Solutionbank M1

Heinemann Modular Maths for Edexcel AS and A-level

5 Newton's laws of motion

Exercise A, Question 8

Question:

A lorry when fully laden has a mass of 40 tonnes. Its maximum speed when freewheeling down a slope inclined at 6° to the horizontal is 40 m s^{-1}, subject to air resistance which is proportional to the square of the speed of the lorry. When empty the lorry weighs 8 tonnes. What would be the maximum speed of the empty lorry when freewheeling down the same hill?

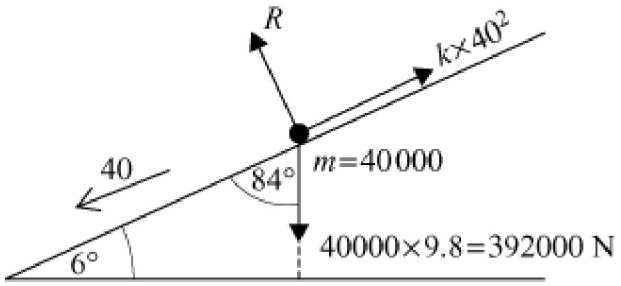
Solution:

Newton 1 down slope

$$392000 \cos 84° - k \times 40^2 = 0$$

$$\therefore \frac{392000 \cos 84°}{40^2} = k$$

$$\therefore k = 25.6094...$$



Newton 1 down slope

$$78400 \cos 84° - 25.6094 \times v_1^2 = 0$$

$$\therefore \frac{78400 \cos 84°}{25.6094...} = v_1^2$$

$$\therefore 320 = v_1^2$$

$$\therefore v_1 = 17.888...$$

$v_1 = 17.9$ m s^{-1} (3 s.f.) is the maximum speed .