

2001 HIGHER SCHOOL CERTIFICATE EXAMINATION
Physics

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Centre Number

Section I – Part B (continued)

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Student Number

Marks

Question 21 (3 marks)

A fan that ventilates an underground mine is run by a very large d.c. electric motor. This motor is connected in series with a variable resistor to protect the windings in the coil.

3

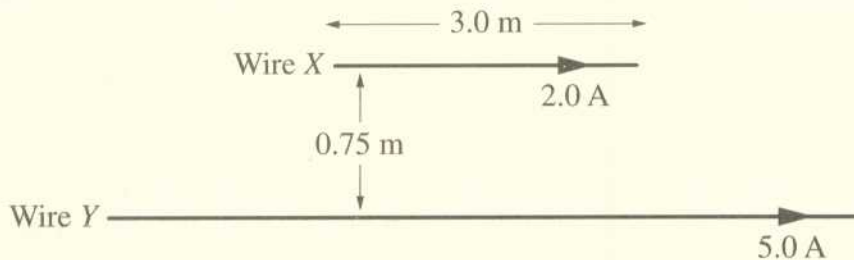
When the motor is starting up, the variable resistor is adjusted to have a large resistance. The resistance is then lowered slowly as the motor increases to its operating speed.

Explain why no resistance is required when the motor is running at high speed, but a substantial resistance is needed when the motor is starting up.

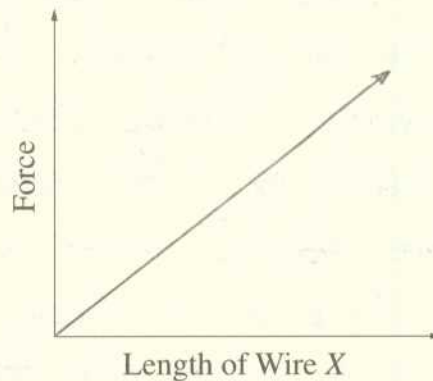
When the motor is turned on there will be a large current in the circuit and can blow out the motor if a high resistance is not added. as the motor runs, it acts like a generator, since the relative motion of a conductor to a magnetic field induces a current in a direction to oppose its motion (Lenz's Law) so a back emf is induced in the motor and regulates the speed of the motor and so the resistance can be removed gradually.

Question 22 (7 marks)

Two parallel wires are separated by a distance of 0.75 m. Wire X is 3.0 m long and carries a current of 2.0 A. Wire Y can be considered to be infinitely long and carries a current of 5.0 A. Both currents flow in the same direction along the wires.



- (a) What is the direction of the force that exists between the two wires? 1
It is a force of attraction. The force acts towards the opposite wire.
- (b) On the axes, sketch a graph that shows how the force between the two wires would vary if the length of Wire X was increased. 2



- (c) In your Physics course you have performed a first-hand investigation to demonstrate the motor effect. Explain how your results demonstrated that effect. 4

The motor effect is that a current carrying conductor in a magnetic field experiences a force (given by $F = BIL$). A piece of copper wire (connected to a current source) was placed on a balance, and the balance zeroed. An electromagnet was brought nearer near the copper and the "mass" (which is proportional to the force) was measured. The current in the electromagnet was increased (increasing the magnetic field strength) and it was seen that the mass (and force) increased. The current in the copper was increased, which increased the mass again. Also the size of the copper wire was varied (repeating the experiment) and it was seen that as the length of the copper wire in the field increased, so did the force. This shows that $F \propto B, I$ and L .

Marks

Question 23 (6 marks)

Discuss the effects of the development of electrical generators on society and the environment.

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No sample available for Question 23, Band 5/6, Sample 3.