2003 HIGHER SCHOOL CERTIFICATE EXAMINATION

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.

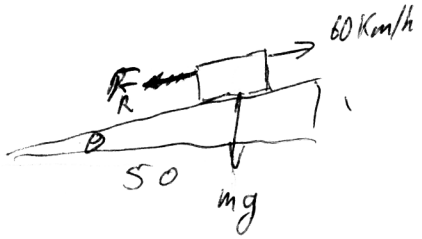
(a) The surface of the rails has been induction heated and water quenched. Describe the final structure and properties of the rail. **3**

The final structure of the rail will have a large mainly-peritic core which is tough and strong but a little softer than the hardened, more brittle surface which has a ~~fine~~ martensite structure.

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

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

SOH



$\theta = 1^\circ 8' 44.75''$

$mg = 400\,0000\ N$

$v = 16\frac{2}{3}\ m/s$

$F_R = \sin\theta \times 4000\,000$

$= 79\,984.08\ N$

$P = Fv$

$= 79\,984.08 \times 16\frac{2}{3} + 450\,000$

$= 17\,83\,067.97\ W$

Power = 1783 KW

Question 13 continues on page 16

Marks

Question 13 (continued)

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

An electric motor uses a coil of wire on a rotating armature set in a magnetic stator field. When an electric current is applied to the coil it creates a magnetic field on the rotor which repels the stator field and forces the rotor to turn. A brush/commutator system transfers and reverses the polarity of the current supplied to the coil. 2

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

Electrical motors are used in electric locomotives to drive the train as well as in automobiles to cause windscreen wipers to move.

End of Question 13

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