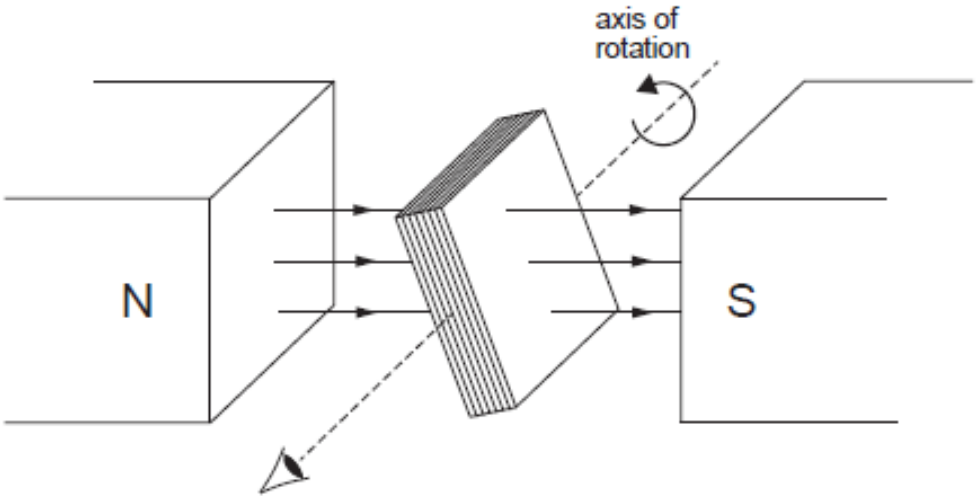
Physics

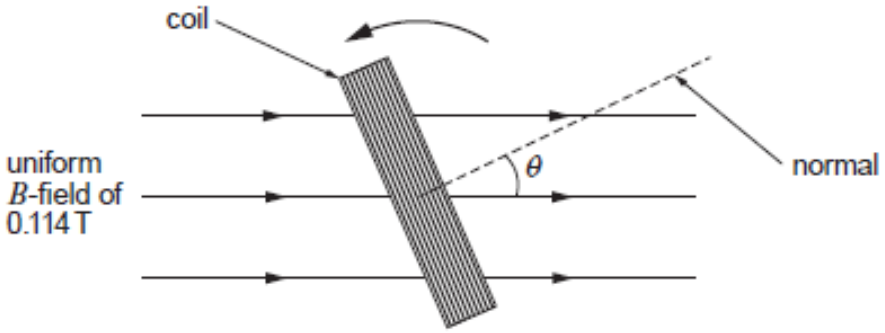
Question	Maximum Mark	Mark Awarded
#1	5	
#2	11	
#3	15	
#4	16	
Total	47	

#1

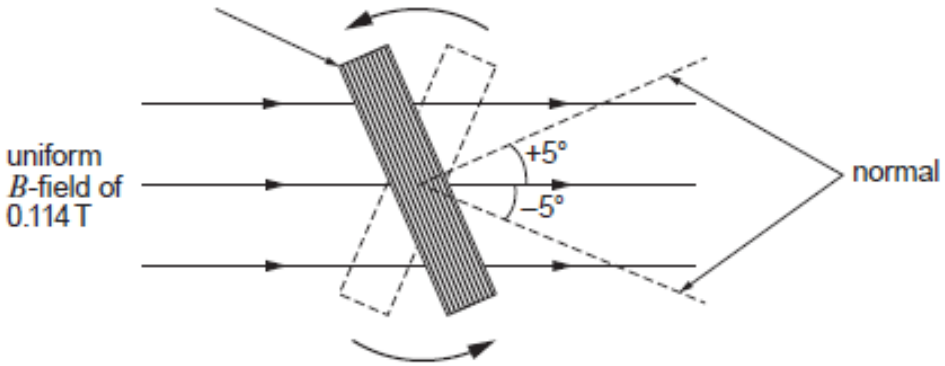
10. A rectangular coil rotates at a constant angular velocity within a uniform magnetic field of 0.114 T. The coil has 270 turns and cross-sectional area 420 cm^2. The diagram below is a simplified 3D diagram of the coil.



This second diagram is a 2D representation of the coil looking along the axis of rotation.



The flux **linkage** of the coil for the angles $\theta = -5°$ and $\theta = +5°$ is 1.29 Wb turn in each case.



(a) Show clearly how this value for the flux linkage is obtained. [2]

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(b) Explain why the induced emf is zero when $\theta = 0$. [1]

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(c) The flux **linkage** of the coil for the angles $\theta = 85°$ and $\theta = 95°$ are 0.11 Wb turn and −0.11 Wb turn respectively. The coil rotates 10° in a time of 5.8 ms. Calculate the mean induced emf when rotating between $\theta = 85°$ and $\theta = 95°$. [2]

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Question taken from Eduqas examination paper 842103, June 2019

#2

10. A silver ring on a light rod swings as a pendulum with damped simple harmonic motion. The damping is caused by a stationary magnet as shown in the diagram.

(a) Explain why the motion of the pendulum is damped. [4]

(b) Explain what, if anything, would happen to the motion of the pendulum if the bar magnet were reversed. [2]

(c) The resistivity of silver is $1.59 \times 10^{-8}\,\Omega\text{m}$, the radius of the silver ring is 2.5 cm and the cross-sectional area of the silver wire of the ring is $2.4 \times 10^{-5}\,\text{m}^2$. Show clearly that the resistance of the silver ring is approximately $0.1 \times 10^{-3}\,\Omega$. [2]

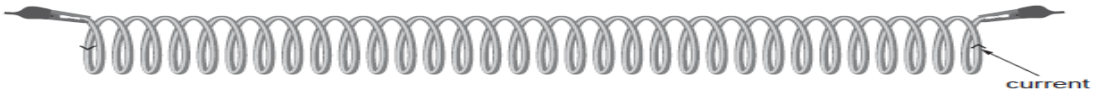
(d) The maximum current induced in the silver ring is 5.5 A. Calculate the maximum rate at which the magnetic flux density inside the ring changes. [3]

Question taken from Eduqas examination paper 842103, June 2018

#3

(a) (i) A long solenoid has 12 000 turns per metre and carries a current of 3.8 A. Calculate the magnetic flux density at its centre. [1]

(ii) **Sketch the magnetic field lines** due to this long solenoid. [2]



(iii) State how the strength of the magnetic field produced by **this solenoid** can be increased greatly without increasing the current or changing the dimensions of the solenoid. [1]

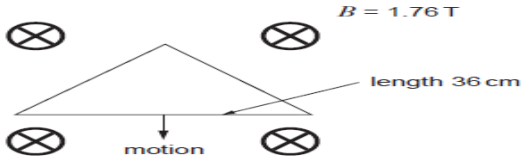
(b) Maria carries out an experiment inside an extremely large magnetic field of uniform density 1.76 T. She uses a copper wire and deforms it from shape 1 to shape 2 in a time of 42 ms.

(i) Explain why a large current flows in the copper wire during this deformation. [3]

(ii) Explain how you can deduce that this current flows anticlockwise. [2]

(iii) Calculate the mean current flowing in the copper wire given that its resistance is $6.75 \times 10^{-3}\,\Omega$. [3]

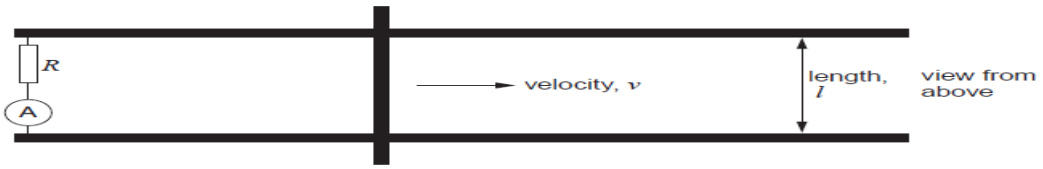
(iv) Halfway through the deformation of the copper wire it is in the position shown below. Maria claims that in this position, a "motor effect" force of approximately 200 N will act upwards on the length of copper wire shown. Determine whether or not Maria is correct. [3]



Question taken from Eduqas examination paper 842103, November 2020

#4

An experiment is carried out on a flat, horizontal railway track to measure the vertical component of the Earth's magnetic field, B. A metal conductor is placed across the railway tracks and moved quickly in the direction shown.



(a) (i) Explain why a current is detected by the ammeter. [2]

(ii) Explain why the current is independent of the horizontal component of the Earth's magnetic field. [1]

(b) Use Faraday's law to derive the expression for the current: [3]

$$I = \frac{Bl}{R} v$$

(c) The results obtained are tabulated.

Velocity / $m\,s^{-1}$ $\pm 1\,m\,s^{-1}$	Current / μA $\pm 10\,\mu A$
20	40
40	80
60	110
80	150

(i) Without drawing a graph, explain whether or not the data are consistent with the equation: [4]

$$I = \frac{Bl}{R} v$$

(ii) Use the data in the table with the smallest percentage uncertainties to calculate the vertical component of the Earth's magnetic field, B, together with its **absolute uncertainty** (l =1.400 m, R = 43.0 Ω with negligible uncertainties). [6]

Question taken from Eduqas examination paper 842103, June 2017