Connected Objects Horizontal Plane - Edexcel Past Exam Questions

1. A car is towing a trailer along a straight horizontal road by means of a horizontal tow-rope. The mass of the car is 1400 kg. The mass of the trailer is 700 kg. The car and the trailer are modelled as particles and the tow-rope as a light inextensible string. The resistances to motion of the car and the trailer are assumed to be constant and of magnitude 630 N and 280 N respectively. The driving force on the car, due to its engine, is 2380 N. Find

(*a*) the acceleration of the car, **(3)**

(*b*) the tension in the tow-rope. **(3)**

When the car and trailer are moving at 12 m s^{-1}, the tow-rope breaks. Assuming that the driving force on the car and the resistances to motion are unchanged,

(*c*) find the distance moved by the car in the first 4 s after the tow-rope breaks. **(6)**

(*d*) State how you have used the modelling assumption that the tow-rope is inextensible. **(1)**

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2.

Two particles *P* and *Q*, of mass 2 kg and 3 kg respectively, are joined by a light inextensible string. Initially the particles are at rest on a rough horizontal plane with the string taut. A constant force **F** of magnitude 30 N is applied to *Q* in the direction *PQ*, as shown in Figure 4. The force is applied for 3 s and during this time *Q* travels a distance of 6 m. Q and P experiences frictional forces of 14 N and 9.3 N respectively. Find

(*a*) the acceleration of *Q*, **(2)**

(*b*) the tension in the string. **(4)**

(*c*) State how in your calculation you have used the information that the string is inextensible. **(1)**

When the particles have moved for 3 s, the force **F** is removed.

(*d*) Find the time between the instant that the force is removed and the instant that *Q* comes to rest. **(4)**

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3. A car of mass 800 kg pulls a trailer of mass 200 kg along a straight horizontal road using a light towbar which is parallel to the road. The horizontal resistances to motion of the car and the trailer have magnitudes 400 N and 200 N respectively. The engine of the car produces a constant horizontal driving force on the car of magnitude 1200 N. Find

(*a*) the acceleration of the car and trailer, **(3)**

(*b*) the magnitude of the tension in the towbar. **(3)**

The car is moving along the road when the driver sees a hazard ahead. He reduces the force produced by the engine to zero and applies the brakes. The brakes produce a force on the car of magnitude F newtons and the car and trailer decelerate. Given that the resistances to motion are unchanged and the magnitude of the thrust in the towbar is 100 N,

(*c*) find the value of F. **(7)**

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4. A car of mass 1000 kg is towing a caravan of mass 750 kg along a straight horizontal road. The caravan is connected to the car by a tow-bar which is parallel to the direction of motion of the car and the caravan. The tow-bar is modelled as a light rod. The engine of the car provides a constant driving force of 3200 N. The resistances to the motion of the car and the caravan are modelled as constant forces of magnitude 800 newtons and R newtons respectively.

Given that the acceleration of the car and the caravan is 0.88 m s^{-2},

(*a*) show that $R = 860$, **(3)**

(*b*) find the tension in the tow-bar. **(3)**

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