InkPhysics

ANSWER BOOK

Magnetic flux and flux linkage

Magnetic fields · Year 13

AQA 3.7.5.3 · CIE 20.5 · OCR A 6.3.3

10 questions · 30 marks

NAVY EDITION

inkphysics.co.uk

SECTION A · Warm-up

A1 $\Phi = BA$, where B is the flux density and A the area perpendicular to the field. The unit of flux is the weber (Wb). [2]

A2 $\Phi = BA = 0.20 \times 0.05 = 0.01$ Wb. [2]

A3 The flux linkage is the product of the magnetic flux through the coil and the number of turns, $N\Phi$. Its unit is the weber-turn. [2]

SECTION B · Standard

B1 $N\Phi = NBA = 200 \times 0.15 \times 0.02 = 0.60$ Wb-turns. [3]

B2 $N\Phi = BAN\cos\theta = 100 \times 0.30 \times 0.01 \times \cos 60^\circ = 0.15$ Wb-turns. [4]

B3 $B = \Phi/A = (8.0 \times 10^{-3})/0.04 = 0.20$ T. [3]

B4 Flux linkage follows $N\Phi = BAN\cos\theta$, where θ is between the coil normal and the field. It is maximum when $\theta = 0^\circ$ (coil plane perpendicular to the field) and zero when $\theta = 90^\circ$ (coil plane parallel to the field). [3]

SECTION C · Stretch

C1 (a) $N\Phi = NBA\cos 0^\circ = 50 \times 0.40 \times 0.02 = 0.40$ Wb-turns. (b) $N\Phi = NBA\cos 90^\circ = 0$. [4]

C2 $\Delta(N\Phi) = NA\Delta B = 500 \times 0.008 \times (0.30 - 0.10) = 0.80$ Wb-turns. [4]

C3 A small coil of known turns and area is connected to a voltmeter or oscilloscope and placed in the field. Changing the flux through it (by moving it, or using an alternating field) induces an emf proportional to the rate of change of flux linkage, from which the flux density can be found. [3]