2001 HIGHER SCHOOL CERTIFICATE EXAMINATION

Physics

Centre Number

Student Number

Section I – Part B (continued)

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.

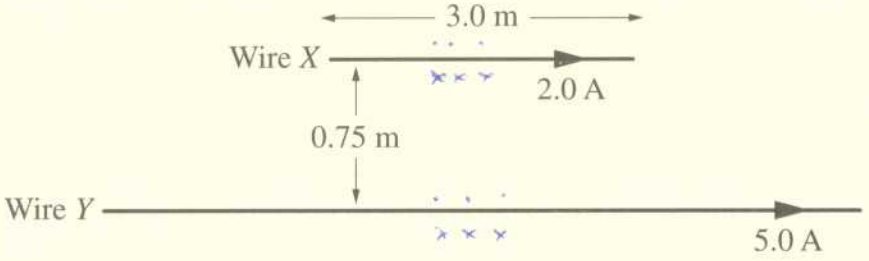
Explain why no resistance is required when the motor is running at high speed, but a substantial resistance is needed when the motor is starting up.

This is due to back EMF, when the motor is running at low speed, the induce EMF is small since the rate of change is small. The resistance is then used to stop the motor from burning up. As the motor increases speed the back EMF will also increase, Lenz's law states that the EMF produce is such that it opposes the change. Here it will slow it down and the motor will not burn up. What causes the motor to burn is the high current when there is no resistance.

Marks

Question 22 (7 marks)

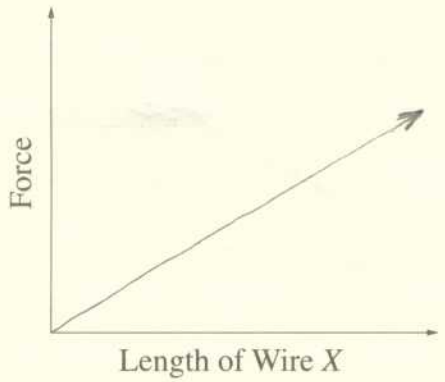
Two parallel wires are separated by a distance of 0.75 m. Wire X is 3.0 m long and carries a current of 2.0 A. Wire Y can be considered to be infinitely long and carries a current of 5.0 A. Both currents flow in the same direction along the wires.



(a) What is the direction of the force that exists between the two wires? **1**

the wires are attracted towards each other.

(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**



F ∝ l

(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 states that a current-carrying wire placed within a magnetic field will have a force applied to it as a result of the magnetic field. By placing a coil of wire (attached to an axle) within a ~~vertical~~ horizontal magnetic field and then applying a current to the wire, a force could be seen to act on the opposite sides of the wire coil causing it to turn until it reached a vertical position. This both demonstrated the effect of a magnetic field on currents in different directions, and demonstrated the basic principle behind an electric motor (without a commutator)

Marks

Question 23 (6 marks)

Discuss the effects of the development of electrical generators on society and the environment. **6**

Electrical generators have had an ~~extremely~~ extremely large effect on both society and the environment. For society the creation of a device capable ~~for~~ of generating an electric current has allowed mankind's developements from the simple lightbulb to the most complex electronic systems. Electricity has allowed much safer and less costly industry and transport (eg trains). The impact on the environment has been detrimental, however, although is being decreased by modern efficiency and alternative power sources. This is because the primary fuels used to generate electric current by generators are fossil fuels, the burning of which pollutes the environment. The use of electricity to power, for example, a train is more efficient than its previous steam-powered alternative, which means that despite the large amounts of fossil fuel burnt, electrical generators are simpler and more efficient in their use of such fuels ~~than~~ than their fuel-based alternatives. This simplicity and efficiency of electricity has, however, made society virtually dependant on it, therefore increasing fuels and damaging the environment.