WORK ENERGY AND POWER QUESTIONS WITH CARS, TRAILERS, CARAVANS.

1. A car of mass 1500 kg is towing a caravan of mass 500 kg by means of a tow rope up a straight road which is inclined at an angle α to the horizontal, where $\sin \alpha = \frac{1}{10}$. The car's engine is producing a driving force of 7000 N. The resistance to motion due to non-gravitational forces is 1000 N on the car and 400 N on the caravan, both assumed to be constant.

When the speed of the car is 10 m s^{-1}, the tow bar breaks. By considering energy, or otherwise,

find, in m to 3 significant figures, the further distance moved by the caravan before it comes momentarily to rest.

2 A car of mass 1000 kg is towing a trailer of mass 1500 kg along a straight horizontal road. The tow-bar joining the car to the trailer is modelled as a light rod parallel to the road. The total resistance to motion of the car is modelled as having constant magnitude 750 N. The total resistance to motion of the trailer is modelled as a force of magnitude R newtons, where R is a constant. When the engine is working at a rate of 50 kW, the car and the trailer travel at a constant speed of 25 m s^{-1}.

a Show that $R = 1250$. **(3)**

When travelling at 25 m s^{-1} the driver of the car disengages the engine and applies the brakes. The brakes provide a constant braking force of magnitude 1500 N to the car. The resisting forces of magnitude 750 N and 1250 N are assumed to remain unchanged. Calculate:

b the deceleration of the car while braking **(3)**

c the thrust in the tow-bar while braking **(2)**

d the work done, in kJ, by the braking force in bringing the car and the trailer to rest. **(4)**

e Suggest how the modelling assumption that the resistances to motion are constant could be refined to be more realistic. **(1)**