

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

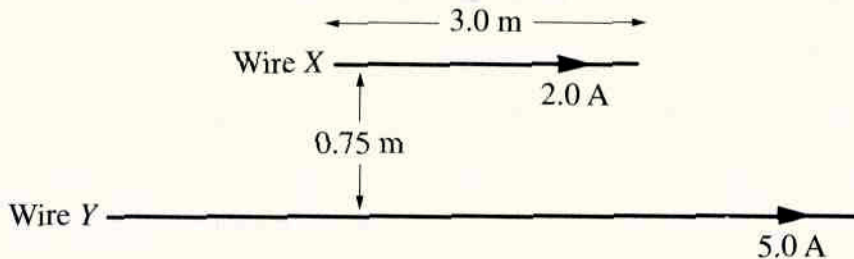
When the motor is starting up, the variable resistor is adjusted to have a large resistance. The resistance is then lowered slowly as the motor increases to its operating speed.

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.

.....
No resistance ~~is~~ required when motor running at high speed because a large back EMF is induced in the motor (due to Lenz's law), which ~~lowers~~ ^{lowers} the voltage & hence current in the motor to ~~safe~~ safe levels. However when motor is starting up, the temporary high spin of motor due to large EMF (as back EMF takes time to take effect) creates large currents in the motor, which can be dangerous & also damage ~~the~~ motor coils. (ie I exceed ~~the~~ limit & burns out)

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.

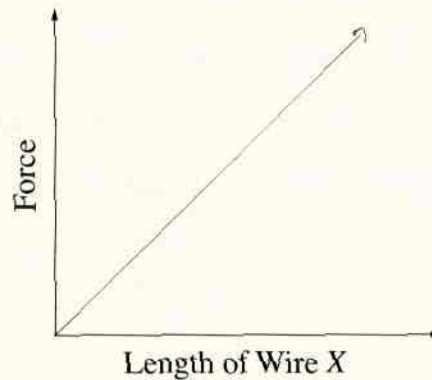


- (a) What is the direction of the force that exists between the two wires? 1

There is an attractive force between the wires

- (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

$F = k \frac{I_1 I_2}{d} \times L$



as long as the currents and distance between the wires remains constant.

- (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 wire in a magnetic field will have a force acting upon it. This was demonstrated by placing a single wire coil between the poles of a magnet, creating a stator (magnetic field). The coil was connected to DC power using a split ring commutator to alter the direction of the current. The coil was secured in a rigid clamp which allowed it to rotate freely.

Question 23 (6 marks)

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

6

Electric generators have affected society in a positive and negative manner. Generators have impacted positively on society in that it has allowed factory work ^{and the environment} to be more efficient. It has allowed people to work from home, by the use of generators in computers, generators has allowed electricity to reach every home and power all sorts of appliances. On the environment, by improving machinery it has reduced the amount of hazardous material and gases produced by machinery, which affects society (harmful) and vegetation (floods + famines). It also has had a negative impact on the environment, in burning coal, produces CO₂ which leads to the greenhouse effect. Burning of coal releases sulphur dioxide into the air, which produces acid rain. This leads to deforestation, erosion of marble and limestone surfaces, as well as danger to humans. There is a major problem with nuclear waste disposal with the long half life (20,000 years). This leads to impacts on society in possible accidents, and also increased dependence on machinery. Society is becoming machine and technology orientated.