OCR
RECOGNISING ACHIEVEMENT

GCE

Physics B (Advancing Physics)

Advanced GCE **2864/01**

Field and Particle Pictures

Mark Scheme for June 2010

Oxford Cambridge and RSA Examinations

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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.

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Q	expected answer	mark	additional guidance
1a	T	1	
1b	V	1	
2	neutron	1	
3	$E = kq/r^2$ (eor) 1.2×10^{10} N C^{-1}	1 1	
4a	arrow through X pointing to centre of conductor.	1	
4b	increasing distance between equipotentials with increasing distance from the conductor (for same p.d.)	1	
5a	flux = 6.3×10^{-4} / 420 = 1.5×10^{-6} Wb ecf: $B = 1.5\times10^{-6}/2.6\times10^{-5}$ $= 5.8\times10^{-2}$ Wbm^{-2}	1 1	 ecf: 6.3×10^{-4} gives 24 Wb [1] correct method [1]
5b	emf = 6.3×10^{-4} / 5.0×10^{-3} = 0.13 V	1	

6	$V_p/V_s = N_p/N_s$ (eor) V_s = 22 V f = 50 Hz	1 1 1	
7a		1	
7b	C	1	
8a	10^{-18}	1	
8b	10^{-14}	1	
9a	N and ΔN have no units, $1/\Delta t$ is s^{-1}	1	**accept** $\lambda = \frac{\Delta N}{N\Delta t} = \frac{1}{\Delta t}$
9b	λ = 2.3×10^{-5} s^{-1}	1	
9c	N = 1.6×10^{9}	1	2×10^{-5} s gives 1.9×10^{9}

Q	expected answer	mark	additional guidance
10a	high permeability/permeance increases flux density / guides flux (from stator to rotor) / flux flows easily	1 1	**accept** good conductor of flux **not** magnetic / easily magnetised
10b	any three of the following, [1] each changes of flux; induce emf in the core; making (eddy) currents; which heat core / waste energy / reduce flux; which are reduced by insulator; sheets allow flux to flow around core easily;	3	
10ci	increases flux (in stator and rotor); use of *BIl* to explain force increase due to either increased *I* or increased *B*.	1 1	**accept** flux linkage
10cii	any **two** of these suggestions, [1] each decrease gap between rotor and stator; more coils in rotor; more coils in stator; shorter / fatter iron core increase all dimensions explanation: increases flux / flux density	2 1	 **accept** more coils for [1]

Q	expected answer	mark	additional guidance
11a	$Q = It$, $Q = ne$ (eor)	1	
	$n = 70\times10^{-12} / 1.6\times10^{-19} = 4.4\times10^{8}$ s^{-1}	1	$4.4\times10^{??}$ for [1]
11bi	$E = mc^2 = 8.2\times10^{-14}$ J	1	
	$8.2\times10^{-14} / 1.6\times10^{-19} = 5.1\times10^{5}$ J (eor)	1	accept reverse calculation: 900 MeV gives 1.4×10^{-10} J
11bii	$p = 9.0\times10^{8}\times1.6\times10^{-19}/3.0\times10^{8}$ $= 4.8\times10^{-19}$ N s	1	**not** use of $E = hf$, $c=f\lambda$
	ecf: $\lambda = h/p = 6.6\times10^{-34}/4.8\times10^{-19} = 1.4\times10^{-15}$ m	1	p = 3.0 Ns gives 2.2×10^{-34} m for [1]
11biii	minimum of pattern at 25°	1	
	$\lambda = d\sin\theta$	1	
	$d = 1.4\times10^{-15} / 0.42 = 3.3\times10^{-15}$ m	1	ecf on angle and λ
11c	proton is three quarks;	1	
	(higher energy) means smaller wavelength (and increases resolution)	1	

Q	expected answer	mark	additional guidance
12ai	gamma photons are not completely absorbed by water, but beta particles are.	1	**must** refer to both particles
12aii	d.e = $6\times10^{-3} \times 600 = 3.6$ Sv	1	**accept** 0.11 with no units
	ecf: risk = $3.6 \times 3 = 11\%$	1	
12aiii	any two of these suggestion / explanation pairs, [1+1] each	4	**ignore** dose / radiation / sieverts / grays ...
	place astronauts further away; less chance of absorbing a photon;		
	put stores/shielding in the way; to absorb photons;		**not** lead / concrete shield
	reduce reactor power; to reduce rate of emission of photons;		
12bi	nucleus splitting into two (or more fragments)	1	**accept** atom
12bii	206 MeV = 3.3×10^{-11} J (eor)	1	
	$n = 7.0\times10^{3}/3.3\times10^{-11} = 2.1\times10^{14}$ s^{-1}	1	ecf incorrect E in joules so 206 J gives 34 for [1]
12biii	any three of the following, [1] each	4	**ignore** references to chain reaction
	collide with moderator/carbon/water; to slow them down; increasing probability of fission; absorbed by control rods; to establish one new fission from each previous one (owtte);		

Q	expected answer	mark	additional guidance
13ai	neutron number = 138 (eor)	1	**look for** 2 d.p.
	mass = 3.784×10^{-25} kg	1	**allow** ecf on incorrect neutron number
13aii	work/energy is required to separate particles;	1	**accept** reverse argument
	because of attractive forces between nucleons;		
	energy related to mass by $E = mc^2$	1	
		1	
13bi	length of standing wave is half a wavelength / $4\times7.1\times10^{-15} = 2.8\times10^{-14}$ m	1	
13bii	$p = h/\lambda$ (eor)	1	
	$p = 2.3\times10^{-20}$ Ns	1	**accept** 2.4×10^{-20} 3×10^{-14} m gives 2.2×10^{-20} m
13biii	$v = p/m = 3.5\times10^{6}$ m s^{-1}	1	
	$E_k = 0.5mv^2 = 4.0\times10^{-14}$ J	1	ecf from incorrect v 3×10^{-14} m gives 3.6×10^{-14} J 2.8×10^{-14} m gives 4.1×10^{-14} J
13c	idea of all paths for a quantum object allows possibility of particle being outside nucleus	1	accept collisions with other nucleons raise it to a higher energy state
	QWC	**4 Marks**	

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 B 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.

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