Connected Particles (horizontal)

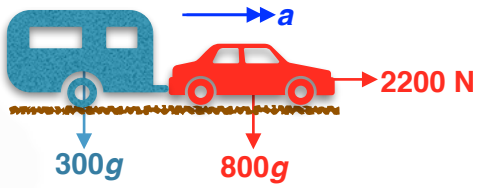
E.g. 1 A car of mass 800 kg exerting a driving force of 2200 N is pulling a trailer of mass 300 kg along a level road. If there is no resistance to the motion of either car or trailer, find
(a) the acceleration of the car and trailer and
(b) the tension in the tow bar.

Working (a) Whole system:

$F = ma(\rightarrow)$:

$2200 = (800 + 300)a$

$a = 2$ m/s^2.



The acceleration of the car and trailer is 2 m/s^2.

N.B. The tension in the tow bar is not involved in calculations for the whole system.

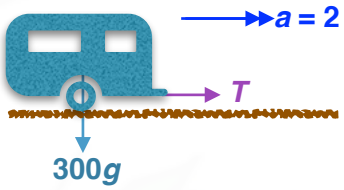
(b) *To find the tension in the tow bar we must consider either **just the trailer** or **just the car**.*

Trailer's POV *— the trailer sees the tension as a **pulling** force*

$F = ma(\rightarrow)$:

$T = 300 \times 2 = 600$ N

The tension in the tow bar is 600 N.



OR

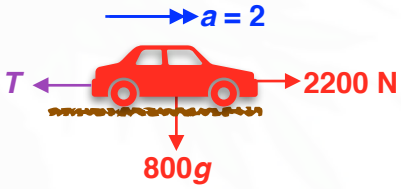
Car's POV *— the trailer sees the tension as a **resisting** force*

$F = ma(\rightarrow)$:

$2200 - T = 800 \times 2$

$T = 600$ N

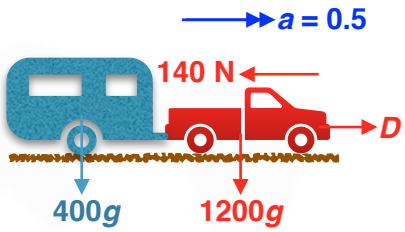
The tension in the tow bar is 600 N.



N.B. **POV** means "point of view".

E.g. 2 A pick-up truck of mass 1200 kg tows a trailer of mass 400 kg. They accelerate at 0.5 m/s^2. There is air resistance of 140 N on the truck but negligible on the trailer. Find:
(a) the force, T, in the coupling (or tow bar) and
(b) the driving force, D, of the truck.

Working Here is the diagram for the whole system.



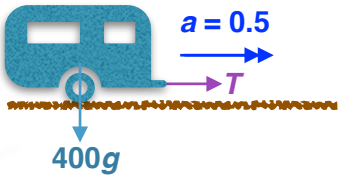
(a) Since we don't know the driving force, D, we look at only the trailer

Trailer's POV

$F = ma(\rightarrow)$:

$T = 400 \times 0.5 = 200$ N

The force, T, in the coupling is 200 N.



(b) We can look at ***either*** the whole system ***or*** just the car

Car's POV

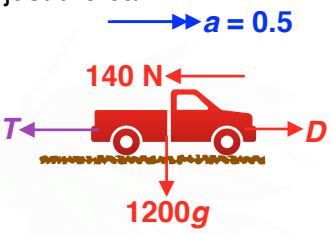
$F = ma(\rightarrow)$:

$D - T - 140 = 1200 \times 0.5$

$D - 200 - 140 = 600$

$D = 940$ N

The driving force, D, of the truck is 940 N.



OR

Whole system (ignore tension in tow bar)

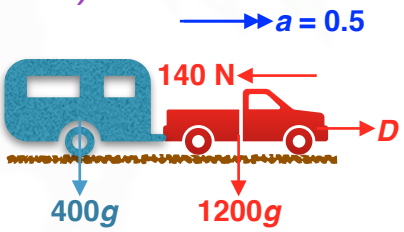
$F = ma(\rightarrow)$:

$D - 140 = (1200 + 400) \times 0.5$

$D - 140 = 800$

$D = 940$ N

The driving force, D, of the truck is 940 N.



Video: Connected particles - horizontal

Solutions to Starter and E.g.s

Exercise
p522 22D Qu 1-7