

Question 27 (4 marks)

There are two areas in which energy savings can be made by the use of superconductors. These are:

4

- electricity generation and transmission;
- transportation.

Discuss how energy savings can be achieved in each of these two areas.

Electricity generation and transmission:

Power loss

$$= I^2 R$$

↑

no power loss since

$$R = 0$$

If power lines were superconductive there would be ZERO power loss due to no resistance heating effects.

The energy savings from using superconductors in power transmission would be enormous. (Also, it would not be necessary to step voltages up to dangerous levels, increasing safety without affecting efficiency)

Transportation:

Magnetic levitation by use of the Meissner effect allows trains to float above their track and therefore have very little resistance to motion. Such trains can travel several hundred $\text{km}\cdot\text{h}^{-1}$ only using energy to keep the superconductors cold and minimal propulsion when up to speed. The energy savings are significant as much less energy is required and the train carries more people per hour than a conventional train due to its higher speed.