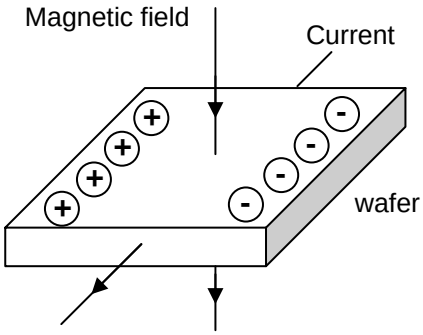
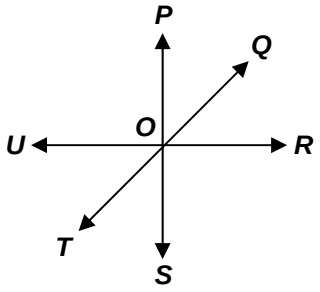
RJC PHYSICS DEPARTMENT
EM, EMI REVISION SOLUTIONS
for selected questions
Prepared by Mr fRancis

Question 8





Using Fleming's left hand rule, there will be a force acting on the electrons towards ***OR***. Electrons are considered instead of positive charges because electrons are the charge carriers. Hence electrons will move towards the right side of the wafer. The left side of the wafer will be of higher potential than the right side, thus the electric field produced is in the direction of ***OR***.

HCI P2/Q6

(a) $Bqv = mr\omega^2$

$\Rightarrow Bqr\omega = mr\omega^2$

$\Rightarrow \omega = \dfrac{Bq}{m}$ (shown)

(b)(i) 1. $\omega = \dfrac{Bq}{m}$

$\dfrac{2\pi}{T} = \dfrac{Bq}{m}$

$T = \dfrac{m}{2\pi Bq}$

Since m, q, B are the same throughout, the time required for one oscillation is constant.

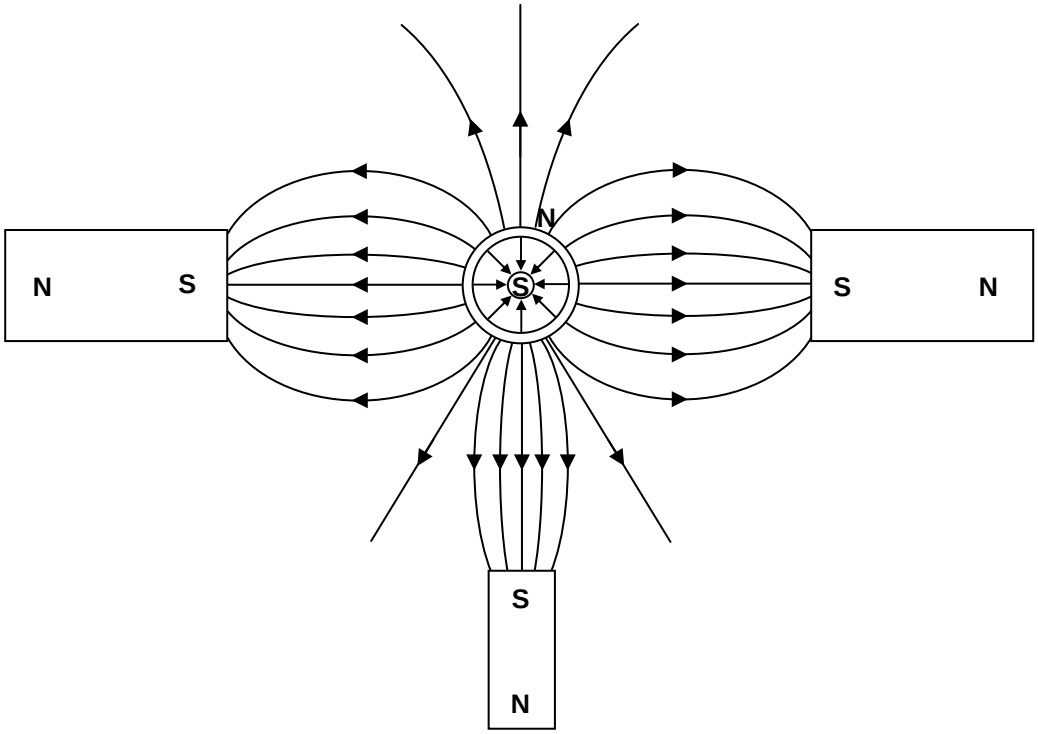
2. $\omega = \dfrac{Bq}{m} = \dfrac{0.40 \times 1.6 \times 10^{-19}}{3.34 \times 10^{-27}} = 1.92 \times 10^{7}$ rad s^{-1}

(ii) $v = r\omega = 1.30 \times 1.916 \times 10^{7} = 2.49 \times 10^{7}$ m s^{-1}

(iii) $KE = eV_p = 1.6 \times 10^{-19} \times 100 \times 10^{-3} = 1.6 \times 10^{-20}$ J

PJC P2/Q5

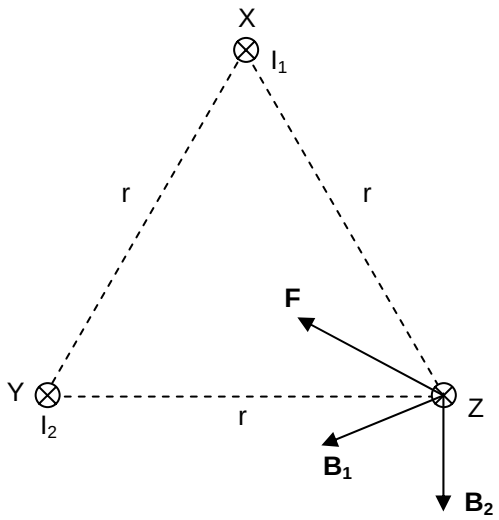
(e)



(f) Gravitational field lines of the mass will always point towards the mass itself because gravitational force is attractive. Hence there is no way we can connect gravitational field lines between two masses and gravitational field of such shape can never be achieved.

PJC P3/Q5

(c)(i),(ii)

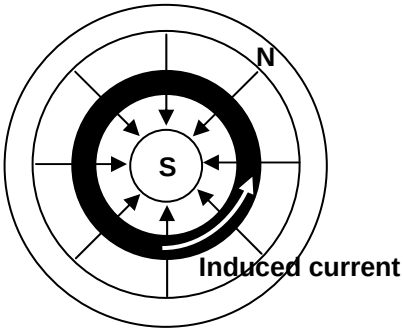


(iii) No effect on the charge because it is stationary.

(d) Student B.
When the ring enters the field, it experiences a change in flux as it cuts through the magnetic field. According to Faraday's law, e.m.f. is set up and by Lenz's law, a current is induced in a direction such that a magnetic field is set up to oppose the increasing flux threading the ring. This slows down the entry of the ring.

When the ring leaves the magnetic field, current is induced in a direction such that a magnetic field is set up to oppose the decreasing flux threading the ring. This slows down the exit of the ring.

(e)(i) When the ring is released from rest in the radial magnetic field, it will initially fall with increasing velocity. As it moves down, it will slow down until it reaches terminal velocity. (Note that the motion described is all within the magnetic field)



Plan view from the top

(f)(i) Axle – positively charged.
Rim – negatively charged.

(ii) $\varepsilon = \dfrac{d\Phi}{dt} = BAf$

$\Rightarrow 1.0\times10^{-2} = \left(5.0\times10^{-5}\right)\left(\pi\times1.2^2\right)f$

$\Rightarrow f = 44.2$ rev s^{-1}

Note: The e.m.f. induced is not 4ε even though there are 4 spokes. The potential difference between the rim and the axle is ε throughout instead of 4ε. Their individual e.m.f across each spoke does not add up as they can be regarded as 4 spokes in parallel with the same potential difference.