Oxford Cambridge and RSA Examinations

OCR

RECOGNISING ACHIEVEMENT

ADVANCED GCE
ADVANCED SUBSIDIARY GCE

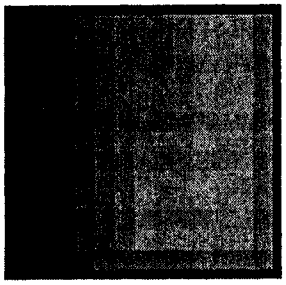
A2 7888
AS 3888

PHYSICS B (ADVANCING PHYSICS)

MARK SCHEME FOR THE UNITS

JUNE 2004

AS/A2



3888/7888/MS/04

Advanced Subsidiary GCE Physics B (Advancing Physics) 3888
June 2004 Assessment Session

Unit Threshold Marks

Unit		Maximum Mark	a	b	c	d	e	u
2860	Raw	90	64	56	49	42	35	0
	UMS	100	80	70	60	50	40	0
2861	Raw	90	59	51	44	37	30	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

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

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

	A	B	C	D	E	U	Total Number of Candidates
3888	24.0	43.7	62.3	79.6	91.0	100.0	6682

Advanced GCE Physics B (Advancing Physics) 7888
June 2004 Assessment Session

Unit Threshold Marks

Unit		Maximum Mark	a	b	c	d	e	u
2863A	Raw	127	96	86	76	66	56	0
	UMS	100	80	70	60	50	40	0
2863B	Raw	127	96	86	76	66	56	0
	UMS	100	80	70	60	50	40	0
2864A	Raw	119	92	82	72	62	53	0
	UMS	110	88	77	66	55	44	0
2864B	Raw	119	92	82	73	64	55	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
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
7888	30.7	52.9	73.0	88.2	96.9	100.0	5214

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.
- Quality of written communication will be assessed where there are 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

Qn	Expected Answers	Marks	Additional guidance
1	**Section A** tough ✓	1	
2a; b; c	i) **B** ii) **A** ✓ ; a light line / low values AW ✓ ; smoothing / averaging / mean / median AW ✓	1 1 1	both for the mark at 10 / near zero NOT just filter
3a b	r correctly labelled ✓ ; rearrangement or substitution $\sin r = \sin 80°/ 1.3$ ✓ ; correct value for $r = 49.(2)°$ ✓ ; accept 1 / 2 / 3 S.F. ✓	1 1 2	 $\sin 80° / \sin r = 1.3$ S.F. mark not penalty accept 50°
4a b	= 220 / 880 / = ¼ / 1 : 4 ✓ ; method = 220 x 6 / (220+880) / correct symbolic✓ ; evaluation = 1.2 V ✓	1 1 1	accept 0.25 NOT 4 accept 6 / 5
5a b	$P = IV = II R = (I^2 R)$ / $P/I = I$ R and $P = I^2 R$ ✓ ; 4 ✓	1 1	 NO ecf from (a)
6	e.g. rotate **T** / **R** / grille / slit (about x-axis) ✓ ; loudness varies ✓ ; reaches zero / minimum after 90° rotation ora ✓	1 1 1	accept any other valid method e.g.rotating a metal grille 1/2/3 style AW
7ai; ii bi;ii	50 μs ✓ ; 20 000 Hz ✓ ; 3 bits ✓ ; 3×10^6 bits s^{-1} ✓ Total section A	1 1 2 20	accept up to 52μs ecf on 1/T ecf on bits x 10^6

Qn	Expected Answers	Marks	Additional guidance
	Section B		
8a;	Angle of incident ray correct by eye ✓ ;	1	
b;	adv. wider angle of view ✓; disadv. missing angles /	1	NOT see more
	non-continuous field of view / hazard ✓;	1	other sensible suggestions
ci	$I = P/V$ / = 50 / 12 ✓ ; = 4.17 / 4.2 A ✓ ;	2	rearrange ; decimal evaluation i and ii
	($G = I/V$) = 4.17 / 12 ✓ ; = 0.347 S ✓ ;		
ii		2	allow ecf on 4.0 A
	$t = GL / \sigma h$ OR $A = GL / \sigma$ ✓ ;	1	i.e. 0.33 S
iii	= 0.347 × 0.2 / (3.1 × 10^5 × 0.08) OR = 2.2 x 10^{-7} m^2 ✓ ;	1	rearrangement
	= 2.8 × 10^{-6} m ✓	1	substitution / evaluation final evaluation ecf
		10	
9a	50 ± 20 pixels ✓ ;	1	
b	135 / (a) = 2 or 3 or 4 or 5 (to 1 S.F.) ✓ ;	1	must match their (a)
c	same length per pixel AW ✓ ;	1	accept same image
d	1.28 M(bits) ✓ ;	1	accept 1.22 M(bits)
ei	(M = v / u) = 0.16 / 2 x 10^5 ✓ ; (= 8 x 10^{-7}) ora	1	
ii	10^{-3} / 8 × 10^{-7} = 1.25 × 10^3 m ✓ ;	1	
iii;	use of geometry similar triangles / equal angles ✓ ;	1	AW
f	$1/u \approx 0$ ✓ ; so $1/v \approx 1/f$ (and $v \approx f$) ✓	2	complete argument for
	OR correct numerical / curvature arguments	9	both marks
10ai	any straight line of best fit judged by eye	1	
ii	**1.** 6.0 ± 0.2 V / consistent with the y-intercept of their graph	1	
	2. r = gradient / $(\mathcal{E} - V) / I$ / = V_{LOST} / I ✓ ;	1	any correct method ;
	e.g. = (6.0 – 0) / 2.0 ✓ ; = 3.0 Ω ✓ no working max 1	2	substitution ; evaluation consistent with their graph values
b	(total) delivered internally and externally / of battery ✓	1	
	(dissipated) in internal resistor ✓ ;	1	or whole circuit
ci	$R = V/I$ = 3(.0)Ω ✓ and $P = IV$ = 3(.0) W ✓ ;	2	NOT in heat
ii	(efficiency = $IV / I\mathcal{E}$ = 3.0 / 6.0) = 0.5 / 50% ✓ ;	1	consistent with graph
iii	Power = 2.5 ± 0.1 W / 1.6 ± 0.1 W / 1.9 ± 0.1 W UP ✓	1	consistent calculation of P from a graph point
		11	
11a	σ = ε E = 0.05 x 5.0 x 10^9 any arrangement ✓ ;	1	correct substitution
b	proportional up to point (250 MPa , 5%) ✓ ;	1	no line no marks
	any shape ending at point (300MPa , 25%) ✓ ;	1	
ci;	$A = \pi R^2 = \pi$ x (25 x 10^{-6}) ^{2} = 1.96 x 10^{-9} m^2 ✓ ;	1	evidence of evaluation
ii	$F = \sigma A$ / = 3.0 x 10^8 x 1.96 x 10^{-9} ✓ ;= 0.59 / 0.6 N ✓ ;	2	method ; evaluation AW
di	any mechanical property ✓ of a composite related to microstructure ✓ ; explain by ref to matrix and fibres ; e.g. strength / stiffness : of fibres shifted to matrix / toughness : stress shared by matrix to other fibres / anisotropy : stronger axially than transverse - split ends	2	reward other sensible physics suggestions NOT ductile
ii	suggest: coiled protein molecules can uncoil and coil up again when stress is removed ✓ ; weak bonds between coiled molecules can be broken under stress then reform when stress is removed / strong sulphur bonds to matrix pull coils back to shape ✓	1	reward sensible suggestions or AW but NOT spring analogy
		1	
		10	
		40	

Qn	Total section B Expected Answers	Marks	Additional guidance
	Section C		
12ai	e.g. text / logos ✓ ; by FAX✓ ;	2	
ii	a frequency estimate ✓ 64 kHz (allow kbits per s) ✓ ; frequency at which binary bits of information are transmitted down the telephone line from transmitting to receiving FAX machines ✓	2 1	sensible for example chosen with unit accept speech / carrier / sampling frequencies
iii	higher *f* enables greater rate of information transfer ✓	1	NOT more data
b	1/2/3 style ✓ ✓ ✓ analogue – continuously variable signal digital – two level / binary signal accept correct diagrams or explanation to max 3	3	AW
c	adv - communication on the move / worldwide ✓ ; exp – emergency services can be contacted immediately at an accident ✓ ;	1 1	allow any sensible justified cases of making physics connect
	disadv – mobile phones ringing in trains / concerts ✓ ; exp – annoyance to other passengers / audience ✓ ;	1 1	
	Total	13	
13a	e.g. light intensity ✓ ; LDR ✓	2	allow amount of fuel
b	circuit diagram 1/2/3 style ✓ ✓ ✓ penalise incorrect circuit symbols	3	full marks for active sensor circuit with suitable output monitor
ci	e.g. vary light intensity and measure (against a known standard / digital luxmeter) ; plot graph of output p.d. against intensity ; gradient of graph / AW for sensitivity		vary input and measure correct plot measure sensitivity
	OR 1/2/3 style ✓ ✓ ✓	3	
ii	e.g. 3 ✓ mV per lux / mV per W m^{-2} ;✓	2	unit must relate to b / c value plus incorrect unit scores 0
iii	any change to fixed resistor in potential divider / increase emf / amplify (output) ; to give appropriate output alteration ; to increase range of output (for similar input change) OR 1/2/3 style ✓ ✓ ✓	1 1 1 —	easy first mark look back to circuit tough third mark other approaches
	Total	13	
	Quality of written communication	4	
	Total section C	30	

QoWC Marking quality of written communication

The appropriate mark (0-4) should be awarded based on the candidate's quality of written communication in Section C of the paper.

4 max The candidate will express complex ideas extremely clearly and fluently. Answers are structured logically and concisely, so that the candidate communicates effectively. Information is presented in the most appropriate form (which may include graphs, diagrams or charts where their use would enhance communication). The candidate spells, punctuates and uses the rules of grammar with almost faultless accuracy, deploying a wide range of grammatical constructions and specialist terms.

3 The candidate will express moderately complex ideas clearly and reasonably fluently. Answers are structured logically and concisely, so that the candidate generally communicates effectively. Information is not always presented in the most appropriate form. The candidate spells, punctuates and uses the rules of grammar with reasonable accuracy; a range of specialist terms are used appropriately.

2 The candidate will express moderately complex ideas fairly clearly but not always fluently. Answers may not be structured clearly. The candidate spells, punctuates and uses the rules of grammar with some errors; a limited range of specialist terms are used appropriately.

1 The candidate will express simple ideas clearly, but may be imprecise and awkward in dealing with complex or subtle concepts. Arguments may be of doubtful relevance or obscurely presented. Errors in grammar, punctuation and spelling may be noticeable and intrusive, suggesting weakness in these areas.

0 The candidate is unable to express simple ideas clearly; there are severe shortcomings in the organisation and presentation of the answer, leading to a failure to communicate knowledge and ideas. There are significant errors in the use of language which makes the candidate's meaning uncertain.

Qn	Expected Answers	Marks	Additional guidance
	Section A		
1 (a)	5×10^{-4} (m) ✓	1	
1 (b)	500 (nm) ✓	1	or 5×10^{2} (nm)
2	$(3.0)^2/(1.5)^2$ or 9/2.25 or 2^2 ✓ ratio = 4 ✓	2	for ratio = 4 ✓✓
3 (a)	$t = 2s/(u + v)$ ✓ $t = (v - u)/a$ ✓	2	
3(b)	$(2s/(u + v) = (v - u)/a)$ to $2as = (uv - u^2 + v^2 - uv)$ ✓ or $2as = v^2 - u^2$	1	not $2as = u^2 - v^2$
4	2 correct additional points (other than 0,0) ✓✓ appropriate line through the points plotted and (0,0)✓	3	error in point plotted –1 judge line through points plotted
5(a)	1.0×10^{15} (Hz) ✓ (1.0 Hz = zero)	1	
5(b)	below f_o no electrons (above f_o you get electrons)✓ min f corresponds to min photon energy = hf ✓	2	
5(c)	$(10 \times 10^{-19})/(1.5 \times 10^{15})$ = 6.7×10^{-34} ✓ (J s) penalise more than 3 sf	1	accept 1 s.f.
6	Line/curve up from (0,0) to t_1 ✓ plateau from t_1 to t_2 ✓ Line/curve down from plateau to $(t_3,0)$ ✓	3	
7(a)	90° or 270 ° or $\pi/2$ or $3\pi/2$ or ¼ of a cycle✓ (not $\lambda/4$)	1	
7(b)	A at 6 o'clock ✓ B at 9 o'clock ✓	2	
	Section A total	20	

Qn	Expected Answers	Marks	Additional guidance
	Section B		
8 (a)(i)	correct standing wave ✓ one A and one N labelled ✓	2	
(ii)	**clear** method ✓ showing $l_2 - l_1 = \lambda/2$	1	
(iii) 1	$0.506 - 0.170 = \lambda/2$ ✓ $\lambda = 0.672$ (m) ✓ (0.67)	2	not by $v = f\lambda$ here, must be using $l_2 - l_1 = \lambda/2$
(iii) 2	$v = 500 \times 0.672$ ✓ $= 336$ m s^{-1} ✓ (ecf from (a)(iii)) accept 340 m s^{-1}	2	0.67 gives 335
(b)	smaller wavelength ✓ smaller distances (to measure) ✓ less accuracy **in the measurements** ✓	3	
	total	10	
9 (a)(i)	orange; brighter; broader(wider) ✓ ✓	2	maximum 2 marks
(ii)	2 wavelengths (or frequencies) ✓	1	
(iii)	Shorter λ ✓ $\sin\theta = \lambda/d$ idea ✓	2	or rotating phasors argument
(iv)	both wavelengths contribute in phase (AW) ✓	1	or rotating phasors argument
(b) (i)	larger distance from orange ✓ approx double ✓	2	see acceptable limits
(ii)	'd' (slit separation) is halved (or less) ✓ $\sin\theta = \lambda/d$ idea ✓ (or bigger angle to give same path diff)	2	rotating phasors idea
	total	10	