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Jan 04

Oxford Cambridge and RSA Examinations

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RECOGNISING ACHIEVEMENT

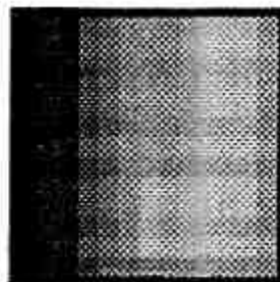
ADVANCED GCE
ADVANCED SUBSIDIARY GCE

A2 7888
AS 3888

PHYSICS B (ADVANCING PHYSICS)

**MARK SCHEME FOR THE
UNITS**
JANUARY 2004

AS/A2



3888/7888/MS/04J

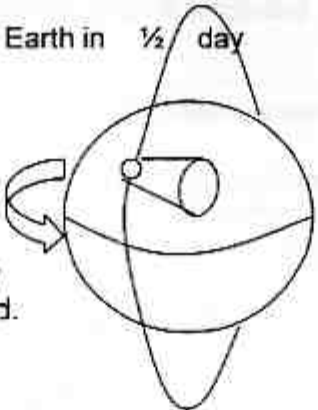


RECOGNISING ACHIEVEMENT

Mark Scheme 2860
January 2004

Abbreviations, annotations and conventions used in the Mark Scheme			
		/	= alternative and acceptable answers for the same marking point
		:	= separates marking points
		NOT	= answers which are not worthy of credit
		()	= words which are not essential to gain credit
		<u> </u>	= (underlining) key words which must be used to gain credit
		ecf	= error carried forward
		AW	= alternative wording
		ora	= or reverse argument
Qn	Expected Answers	Marks	Additional guidance
1a;b	Section A V ; C s ⁻¹	2	
2a;	32 ;	1	
bi;	(samples/sec x bytes/sample x time) / 44.1 x 10 ³ x 4 x 150 method ; = 26.4(6) Mbytes ; eval.	2	allow 25.2(3) Mbytes pc correct eval. scores 2
ii	(data) compression / fewer samples/sec / fewer bytes/sample / reduce quality / AW	1	other sensible comments NOT filtering
3 a;b;c	metal ; rubber ; glass	3	
4a;b c	0.13(0) m ; 8.33 / 8.3 ; ± 0.3 / 0.4 D ecf on (b)	2 1	accept 0.33 or 0.31 or 0.32 or 0.34
5ai;ii bi ; ii	3 ; 8 / 2 ³ 50 mV more (than 3) bits (per sample) / more levels / better voltage resolution AW	2 1 1	NOT 7 accept 100 mV NOT greater sampling rate
6ai;ii	x ¼ ; x 2	2	
7		1 1	zero marks for no attempt In col. 1 accept 2/3/4 bass bars In col.5 expect 0 treble bars / OR (accept 0/1 bars in col. 4)
Section A total		20	

Qn	Expected Answers	Marks	Additional guidance
8a	Section B decreases / falls / drops ; 100 (± 10) ; low(er) / 22 °C	3	"30 to 40°C" / (value in range) 20 - 30 °C
bi	connections in parallel with fixed resistor	1	
ii	$R_{\text{Thermistor}} = 100 \text{ to } 105 \text{ } (\Omega)$; $R_{\text{Total}} = 200 + R_{\text{Thermistor}} \text{ } (\Omega)$; $I = (V/R_{\text{Total}}) = 6 / R_{\text{Total}} \text{ } (= 0.02 \text{ A})$	1 1 1	evidence from graph total resistance substitution ora ecf R from b(ii)
iii	$(V = IR = 0.02 \times 200) = 4.0 \text{ V}$	1	accept 4 V
ci ; ii	X ; advantage (near) constant sensitivity / linear (output) disadvantage less sensitive (over most of range) / range of voltages is small / battery lasts for less time	1 1 1	NOT "just" straight line allow AW or other sensible quality physics
9a	$\lambda = v/f$; = 1500 / 8000 ; = 0.19 m ora $v = 1600 \text{ m s}^{-1}$ is about 1500 m s^{-1} full marks	3	allow $v = f\lambda$ recall 1 st mark
b	$t = s/v$ / = 5000 / 1500 ; = 3.3 s	2	2 marks correct answer
c	$t = \text{info} / \text{rate}$ / = (1500 x 8) / 2400 ; = 5.0 s	2	words / numbers ; allow 1 mark for 0.63s
d	1/2/3 style look for: time delay, live video needs larger info rate, large amount of information, still pictures can be slowly built up, stored at receiving computer	3	AW if good physics NOT "it" is too slow expect quality reasons for the 3 rd mark
10a	brittle: shatters (on impact) / cracks (propagate) / no plastic region ; hard: difficult to scratch / dent ; strong: large breaking stress ; tough: difficult to crack / large energy to break / create new surface	1 1 1 1	AW for all these or other correct physics NOT large yield stress accept not brittle IF brittle correct OR v.v. NOT just tougher
bi	x 4 / much tougher ;	1	
ii	(toughness is) energy ; per (new surface) area ;	2	
ci ; ii	B ; tougher than A / less tough than C / stronger than A / less strong than C / about $\frac{3}{4}$ of the strength of C	2	one correct reason or any combination / other correct physics
11a	to reflect light back / up ; to increase illumination	2	AW
b	$P = 1/f$ OR = $1/v - 1/u$; = $1/0.4 - 1/(-0.1)$; = 2.5 + 10 = 12.5 ; D	2 2	3 marks correct value 1 mark for unit D
c	transparency ; to allow light to transmit / high refractive index ; to allow thinner lens / high melting point ; to withstand temperature / low density ; to reduce weight of lens / strong / tough / hard / stiff etc ; correct reasoning	2 2	AW allow all sensible physics answers with correct explanation NOT economics
	Total B	40	

Qn	Expected Answers	Marks	Additional guidance
Section C			
12ai	student choice sets appropriate context – no marks	0	
ii	any shape of constant cross section ;	1	
iii	(good conductor) : long / thin for measurable $R / G /$ (low E) : short / "fat" for measurable extension / constant cross-sectional area	1	
iv	Two sensible lab estimates: length ; diameter / width / thickness / area	2	
v	Micrometer / Vernier caliper / (travelling) microscope ; justification - need greater precision (accept accuracy)	1 1	allow rulers down to 10mm
bi	A practical difficulty identified e.g. very small extension in stiff material / small resistance in a good conductor	1	accept other sensible suggestions and solutions
ii	solution to difficulty – long specimen ; more relevant detail – repeat readings / averaging	1 1	
ci	For Y expect force ; extension / for σ expect p.d. ; current / Resistance	2	accept standard symbols $R = V/I$
ii	Correct words / symbols ; combined correctly e.g. $Y = Fl / Ae / \sigma = Il / VA$	2	accept a complete set of equations
13a	imaging system example: e.g. satellite imaging system ; 3 obs: e.g. cloud cover ; sea temperature ; land use	1 3	expect descriptions
bi	waves / radiation : infra-red ;	1	
ii	how data obtained: e.g. low polar orbit covers whole Earth in $\frac{1}{2}$ day satellite scans Earth building up infra-red images infra-red energy detected by photodiode which gives a p.d. in proportion to pixel value on image	3	1/2/3 style full marks for well annotated diagram
			
ci	resolution is length represented on object / pixel ; NOT the number of pixels	1	AW e.g. smallest resolvable detail
ii	5 km on Earth / pixel ; UP	1	allow ± 1 order of mag.
d	false colour could be added to image, infra-red has no colour, but pixel value ranges can be given colour to represent intensity. This makes images easier to interpret.	3	1/2/3 style give credit for connecting physics
Q of WC	Total C	<u>4</u> 30	



RECOGNISING ACHIEVEMENT

**Mark Scheme 2861
January 2004**

Qn	Expected Answers	Marks	Additional guidance
1 (a)	600 ✓	1	
(b)	60 ✓	1	
(c)	0.6 ✓	1	
2(a)	g.p.e. to k.e. ✓	1	
(b)(i)	$v^2 = 2 \times 9.8 \times 2.8$ ✓ $v = 7.4 \text{ (m s}^{-1}\text{)}$ ✓ (g = 10 gives 7.48)	2	By energy change or by suvat
(ii)	neglecting/negligible/no air resistance ✓ (all gpe goes to ke) (constant 'a' if suvat approach)	1	not wind resistance
3(a)	representation of 3 fringes minimum ✓ equispaced peaks ✓ (4 needed)	2	intensity variation is fine
(b)	fringes further apart ✓	1	
4 (a)	$f = (3 \times 10^8) / 1500$ ✓ _m = $2.0 \times 10^5 \text{ (Hz)}$ ✓ _e	2	
(b)	method mark $(2.4 \times 10^{17}) / (2.0 \times 10^5)$ ✓ _m = 1.2×10^{12} ✓ _e ecf from (a)	2	not 1.2E12 / 1.2 ¹²
5(a)	horizontal = $300 \cos 50^\circ = 192.8$ ✓ _m	1	
(b)	P = (horizontal component from (a)) × 0.6 ✓ _m So P = 116 (120) (W) ✓ _e (120 W from F = 200 N)	2	penalise using wrong F
6(a)	phasor arrow pointing to S.E. ✓	1	
(b)	same amplitude and wavelength ✓ 180° phase diff ✓	2	minimum of 1 cycle
	total	20	

7(a)	destructively interfering ✓	1	phasors antiphase / waves out of phase
(i)			
(ii)	mention path difference ✓ $\lambda/2$ idea ✓	2	phasors cancel resultant phasor = 0 so probability=0 or AW
(iii)	* (LOOK AT (a)(i) and (ii) together) idea that 2 amplitudes different ✓ cause (absorption) or effect ... not complete cancelling ✓ (others possible)	2	not quite out of phase = 0
(b)	white = many colours ✓ green not reflected ✓ other wavelengths give the purple colour ✓	3	not purple light reflected
(c)	brighter/ greater contrast/ more focused /greener ✓ explained ✓	2	
	total	10	
8	One loop ✓ nodes and antinodes labelled ✓	2	
(a)(i)			
(ii)	0.8 (m) ✓ ecf from (a)(i)	1	
(iii)	= 440×0.8 ✓ = $352 \text{ (m s}^{-1}\text{)}$ ✓ ecf from (a)(ii)	2	
(b)	$N = \text{kg m s}^{-2}$ ✓ for coherent development ✓	2	
(c)(i)	different mass per unit length (thickness/density) ✓ thicker string lowest note ✓	2	
(ii)	equal force on neck/ won't distort instrument/ easier to bow ✓ or other mechanical reason	1	
	total	10	
9	constant speed ✓ equal distance in equal times ✓	2	or no forces acting horizontally
(a)(i)			
(ii)	accelerating ✓ increasing distances in equal times ✓	2	or gravity is acting vertically
(b)(i)	$t = x/v$ ✓ so $t^2 = x^2/v^2$ ✓	2	$t^2 = x^2/v^2$ 2 marks
(ii)	$y = \frac{1}{2}gt^2$ rearranged ✓ to give $t^2 = 2y/g$	1	
(iii)	$x^2/v^2 = 2y/g$ rearranged ✓ to give $v^2 = x^2g/2y$	1	
(c)	$v^2 = ((4.0)^2 \times 9.8)/(2 \times 1.5)$ ✓ = 52 (52.27) $v = 7.2$ ✓ (m s ⁻¹) 3 s.f. max	2	
	total	10	

10	arrow backwards ✓ labelled 'drag' / air or wind resistance (not just 'friction') ✓	2	through common point, drawn <u>on</u> the aircraft
(a)(i)			
(ii)	thrust = drag ✓ lift = weight ✓ forces must be 'balanced' idea/ no acceleration ✓	3	
(b)(i)	appropriate velocity vector arrows to scale ✓ to match Fig. 10.1	1	must have arrows
(ii) 1	method mark ✓ 11 m s ⁻¹ (10.8) ✓ (10.5 to 11.5 by diag)	2	by Pythagoras or measurement
(ii) 2	method mark ✓ 21.8° ✓ (20° to 25° by diag)	2	by trig or measurement
	total	10	
11	clear statement of measurement ✓	1	
(a)(i)			
(ii)	sensible estimate with unit ✓ (check for appropriateness)	1	UP
(b)(i)	diagram labelled - could be set up ✓✓✓ some errors or omissions ✓✓ some plausible attempt made ✓	3/2/1	
(ii)	radiation sent out ✓ pulse ✓ reflected and received ✓ time delay measured/recorded ✓	4	what would need to be done in this case.. addressed (prose)
(c)(i)	s = vt ✓ stating specifically what v represents here ✓ time delay halved ✓	3	depends on example selected (analysis)
(ii)	for 2 relevant sources of error ✓✓	2	or 1 factor and the consequence
	total	14	
12	For a situation where a quantum phenomenon is observed ✓	1	if not a quantum phenomenon ... zero marks total
(a)			
(b)	clear labelled diagram ✓✓✓ ...with some minor omissions or errors ✓✓ for some attempt made ✓	3/2/1	
(c)	for four separate relevant and correct items of description ✓✓✓✓	4	
(d)	read as a whole ... upto 4 marks for relevant quantum ideas ✓✓✓✓	4	
	total	12	
Qo	✓✓✓✓	4	Judged solely on written communication in questions 11 and 12
WC			

