## Physics with Synno - Motion-2 - Lesson 13

## M.3.6 Newton's Third Law

The reaction force leads us to Newton's third law, which states:
If one object exerts a force on another then there is an equal and opposite force (reaction) on the first object by the second. i.e. for every action there is an equal and opposite reaction.

Example 1


$$
\begin{aligned}
& \mathrm{W}=\mathrm{mg} \\
& \mathrm{~W}=5 \times 9.8 \\
& \mathrm{~W}=49 \mathrm{~N} \text { Down }
\end{aligned}
$$

Reaction $=49 \mathrm{~N}$ Up

## Example

A large car of mass 1600 kg starts from rest on a horizontal road with a forward thrust of 5400 N due east. The sum of the forces resisting the motion of the car is 600 N .
a) Determine the acceleration of the car.

$$
\begin{aligned}
& \Sigma \mathbf{F}=\mathrm{m} \mathbf{a} \\
& 5400-600=1600 \times \mathrm{a} \\
& 4800=1600 \times \mathrm{a} \\
& \mathbf{a}=3 \mathrm{~m} / \mathrm{s}^{2} \text { East }
\end{aligned}
$$

b) The same car is used to tow a 400 kg trailer with the same forward thrust as before. The sum of the forces resisting the motion of the trailer is 200 N .
i) Determine the acceleration of the system of the car and trailer.

$$
\begin{aligned}
& \Sigma \mathbf{F}=\mathrm{m} \mathbf{a} \quad \text { Key word in question }- \text { System } \\
& 5400-600-200=(1600+400) \times \mathrm{a} \\
& 4600=2000 \times \mathrm{a} \\
& \mathbf{a}=2.3 \mathrm{~m} / \mathrm{s}^{2} \text { East }
\end{aligned}
$$

ii) What is the magnitude of the force exerted by the car on the trailer?

$$
\begin{array}{ll}
\Sigma \mathbf{F}=\mathrm{m} \mathrm{a} & \text { Key words in question }- \text { force } \ldots \text { on the trailer } \\
\mathbf{a}=2.3 \mathrm{~m} / \mathrm{s}^{2} \text { East } & \mathrm{m}=400 \\
\mathrm{~F}-200=400 \times 2.3 & \\
\mathrm{~F}-200=920 & \\
\mathbf{F}=1120 \text { N East } &
\end{array}
$$

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