

SCIENCE • CLASS 9

CHAPTER 6

How Forces Affect Motion

NCERT SOLUTIONS



FORCES ON A STEADY BARBELL

Pause and Ponder - Question 1

Question: A weightlifter lifts a barbell. Name two forces acting on it.
Are they balanced when she keeps the barbell steady?

Answer:

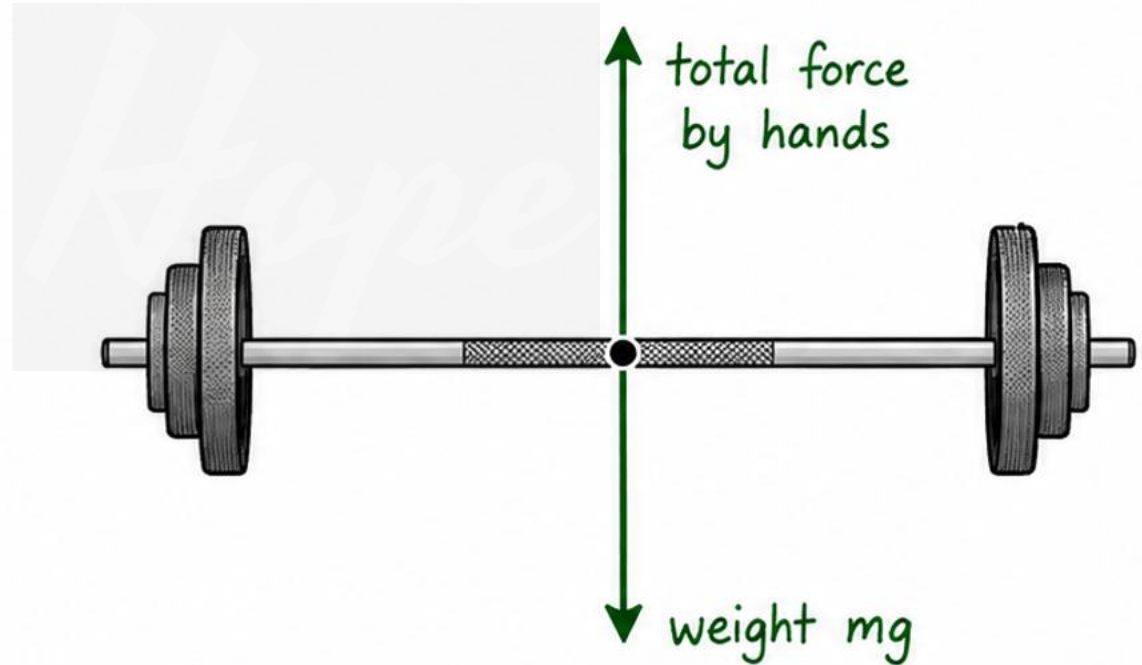
- The Earth pulls the barbell downwards: gravitational force or weight.
- The weightlifter's hands push the barbell upwards: muscular force.

When the barbell is held steady, its acceleration is zero. The total upward force equals its weight, so the forces are balanced.

$$F_{(\text{upward})} = mg$$

$$F_{(\text{net})} = F_{(\text{upward})} - mg = 0$$

These two forces act on the same object: the barbell.



ARM-WRESTLING AND FORCE PAIRS

Pause and Ponder – Question 2

Question:

Players R and S are arm-wrestling.
Their arms tilt towards the viewer.
Are their forces balanced?
Which player exerts the larger force?

Careful answer:

- If the arms start tilting from rest, the overall turning effects are not balanced.
- But the forces that the two hands exert on each other are always equal in magnitude and opposite in direction, by Newton's third law.
- They act on different players, so they are not a pair of balanced forces acting on one arm.
- Which mutual force is larger? Neither.
- Different muscular turning effects can make one player win. The direction of tilting does not show that one hand exerts a larger force on the other.

Correction to the wording: Do not confuse unequal turning effects with unequal action-reaction forces.

MOTION WITH ZERO NET FORCE

Pause and Ponder - Questions 3, 4 and 6

Question 3: An object moves with constant velocity. Is a net force acting on it? Answer: No. Constant velocity means zero acceleration, so $F_{(\text{net})} = 0$.

Question 4: With no net force, which situations are possible?

- (i) An object initially at rest remains at rest. YES.
- (ii) An object already moving keeps a constant velocity. YES.
- (iii) An object moves with constant acceleration. Not if the acceleration is non-zero.

Usual intended answer: (i) and (ii). Zero acceleration is also a constant value, so (iii) needs the word "non-zero" to be unambiguous.

Question 6: A 100 g toy car moves with constant velocity 0.5 m/s. Find its net force.

$$m = 100 \text{ g} = 0.1 \text{ kg}; a = 0 \text{ m/s}^2$$

$$F_{(\text{net})} = ma = 0.1 \times 0 = \underline{\underline{0 \text{ N}}}$$

BALANCING FRICTION

Pause and Ponder - Question 5

Question: Individual forces are usually present. Explain how an additional force can make the net force zero.

Answer: Push a box across a level floor at constant velocity. Adjust the forward push so that it equals the backward frictional force. The horizontal forces then cancel. The floor's upward support also balances the weight.

Exercise - Question 1

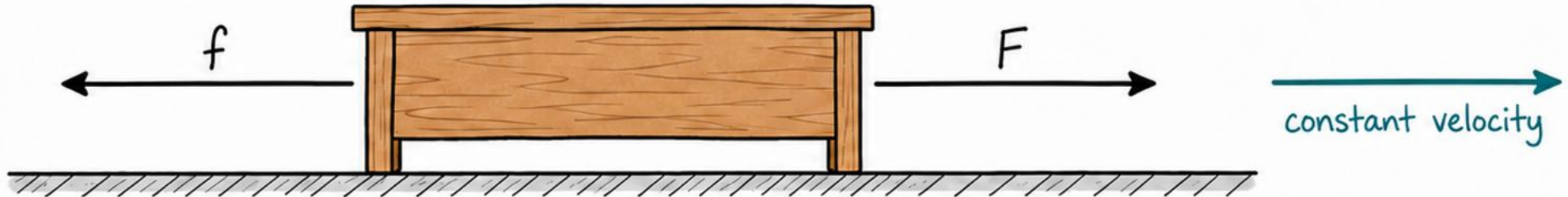
Question: A horizontal force F moves a table across a floor at constant velocity. What is the frictional force on the table?

$$a = 0; F_{(\text{net})} = 0$$

$$F - f = 0$$

$$f = F$$

Answer: Friction has magnitude F and acts opposite to the motion.





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