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Jan 04

Oxford Cambridge and RSA Examinations

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RECOGNISING ACHIEVEMENT

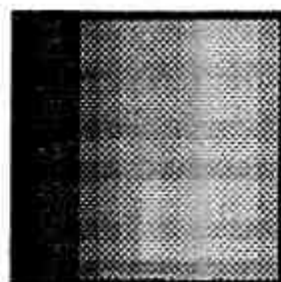
ADVANCED GCE
ADVANCED SUBSIDIARY GCE

A2 7888
AS 3888

PHYSICS B (ADVANCING PHYSICS)

**MARK SCHEME FOR THE
UNITS**
JANUARY 2004

AS/A2

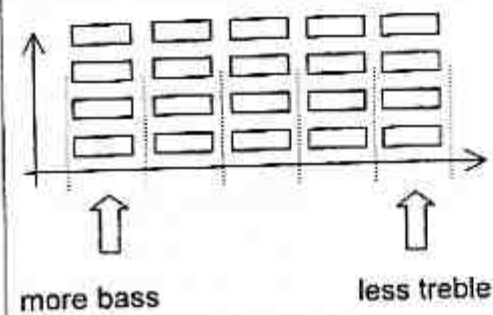


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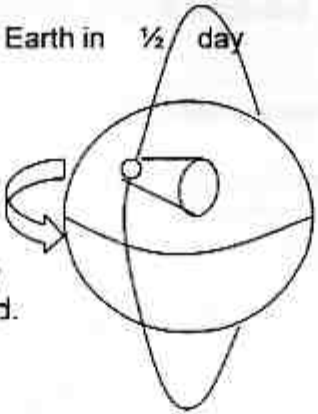


RECOGNISING ACHIEVEMENT

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			



RECOGNISING ACHIEVEMENT

Mark Scheme 2863/1
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 _____ = (underlining) key words which must be used to gain credit ecf = error carried forward AW = alternative wording ora = or reverse argument	
Question	Expected Answers	Marks	
1 (a)	J ✓	1	
(b)	N ✓	1	
2	$\Delta\theta = Q/mc = 3.5 \times 10^4 / 0.21 \times 4200 \checkmark = 40^\circ \text{C} (39.7^\circ \text{C}) \checkmark$ Final temperature = $40 + 20 = 60^\circ \text{C} \checkmark (59.7^\circ \text{C})$ marking points 'stand alone'	3	
3 (a)	$Q = CV \checkmark \rightarrow E = \frac{1}{2} CV^2 \checkmark = \frac{1}{2} CV^2$	2	
(b)	Graph starting at 0,0 ✓ and curving upwards ✓	2	
4 (a)	e.g. galaxies <i>receding</i> / (cosmological) redshift, Hubble's Law ✓	1	
(b)	Link to early Universe, e.g.: microwave radiation remnant of era of recombination (accept remnant of 'big bang') ✓ present distribution reflects earlier distribution ✓ (therefore, any large scale anisotropy in early universe would be reflected in variation in background AW)	2	
5 (a)	$pV = nRT \checkmark \rightarrow V = nRT/p = 1 \times 8.31 \times 300 / 1.0 \times 10^5 \checkmark = 0.0249 \text{ m}^3$ (can work backwards or use $pV = NkT$)	2	
(b)	$1.0 \times 10^5 \times 0.025 = p_2 \times 0.020 \checkmark p_2 = 1.3 \times 10^5 \text{ Pa} \checkmark$ (accept 1.25×10^5) candidates can use their answer to 5 (a) (ecf) (e.g. 1.2×10^5 if 0.0249 used).	2	
6 (a)	$I = V/R = 6 / 5.6 \times 10^3 \checkmark = 1.1 \times 10^{-3} \text{ A} =$ (about) 1 mA ✓	2	
(b)	$I = 1.1 \times 10^{-3} \times e^{-1} = 1.1 \times 10^{-3} \times 0.37 \checkmark = 0.4 \text{ mA} \checkmark$ (accept rule of thumb third, answers using 1 mA & answers using decay equation)	2	
Section A total		20	

7	(a) (i)	Max depth = 15m ✓	1
	(a) (ii)	Amplitude = 5 m ✓	1
	(a) (iii)	Gradient at t = 6 hours ✓ correct reading from graph ✓ answer worked to 3.0 m hr ⁻¹ ✓ (answers in range 2.5 m hr ⁻¹ to 3.5 m hr ⁻¹)	3
	(b)	time period from graph = 12.5 hrs ✓ $f = 1/T = 1/12.5$ ✓ = 0.080 hr ⁻¹ ✓	3
	(c)	shading or lines drawn on graph ✓ answer in range of 15.5 hrs to 16.5 hrs ✓	2
	(d)	$d = 10 + 5 \sin(2\pi \sin 0.080 * 9.5)$ ✓ = 5.0 m ✓ (allow ecf from a(ii) and b) or sin varies between +1 and -1 ✓ so lowest value is 10 - A (this allows incorrect value for A to ecf) ✓	2
8	(a)(i)	$\Delta p = 280 \times 55 - 280 \times 0$ ✓ = 15 400 ✓ kg ms ⁻¹ ✓	3
	(a) (ii)	$f = ma = 280 \times (55/0.25)$ ✓ = 61600 N ✓ (or use $F = \frac{mv - mu}{t}$)	2
	a(iii)	argue from Newton 3 or conservation of momentum leading to a force on the plane ✓ this makes the plane move down ✓ (as plane is much more massive so acceleration/movement much less than that of the pilot) . (Accept plane won't move because its on the ground for second mark)	2
	(b)	$\frac{1}{2} mv^2 = mg\Delta h$ ✓ $\Delta h = v^2 / 2g = 55^2 / 19.6$ ✓ = 154 m ✓ S.F. penalty. Or suitable equation of motion chosen ✓ values substituted ✓ evaluation ✓	3
	(c)	Collisions between pilot and particles ✓ momentum/ direction/ velocity change of particles during collision ✓ change of momentum of particles exerts force on pilot. ✓	3
9	(a)	$250 \times 50 = 12500$ J ✓	1
	(b)	number of molecules = $5 \times 6.02 \times 10^{23} / 18$ ✓ = 1.67×10^{23} ✓	2
	(c)	$E = 12500 / 1.7 \times 10^{23}$ ✓ = 7.35×10^{-20} ✓ J (or 7.48×10^{-20} if 1.67×10^{23} used)	2
	(d)	$kT = 1.4 \times 10^{-23} \times 373 = 5.2 \times 10^{-21}$ J ✓	1
	(e) (i)	$5.2 \times 10^{-21} / 7.5 \times 10^{-20} = 0.07$ ✓. (ecf)	1
	(ii)	Argument from average energy ✓ explanation of why there is a range of energies e.g. molecular collisions or 'getting lucky' ✓ (or Boltzmann arguments)	2

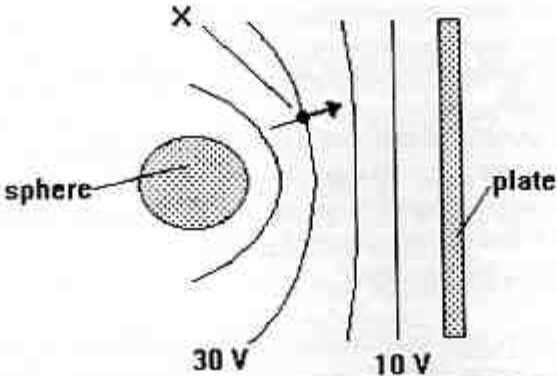
- 10 (a) (i) $V_{\text{grav}} = -6.67 \times 10^{-11} \times 5.98 \times 10^{24} / 6.38 \times 10^5 \checkmark = -6.252 \times 10^7 \checkmark \text{ J kg}^{-1}$ 2
Own value needed.
- (a) (ii) Calculating $V_{\text{grav}} = -6.27 \times 10^7 \checkmark \text{ J kg}^{-1}$ using this to give ratio $6.27/6.25 = 1.003(2) \checkmark$ 2
Own value needed.
OR: explanation leading to $6.38/6.36 \checkmark = 1.0031 \checkmark$
- a(iii) Gravity is always attractive (AW) \checkmark hence it always takes energy/work to separate 2
gravitationally bound masses. At infinity the energy 'stored' is zero therefore an object
in a field will be in a potential well. \checkmark (AW)
- (b) $g = (-)GM/r^2 \checkmark$ 1
- (c) (i) $g = -6.67 \times 10^{-11} \times 5.98 \times 10^{24} / (6.36 \times 10^6)^2 \checkmark = 9.86 \checkmark \text{ N kg}^{-1} \checkmark$ 3
(ii) Value for potential depends on r whereas field strength depends on r^2 . \checkmark Hence field 2
strength more sensitive to changes in $r \checkmark$ or evaluate ratio \checkmark (OWTTE)
- QWC marks on questions 8 a(iii), 8 (c) , 9 e (ii) $\checkmark \checkmark \checkmark \checkmark$ 4

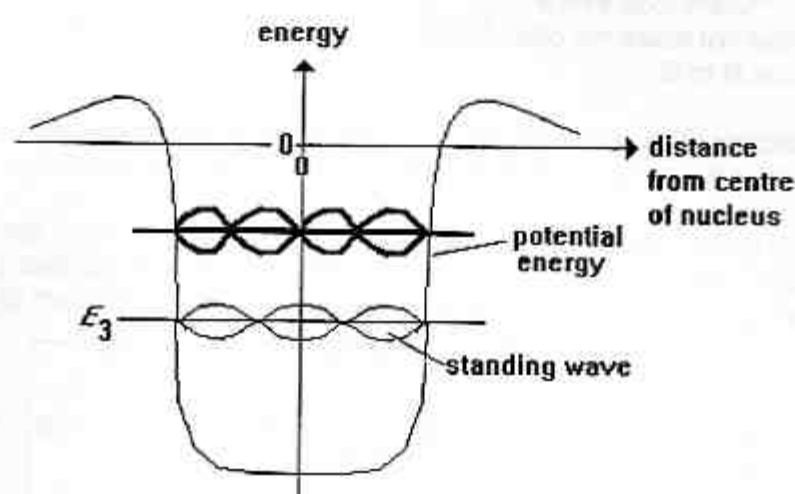
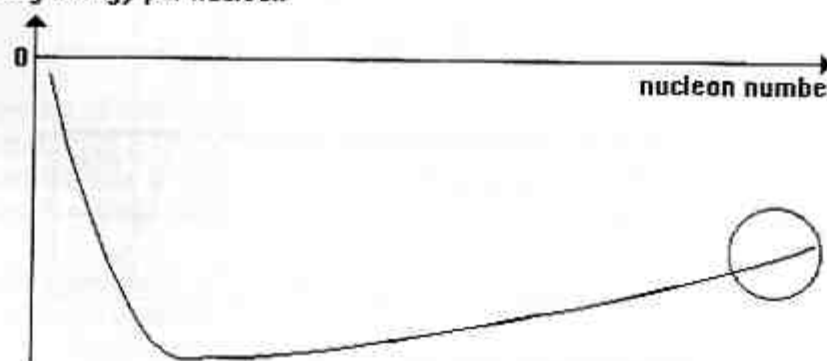
Section B total: 50 marks

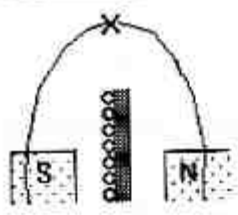
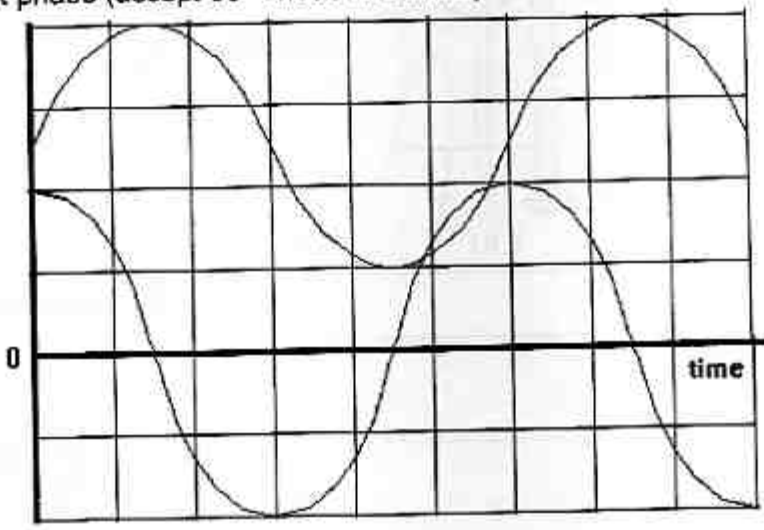


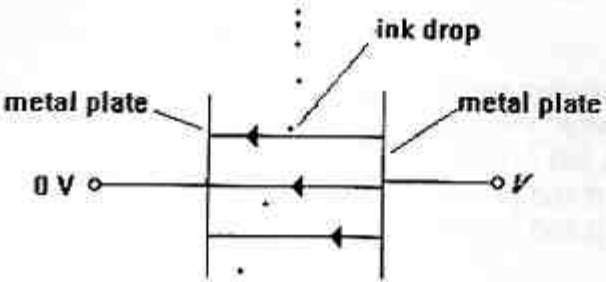
RECOGNISING ACHIEVEMENT

Mark Scheme 2864/1
January 2004

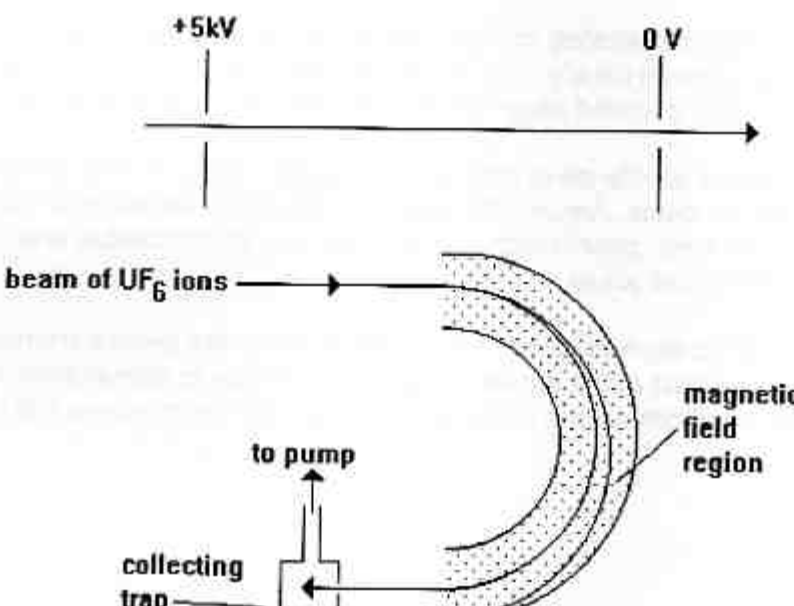
1	s^{-1}	1
2	A	1
3	10^3	1
4 (a)	A	1
4 (b)	E is electric field (strength) / force on unit charge	1
5 (a)	<p>at right angles to equipotential through the point (by eye) pointing away from sphere ACCEPT curved field lines which have the correct direction at X</p> 	<p>1 1</p>
5 (b)	0 V	1
6	A C	1 1

7(a)	B	1
7(b)	C	1
8	<p>higher energy level standing wave to fit potential well more than two antinodes</p> 	<p>1 1 1</p>
9 (a)	<p>binding energy per nucleon</p>  <p>as shown, by eye</p>	1
9 (b)	<p>total binding energy = $56 \times 8.8 \times 10^6 = 4.93 \times 10^8$ eV ecf incorrect eV: energy = $4.93 \times 10^8 \times 1.6 \times 10^{-19} = 7.9 \times 10^{-11}$ J (steps clearly shown to earn marks)</p>	<p>1 1</p>
9 (c)	<p>$E = mc^2$ ecf incorrect E: $m = E/c^2 = 7.9 \times 10^{-11} / 9 \times 10^{16}$ $m = 8.8 \times 10^{-28}$ kg (1×10^{-10} J gives 1×10^{-27} kg)</p>	<p>1 1</p>

<p>10 (a) (i)</p>		<p>1</p>
<p>10 (a)(ii)</p>	<p>Any complete loop which</p> <ul style="list-style-type: none"> • does not cross the other loops • joins N to S 	<p>1</p>
<p>10 (b)</p>	<p>substitution: $1.2 \times 10^{-3} / 0.25$ answer: $4.8 \times 10^{-3} \text{ V}$</p>	<p>1 1</p>
<p>10 (c)(i)</p>	<p>correct period and sinusoidal shape, any amplitude average value of zero correct phase (accept 90° ahead or behind)</p>	<p>1 1 1</p>
<p>10 (c)(ii)</p>		<p>2</p>
<p>10 (c)(ii)</p>	<p>Description: any two of the following, 1 mark each</p> <ul style="list-style-type: none"> • wind more turns on the coil • use a stronger magnet • increase the area of the turns • decrease the air gap between the poles • wind coil on an iron former • mechanical arrangement (e.g. lever) to increase displacement <p>Explanation: each modification increases flux linkage (change) of the coil</p>	<p>1</p>

11 (a)	$Q = ne$ (eor) $n = 8 \times 10^{-10} / 1.6 \times 10^{-19} = 5.0 \times 10^9$	1 1
11 (b)(i)	positive EITHER so that right-hand plate becomes positively charged repelling positive charge on drop OR left-hand plate becomes negatively charged to attract positive charge on the drop OR potential decreases as drop moves to the left resulting in drop gaining KE as it moves that way	0 1
11 (b)(ii)	horizontal lines equally spaced (accept correct edge-effects) arrow to the left 	1 1 1
11 (c)(i)	statement of formula: $E = V/d$ elimination of E to obtain required expression accept formula $E = V/d$ derived from expression for [2] accept $F = QV/d$ for [1]	1 1
11 (c)(ii)	correct substitution of powers of 10 ecf incorrect powers of ten: $V = \frac{Fd}{Q} = \frac{3.6 \times 10^{-6} \times 15 \times 10^{-2}}{0.8 \times 10^{-9}} = 675 \text{ V (accept 680 V)}$	1 1

12 (a)(i)	number of X-rays = 120 ecf: total dose equivalent = $120 \times 16 \times 10^{-6} = 1.9 \times 10^{-3}$ Sv ecf: risk = $1.9 \times 10^{-3} \times 3 = 0.0058$ %	1 1 1
12 (a)(ii)	cancers = $0.0058 \times 55 \times 10^6 / 100 = 3200$ (0.006% gives 3300)	1
12 (a)(iii)	[1] + [1] per valid statement backed by correct calculation, up to [4] No ecf: e.g. <ul style="list-style-type: none"> • annual dose equivalent from X-rays is 32 μSv • $32/2000 = 0.016$ of dose equivalent from background (ora) • risk of background is unavoidable (owtte) • and will lead to $2 \times 10^{-3} \times 60 \times 0.03 \times 55 \times 10^6 = 200\ 000$ cancers • lifetime X-ray dose similar to annual background dose • so any cancer is much less likely to come from X-ray (ora) 	4
12 (b)(i)	proposal: d.e. \times distance ² = constant shown clearly calculations: -1 per error, maximum -2 $2.6 \times 10^{-6} \times 0.25^2 = 0.163$ ($\times 10^{-6}$) $0.95 \times 10^{-6} \times 0.41^2 = 0.160$ ($\times 10^{-6}$) $0.27 \times 10^{-6} \times 0.77^2 = 0.160$ ($\times 10^{-6}$)	1 2
12 (b)(ii)	any of the following, maximum [2] <ul style="list-style-type: none"> • X-ray emitter acts as a point source (owtte) • photons spread out evenly in all directions/in a cone • X-ray photons not absorbed by air • dose equivalent depends on photons per square metre (owtte) • doubling distance quadruples area for photons to pass through (owtte) 	2
12 (b)(iii)	dose equivalent per X-ray = $0.2 \times 10^{-3} / 4000 = 5 \times 10^{-8}$ Sv X-ray dose equivalent = $0.16 \times 10^{-6} / x^2$ $x = (0.16 \times 10^{-6} / 5 \times 10^{-8})^{0.5} = 1.8$ m	1 1

13 (a)(i)	$+4.8 \times 10^{-19} \text{ C}$	1
13 (a)(ii)	$m = (235 + 6 \times 19) = 349u$ ecf incorrect m : mass = $349 \times 1.7 \times 10^{-27} = 5.9 \times 10^{-25} \text{ kg}$ (NOT 6×10^{-25}) ($235u$ gives $4.0 \times 10^{-25} \text{ kg}$)	1 1
13 (b)(i)	EITHER (accelerating) force = charge \times electric field (owtte) OR (potential) energy = charge \times potential (owtte) OR charged particles repelled / attracted by charges on electrodes	1
13 (b)(ii)	pair of electrodes / colinear tubes 5 kV apart ions move from high potential to low potential	1 1 1
13 (c)(i)	 <p>The diagram illustrates the final stage of a mass spectrometer. At the top, a horizontal line with an arrow pointing to the right represents the ion beam path. The left end of this line is labeled '+5kV' and the right end is labeled '0V'. Below this, a 'beam of UF₆ ions' is shown as a horizontal arrow pointing right. This beam enters a semi-circular 'magnetic field region' from the left. The magnetic field region is depicted as a shaded area with a dotted pattern. The beam is deflected downwards and then back to the left, following the curve of the magnetic field. At the end of this path, the ions enter a 'collecting trap', which is a rectangular box. An arrow points from the trap upwards to a 'to pump' label, indicating the removal of ions from the system.</p>	1
13 (c)(ii)	vacuum means no collisions with air molecules (owtte) to alter velocity / charge of ions which would result in a different path in magnetic field	1 1 1
Quality of Written Communication		4

