Power

Power is the **rate of doing work** or **energy input per unit of time**

Using the second definition:

$$Power = \frac{energy}{time} = \frac{Force \times distance}{time} = Force \times velocity = \boldsymbol{Fv}$$

Units: Power is measured in Watts (W).
A Watt is equivalent to a Js^{-1} or kgm^2s^{-3}.

A van of mass 1250kg is travelling along a horizontal road. The van's engine is working at 24kW. The constant resistance to motion has a magnitude of 600N. Calculate :

a) the acceleration of the van when it is travelling at $6ms^{-1}$

b) the maximum speed of the van.

A car of mass 1100kg is travelling at a constant speed of $15ms^{-1}$ along a straight road which is inclined at 7° to the horizontal. The engine is working at a rate of 24kW.

a) Calculate the magnitude of the non-gravitational resistance to motion.

The rate of working of the engine is now increased to 28kW.
Assuming the resistances to motion are unchanged,
b) Calculate the initial acceleration of the car.

A car of mass 2600kg is travelling in a straight line. At the instant when the speed of the car is $v\ \mathrm{ms}^{-1}$, the total resistances to motion are modelled as a variable force of magnitude $(800 + 5v^2)N$. The care has a cruise control feature which adjusts the power generated by the engine to maintain a constant speed of $18\ \mathrm{ms}^{-1}$.
Find the power generated by the engine when:
a) The car is travelling on a horizontal road
b) The car is travelling up a road that is inclined at an angle 4° to the horizontal.

The rate of working of the engine is now increased to 28kW.
Assuming the resistances to motion are unchanged,
b) Calculate the initial acceleration of the car.

Ex 2D Q10-19

Side Note: Maximum speed is when acceleration is 0 - i.e. in equilibrium

Edexcel M2 June 2003 Q6

A girl and her bicycle have a combined mass of 64 kg. She cycles up a straight stretch of road which is inclined at an angle α to the horizontal, where $\sin\alpha = \frac{1}{14}$. She cycles at a constant speed of 5 m s^{-1}. When she is cycling at this speed, the resistance to motion from non-gravitational forces has magnitude 20 N.

(*a*) Find the rate at which the cyclist is working.

(4)

8. [*In this question use* $g = 10\,m\,s^{-2}$]

A jogger of mass 60 kg runs along a straight horizontal road at a constant speed of $4\,m\,s^{-1}$. The total resistance to the motion of the jogger is modelled as a constant force of magnitude 30 N.

(a) Find the rate at which the jogger is working.

(3)

The jogger now comes to a hill which is inclined to the horizontal at an angle α, where $\sin\alpha = \frac{1}{15}$. Because of the hill, the jogger reduces her speed to $3\,m\,s^{-1}$ and maintains this constant speed as she runs up the hill. The total resistance to the motion of the jogger from non-gravitational forces continues to be modelled as a constant force of magnitude 30 N.

(b) Find the rate at which she has to work in order to run up the hill at $3\,m\,s^{-1}$.

(5)