2001 HIGHER SCHOOL CERTIFICATE EXAMINATION

Physics

Centre Number

Section I – Part B (continued)

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.

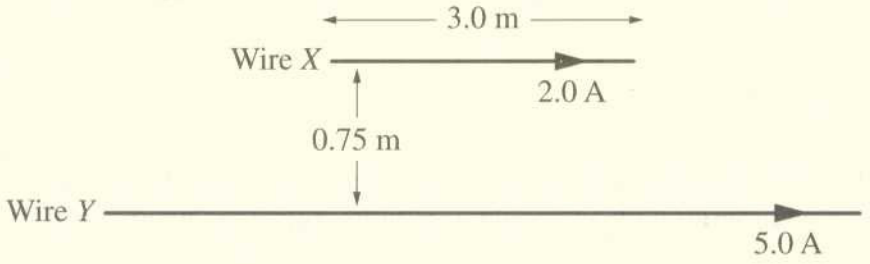
Explain why no resistance is required when the motor is running at high speed, but a substantial resistance is needed when the motor is starting up.

when the motor is switched on, back emf is very small. This allows large currents to run through the coils which might burn it out. By having a starting resistance the current is kept at manageable levels. As the coil begins to rotate the back emf increases reducing the current flow. The back emf is an application of Lenz's Law ie. a current is produced to oppose the motion that caused it. Because this back emf reduces the current, there is no need for a resistance when the motor is running.

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.

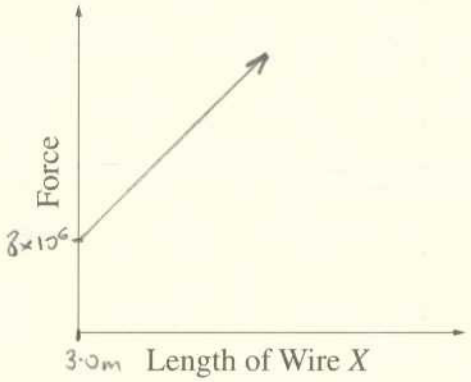


(a) What is the direction of the force that exists between the two wires? **1**

There is a force of attraction between the wires.
Wire Y is forced up, Wire X is forced down

(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**

$F = \frac{\mu_0 I_1 I_2 l}{2\pi d}$



(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**

Two parallel metal rods were set up with a third rod allowed to roll along the first two. The ends of the parallel rods were connected to a high current which flowed through the rolling rod. When magnets were held above and below the rolling rod, to create a magnetic field the rod would move quickly along the parallel rods. This demonstrated that a current carrying conductor experiences a force when placed in a magnetic field. This force could be predicted using the right-hand rule.

Marks

Question 23 (6 marks)

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

Prior to electricity, the burning of wood and coal were the major sources of energy. With the discovery of electromagnetic induction by Faraday and Joseph Henry electricity became the primary energy source. Faraday devised the first generator, and with the development and production of the electric motor, and the first continuous generator by Gramme electricity was soon able to be mass produced. Thomas Edison in 1879 invented the incandescent light bulb and within two years of this electricity was in the homes and the infrastructure in place.

In employment, the steam engine wiped out the textile looms. Soon there was a demand for labour in industry. This caused rural urban migration and overcrowding in cities. Slums developed and the working conditions were poor. The introduction allowed many advances in technology however the ~~electric~~ incandescent + electricity light allowed people to work longer days in poorer conditions.

Electricity has had many detrimental affects on the environment. The burning of fossil fuels has caused increases in greenhouse gas emissions, global warming and acid rain. Solar energy and other natural sources would be much more environmentally friendly.