

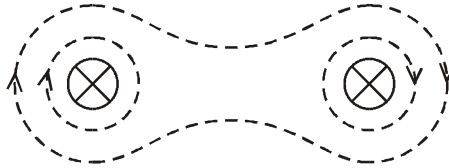
**SL Magnetic Fields and Forces MS**

1. C [1]

2. A [1]

3. B [1]

4. (a) (i)  $\rightarrow \leftarrow$ ; 1  
 (ii)



general shape: at least one circle around each wire and one loop around both wires;  
 appropriate spacing of lines: increasing separation with distance from wires;  
 correct direction of field;

3

(b) velocity increases;  
 acceleration increases;  
 because the force is getting larger the closer the wires get together; 3  
*Watch for ECF if force is drawn in wrong direction in (a) (i) i.e. velocity increases, acceleration decreases, force gets smaller.*

[7]

5. B [1]

6. B [1]

7. (a) (i) lines parallel and normal to plates; *(ignore any edge effect)*  
 equally spaced;  
 direction from (+) to (-); 3

(ii) curved path between plates and no curvature outside;  
 in downward direction; 2

(b) (i)  $\text{change} = q\Delta V$ ;  
 $= 1.6 \times 10^{-19} \times 750$   
 $= 1.2 \times 10^{-16} \text{ J}$ ; 2  
*Or 750 eV.*

(ii)  $\frac{1}{2}mv^2 = 1.2 \times 10^{-16}$ ;  
 $\frac{1}{2} \times 9.1 \times 10^{-31} \times v^2 = 1.2 \times 10^{-16} / v^2 = 2.64 \times 10^{14}$   
 to give  $v = 1.67 \times 10^7 \text{ m s}^{-1}$ ; 2

- (c) (i) inside solenoid, lines parallel to axis;  
line spacing about double at ends / lines equally spaced in solenoid;  
reasonable shape (symmetry and curving);  
correct direction (to left); 4
- (ii) path with no deviation along axis; 1
- (d) (i) velocity component normal to field =  $1.6 \times 10^7 \times \sin 35$ ;  
=  $9.2 \times 10^6 \text{ m s}^{-1}$ ; 2
- (ii) circular motion;  
in plane normal to paper;  
$$\frac{mv^2}{r} = Bqv / r = \frac{(9.1 \times 10^{-31} \times 9.2 \times 10^6)}{(4.0 \times 10^{-3} \times 1.6 \times 10^{-19})}$$
;  
radius of circle =  $1.3 \times 10^{-2} \text{ m}$ ; 4
- (iii) velocity component along field =  $1.6 \times 10^7 \times \cos 35$   
=  $1.3 \times 10^7 \text{ m s}^{-1}$ ; 1
- (iv) force is zero;  
because  $F = Bqv \sin \theta$  and  $\theta = 0$  or in "words"; 2
- (e) helical shape (*allow spiral shape*);  
any further detail e.g. constant pitch etc.; 2  
*Award [2] for a good diagram.*

**[25]**