

## Stage 3 Physics: Motion and Forces in Electric and Magnetic Fields

### UNIT TEST

Name: \_\_\_\_\_ (40 marks)

1. When drawing field lines around point charges, they are drawn such that the lines are closer together near the point charge but further apart as you move away.

a. Explain what this tells us about the fields around point charges. (1 mark)

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In parallel plates however, the lines are drawn parallel and the same distance apart.

b. Why is this different to point charges? (1 mark)

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2. Draw the electric field lines for the following two situations. (4 marks)

a. Two positively charged point charges.      b. A positive point charge above a negatively charged plate.

3. A pith ball (small foam ball) has been given a charge of  $-8.45 \times 10^{-2} \mu\text{C}$  and is placed within an electric field. The pith ball experiences a force of  $4.25 \times 10^{-4} \text{ N}$  north.

a. Calculate the magnitude of the field at that point. (2 marks)

b. What is the direction of the force? Explain your answer. (2 marks)

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4. In an experiment, two parallel plates are set up in a vacuum. The plates are 2.50 cm apart and connected to opposite terminals of a 240 V power supply
- a. Determine the magnitude of the electric field between the plates. (2 marks)

- b. Calculate the force the electric field exerts on an electron within the field. (2 marks)

- c. Calculate the lost in potential energy for an electron as it leaves the negative plate and hits the positive plate. (2 marks)

- d. Calculate the maximum speed of the electron. (2 marks)

- e. If the plates were moved closer, how would it affect:

- (i) the electric field strength between the plates? Explain. (2 marks)

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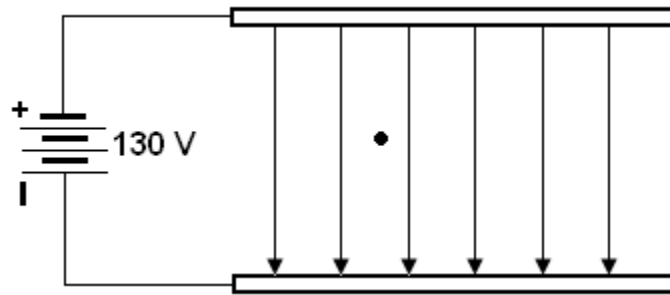
- (ii) the potential difference? Explain. (2 marks)

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5. A charged particle of mass  $3.80 \times 10^{-6} \text{ g}$  is suspended between two plates as shown. The plates are 5.45 mm apart.

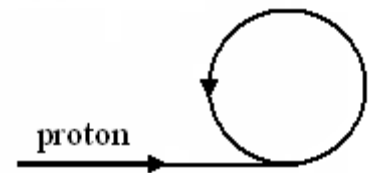


- a. Determine the strength of the electric field between them. (2 marks)
- b. Calculate the charge on the particle. (3 marks)
- c. The charge is due to a number of excess electrons on the particle. Calculate the number of excess electrons. (1 mark)
6. Calculate the force on an electron which is moving horizontally with a constant velocity of  $8.25 \times 10^7 \text{ m s}^{-1}$  south when it enters a uniform magnetic field of  $5.5 \times 10^{-3} \text{ T}$  east. (2 marks)

7. A proton experiences a force of  $2.11 \times 10^{-14} \text{ N}$  when it enters a magnetic field as shown in the diagram. The velocity of the proton is  $1.50 \times 10^6 \text{ ms}^{-1}$ .

a. Describe the direction of the magnetic field. (1 mark)

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b. Calculate the strength of the magnetic field that is acting on the proton. (2 marks)

c. What is the diameter of the path followed by the proton? (3 marks)

d. Calculate the frequency of the path of the proton. (2 marks)

8. The diagram below shows a uniform magnetic field with three particles A, B and C having masses and charges as shown in the table below. They each enter the magnetic field with the same velocity,  $v$ . Complete the diagram to show the paths of particles A, B and C. (3 marks)

Particle	Relative charge	Relative mass
A	1 +	$m$
B	2 +	$2m$
C	1 -	$m$

