Engineering Studies

Section II (continued)

Marks

Question 13 — Personal and Public Transport (10 marks)

A railway track has rails made of 0.8% carbon steel.

(a) The surface of the rails has been induction heated and water quenched. Describe   **3**
the final structure and properties of the rail.

- ~~Whorter larger~~ Shorter equizxed grains
- Smaller percentage of carbon steel
- Very brittle Hard and malleable

(b) A suburban train weighing 400 tonnes has to climb a gradient of 1 in 50 at a   **3**
constant velocity of 60 km per hour.

If the power required to overcome rolling resistance at this velocity is 450 kW,
calculate the overall power needed to climb the gradient.

$$KE = \tfrac{1}{2} m \times v^2$$

$$KE = \tfrac{1}{2} \times 400 \times \left(\tfrac{60}{400}\right)^2$$

$$KE = 720 KW$$

$$PE = m \times g \times h$$

$$= 400 \times 9.8 \times \tfrac{1}{50}$$

$$= 78.4 kW$$

$$W = 720 + 78.4$$

$$W = 798.4 KW$$

Power = ...13.3 KW.........

$$P = \frac{W}{t}$$

$$P = \frac{798.4}{60}$$

$$P = 13.3 KW$$

Question 13 continues on page 16

Question 13 (continued)

(c)   (i)   Describe how an electric motor is used to convert electricity into rotary   **2**
motion.

• The current runs through a copper coil, creating a magnetic field.
• The magnets then spin and rub on the brushes creating friction
• The friction then moves the motor.

(ii)   Describe TWO different applications of electrical motors that are used in   **2**
transport systems.

Trains used electrical motors
1. Induction Motors
2. —

End of Question 13