What a Spring Balance Reads

Physics | JEE Main & Advanced

Don't Memorize. Visualize.

A spring balance at rest reads the tension in its spring: the pull at *one* end. Pulled with 100 N at each end, it reads 100 N, not 200 N.

TENSION

The pull a string, rope or spring passes along itself. In a light one at rest, it is the same all along.

Measured in newtons.

SPRING BALANCE

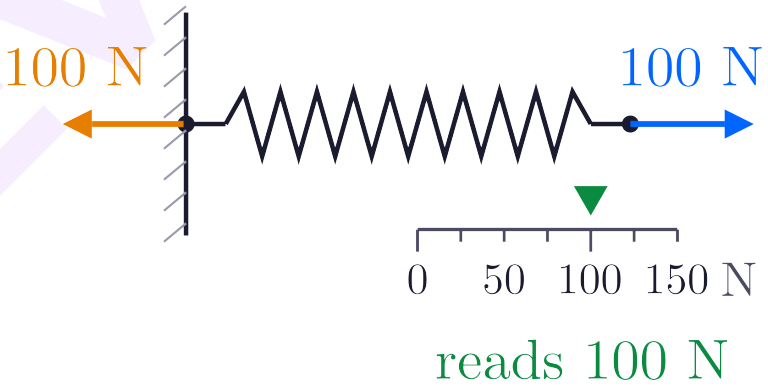
A spring with a scale. The stretch of the spring shows the tension in it.

Taken as light (no mass) in JEE problems.

One end on a wall

Tie the left end to a wall and pull the right end with 100 N. The balance stays at rest, so the forces on it balance: the wall must pull the left end back with 100 N. (It is also Newton's third law: the balance pulls the wall with 100 N, the wall pulls back with 100 N.)

The spring is pulled at both ends with 100 N, and the scale reads **100 N**.

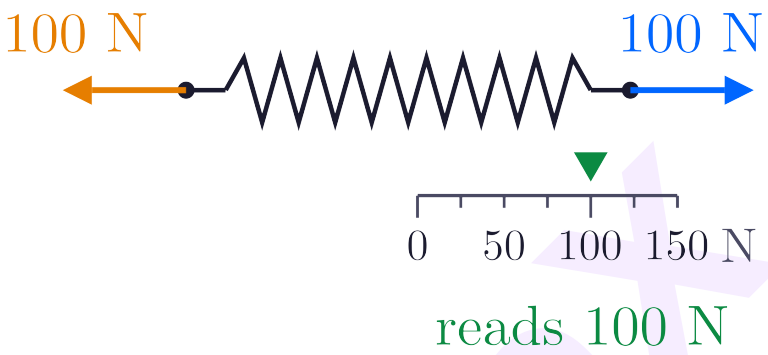


Why the reading is the pull at one end

Imagine cutting the spring anywhere. The piece on the right is at rest, with 100 N pulling it to the right, so the left piece must pull it with 100 N to the left. The force across every cut is 100 N: that is the tension, and the scale shows it. To read 200 N, the balance would need 200 N at each end.

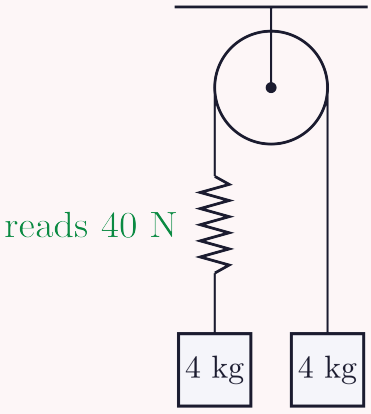
A person in place of the wall

Now a person holds the left end and pulls with 100 N. The balance cannot tell a wall from a person: it feels the same two pulls, so it stretches the same and reads the same, **100 N**.
This is the hook of the Short: 100 N at each end is exactly the wall case.



CAREFUL

Two light balances hooked together in a line and pulled with 50 N at each end read **50 N each**, not 25 N each and not 100 N: the same tension runs through both.
A balance in a string over a pulley, with 4 kg hanging on each side at rest, reads $4 \times 10 = 40$ N, **not 80 N**. The string pulls each block up with 40 N; the balance feels 40 N at each of its ends, exactly the Short's case.



Solved example

A 5 kg block hangs from a spring balance fixed to the ceiling. What does it read? ($g = 10\ \mathrm{m\,s^{-2}}$)

Forces on the balance. The block pulls down with $mg = 50$ N; the ceiling pulls up with 50 N. One end's pull is 50 N.

50 N

Key formulas

light balance at rest: reading $=$ tension $=$ pull at one end

Atwood machine (masses m_1, m_2): $T = \dfrac{2m_1m_2g}{m_1 + m_2}$

Practice set

Easy to hard. Take $g = 10\ \mathrm{m\,s^{-2}}$; balances, strings and pulleys are light, pulleys frictionless. The answers start on the next page.

Q1. Quiz from the Short. Two people pull the ends of a spring balance, 50 N each way, and it is at rest. It reads: (A) 50 N (B) 100 N (C) 0 N.

Q2. A 2 kg mass hangs from a spring balance fixed to the ceiling. What does the balance read?

Q3. Two spring balances hang one below the other, with a 3 kg mass at the bottom. What does each read?

Q4. A string over a pulley carries 4 kg on each side, at rest, with a spring balance in the string. What does it read?

Q5. A spring balance is tied to a wall and pulled with 60 N. What does it read, and what force does the wall exert on it?

Q6. Masses of 3 kg and 5 kg hang on either side of a pulley (an Atwood machine), with a balance in the string. What does it read while they move?

Watch the animated lesson on YouTube

What a Spring Balance Reads (Short)

Scan the code to open the JEEVisionX channel on YouTube. This lesson is in the JEE Concepts Visualization Shorts playlist.

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Answers

Q1

(A) 50 N

A spring balance reads the pull at one end. At rest, each end is pulled with 50 N, so the tension in the spring is 50 N: the same as one end tied to a wall and the other pulled with 50 N. 100 N adds two pulls that act on opposite ends.

Q2

20 N

$mg = 2 \times 10$; the ceiling pulls the other end with 20 N.

Q3

30 N each

The same tension, $mg = 30$ N, runs through both light balances.

Q4

40 N

Each side's string holds 4 kg at rest: tension 40 N. Not 80 N.

Q5

60 N; 60 N towards the wall

At rest, the wall's pull balances yours.

Q6

37.5 N

$T = \frac{2\times3\times5\times10}{3+5}$. Check:
$a = \frac{(5-3)\times10}{8} = 2.5\ \mathrm{m\,s^{-2}}$ and
$3 \times (10 + 2.5) = 37.5$.

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