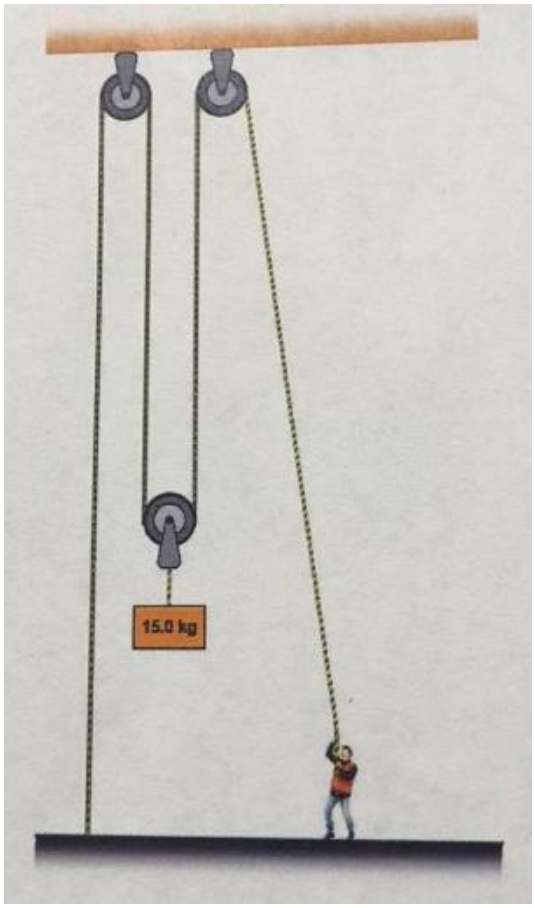
Answer on Question #82527 - Physics - Mechanics – Relativity

Clark is trying to lift the 15.0 kg crate using the series of ropes anв pulleys shown in the figure. The rope on the left is tied to the floor. The two pulleys on the ends are fixed to the ceiling, but the pulley in the middle rides freely on the rope. We take all the pulleys and ropes to be massless. The crate starts off on the floor. Clark attempts to lift the crate by exerting a constant force of 300.0 N on the rope. But after lifting it for 1.20 s, the rope breaks.

a) What's the highest point the crate reaches?

b) How long does it take the crate to hit the floor after the rope breaks?

c) What can you say about Clark?



Solution

a) We see that with this construction, if Clark pulls L metres of the rope, the crate will go up on height $L/2$. Why? On the other hand, we'll win in force: if the crate's mass is m kilos, with the mechanism shown force $mg/2$ will be enough to pull it.
According to Newton's second law:

$$F - mg = 2ma,$$

$$a = \frac{F}{2m} - \frac{g}{2}.$$

$$h = \frac{at^2}{2} = \left(\frac{F}{2m} - \frac{g}{2}\right)\frac{t^2}{2} = \left(\frac{300}{2 \cdot 15} - \frac{9.8}{2}\right) \cdot \frac{1.2^2}{2} = 3.672 \text{ m}.$$

b) Similar to the previous formula:

$$t = \sqrt{\frac{2h}{g}} = \sqrt{\frac{2 \cdot 3.672}{9.8}} = 0.866 \text{ s}.$$

c) Either he's a strong guy or his mass is 30.6 kg.

Answer

a) 3.672 m; b) 0.866 s.