**5** **(a)** A copper disc of radius *r* is made to spin at a constant rate between the poles of an electromagnet as shown in **Fig. 5.1**. When a voltmeter was connected across points P and R (see **Fig. 5.2**) by means of frictionless brushes, an e.m.f. of 10.0 mV was measured.

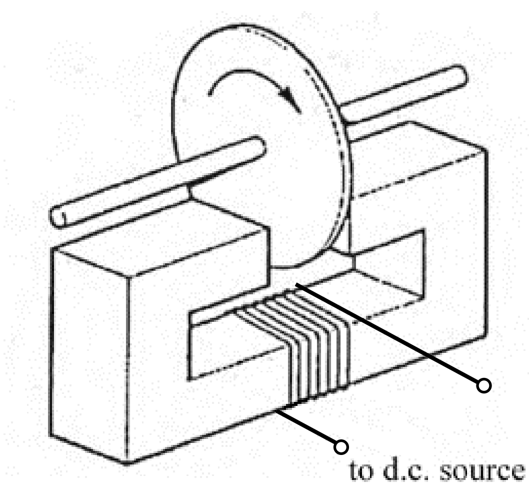


**Fig. 5.1**

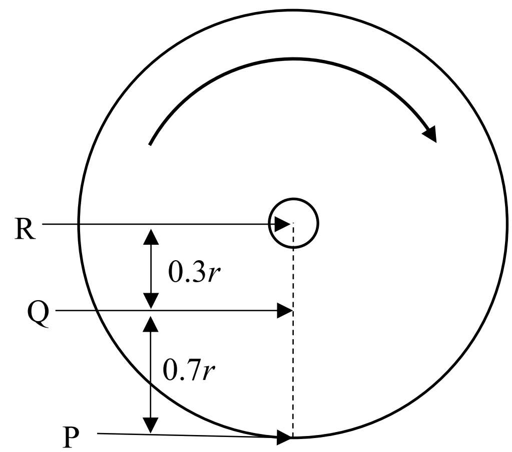


**Fig. 5.2**

**(i)** Explain how an e.m.f. is formed across PR when the disc spins.

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**(ii)** Calculate the e.m.f. measured if the frictionless brushes were connected across QR. State your assumption.

e.m.f. = …………………… V [2]

Assumption: ……………………………………………………….. [1]

**(iii)** Hence calculate the e.m.f. generated when the brushes are connected across PQ.

e.m.f. generated = ………………………. V [1]

**(b)** In part **(a)**, P is at a higher potential compared to R.

**(i)** On **Fig. 5.2**, indicate clearly the direction of the magnetic field acting on the disc. [1]

**(ii)** On **Fig. 5.1**, indicate the polarity of the ends of the electromagnet facing the disc, using the letters 'N' and 'S'. [1]

**(iii)** On **Fig. 5.1**, indicate clearly the direction of current in the coil. [1]

**(c)** Suppose that a much larger magnet is now used such that the whole disc is subjected to a uniform magnetic flux density of *B*, in contrast to where only the bottom region of the disc is being subjected to the magnetic flux density of *B*. State how this change would affect the value of e.m.f. across PR.

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