Magnetic Fields & Moving Charges

Mark Scheme 1

Level	International A Level
Subject	Physics
Exam Board	CIE
Topic	Magnetic Fields
Sub Topic	Magnetic Fields & Moving Charges
Paper Type	Theory
Booklet	Mark Scheme 1

Time Allowed: **78 minutes**

Score: **/65**

Percentage: **/100**

A*	A	B	C	D	E	U
>85%	'77.5%	70%	62.5%	57.5%	45%	<45%

1 **(a)** e.g. both transverse/longitudinal/same ty
meet at a point,
same direction of polarisation, etc.....1 *each, max 3* ..... B3 [3]
(allow 1 mark for any condition for observable interference)

(b) **(i)1** allow 0.3 mm → 3 mm..... B1

(i) $\lambda = ax/D$ (allow any subject)..... B1

(ii) separation increased..... B1
less bright B1

(ii) separation increased..... B1
less bright B1

(ii) separation unchanged..... B1
fringes brighter..... B1
further detail, i.e quantitive aspect in (ii)1 or (ii)2..... B1 [7]
(in (b), do not allow e.c.f. from (b)(i)2)

2 **(a)** **(** gravitational [1]

(ii) gravitational and electric B1 [1]

(iii) magnetic and one other field given B1
magnetic, graviational and electric B1 [2]

(b) **(i)** out of (plane of) paper/page (*not "upwards"*) B [1]

(ii) $B = mv/qr$ C1
$= (3.32 \times 10^{-26} \times 7.6 \times 10^{4}) / (1.6 \times 10^{-19} \times 6.1 \times 10^{-2})$ C1
$= 0.26\,\text{T}$ A1 [3]

(c) sketch: semicircle with diameter < 12.2 cm [1]

3 **(a** $F = BIL\sin\theta$ C1
$= 2.6 \times 10^{-3} \times 5.4 \times 4.7 \times 10^{-2} \times \sin 34°$
$= 3.69 \times 10^{-4}$ N A1 [2]
(*allow 1 mark for use of cos 34°*)

(b) peak current = $1.7 \times \sqrt{2}$ C1
$= 2.4$ A

max. force $= 2.6 \times 10^{-3} \times 2.4 \times 4.7 \times 10^{-2} \times \sin 34°$
$= 1.64 \times 10^{-4}$ N C1

variation $= 2 \times 1.64 \times 10^{-4}$
$= 3.3 \times 10^{-4}$ N A1 [3]

4 **(a** smooth curve with decreasing gradient, not starting at $x = 0$ M1
end of line not at $g = 0$ or horizontal A1 [2]

(b) straight line with positive gradient M1
line starts at origin A1 [2]

(c) sinusoidal shape B1
only positive values and peak / trough height constant B1
4 'loops' B1 [3]

5 **(a** *either* charge exists in discrete and <u>equal</u> quantities
or multiples of elementary charge / e / 1.6×10^{-19} C B [1]

(b) **(** force due to magnetic field must be upwards B1
B-field into the plane of the pap B1 [2]

(ii) sketch showing: deflection consistent with force in **(b)(i)** B1
reasonable curve B1 [2]

6 **(a)** electric and magnetic fields normal to each other B1

either charged particle enters region normal to both fields
or correct B direction w.r.t. E for zero deflection B1
for no deflection, $v = E/B$ B1 [3]

(*no credit if magnetic field region clearly not overlapping with electric field region*)

(b) **(i)** $m = Bqr/v$ C1
$= (640 \times 10^{-3} \times 1.6 \times 10^{-19} \times 6.2 \times 10^{-2})/(9.6 \times 10^{4})$ C
$= 6.61 \times 10^{-26}$ kg
$= (6.61 \times 10^{-26})/(1.66 \times 10^{-27})$ u
$= 40$ u A [4]

(ii) $q/m \propto 1/r$ *or* m constant and $q \propto 1/r$ B1
q/m for A is twice that for B B1
ions in path A have (same mass but) twice the charge (of ions in path B) B1 [3]

7 **(a** force due to magnetic field is constant B1
force is (always) normal to direction of motion
this force provides the centripetal force A1 [3]

(b) $mv^2 / r = Bqv$ M1
hence $q / m = v / Br$ A0 [1]

(c) **(** $q / m = (2.0 \times 10^{7}) / (2.5 \times 10^{-3} \times 4.5 \times 10^{-2})$ C
$= 1.8 \times 10^{11}$ C kg^{-1} A1 [2]

(ii) sketch: curved path, constant radius, in direction towards bottom of page M1
tangent to curved path on entering and on leaving the field A1 [2]

8 (a) *either* constant speed parallel to plate
or accelerated motion/force normal to plate/in direction field B1
so not circular A1 [1]

(b) (i) direction of force due to magnetic field opposite to that due to electric field B1
magnetic field into plane of page B1 [2]

(ii) force due to magnetic field =force due to electric field B1
$Bqv = qE$
$B = E/v$ C1
$=(2.8 \times 10^{4}) / (4.7 \times 10^{5})$
$=6.0 \times 10^{-2}$ T A1 [3]

(c) (i) no change/not deviated B1 [1]

(ii) deviated upwards B1 [1]

(iii) no change /not deviated B1 [1]