STEP/Forces, Q2 (11/6/23)

(i) A lift of mass $400kg$ has a maximum acceleration or deceleration of $1ms^{-2}$, and the lift cable can support a tension of $9000N$. What is the maximum number of people of mass $80kg$ that can safely be carried? (Assume $g = 10ms^{-2}$.)

(ii) If a single person of mass $80kg$ is in the lift when it is accelerating downwards at $1ms^{-2}$, how much lighter does the person feel, compared with their usual weight, as a percentage?

Solution

(i) When the lift is accelerating upwards (or decelerating downwards) at $1ms^{-2}$,

$N2L \Rightarrow T - (400 + 80n)g = (400 + 80n)(1)$

When the lift is accelerating downwards (or decelerating upwards) at $1ms^{-2}$,

$N2L \Rightarrow T - (400 + 80n)g = (400 + 80n)(-1)$

T is greater in the 1st case

When $T = 9000$, $9000 = 4400 + 880n$,

so that $n = \frac{115}{22}$, and hence 5 people can safely be carried

(ii) Let R be the reaction of the lift floor on the person.

Then, considering the forces on the person,

$N2L \Rightarrow R - 80g = 80(-1)$

$\Rightarrow R = 720N$

Their usual weight is $80g = 800N$,

and so there has been a reduction of 10%.