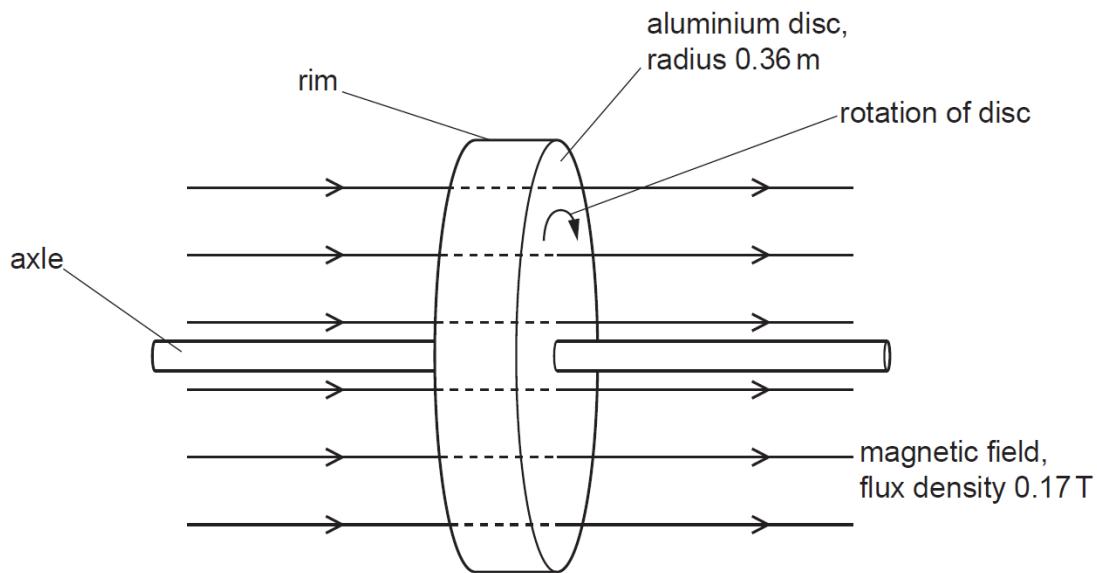


- 4 (a) A heavy aluminium disc has a radius of 0.36 m. The disc rotates with the wheels of a vehicle and forms part of an electromagnetic braking system on the vehicle.



**Fig. 4.1**

In order to activate the braking system, a uniform magnetic field of flux density 0.17 T is switched on. This magnetic field is perpendicular to the plane of rotation of the disc, as shown in Fig. 4.1.

- (i) Define magnetic flux linkage.

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[2]

- (ii) The disc is rotating at a rate of 25 revolutions per second.

Calculate the magnitude of the electromotive force (e.m.f.) induced between the axle and the rim of the disc.

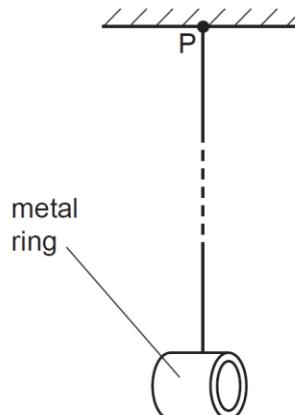
$$\text{e.m.f.} = \dots \text{V} [3]$$

- (iii) The axle and the rim are connected to an external circuit that enables the energy of the rotation of the disc to be stored for future use. The direction of rotation is shown in Fig. 4.1.

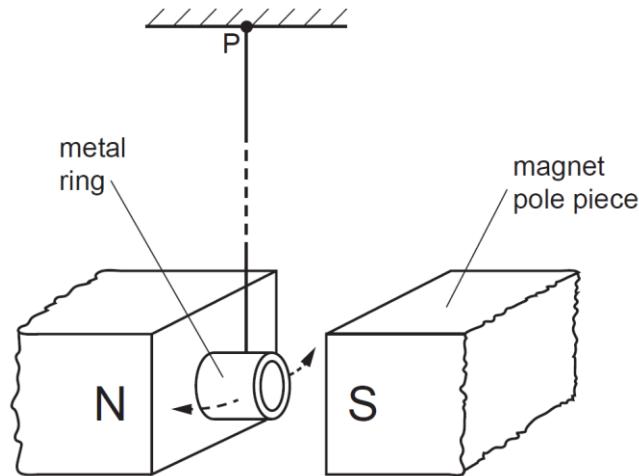
Use Lenz's law of electromagnetic induction to determine whether the current in the disc is from the rim to the axle or from the axle to the rim. Explain your reasoning.

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..... [3]

- (b) A metal ring is suspended from a fixed point P by means of a thread, as shown in Fig. 4.2.



**Fig. 4.2**



**Fig. 4.3**

The ring is displaced a distance  $d$  and then released. The ring completes many oscillations before coming to rest.

The poles of a magnet are now placed near to the ring so that the ring hangs midway between the poles of the magnet, as shown in Fig. 4.3.

- (i) The ring is again displaced a distance  $d$  and then released.

Explain why the ring completes fewer oscillations before coming to rest.

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[4]

- (ii) The ring in (b) is now cut so that it has the shape shown in Fig. 4.4.



Fig. 4.4

Explain why, when the procedure in (b) is repeated, the cut ring completes more oscillations than the complete ring when oscillating between the poles of the magnet.

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[3]