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2. A car of mass 600 kg tows a trailer of mass 200 kg up a hill along a straight road that is inclined at angle θ to the horizontal, where $\sin\theta = \frac{1}{20}$. The trailer is attached to the car by a light inextensible towbar. The resistance to the motion of the car from non-gravitational forces is modelled as a constant force of magnitude 150 N. The resistance to the motion of the trailer from non-gravitational forces is modelled as a constant force of magnitude 300 N.

When the engine of the car is working at a constant rate of P kW the car and the trailer have a constant speed of $15\,\text{m s}^{-1}$

(a) Find the value of P.

(5)

Later, at the instant when the car and the trailer are travelling up the hill with a speed of $20\,\text{m s}^{-1}$, the towbar breaks. When the towbar breaks the trailer is at the point X. The trailer continues to travel up the hill before coming to instantaneous rest at the point Y. The resistance to the motion of the trailer from non-gravitational forces is again modelled as a constant force of magnitude 300 N.

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

(4)

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