Work, Energy and Power – 2022 GCE Mechanics Further Math A Y543

1. June/2022/Paper_ Y543/01/No.1

A car has mass 1200 kg. The total resistance to the car's motion is constant and equal to 250 N.

(a) The car is driven along a straight horizontal road with its engine working at 10 kW.

Find the acceleration of the car at the instant that its speed is $5\,\mathrm{m\,s^{-1}}$. **[3]**

The maximum power that the car's engine can generate is 20 kW.

(b) Find the greatest constant speed at which the car can be driven along a straight horizontal road. **[2]**

The car is driven up a straight road which is inclined at an angle θ above the horizontal where $\sin\theta = 0.05$.

(c) Find the greatest constant speed at which the car can be driven up this road. **[2]**

2. June/2022/Paper_ Y543/01/No.2

The coordinates of two points, A and B, are $(-1, 6)$ and $(5, 12)$ respectively, where the units of the coordinate axes are metres. A particle P moves from A to B under the action of several forces. The force $\mathbf{F} = 7\mathbf{i} - 2\mathbf{j}$ N is one of the forces acting on P.

(a) Calculate the work done by $\mathbf{F}$ on P as P moves from A to B. **[2]**

At the instant when P reaches B its velocity is $-\mathbf{i} - 5\mathbf{j}\,\text{m s}^{-1}$.

(b) Find the power generated by $\mathbf{F}$ at the instant that P reaches B. **[2]**

One end of a light elastic string was attached to the origin of the coordinate system and the other to P when P was at A, before it moved to B. The natural length of the string is 8 m and its modulus of elasticity is 24 N.

(c) At the instant that P reaches B, find the following.

- The tension in the string
- The elastic potential energy stored in the string **[3]**