maximum Mark	A	B	C	D	E	U
3888	300	240	210	180	150	120	0
7888	600	480	420	360	300	240	0

The cumulative percentage of candidates awarded each grade was as follows:

	A	B	C	D	E	U	Total Number of Candidates
3888	**24.7**	**44.5**	**63.2**	**78.8**	**90.1**	**100.0**	**7407**
7888	**30.0**	**51.3**	**70.0**	**85.7**	**95.9**	**100.0**	**5892**

These percentages are correct at the time of going to press (October 2002).

Physics B (Advancing Physics) mark schemes - an introduction

Just as the philosophy of the *Advancing Physics* course develops the student's understanding of Physics, so the philosophy of the examination rewards the candidate for showing that understanding. These mark schemes must be viewed in that light, for in practice the examiners' standardisation meeting is of at least equal importance.

The following points need to be borne in mind when reading the published mark schemes:

- Alternative approaches to a question are rewarded equally with that given in the scheme, provided that the physics is sound. As an example, when a candidate is required to "Show that..." followed by a numerical value, it is always possible to work back from the required value to the data.
- Open questions, such as the questions in section C permit a very wide variety of approaches, and the candidate's own approach must be rewarded according to the degree to which it has been successful. Real examples of differing approaches are discussed in standardisation meetings, and specimen answers produced by candidates are used as 'case law' for examiners when marking scripts.
- Final and intermediate calculated values in the schemes are given to assist the examiners in spotting whether candidates are proceeding correctly. Mark schemes frequently give calculated values to degrees of precision greater than those warranted by the data, to show values that one might expect to see in candidates' working.
- Where a calculation is worth two marks, one mark is generally given for the method, and the other for the evaluation of the quantity to be calculated.
- If part of a question uses a value calculated earlier, any error in the former result is not penalised further, being counted as *error carried forward*: the candidate's own previous result is taken as correct for the subsequent calculation.
- Inappropriate numbers of significant figures in a final answer are penalised by the loss of a mark, generally once per examination paper. The maximum number of significant figures deemed to be permissible is one more than that given in the data; two more significant figures would be excessive. This does not apply in questions where candidates are required to show that a given value is correct.
- Where units are not provided in the question or answer line the candidate is expected to give the units used in the answer. Missing or incorrect units in a final answer are penalised by the loss of a mark, generally once per examination paper.
- Quality of written communication will be assessed in Section C where there are more opportunities to write extended prose.

SECTION C

The outline mark schemes given here will be given more clarity by the papers seen when the examination is taken. Some of these scripts will be used as case law to establish the quality of answer required to gain the marks available.
It is not possible to write a mark scheme that anticipates every example which students have studied.

For some of the longer descriptive questions three marks will be used (in scheme called the 1/2/3 style).

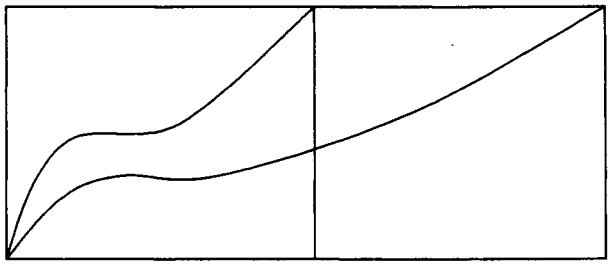
1 will indicate an attempt has been made
2 will indicate the description is satisfactory, but contains errors
3 will indicate the description is essentially correct

The following annotations may be used when marking:

X	=	incorrect response (errors may also be underlined)
^	=	omission mark
bod	=	benefit of the doubt (where professional judgement has been used)
ecf	=	error carried forward (in consequential marking)
con	=	contradiction (in cases where candidates contradict themselves in the same response)
sf	=	error in the number of significant figures

Abbreviations, annotations and conventions used in the Mark Scheme:

/	=	alternative and acceptable answers for the same marking point
;	=	separates marking points
NOT	=	answers not worthy of credit
( )	=	words which are not essential to gain credit
___ (underlining)	=	key words which must be used
ecf	=	allow error carried forward in consequential marking
AW	=	alternative wording
ora	=	or reverse argument

Question	Expected Answers	Marks
	Section A	
1. a	idea of constant error (in all readings) / error on same side of true value / off by 0.5 / 0.6 A (+/- sign) AW ✓ NOT any description of random error ;	1
b	7 / 7.0 / 7.1 A ✓ NOT 5.9 / 6.0 A	1
2. a	stiff / hard / tough / low density / low friction / non porous / other relevant **mechanical** property ✓ ; NOT (durability / strength / plasticity / brittleness)	1
	correct meaning of any relevant property explained ✓NOT cost ;	1
b	importance to hip joint explained: e.g. stiffness matched to bone OR to avoid bending of replacement / to avoid frictional wear at socket / will not break under impulsive loads AW ✓ ecf on incorrect meaning from (a)	1
3.	greater initial gradient ✓; gradient decreases then increases ✓; breaks at 30 MPa stress and 0.3 strain ✓ 	3
4. a;b	D ✓; Sm^{-1} ✓	2
5. a	M =1.2 / 0.2 = 6 ✓ ;	1
b	$M=v/u$ / $u = v/M$ / = 2.4 / 6 ✓; = 0.4(0) (m) ✓ ecf wrong M in (a)	2
6.	$v = f\lambda$ / $\lambda = c/f$ / = 300 Mm s^{-1} / 99.8 MHz ✓ ; = 3 (.01) m ✓	2
7. a;b	C ✓; A ✓	2
8.	n = sin50 ° / sin35 ° ✓ ; = 1.3(4) ✓ ; SF mark - accept 2 or 3 ✓ (rads mode yields 0.61(3)) n.b. incorrect values can still score the SF mark	3
	Total	20

		Section B	
9.	a	alternatives (= 2^4) = 16 ✓ ; 16 (or ecf) > 10 so 4 bits sufficient /	1
		appropriate binary coding e.g. (0 to) 9 ✓	1
	b	bits = 100 x 12 x 4 = 4800 ✓ ; bytes = bits / 8 = 600 ✓ ecf wrong bits	2
	c	correct comment on number of letters e.g more letters than digits / 26 letters ✓ ;	
		better quality answer e.g. 26 letters need 5 bits /	1
		52 letters need 6 bits / 4 bits codes only 16 letters AW ✓	1
	d i	5 kHz / 5000 Hz ✓	1
	ii	(any two reasons beware repetition) music may contain wider frequency spectrum than speech / lower quality reproduction of speech is acceptable to human perception / music has more complex waveform / poor speaker quality / stereo needed for music / sampling rate / quantisation errors / music suffers more from: high frequency cut-off / aliasing / spurious frequencies / AW ✓✓	2
			total 9
10.	a	correct symbols ✓ ; R in series with Ammeter ✓ ;	2
		Voltmeter in parallel with R / solar cell ✓ (-1 for superfluous components)	1
	b i	p.d. drops (as current increases)✓ ;	1
		gradually at first then at a greater rate ✓ ; AW	1
	ii	solar cell has (internal) resistance / mention of internal r / photon flux limits the output AW ✓	1
	c i	correct values ✓; $P (= I V) = 0.05 \times 0.5$ ✓ ecf ; = 0.025 W ✓ ecf ;	3
	ii	At B I is a lot less AW ✓ ; at C V is a lot less ✓ /	
		calculations of powers at B ≈ 6 (mW) , at C ≈ 6 (mW) ecf on mA AW	2
			total 11
11.	a	extension ∝ force / linear through origin / F doubles as e doubles AW ✓	1
	b i	½ x 90 x (4.0×10^{-3}) ✓ ; = 0.18 (0.36 or 180 score 1 ecf) ✓ ; J / Nm ✓	3
	ii	stress = 90 / (2.5×10^{-7}) ✓ = 3.6×10^8 ($N\ m^{-2}$) ecf ✓	2
		strain = (4.0×10^{-3}) / 2.0 ✓ = 2.0×10^{-3} ecf ✓	2
		E = (3.6×10^8) / (2.0×10^{-3}) = 1.8×10^{11} $N\ m^{-2}$ ecf ✓	1
	c i	straight line graph of double gradient i.e. passing (2.0, 90) ✓	1
	ii	E is the same ✓ ; because E is constant for a material NOT wire /	1
		½ length means ½ extension and same strain at given stress AW ✓	1
			total 12
12.	a i	equal increments along the amplitude / frequency axis represent equal multiples in value (x10) AW ✓	1
	ii	logs used to accommodate the large range of values / logs represent data more clearly AW ✓	1
	b i	200 Hz ✓	1
	ii	reference to spreading / scattering / absorbtion / energy transfer to surroundings AW ✓	1
	iii	0.1 or $^1/_{10}$ ✓ ; 0.01 or $^1/_{100}$ ✓ (if both correct raw ratios score 1)	2
	iv	20 000 (Hz)✓ ; any plausible comparison e.g. - shorter waves are scattered more (by rough surfaces with variations of order of wavelength) / accept lower frequencies are more penetrating ora / molecular vibrations can absorb translational kinetic energy AW ✓	1
			total 8
		section B total	40

		Section C: see also guidelines	
13.	a i	type of information identified (image, sound, data, alphabetic etc.) ✓ ;	1
		relevant signal system identified (satellite, radio wave, modem, telegraph)✓	1
	ii	block or schematic diagram of production ; transmission ; reception of signal 1/2/3 style ✓✓✓	3
	b i	statement of how noise recognised in information – glitches in data AW ✓;	1
		more relevant detail - snow on images / crackle on sound etc. ✓	1
	ii	mention of screening / blocking / filtering etc. ✓ ;	1
		more details: coax screened cable / image processing / frequency filtering✓	1
	c i	two factors identified – speed of carrier / signal frequency / bandwidth / compression / internet usage loading / modem speed ✓✓ NOT resolution or sampling rate	2
	ii	a sensible unit e.g. kbit per s / GHz / A4 Fax sheets per hour✓	2
		a sensible value for the estimate ✓	total 13
14.	a	Imaging system selected e.g. satellite image of N. Europe ✓ ;	1
		3 pieces of information – cloud cover ; temperature ; land use etc. 1/2/3 style ✓✓✓	3
	b i	Nature of waves / radiation made clear – infra-red / microwave ✓ ;	1
	ii	labelled diagram and description of how image is obtained 1/2/3 style ✓✓✓ satellite scans Earth ; infra-red sensor detects energy per pixel ; A to D converts to binary data value or other sensible details	3
	c i	resolution is size represented by length of pixel ✓ ;	1
		reasonable resolution estimate e.g. 100 m per pixel side ✓	1
	ii	**two** factors limiting resolution e.g. wavelength of radiation / diameter of detector dish / pixel density (number) on detector / distance at which object is being imaged / bits per pixel ✓✓	2
		some detail on either factor e.g. numerical or descriptive detail ✓	1
		Quality of written communication	4
			total 17
		total section C	30

13ai	speech information analogue telephone system	text message mobile phone system	binary computer data data bus from hard disk to memory
ii	speech to electrical signal by mic. in handset signal along wire conductors electrical signal to sound by loudspeaker in the receiver	text entered on mobile keypad converted to digital code signal through air by microwave transmission signal received, decoded and displayed as text at receiver	binary data read from hard disk by read head data switched through databus to processor / memory data displayed on screen of pc
bi	crackles on speech whistling tones	incorrect characters unexpected graphics	data or graphic glitches on screen programme crashes
ii	use fibre optic link rather than copper wire optics do not pick up external electrical noise like lightning	Ensuring that no other nearby signal is using the same transmitting frequency avoids cross-talk between channels	cleaning the surface of hard disk and read head prevents dust from corrupting data as it is read from disk
ci	carrier signal speed electric signal on wires at near light speed frequency / bandwidth	carrier wave speed microwaves at light speed number of other local users loading the system	carrier signal speed electric pulses travel on databus at near light speed frequency rating of the databus / number of parallel wire in the bus
ii	10's of kbits / s OR a few words / s	100's of kbits / s OR a message / few ms	100's of Mbits / s OR 10's of pc screens / s