GCE

Physics B (Advancing Physics)

Advanced GCE **A2 7888**

Advanced Subsidiary GCE **AS 3888**

Mark Scheme for the Units

January 2008

3888/7888/MS/R/08J

Oxford Cambridge and RSA Examinations

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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MARK SCHEMES FOR THE UNITS

Mark Scheme 2860 Physics in Action

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 forwar*d: 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

ADVICE TO EXAMINERS ON THE ANNOTATION OF SCRIPTS

1. Please ensure that you use the **final** version of the Mark Scheme.
   You are advised to destroy all draft versions.

2. Please mark all post-standardisation scripts in red ink. A tick (✓) should be used for each answer judged worthy of a mark. Ticks should be placed as close as possible to the point in the answer where the mark has been awarded. The number of ticks should be the same as the number of marks awarded. If two (or more) responses are required for one mark, use only one tick. Half marks (½) should never be used.

3. The following annotations may be used when marking. No comments should be written on scripts unless they relate directly to the mark scheme. Remember that scripts may be returned to Centres.

   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

4. The marks awarded for each part question should be indicated in the margin provided on the right hand side of the page. The mark total for each double page should be ringed at the end of the question, on the bottom right hand side. These totals should be added up to give the final total on the front of the paper.

5. In cases where candidates are required to give a specific number of answers, (e.g. 'give three reasons'), mark the first answer(s) given up to the total number required. Strike through the remainder. In specific cases where this rule cannot be applied, the exact procedure to be used is given in the mark scheme.

6. Correct answers to calculations should gain full credit even if no working is shown, unless otherwise indicated in the mark scheme. (An instruction on the paper to 'Show your working' is to help candidates, who may then gain partial credit even if their final answer is not correct.)

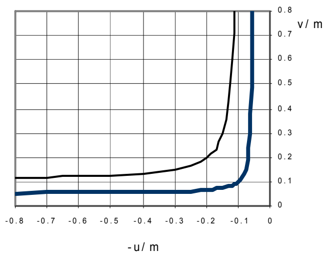
7. Strike through all blank spaces and/or pages in order to give a clear indication that the whole of the script has been considered.

8. An element of professional judgement is required in the marking of any written paper, and candidates may not use the exact words that appear in the mark scheme. If the science is correct and answers the question, then the mark(s) should normally be credited. If you are in doubt about the validity of any answer, contact your Team Leader/Principal Examiner for guidance.

Unit Code	Session	Year	Version
2860	January	2008	Final

m = method mark
s = substitution mark
e = evaluation mark
/ = 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 **<u>must</u>** be used to gain credit
ecf = error carried forward
AW = alternative wording
ora = or reverse argument

Qn	Expected Answers	Marks	Additional guidance
1	**Section A** kg m^{-3} ; J m^{-2} ; N m^{-2}	3	
2(a) (b)	n = sin 60° / sin 36° = 1.47 / = 1.5 $v = c / n$ / = 3.0×10^8 / 1.47 ; = $2.0(4) \times 10^8$	1 2	evaluation method ; evaluation ecf (a) condone $v > c$
3(a) (b)	**A** ; **D** ; **C** 1.25 / 100 ; = 0.0125 (V kPa^{-1}) / 13 m(V kPa^{-1})	3 2	 method Δout / Δin evidence ; evaluation
4	Transverse waves ; knowledge or evidence that vibration has a fixed direction / plane	2	gain full credit for clearly annotated diagram of any polarised waves
5	**A** ; **D** ; **C**	3	
6	similarity e.g. : both have frequency components near 20 Hz / just under 300 Hz / same bandwidth difference e.g. : "oh" has / "mm" does not have some frequency components in the range 50 to 100 Hz / "mm" has fewer/ about 2 main frequency components / "oh" has more / about 6 main frequency components "mm" has highest amplitude component at about 20 Hz / "oh" has highest amplitude component at about 10 Hz Total Section A:	1 <u>1</u> 18	Accept any two valid significant comparisons for a similarity and a difference avoid giving same point twice



for 7. (c) on following page

Qn	Expected Answers	Marks	Additional guidance
	Section B		
7(a)	further / away (from the lens) ; …moves to ∞ / far away / larger / magnified	2	AW
(b)	when $\lvert u \rvert = v = 2f$; $f = 0.2/2 = 0.10$ (m) OR by lens equation sub'd correctly allow 0.09 to 0.11 m	2	method ; evaluation other valid methods
(c)	lower curve by eye ; passing through (-0.1, 0.1)	2	see graph previous page
(d)	(i) 1/*u* and/or 1/*v* are curvatures of wavefronts / curvature out of lens = curvature into lens + lens power / graph of form y = (m) x + c / c is constant / power of lens is constant (ii) evidence of finding intercept ; c = 1/f = 10 $\therefore$ f =0.1m OR lens equation for point on line	2 2 10	Any two points or curvature added by lens refer to (b) if 1/f $\approx$ 10 both times 2 marks
8(a)	(i) 40 M(W) ; (ii) (dissipated) into atmosphere (as thermal / ionisation / em radiation energy) (iii) $G = I^2/P$ / $= 100^2 / 1400$; $= 7.1(4)$ (S km^{-1}) one mark for $R = 0.14\Omega$ OR $V = 14$ V	2 2	AW accept lost as heat method ; evaluation part marks
(b)	(i) $m = GLL\ \rho / \sigma$ OR $A = GL / \sigma$ (ii) (ratio) = $\rho_{ratio} / \sigma_{ratio}$ / *G*, *L* constant = (2.9 / 0.18) = 16.(1)	1 1 1	clear algebra any correct method evaluation
(c)	(i) $G \propto A$ so x 30/ 7 = 4.3 ; $G \propto \sigma$ so $\div$ 0.18 (x 5.6) G_{Al} = 0.29 x 4.3 / 0.18 = 6.9 S (ii) G_{Total} = 0.29 + 6.9 = 7.2 (S) / (7.0 + 0.29) = 7.29 (S) (iii) aluminium provides good conductivity / conductance / low density / mass / weight Steel provides good strength / stiffness / (composite material) benefits of two named properties stranded cables for more flexibility	2 1 1 1 12	give credit for correct part calculations and allow ecf on sum Any sensible statement
9a)	cell / +- rails ; resistors in series ; Vmeter across fixed R	3	correct symbols
(b)	(i) $f = 1 / T$ / $= 1 / 0.02$; $= 50$ Hz (ii) sensor p.d. does not settle instantly / output p.d. rises and levels ; when LED graph rises vertically / const (iii) 10 $\pm$ 5 ms (iv) persistence of vision / reference to response time of eye-brain / eye like LDR	2 1 1 1 1	method ; evaluation any 2 points AW AW any reasonable suggestion about rods / cones
(c)	sawtooth waveform ; since less / 1/10 time to respond smaller amplitude ; ditto min higher / max lower ; ditto	2 11	accept less time to respond
10a)	method (e.g. 480 $\pm$ 20 pixels x 2.1×10^{-4} m) ; = 0.10 m	2	accept 9.7 to 10.5 cm
(b)	(i) 2^6 / 64 (ii) 500 x 500 pixels image^{-1} ; 250000 x 6 bits image^{-1} ; $1.5 \times 10^6 \times 4 = 6.0 \times 10^6$ (bits s^{-1})	1 2 1	250 000 ; 1.5×10^6
(c)	each column of figures consistent ; values 0 , 40 , 0	2	any values ; correct values
(d)	$0.08 / 2.1 \times 10^{-4} = 380$ / allow 400	1 9	
	Total Section B :	42	

Qn	*Expected Answers*	Marks	**Additional guidance**
	Section C		
11a) & (b) (c)	evidence of: adding force to a specimen ; to long thin specimen ; quality mark for diagram given for a feasible method measuring diameter NOT area measuring the original length of specimen measuring the extension $\sigma = F / (\pi D^2 / 4)$ ecf on F / A in (b) ; $\varepsilon = x / L$ $E = \sigma/\varepsilon$ (one value) ; average multiple values OR plot graph of σ against ε ; (initial) gradient graph	1 1 1 1 1 1 2 2	mark (a) & (b) & (c) together look for evidence in diagram / description for the six points OR F vs x graph and times by (L / A)
(d)	1/2/3 style e.g. use of uniform / long / thin wire initially use standard steel metre rule / tape to measure length use micrometer ; measure diameter $\pm$ 0.01 mm Vernier ; to measure small extension $\pm$ 0.1 mm repeat readings and average to find mean and spread plot line of best fit	<u>3</u> 13	one procedure well described max 2 Look back to (a) and (b) also
12a)	(i) e.g. computer disk drive through databus to processor (ii) (speed) at which the signal / wave travels NOT info (iii) the amount of information sent / received per second e.g. 80 M ; bits s^{-1} (iv) 1/2/3 style expect continuous signal waveform for analogue and binary 0/1 signal for digital	1 1 1 2 3	accept near light speed no unit no value mark 3rd mark for quality
(b)	(i) relevant diagram ; **noise** is random / unwanted interference on a signal / contains no useful information content / from outside the system ; **signal** is the variation carrying the useful / wanted information being transmitted	2	AW accept any 2 parts
	(ii) 1/2/3 style: in analogue signals noise cannot be distinguished from the signal, amplification increases both ; digital signals can be amplified / filtered / cleaned up to eliminate noise they have gained ; easy to decide if a digital signal is 0/1 provided S/N ratio is large enough	<u>3</u> 13	credit fully well annotated diagrams illustrating the ideas accept error correction techniques AW throughout
	Quality of Written Communication	<u>4</u>	
	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.

Mark Scheme 2861 Understanding Processes

Unit Code 2861	Session January	Year 2008	Version *final*

m = method mark
s = substitution mark
e = evaluation mark
/ = 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
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Qn	*Expected Answers*	Marks	**Additional guidance**
1 (a)	114 x 10^3 / (60 x 60) = **31.7** ✓ $_e$ (**calculator** value)	1	
(b)	a = 31.7 /8.4 ✓$_m$ = **3.8** (m s^{-2}) ✓$_e$	2	
2	*(e.g.* ***double distance because*** *..)* twice the energy ✓ so Fs (or work done) doubled ✓ **assumes** F constant ✓	3	the marks are **for** the elements of physical **justification** of the distance stated
3(a)	s = 30 x 0.6 = **18** ✓e (m)	1	
(b)	s = 30 x 0.27 = 8.1 (m) ✓ (in response time of filament) min distance =(18 + .8.1) = **26.1** (m)✓ (or 26.2)	2	or total reaction time = 0.87s so dist = 30 x .87 …
4(a)	must be **a = F/m** ✓	1	
b)	**using** v^2 = 2as (or Fs = $^1/_2mv^2$) ✓$_m$ (v^2 = 2Fs/m) gives constant = √(2Fs) ✓	2	
5	for evidence of working with 4^{10}✓$_m$ = 1,048,576 ✓$_e$ (accept 1000 000)	2	✓$_m$ for repeatedly multiplying by 4
6	... energy in lumps / packets / discretely / randomly ✓ … energy = hf / proportional to frequency / or α RPA^2 / or α probability of arrival of photons ✓ …. where constructive interference occurs / or where waves in phase ✓	3	**not** simply ,,, where photons arrive here getting at <u>why</u> it's bright
7	λ is doubled ✓ v same ***<u>or</u>*** f = v/λ ✓ 128 (Hz) ✓	3	
	Section A total	**20**	

Qn	Expected Answers	Marks	Additional guidance
8(a)	use d = 1/(no. lines mm^{-1})✓ for calculator value **2.94** x 10^{-6} (m) ✓	2	may find *d* in mm then convert to m, or work in lines per m 340 000 lines m^{-1} d = 1/340 000
(b)	consists of 2 wavelengths ✓	1	
(c)(i)	(tan θ = 0.46 / 3.0) θ = **8.7°** ✓ $_e$	1	
(ii)	λ = 3.0x10^{-6} x sin **8.7**✓ $_m$ = 4.5x 10^{-7} (m) ✓ $_e$ ***(ecf from (c)(i) gets method** mark in this 'show that …)*	2	accept λx / L approach
(d)(i)	$\lambda_{red} > \lambda_{blue}$ ✓ sinθ = λ/d idea ✓	2	1λ is path diff at θ, red line occurs at larger θ since $\lambda_{red} > \lambda_{blue}$
(ii)	$\theta = \sin^{-1}$[(620 x 10^{-9}) / (2.9 x 10^{-6})] = **12.3°**✓ (or **11.9**° from 3.0x10^{-6} (m) (tanθ = **x** / 3.0 gives ..) x = **0.65** (m) ✓ (or **0.63** (m)**)** fringe sepn = 0.65 – 0.46 = **0.19** (m) ✓ (or **0.17** (m))	3	**x** is the distance from central maximum to red in 1st order spectrum
	total	11	
9(a)(i)	accurate plot of points ✓ appropriate line ✓	2	
(ii)	gradient increasing ✓ gradient is velocity ✓ (or dist. increases in equal intervals of t ✓ this is speed ✓)	2	
(iii)	t =√ (2x3.0/9.8) ✓$_m$ = **0.<u>783</u>** (s) ✓$_e$ (0.78 or 0.8) **(3 sf max)**	2	poss sig fig penalty
(iv)	line of fit intercepts t axis at t = 0.8s which fits ✓	1	
(v)	horizontal displacements decreasing in equal intervals of time ✓ so horizontal speed decreasing ✓ OAW	2	or may calc 2 speeds and show decrease
(b)	θ = $\tan^{-1}$(7.6/14) ✓$_m$ = **28.5** ° ✓$_e$ (or by careful scale drawing ✓ to give 27° – 30° ✓)	2	must be the correct angle required
		11	

Qn	Expected Answers	Marks	Additional guidance
10 (a)	$\lambda = (3.0 \times 10^8) / (5 \times 10^5)$ ✓$_m$ = 600 (m) ✓$_e$	2	1 mark for **<u>using</u>** $\lambda = v/f$
(b)(i)	waves superimpose in antiphase (out of phase) /<u>or</u> path diff odd no.of half wavelengths (accept $\lambda/2$) ✓ so destructive interference ✓	2	<u>precise</u> language (**<u>not</u>** phase diff is half a wavelenghth etc)
(ii)	amplitude different ✓ (owing to …..)	1	
(iii)	waves superimpose IN phase /or path diff. = whole no. wavelengths ✓ so constructive interference ✓	2	<u>precise</u> language
(c)	**using** v = s/t ✓ 300 ✓/ 900 ✓ (= 0.33 m s^{-1})	3	**using** s/t ✓ **correct** distance ✓ time in **s** ✓ (**<u>zero</u>** <u>for v = fλ</u>)
	Total	10	
11 (a) i	70% of the input power (or energy) is converted into visible light (or **useful** power/energy) ✓ (or 30% not converted to light)	1	must refer to 'light' or 'useful' energy
(ii)	power output = 4.5 + 2.5 = 7 W ✓ which is 70% of 10 W ✓	2	
(b)(i)	$E_{red} = 6.6 \times 10^{-34} \times 4.8 \times 10^{14}$ ✓$_m$ = **3.2** $\times 10^{-19}$ (J) ✓$_e$	2	
(ii)	= **3.6** $\times 10^{-19}$ (J) ✓$_e$	1	for red and green confused 2 marks max.
(c)	(no. of **red** photons) = 4.5 / (**3.2** $\times 10^{-19}$) = **1.4 x 10 ^{19}** ✓ (no. of **green** photons) = 2.5 / (**3.6** $\times 10^{-19}$) = **6.9 x 10 ^{18}** ✓ no. red photons / no. green photons = **2** ✓	3	If red and green confused in (b) internal consistency here means these two calcs reversed ✓ecf ✓ecf but wil not get 3rd mark (0.5 x)
	Total	9	
	Section B total	**41**	

Qn	Expected Answers	Marks	Additional guidance
12 (a)	standing wave example stated ✓	1	
(b)	diagram is essentially correct ✓✓✓ diagram is satisfactory, but some errors/omissions ✓✓ some attempt has been made ✓ ……… **labelled** ✓	3/2/1 1	
(c)	description sufficient to execute ✓✓ description partial ✓	2	e.g blow across top of pipe until loud sound ..
(d) (i)	a correct representation of a standing wave that could be generated **in <u>this</u> situation** ✓ N and A as appropriate to diagram ✓	2	accept just one **N** and **A** correctly labelled
(ii)	2 waves passing through each other/ superposing ✓ **A** and **N** explained ✓	2	
(e)	a correct representation of another standing wave that could be generated ✓ change to system described ✓	2	
	total	**13**	
13 (a)(i	a **distance** measurement stated ✓	1	
(ii)	sensible estimate of the distance with units✓ (within a reasonable range expected)	1	moon 10^{7}-10^{9} (m) sun 10^{10}-10^{12} (m)
(b) (i)	diagram is essentially correct ✓✓✓ diagram is satisfactory, but some errors/omissions ✓✓ some attempt has been made ✓ (implausible method (zero marks) see guidance →) … + important equipment **labelled** ✓	3 1	'echo sounding', 'parallax', or 'triangulation' expected if method implausible (e.g. ultrasound to moon/laser to sun) **zero <u>for diagram</u>**
(ii)	pulse sent out ✓ reflected from target ✓ trip time measured ✓	3	mark as independent of parts (a) and (b)
(c)	s = vt idea ✓ t is half trip time ✓ clear what v correctly represents in this situation ✓	3	
	total	**12**	
	Quality of Written Communication	**4**	
	Section C Total	**29**	

Mark Scheme 2863/01 Rise and Fall of the Clockwork Universe

Unit Code	Session	Year	Version
2863	January	2008	*Final*

m = method mark
s = substitution mark
e = evaluation mark
/ = 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

Qn	Expected Answers	Marks	Additional guidance
1	J✓ or Nm✓ s^{-1}✓	2 1	Order unimportant
2 a b	Red shift ✓AW $300 \times 10^{6} \times 9.6 \times 10^{15} = 2.9$ (or 2.88) $\times 10^{24}$ m✓	1 1	Reject Doppler effect Need own value
3	260 seconds = five half lives✓ Activity = $1500/2^5 = 47$ counts s^{-1}✓	2	accept $\lambda = 0.0133\ s^{-1}$ Various possible methods
4 a b	F = (-) mv^2/r✓ = $60 \times 10^2/3.4$✓ = 1800 N ✓ (2 s.f.) $1800/(9.8 \times 60)$ ✓= 3✓	3 2	No s.f. penalty. Must have own value
5	Temp rise = $40/(1.3 \times 10^{-4} \times 130)$ ✓ = 2400 ✓K	2	
6	pV = nRT ✓so n = $1 \times 10^5 \times 50/8.3 \times 300$✓ = 2000 ✓mol	3	
7a b	Larger amplitude of oscillation ✓when driving frequency matches natural frequency ✓AW Same energy✓ therefore energy transfer (from vibrating block) at greater rate ✓AW	2 2	

Section A Total: 21

Qn	Expected Answers	Marks	Additional guidance
8 a (i) (ii) (iii) (iv) (v)	For body to escape the total energy must be > or = 0 ✓ /valid energy arguments in terms of Potential at infinity ✓ /Loss of KE = gain in PE✓. Work done against resistive forces. ✓ ½ $mv^2 = GMm/r$ ✓∴ $v^2 = 2GMm/mr = 2GM/r$✓ ∴ v = $(2GM/r)^{1/2}$ $g = GM/r^2$ ✓∴ GM/r = gr ✓∴ $v = (2gr)^{1/2}$ v = $(2 \times 9.8 \times 6.4 \times 10^6)^{1/2}$ = 11000 m s^{-1}✓	1 1 2 2 1	 KE left when escaped ✓ penalise incorrect use of - ignoring minus signs 11,200
(b) (i) (ii)	v = $(2 \times 4 \times 10^{-21}/5 \times 10^{-26})^{1/2}$ ✓= 400 ✓m s^{-1} energy/velocity of nitrogen (far) below energy/velocity required. ✓	2 1	
(c)(i) (ii)	= 1.9×10^{-22} any two of: small chance of particle gaining sufficient energy to escape.✓ Over millions of years most particles have enough escape attempts to be successful ✓AW BF for Hydrogen is bigger than BF for Nitrogen✓	1 2	Accept = 2×10^{-22}
d	Allow more (massive) gas particles to escape ✓ greater typical energy /velocity/ BF ✓AW	2	
9 a	mass = 6 x 6 x 10^{-4} ✓= 3.6×10^{-3} kg (or 3.6 g) = approx 4	1	
b(i) b(ii) b(iii)	p = 0.0009 x 12 = 1(.1) x 10^{-2} kg m s^{-1} ✓ Link between force and rate of change of momentum✓ a = 1.1×10^{-2}/0.08 = 0.14✓ m s^{-2}	1 1 1	 Accept algebraic explanation Accept N3 approach ecf
c	Any two from: Pressure/ejection velocity/rate of mass ejection falls therefore **a** is less✓ Explanation✓ e.g air ejected at lower velocity because pressure is less Air resistance therefore **a** is less✓ Explanation✓ e.g air resistance increases as speed increases Mass of car (and air) falls therefore **a** will be greater ✓ Explanation✓ e.g. if roughly similar force ✓	4	
d	Initial acceleration lower ✓as cooler temp leads to lower pressure/ lower ejection velocity/ lower mass ejected per second✓	2	
10 a	Correct amplitude ✓time period correct✓	2	
b	0.05 x sin (2 x π x 50 x 0.013) ✓ = -0.04 m ✓	2	Value must be negative
c (i) (ii) (iii)	Cosine has maximum value of 1 ✓ Answer: 16✓ m s^{-1} Gradient when passing through x axis / maximum gradient✓	1 1 1	 15.7
d(i) (ii)	Point marked on line when x = 0.05 or -0.05 A = (-) 4 π^2 x 50^2 x 0.05✓ = (-) 4900 ✓m s^{-2}	1 2	 3SF max
11 (a) (i) (a) (ii) (a) (iii)	 Q = 4700 x 10^{-6} x 6✓ = 0.028 C I = V/R = 6/1100✓ = 5.5 mA T = 4700 x 10^{-6} x 1100✓ = 5.2 s	 1 1 1	Own answer or method Or by clear graphical method

Qn	Expected Answers	Marks	Additional guidance
(b)	V is proportional to Q ✓, rate of fall of charge = current✓	2	Other arguments possible
c(i) (ii) (iii) (iv)	Use of $t = Q/I$ (or rearranged) ✓ Correct substitution of $Q = CV$ and $R = V/I$✓ Loss of charge = (-0.017/5.2) x 2.0✓ = 6.5(4) x 10^{-3} C Line from (2.0, 0.017) to (4.0, 0.01) by eye ✓ Holds rate of decay constant for smaller time period /closer to continuous change ✓	2 1 1 1	Accept numerical arguments No ecf
	Quality of Written Communication	4	

Marking quality of written communication

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

4 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.

Mark Scheme 2864/01 Field and particle Pictures

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 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 scheme 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 candidate's 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.

ADVICE TO EXAMINERS ON THE ANNOTATION OF SCRIPTS

1 Please ensure that you use the **final** version of the Mark Scheme.
You are advised to destroy all draft versions.

2 Please mark all post-standardisation scripts in red ink. A tick (✓) should be used for each answer judged worthy of a mark. Ticks should be placed as close as possible to the point in the answer where the mark has been awarded. Ticks should **not** be placed in the right-hand margin. The number of ticks should be the same as the number of marks awarded. If two (or more) responses are required for one mark, use only one tick. Half marks ($^1/_2$) should never be used.

3 The following annotations may be used when marking. No comments should be written on scripts unless they relate directly to the mark scheme. Remember that scripts may be returned to Centres.

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

4 The marks awarded for each part question should be indicated in the right-hand margin. The mark total for each double page should be ringed at the bottom right-hand side. These totals should be added up to give the final total on the front of the paper.

5 In cases where candidates are required to give a specific number of answers, mark the first answers up to the total required. Strike through the remainder.

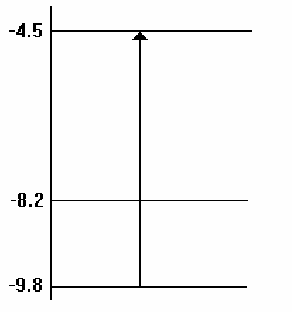
6 The mark awarded for Quality of Written Communication in the margin should equal the number of ticks under the phrase.

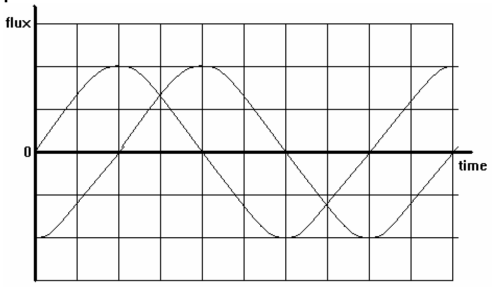
7 Correct answers to calculations should obtain full credit even if no working is shown, unless indicated otherwise in the mark scheme.

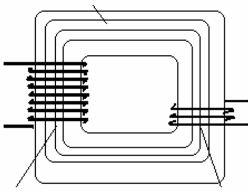
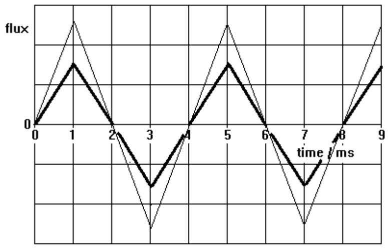
8 Strike through all blank spaces and pages to give a clear indication that the whole of the script has been considered.

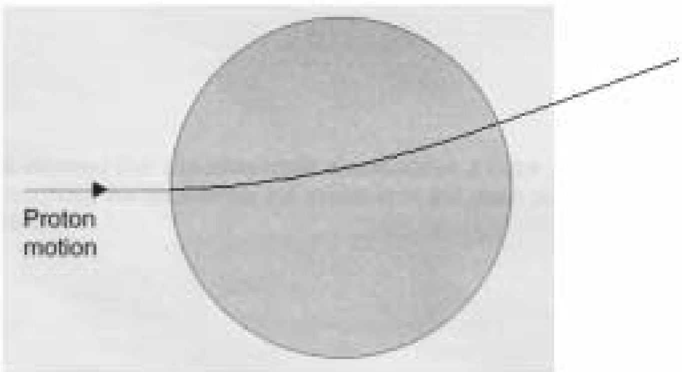
The following abbreviations and conventions are used in the mark scheme:

m = method mark
s = substitution mark
e = evaluation mark
/ = alternative correct answers
; = 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
ora = or reverse argument
eor = evidence of rule

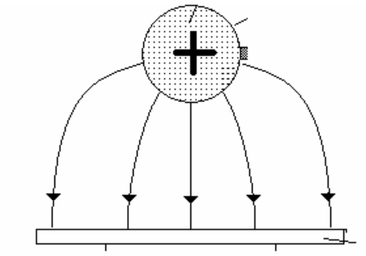
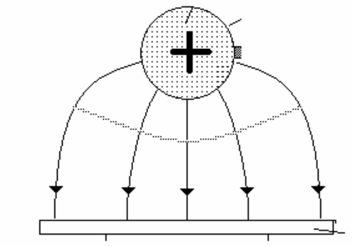
Question	Expected answer	Mark
1 a 1 b	J C^{-1} Wb m^{-2}	1 1
2 a 2 b	2.01355 - 1.00728 - 1.00867 = -0.00240 u ecf: mass = 0.0024 × 1.7×10^{-27} = 4.1×10^{-30} kg (eor) $E = mc^2$ ecf incorrect m: E = 4.1×10^{-30} × (3.0×10^8)^2 = 3.7×10^{-13} J (m = 4×10^{-30} kg gives 3.6×10^{-13} J for [1])	1 1 0 1
3 a 3 b 3 c	B upwards arrow from -9.8 eV to -4.5 eV ACCEPT downwards / doubleheaded arrow  $f = E/h$ E = 5.3 × 1.6×10^{-19} = 8.5×10^{-19} J ecf incorrect E: f = 8.5×10^{-19} / 6.6×10^{-34} = 1.3×10^{15} Hz	1 1 0 1 1

Question	Expected answer	Mark
4	$B = F / Il$ $F = 1.32\times10^{-3} \times 9.8 = 1.3\times10^{-2}$ N ecf incorrect F : $B = 1.3\times10^{-2} / 2.63 \times 25\times10^{-3} = 0.20$ T	0 1 1
5 a 5 b	gamma photons can be detected outside body patient not radioactive for long / activity high for ease of detection ACCEPT not in the body for long / decays rapidly probability of decay of each nucleus (is 1.3×10^{-5}) in each second ACCEPT 1.3×10^{-5} of sample decays in each second ACCEPT calculation showing $T_{1/2}$ = 15 hours ACCEPT ratio of activity to number of nuclei (owtte)	1 1 1
6	C	1
7 a 7 b	sine curve with correct period, any amplitude phase $\pm \pi/2$  **true** **false** **true**	1 1 1
8	(electric field strength) of a spherical / point charge (in free space)	1
9	kinetic energy	1

Question	Expected answer	Mark
10 a	two loops all the way round, in the iron, not touching each other. 	1
10 b	reduces / stops (eddy) currents EITHER by increasing electrical resistance (owtte) OR to reduce heating / increase flux / increase efficiency	1 1
10 c i	triangular waveform with correct frequency, any amplitude in / out of phase with flux (ecf incorrect shape) 	1 1
10 c ii	emf is rate of change of flux linkage (owtte) so emf constant because flux has constant gradient (owtte) emf changes sign when gradient changes sign (owtte)	1 1 1
10 c iii	$B = \Phi / A$ $\Phi_{max} = 0.55 \times 3.1\times10^{-4} = 1.71\times10^{-4}$ Wb $\varepsilon = N \times \Phi_{max} / 0.25T$ $0.25T = 1\times10^{-3}$ s ecf incorrect Φ_{max}, $0.25T$: $\varepsilon = 3 \times 1.71\times10^{-4} / 1\times10^{-3} = 0.51$ V	0 1 0 1 1
10 d	(peak) emf is halved because rate of change of flux linkage has halved / reduced (owtte) one cycle takes 8 ms / period is doubled ACCEPT emf reduced / period increased for [1] NOT wavelength increases / doubles	1 1 1

Question	Expected answer	Mark
11 a	$E_k = mv^2/2$ (eor) $E_k = 9.1\times10^{-31} \times (1.8\times10^7)^2 / 2 = 1.47\times10^{-16}$ J ecf incorrect E_k: $eV = E_k$ (eor) $V = 1.47\times10^{-16} / 1.6\times10^{-19} = 920$ V	1 1 1 1
11 b i	$Bev = mv^2/r$ and processing to obtain formula	1
11 b ii	EITHER $E = \frac{1}{2}mv^2, v = \sqrt{\frac{2E}{m}}$ OR $E = p^2/2m$, $p = mv$ processing to final formula	1 1
11 c	circular track curves upwards smoothly in B field much larger radius of curvature (deflection < 90°) straight line where emerges from field e.g. 	1 1 1

Question	Expected answer	Mark
12 a i	nucleon number = 104, proton number = 46	1
12 a ii	EITHER neutrons neutral so only interact with nucleus in a head-on collision OR electrons are charged so scatter off nucleus without needing to get close NOT just neutrons are neutral / electrons are charged, must also mention interaction with <u>nucleus</u>	1
12 b	beta particle rate = 42×10^{-9} / 1.6×10^{-19} = 2.6×10^{11} s^{-1} ecf : neutron rate = $2.6\times10^{11} \times 6 = 1.6\times10^{12}$ Bq	1 1
12 c	number of half-thicknesses = 48 / 8.0 = 6 (eor) transmission = $0.5^6 = 1.56\times10^{-2}$ or 1.6 %	1 1
12 d i	$5 \times 20\times10^{-3} \times 3$ = 0.3% risk	1
12 d ii	neutron energy = $0.025 \times 1.6\times10^{-19} = 4.0\times10^{-21}$ J (eor) annual absorbed dose = total energy × Q / mass total energy per year = $20\times10^{-3} \times 65$ / 10 = 0.13 J (eor) ecf: neutrons per year = 0.13 / $4.0\times10^{-21} = 3.3\times10^{19}$ neutrons per second = 3.3×10^{19} / 3.2×10^{7} = 1.0×10^{12} Bq	 1 1 1

Question	Expected answer	Mark
13 a i	$E = kQ/r^2$ (eor) $r = 2.0\times10^{-2}$ m ecf r: Q = $Er^2/k = 3.0\times10^6 \times (2.0\times10^{-2})^2 / 9.0\times10^9 = 1.3\times10^{-7}$ C ACCEPT correct reverse calculation for [3]	1 1 1
13 a ii	$V = kQ/r$ ecf incorrect Q, r: $V = 9.0\times10^9 \times 1.3\times10^{-7} / 2.0\times10^{-2}$ $V = 6.0\times10^4$ V (1×10^{-7} C gives 4.5×10^4 V for [2]) ACCEPT $3.0\times10^6 \times 0.02 = 6\times10^4$ V for [2]	0 1 1
13 b i	correct shape and symmetry, five lines at right angles to surfaces all arrows downwards 	1 1
13 b ii	ecf incorrect field lines, at right angles to field lines 	1
13 c	any of the following, maximum [4] • alter Q and/or h • measure Q with a coulomb meter • note change of scales reading when sphere placed / removed • use $W = \Delta mg$ to determine F (accept m for Δm) • suitable numerical or graphical test to verify an aspect of the relationship $F = kQ^2/4h^2$ • suitable numerical or graphical test to verify another / all aspect(s) of the relationship $F = kQ^2/4h^2$	4

Quality of Written Communication 4

Marking quality of written communication

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4 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.

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Mark Scheme 2865 Advances in Physics

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- 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.
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6. Correct answers to calculations should gain full credit even if no working is shown, unless otherwise indicated in the mark scheme. (An instruction on the paper to 'Show your working' is to help candidates, who may then gain partial credit even if their final answer is not correct.)

8. Strike through all blank spaces and/or pages in order to give a clear indication that the whole of the script has been considered.

8. An element of professional judgement is required in the marking of any written paper, and candidates may not use the exact words that appear in the mark scheme. If the science is correct <u>and</u> answers the question, then the mark(s) should normally be credited. If you are in doubt about the validity of any answer, contact your Team Leader/Principal Examiner for guidance.

Unit Code 2865	Session January	Year **2008**	**Final standardisation version**

m	= method mark
s	= substitution mark
e	= evaluation mark
/	= alternative and acceptable answers for the same marking point
;	= separates marking points
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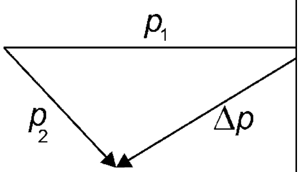
____	= (underlining) key words which <u>**must**</u> be used to gain credit
ecf	= error carried forward
AW	= alternative wording
ora	= or reverse argument

Qn	Expected Answers	Marks	Additional guidance
1 (a)	(i) distance = $2\pi \times 1.50 \times 10^{11}$m = 9.4×10^{11} m ✓ v = 9.4×10^{11} m/3.2×10^{7} s = $2.9\times10^{4} \approx 3 \times 10^{4}$ m s^{-1} ✓ (ii) a = v^2/R = $(2.9 \times 10^4)/1.5 \times 10^{11}$ = 5.8×10^{-3} m s^{-2} $\approx 6 \times 10^{-3}$ m s^{-2} ✓m ✓e (iii) N kg^{-1} = (kg m s^{-2}) kg^{-1} = m s^{-2} ✓m ✓e	2 2 2	**not** R/T allow 3×10^4 m s^{-1} gives 6.0×10^{-3} m s^{-2} ora
(b)	1.989×10^{30} kg (4 sf) ✓ Least accurate datum has 4 sf ✓	1 1	
(c)	Realising that leap years every 1 year in 4, including century years, means an extra 0.25 days year^{-1} ✓ Orbital period slightly shorter than this, so need extra shorter (non-leap) year(s) ✓	1 1	Can answer by calculating (303×365 + 97×366)/400 for ✓m ✓e
	Total:	**10**	
2 (a)	(Equal time) spacings closer meaning less volume owtte (in equal times) ✓	1	
(b)	(i) Δdrops 3.6, 1.8, 0.8, 0.4 ✓ ratios 2.0, 2.3, 2.0 (0.5, 0.4, 05) so yes ✓ (ii) method of increasing flow as fraction of total volume e.g. larger hole, narrower container ✓ more division on the scale✓ (allow different method of measurement of level)	2 2	at least 2 of the first 4 gaps any two valid points, e.g. two improvements or improvement + explanation
(c)	(i) $\varepsilon = 17.0 \times 1.4 \times 10^{-23} \times 290 = 6.9 \times 10^{-20}$ J $\approx 7\times10^{-20}$ J or $\varepsilon = 15.9 \times 1.4 \times 10^{-23} \times 310 = 6.9 \times 10^{-20}$ J $\approx 7\times10^{-20}$ J ✓ (ii) BF = $e^{-\frac{\varepsilon}{kT}} = e^{-15.9} = 1.24 \times 10^{-7} \approx 3 \times 4.18\times10^{-8}$ ✓ (iii) <u>significant increase</u> in number molecules with higher energy ✓ faster evaporation as greater fraction of molecules able to escape ✓	1 1 2	Must compare Scotland and Egypt
	Total:	**9**	

Qn	Expected Answers	Marks	Additional guidance
3 (a)	constant ratio ✓ values 10.6, 10.5, 10.3, 10.1 (0.094, 0.095, 0.098, 0.099) so not true as definite trend away from constant within precision of data ✓	2	(i) constant difference needs extrapolation to zero to confirm direct proportion
(b)	(i) T = 2.0 s ✓ $2\pi\sqrt{L/g} = T \Rightarrow L = T^2g/4\pi^2 = g/\pi^2$ = 0.99 m ✓m ✓e (ii) L increases to L × (1 + 25/50000) = 1.0005L ✓ $T \propto \sqrt{L} \Rightarrow T = \sqrt{1.000\,5}$ × 2s = 2.00050 s so extra time is 0.5 ms ✓ Bald answer 0.0005 s is not enough	3 2	can calculate T based on L =1.0005 m giving 1.0076 s. Allow g=10N/kg giving T=1.987 s or 9.81 N/kg giving 1.0065 s
	Total:	**7**	
4 (a)	(i) 1.0 mm = ½ λ (as fundamental is N-A-N or A-N-A) ✓ (ii) $f = v/\lambda$ ✓ = 5500/2.0 × 10^{-3} = 2.8 × 10^6 Hz ✓	3	can label diagram
(b)	(i) $E = V/d$ = 5.0/1.0 × 10^{-3} = 5.0 ×10^3 V m^{-1} ✓ $\varepsilon = d_pE$ = 2.25 × 10^{-12} × 5.0 ×10^3 V m^{-1} = 1.13 × 10^{-8} ✓ $\Delta x = \varepsilon L$ = 1.13 × 10^{-8} × 1.0 × 10^{-3} = 1.13 × 10^{-11} m ✓ (ii) $\sigma = E\varepsilon$ = 7.9 × 10^{10} × 1.1 × 10^{-8} = 870 ✓ Pa or N m^{-2} ✓	3 2	Watch for cancelling 1 mm omissions! ε = 1.13 × 10^{-8} gives 890 Pa; ecf incorrect ε
	Total:	**8**	
5 (a)	(i) Nitrogen atom significantly more massive than hydrogen atom ✓ same momentum change on both, so velocity change of N less so moves less in same time ✓ (ii) H-2 double mass of H-1 ✓ treating as mass on spring ✓ more mass means longer T / smaller f ✓	2 3	Needs idea of cons. Of momentum / Newton III Can use algebra
(b)	(i) identifies (both) stable positions at minima of potential energy curve ✓ (ii) **X** on either of the downhill slopes from the centre to a minimum ✓ force = - gradient of line owtte ✓	1 2	Can explain in terms of work needed for displacement
	Total:	**8**	

Qn	Expected Answers	Marks	Additional guidance
6 (a)	(i) $E = 2.73 \times 1.6 \times 10^{-19}$ J✓ $= 4.4\times10^{-19}$ J $f=E/h = 4.4\times10^{-19} / 6.6 \times 10^{-34}$ Hz $= 6.6 \times 10^{14}$ Hz ✓ $\lambda = c/f = 3.0 \times 10^{8}/6.6 \times 10^{14} = 4.53 \times 10^{-7}$ m = 450 nm ✓ which is near the violet end of the spectrum ✓ (ii) Cannot put two measurements differing by factor of 10^5 on same diagram. ✓	4 1	(i) Must indicate or imply that 400 nm is the violet end of the spectrum. (ii) Must make comparison of energy magnitudes.
(b)	10^7 years $\times 3.2\times10^7$ s/year $\times$ (3 / 10^{14}) = 9.6 s in ten million years ora ✓ NB article/ question states 1 s in 10 million years so allow use of 1 million years in answer.	1	2×10^{14} gives 6.4 s
(c)	(i) $9.2 \times 10^9 / 5 \times 10^6$ ✓= 1840 $2^{10} = 1024$ & $2^{11} = 2048$ so need 11 stages (allow 10) ✓ (ii) 9 192 631 770 / 5×10^6 = 1838.5… which is not an exact power of 2. ✓	2 1	The mark for (ii) can be earned in (i), so mark both parts together. Allow repeated division by 2 in (i).
	Total:	**9**	
7 (a)	(i) $\Delta x = 3.0 \times 10^8 \times 1.0 \times 10^{-6} = 300$ m ✓ (ii) $t = \Delta x/c = 10 / 3.0 \times 10^8 = 3.3 \times 10^{-8}$ s (so needs accuracy to nearest 10 ns). ✓m ✓e	**1** **2**	
(b)	(i) 128 bytes = 128 × 8 = 1024 bits✓ time = 1024 / 1.024×10^6 s $= 1.0 \times 10^{-3}$ s✓ (ii) satellites move (significant distances during transmission of data) ✓	**2** **1**	
(c)	(i) more than one possible location if just two used✓ (ii) Extra information to confirm data / increase accuracy / 3D location ✓	**1** **1**	(ii) any sensible suggestion
	Total:	**8**	

Qn	Expected Answers	Marks	Additional guidance
8 (a)	40 km h^{-1} = 40 × 10^3 / 60^2 = 11.1 m s^{-1} ≈ 11 m s^{-1}✓m ✓e	2	
(b)	(i) $V = \pi r^2 h = \pi \times 1.0^2$ × 11 = 35 m^3 ✓m ✓e m = ρ V = 1.2 × 11 = 41 kg ✓ (ii) Kinetic energy/s = ½ × 41 × 11^2 = 2500 W✓m ✓e (iii) Not all energy trapped by turbine / wind speed varies and is often less than 11 m s^{-1}/ generator efficiency <100% / air moves away ✓ ✓	3 2 2	11.11 m s^{-1} gives 42 kg 40 kg gives 2420 W Method must have v^2 Energy loss for first mark, mechanism for second.
(c)	(i) By eye, p_1 and p_2 parallel to and proportionate in length to those on the diagram ✓ Δp completes triangle as shown, i.e. p_2 is the resultant. ✓ (ii) Force = Δp / Δt ✓ Apply conservation of momentum/Newton III to equate effect on air with (-) effect on blade. ✓	2 2	
	Total:	**13**	
9 (a)	(i) $R = \rho L/A$ ✓ ⇒ $L = RA/\rho$ L = 8.0 × (0.11×10-3)2/1.7 ×10-8 = 17.9 m ≈ 20 m ✓m✓e (ii) $I=V/R$ = 1.0/8.0 = 0.125 A ✓ ≈ 130 mA✓	**3** **2**	Comparison needed
(b)	(i) 4 radial lines, roughly equally spaced✓ Any two complete loops from N to S returning through back of magnet assembly ✓ correct direction on both ✓ (ii) F = I LB = 0.13 × 18 × 0.4 = 0.94 N ✓m✓e	**3** **2**	If only one diagram has field direction, accept that. 20 m gives 1.0 N
(c)	Destructive interference / waves out of phase ✓ Second source is from back of loudspeaker ✓	**2**	Must imply two sets of waves: can suggest e.g. reflection off rear wall as source for second set Accept baffle vibrates and amplifies sound
(d)	Waves reflected off wall ✓superpose /interfere constructively with waves directly from the loudspeaker ✓	**2**	Allow phase change on reflection
	Total:	**14**	
	Quality of Written Communication	**4**	See next page

QWC Marking quality of written communication

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

Grade Thresholds

Advanced GCE Physics B (Advancing Physics) (3888/7888)
January 2008 Examination Series

Unit Threshold Marks

Unit		Maximum Mark	A	B	C	D	E	U
2860	Raw	90	61	54	48	42	36	0
	UMS	100	80	70	60	50	40	0
2861	Raw	90	65	57	49	42	35	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
2863A	Raw	127	97	87	77	68	59	0
	UMS	100	80	70	60	50	40	0
2863B	Raw	127	97	87	77	68	59	0
	UMS	100	80	70	60	50	40	0
2864A	Raw	119	91	81	71	61	52	0
	UMS	110	88	77	66	55	44	0
2864B	Raw	119	91	81	71	61	52	0
	UMS	110	88	77	66	55	44	0
2865	Raw	90	60	54	48	42	37	0
	UMS	90	72	63	54	45	36	0

Specification Aggregation Results

Overall threshold marks in UMS (ie 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	10.6	29.5	58.0	81.6	96.3	100	379
7888	10.0	38.3	65.0	90.0	98.3	100	60

For a description of how UMS marks are calculated see:
http://www.ocr.org.uk/learners/ums_results.html

Statistics are correct at the time of publication.

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