Further Equilibrium Problems

Starter

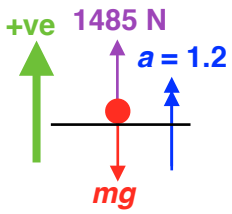
1. **(Review of last lesson)**

A fork-lift truck is raising a container with an acceleration of 1.2 m/s². The normal contact force on the container from the horizontal forks is 1485 N. Calculate the mass of the load.

Working: $F = ma(\uparrow)$:

$$1485 - mg = 1.2m$$
$$1485 = m(1.2 + g)$$
$$m = \frac{1485}{1.2 + g}$$
$$m = 135$$

The mass of the load is 135 kg.



E.g. 1 A lift of mass 500 kg carrying a load of 80 kg is drawn up by a cable. The lift accelerates at $\frac{1}{12}g$ m/s² from rest to its maximum speed which is maintained for a time, after which the lift decelerates to rest at $\frac{1}{10}g$ m/s². For each of the stages of motion (accelerating upwards, constant speed and decelerating upwards) find:

(a) the tension in the cable

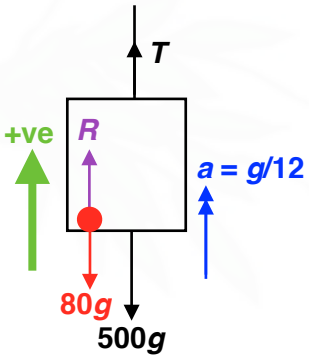
(b) the force exerted by the load on the floor of the lift.

Working: **Accelerating upwards**

Take the positive direction as upwards.

(a) $F = ma(\uparrow)$ for whole system:

$$T - 500g - 80g = (500 + 80) \times \frac{g}{12}$$
$$T = (500 + 80) \times \frac{g}{12} + 500g + 80g$$
$$T = 6157\frac{2}{3}$$



(b) $F = ma(\uparrow)$ for 80 kg mass:

$$R - 80g = 80 \times \frac{g}{12}$$
$$R = 80 \times \frac{g}{12} + 80g$$
$$R = 849\frac{1}{3}$$

When accelerating the tension is $6157\frac{2}{3}$ N and the normal contact force is $849\frac{1}{3}$ N.

Constant speed:

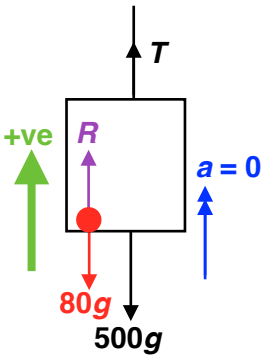
Take the positive direction as upwards.

(a) $F = ma(\uparrow)$ for whole system:

$T - 500g - 80g = 0$

$T = +500g + 80g$

$T = 5684$



(b) $F = ma(\uparrow)$ for 80 kg mass:

$R - 80g = 0$

$R = 80g$

$R = 784$

While at constant speed the tension is 5684 N and the normal contact force is 784 N.

Decelerating upwards:

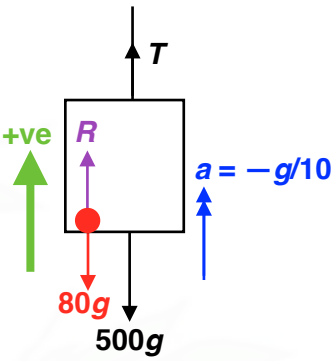
Take the positive direction as upwards.

(a) $F = ma(\uparrow)$ for whole system:

$$T - 580g = (500 + 80) \times \left(-\frac{g}{12}\right)$$

$$T = 580g - 580 \times \frac{g}{10}$$

$T = 5115.6$



(b) $F = ma(\uparrow)$ for 80 kg mass:

$$R - 80g = 80 \times \left(-\frac{g}{10}\right)$$

$$R = 80g - 80 \times \frac{g}{10}$$

$R = 705.6$

When decelerating the tension is 5115.6 N and the normal contact force is 705.6 N.

Video: Lift problems

Lift problems EQ

Solutions to Starter and E.g.s

Exercise

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