3.

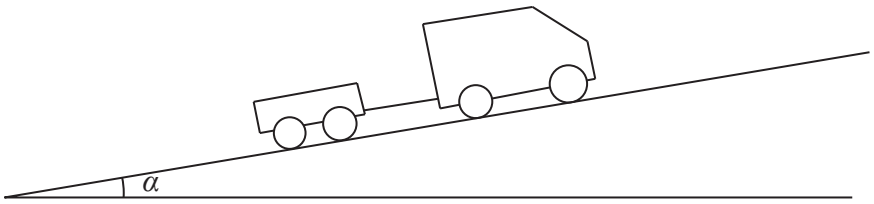


Figure 1

A van of mass 900 kg is moving up a straight road inclined at an angle α to the horizontal, where $\sin\alpha = \frac{1}{25}$. The van is towing a trailer of mass 200 kg. The trailer is attached to the van by a rigid towbar which is parallel to the direction of motion of the van and the trailer, as shown in Figure 1.

The resistance to the motion of the van from non-gravitational forces is modelled as a constant force of magnitude 400 N.
The resistance to the motion of the trailer from non-gravitational forces is modelled as a constant force of magnitude 240 N.

The towbar is modelled as a light rod.

The engine of the van is working at a constant rate of 15 kW.

(a) Find the acceleration of the van at the instant when the speed of the van is $12\,\text{m s}^{-1}$

(5)

At the instant when the speed of the van is $14\,\text{m s}^{-1}$, the trailer is passing the point A on the slope and the towbar breaks.

The trailer continues to move up the slope until it comes to rest at the point B.

The resistance to the motion of the trailer from non-gravitational forces is still modelled as a constant force of magnitude 240 N.

(b) Use the work-energy principle to find the distance AB.

(4)

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Question 3 continued

(Total for Question 3 is 9 marks)