

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 is strong, tough and brittle.~~ The final structure is strong, tough and brittle.

- (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.

~~mass~~ weight = 400 tonnes = 400 000 kg ~~400 000 kg~~

$V = 60 \text{ km/h}$

Power = 450 kW = 450 000 W

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

$P = \frac{400000}{60}$

= 6666.67 (dec) kW

∴ overall power = 6666.67 + 450

Power = ~~666~~ 7116.7 (1 dec) kW

using gradient formulae

~~tan θ =~~

$\tan \theta = \frac{m_1 - m_2}{1 + m_1 m_2}$

$\tan \theta = \frac{\frac{1}{50} - 0}{1 + \frac{1}{50} \times 0}$

$\theta = \tan^{-1} \frac{1}{50}$

∠ of elevation = 1° 08' 44.75

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Question 13 (continued)

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

The electrical motor puts in power to the ~~rotors~~ rotors to spin. ~~at~~
~~electrical motor~~

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

Electrical motors are used in cars sometimes to ~~wind~~ wind down windows and they are also used ~~in~~ for the ~~planes~~ doors in planes ~~to~~ to close the baggage compartment.

End of Question 13