2.4) Power

Worked example

A van of mass 2500 kg is travelling along a horizontal road. The van's engine is working at 48 kW. The constant resistance to motion has a magnitude of 1200 N. Calculate :

a) the acceleration of the van when it is travelling at $12\ ms^{-1}$

b) the maximum speed of the van.

Your turn

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

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

b) the maximum speed of the van.

a) $2.72\ ms^{-2}$ (3 sf)

b) $40\ ms^{-1}$

Worked example

A van of mass $2200\ kg$ is travelling at a constant speed of $30\ ms^{-1}$ along a straight road inclined at $14°$ to the horizontal.
The engine is working a rate of $48\ kW$.

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

The rate of working of the engine is now increased to $56\ kW$. Assuming the resistances to motion are unchanged,

b) Calculate the initial acceleration of the van.

Your turn

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

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

The rate of working of the engine is now increased to $28\ kW$. Assuming the resistances to motion are unchanged,

b) Calculate the initial acceleration of the car.

a) $286\ N$ (3 sf)
b) $0.242\ ms^{-2}$ (3 sf)

Worked example

A car of mass $1300\ kg$ is travelling in a straight line. At the instant when the speed of the van is $v\ ms^{-1}$, the total resistances to motion are modelled as a variable force of magnitude $(400 + 2.5v^2)\ N$.
The car has a cruise control feature which adjusts the power generated by the engine to maintain a constant speed of $9\ ms^{-1}$.
Find the power generated by the engine when the car is travelling on a horizontal road.

Your turn

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

$43600\ W$ (3 sf)

Worked example

A car of mass $1300\ kg$ is travelling in a straight line. At the instant when the speed of the van is $v\ ms^{-1}$, the total resistances to motion are modelled as a variable force of magnitude $(400 + 2.5v^2)\ N$.

The car has a cruise control feature which adjusts the power generated by the engine to maintain a constant speed of $9\ ms^{-1}$.

Find the power generated by the engine when the car is travelling up a road that is inclined at $2°$ to the horizontal.

Your turn

A van of mass $2600\ kg$ is travelling in a straight line. At the instant when the speed of the van is $v\ ms^{-1}$, the total resistances to motion are modelled as a variable force of magnitude $(800 + 5v^2)\ N$.

The van has a cruise control feature which adjusts the power generated by the engine to maintain a constant speed of $18\ ms^{-1}$.

Find the power generated by the engine when the van is travelling up a road that is inclined at $4°$ to the horizontal.

$75600\ W$ (3 sf)

Worked example

A child and his bicycle have a combined mass of $32\ kg$.
He cycles up a straight stretch of road inclined at an angle α to the horizontal, where $\sin\alpha = \frac{1}{7}$.
He cycles at a constant speed of $2.5\ ms^{-1}$.
When he is cycling at this speed, the resistance to motion from non-gravitational forces has magnitude $10\ N$.
Find the rate at which the cyclist is working.

Your turn

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

$324\ W$