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Mark Scheme Summer 2007

GCE

GCE Salters Horners Physics (6754/01)

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1.

(i)	area under graph decreased OR height/amplitude/energy/intensity less	✓	**1**
(ii)	spreading out/smeared/takes longer (time)	✓	**1**
(iii)	energy absorbed/lost [not intensity]	✓	**1**
(iv)	intensity decreases exponentially with length [eqn + words ok; not just eqn]	✓	**1**
(v)	diag: one path with TIR	✓	**up to 2 for diag**
	rays follow different paths through fibre	✓	
	different paths have different lengths/times	✓	
	=> some parts of signal arrive before others	✓	**4**
(vi)	longer fibre => differences in time (or path) greater	✓	**1**
(vii)	[name; detail; consequence] stepped index fibre has cladding of similar but smaller μ => larger critical angle **OR** graded index or multimode μ greater down middle, reducing to outside => longer paths travelled at greater speed **OR** monomode/single mode fibres very thin only possible path is straight down centre	✓✓✓	**3**
			Total 12

2

(a)

(i) Not matter/antimatter pair [stated or implied] ✓
particle/antiparticle have same mass OR electron/proton not same mass OR other correct reason (eg electron is fundamental, proton is quarks) ✓
antiparticle to proton is antiproton OR antiparticle to electron is positron/antielectron ✓

(ii) Not matter/antimatter pair [stated or implied] ✓
anti to up is anti-up OR anti to down is anti-down ✓
up and down have different charge ✓ **any 5**

(b) particles/antiparticles carry opposite charge ✓
(component of) field perpendicular to travel ✓
(magnetic/LH rule) forces act in opposite directions ✓
some pairs uncharged so no separation/deflection ✓ **any 2**
[not annihilation]

(c) number = 5000 x 10^{-12} kg / 9.11 x 10^{-31} kg = 5.5 (5.488) x 10^{21} ✓ **1**

(d)

(i) correct use of $E = mc^2$ [subs] ✓
correct use of $E = hf$ and $c=f\lambda$ [rearranged or subbed] ✓
correct answer [ue] ✓

$E = mc^2$ = 9.11 x 10^{-31} x $(3 \times 10^8)^2$ J (= 8.199 x 10^{-14} J) ✓
$E = hf = hc/\lambda$ => $\lambda = hc/E$ ✓
= 6.63 x 10^{-34} x 3 x 10^8/8.199 x 10^{-14} m
= 2.4 (2.426 or 2.42 or 2.43) x 10^{-12} m [Ignore omission of both factors of 2] ✓ **3**
[factor of 2 wrong is a.e. = -1]
[use of $\lambda = h/p$ scores 0]

(ii) this wavelength is not visible light
OR this is x-ray or gamma or high energy photon so need shielding ✓ **1**

Total 12

3.

(a) (i)	arrow towards centre of curvature	✓	**1**
(ii)	Use of formula with correct q OR v subbed	✓	
	correct answer	✓	
	$F = Bqv$		
	$= 0.5 \times 1.6 \times 10^{-19} \times 800\,000$ N (correct q or v)	✓	
	$= 6.4 \times 10^{-14}$ N	✓	**2**
(iii)	Use of formula: EITHER correct m subbed OR d identified with r	✓	
	correct answer	✓	
	$r = p/Bq = 1.67 \times 10^{-27} \times 800\,000/0.5 \times 1.6 \times 10^{-19}$ (m)	✓	
	$= 0.017$ m	✓	**2**
	[Penalise factor 1000 error once only in question]		
(iv)	derive formula for T	✓	
	correct answer	✓	
	$T = \pi r/v$ (OR $T = 2\pi r/v$ for ✓x)	✓	
	$= \pi \times 0.017/800\,000$ (s) (ecf)		
	$= 6.6$ (6.5 - 6.7) $\times 10^{-8}$ s	✓	**2**
(v)	correct statement of force = change of momentum/time	✓	
	correct use of factor 2	✓	
	correct answer	✓	
	F = change of momentum/time	✓	
	$= 2 \times 1.67 \times 10^{-27} \times 800\,000/6.7 \times 10^{-8}$ (N) (ecf)	✓	
	$= 4.1$ (4.0) $\times 10^{-14}$ N [errors in m are self-cancelling]	✓	**3**
(b)	Recall of formula	✓	
	correct answer	✓	
	$F = k\, q_1\, q_2/r^2$ OR $F = q_1\, q_2/4\pi\varepsilon_o r^2$ OR $k = 1/4\pi\varepsilon_o$	✓	
	$= 1.6 \times 10^{-19} \times 1.9 \times 10^{-6}/4 \times \pi \times 8.85 \times 10^{-12} \times 5 \times 5$ (N)		
	$= 1.1 \times 10^{-16}$ N	✓	**2**
			Total 12

4.

(i)	magnetic field <u>changing</u>	✓	
	field cuts across conductor/flux linkage changes	✓	
	Faraday/V induced	✓	(any 3)
	V causes I	✓	3
(ii)			
	Direction of induced current has an effect tending to cancel its cause OR [reasonable attempt at putting Lenz into words - not just "Lenz"]	✓	1
			Total
			4

5.

(a)(i)	recall of formula	✓		
	correct answer	✓		
	$C = Q/V$ (stated or implied) [this way round]	✓		
	= (appropriate pair of values, eg 4 C/4.8 V)			
	= 0.83 (0.82 - 0.84) F	✓		**2**
(ii)	strip width ΔQ	✓1		
	$\Delta W = V . \Delta Q$	✓2		
	add strips => area under graph	✓3		
	area = $1/2 Q V$	✓4		
	energy stored = work done	✓5		
	showing $1/2QV$ has unit J/joule	✓6		**(any 3)**
	[integration answer - max ✓✓]			
	[answer in words - max ✓✓]			**3**
(iii)	derive or recall $E = 1/2\ C\ V^2$ OR use correct Q value from graph	✓		
	OR line across graph at 4 V			
	correct answer	✓		
	$E = 1/2\ Q\ V$			
	= 1/2 x 3.3 (3.3-3.35) C x 4 V	✓		
	= 6.6 (6.6-6.7) J	✓		
	OR $E = 1/2\ C\ V^2$	✓		
	= 1/2 x 0.83 F x $(4\ V)^2$ = 6.6 J	✓		**2**
(b)				
(i)	Q decreases => V decreases OR I decreases	✓		
	mention of $P = VI$	✓		**2**
(ii)	125-145 s	✓		**1**
				Total 10

6	***B* in accelerators:**		
	changes direction of motion of charged particles OR force/B perpendicular to motion of charged particles OR ref to LHR	✓1	
	(moving) charged particles stored in <u>circles</u>/<u>circular</u> path/spirals	✓2	
	$Bqv = mv^2/r$	✓3	
	cyclotron: $T = 2\pi m/Bq$	✓4	
	fixed frequency voltage for acceleration	✓5	
	diag/construction detail [probably on diag]	✓6	
	synchrotron: *r* fixed, *B* adjusted as needed	✓7	(up to 4)
	***B* in detectors:**		
	charged particles => (detectable) <u>curved</u> paths	✓8	
	find sign of charge from sense of curvature	✓9	
	find momentum/speed/energy/mass from *r* (= *p*/*Bq*)	✓10	**Total 5**

7			
(i)	two correct arrows [ignore labelling]	✓	1
(ii)	Some use of mv^2/r with v correctly subbed OR $mr\omega^2$ with v correctly used [subbing may happen later in answer]	✓	
	$T \cos \theta = mg$ mg OR $T \sin \theta = mv^2/r$ [either gains ✓]	✓	
	$\Rightarrow \tan \theta = v^2/rg$	✓	
	$\Rightarrow r = v^2/g \tan \theta$ = 30 x 30/9.81 x tan 20 m ≈252 m	✓	4
			Total 5

Total for Paper = 60