

- 4 Two parallel conducting rails of negligible resistance are placed 15.0 cm apart as shown in Fig. 4.1 below. Two metal rods, AB and CD, which can slide smoothly along the rails, are being pulled away by external forces. Rod AB is being pulled at a constant speed of  $3.0 \text{ m s}^{-1}$  while rod CD is being pulled at a constant speed of  $5.0 \text{ m s}^{-1}$  in the opposite direction. There is a uniform magnetic field strength of 0.15 T applied perpendicular to the plane of the rails into the paper.

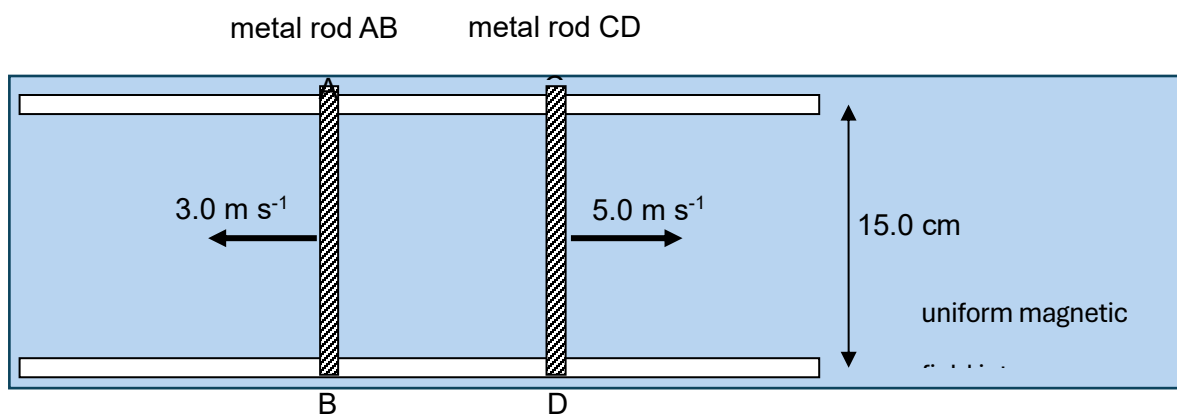


Fig. 4.1

- (a) Define magnetic flux and state its units.

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- (b) Calculate the rate of increase of the area of loop ABDCA.

rate of increase of area = .....  $\text{m}^2 \text{s}^{-1}$  [2]

- (c) As the rods AB and CD move, an e.m.f. is generated in the coil ABDCA. Explain why an e.m.f. is generated using Faraday's law of electromagnetic induction.

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- (d) Calculate the e.m.f. induced in the loop ABDCA.

e.m.f. induced = ..... V [2]

- (e) Describe and explain the direction of the induced current in the loop ABDCA.

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- (f) Rod AB is now being pulled at  $3.0 \text{ m s}^{-1}$  in the same direction as rod CD as shown in Fig. 4.2. Explain whether the e.m.f. induced will have a smaller or larger magnitude compared to that calculated in (d).

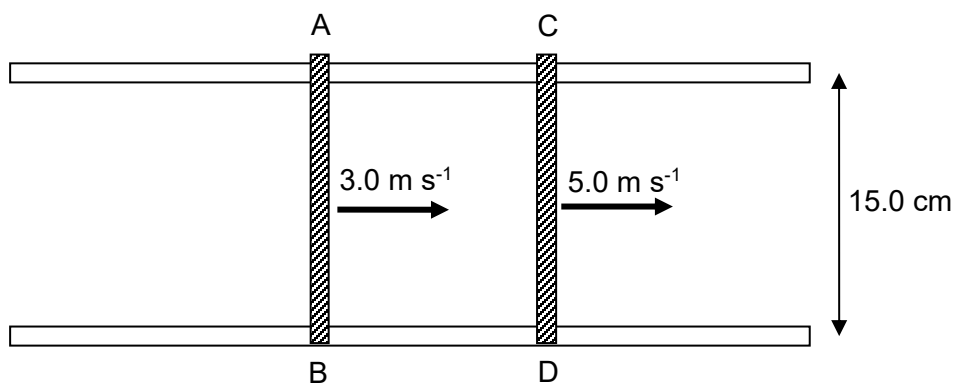


Fig. 4.2

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[Total: 12]