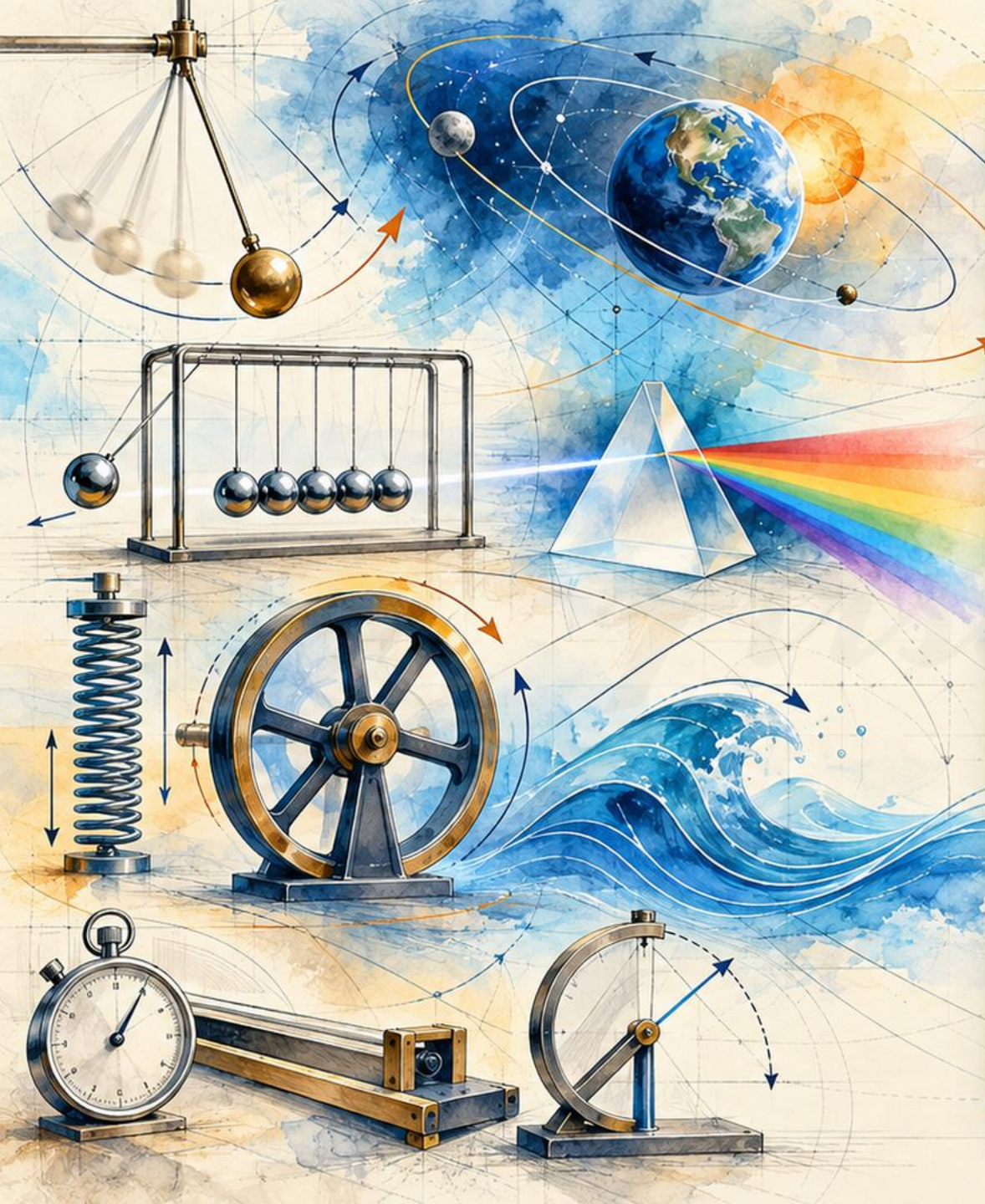




PHYSICS • CLASS 11

4

CHAPTER

Laws of Motion

NCERT SOLUTIONS

EXERCISE SOLUTIONS: QUESTIONS 4.1 & 4.2

4.1 Give the magnitude and direction of the net force in each case.

(a) Rain falling at constant speed.

Answer: Net force is zero: weight and air resistance balance.

$$F_{\text{net}} = 0 \text{ N}$$

(b) A cork of mass 10 g floating on water.

Answer: Net force is zero: buoyancy balances weight.

$$F_{\text{net}} = 0 \text{ N}$$

(c) A kite held stationary in the sky.

Answer: Net force is zero: all forces balance.

$$F_{\text{net}} = 0 \text{ N}$$

(d) A car at constant velocity 30 km h^{-1} on a rough road.

Answer: Net force is zero: driving force balances resistance, and vertical forces balance.

$$F_{\text{net}} = 0 \text{ N}$$

(e) A fast electron far from material objects, without electric or magnetic fields.

Answer: Net force is zero under the stated conditions.

$$F_{\text{net}} = 0 \text{ N}$$

Zero net force has no direction; individual forces need not be zero.

4.2 A pebble of mass 0.05 kg is thrown vertically upward. Find the net force during ascent, descent and at the highest point. Would a throw at 45° change the answers? Ignore air resistance. Take $g = 10 \text{ m s}^{-2}$.

Solution: The only force acting on the pebble is its weight due to gravity, which acts vertically downward at all times.

$$\begin{aligned} F_{\text{net}} &= mg \\ &= 0.05 \times 10 \\ &= 0.50 \text{ N} \end{aligned}$$

(a) Ascent: 0.50 N downward.

(b) Descent: 0.50 N downward.

(c) Apex: 0.50 N downward.

Gravity acts throughout, including the instant of zero vertical velocity. An oblique throw at 45° gives the same net force, because the magnitude and direction of the gravitational force do not depend on the direction of motion. At its apex, its horizontal velocity remains non-zero.

EXERCISE SOLUTION: QUESTION 4.3

Find the magnitude and direction of the net force on a stone of mass 0.1 kg in each train situation. Neglect air resistance. Use the ground frame and $g = 10 \text{ m s}^{-2}$.

(a) Just after release from a stationary train.

Answer: $F_{\text{net}} = mg = 0.1 \times 10 = 1 \text{ N}$, vertically downward.

(b) Just after release from a train at constant velocity 36 km h^{-1} .

Answer: $F_{\text{net}} = mg = 0.1 \times 10 = 1 \text{ N}$, vertically downward.

(c) Just after release from a train accelerating at 1 m s^{-2} .

Answer: $F_{\text{net}} = mg = 0.1 \times 10 = 1 \text{ N}$, vertically downward.

After release, the train no longer exerts a contact force on the stone. Only gravity acts; the train's earlier motion does not add a force.

(d) On the floor of a train accelerating at 1 m s^{-2} , at rest relative to the train.

Answer: $F_{\text{net}} = ma = 0.1 \times 1 = 0.1 \text{ N}$.

The net force is horizontal, in the train's acceleration direction. Static friction accelerates the stone; weight and normal reaction balance vertically.

EXERCISE SOLUTION: QUESTION 4.4

Q.4.4: A particle of mass m is tied by a string of length l to a peg on a smooth horizontal table. It moves in a circle at speed v . If string tension is T , choose the net inward force:

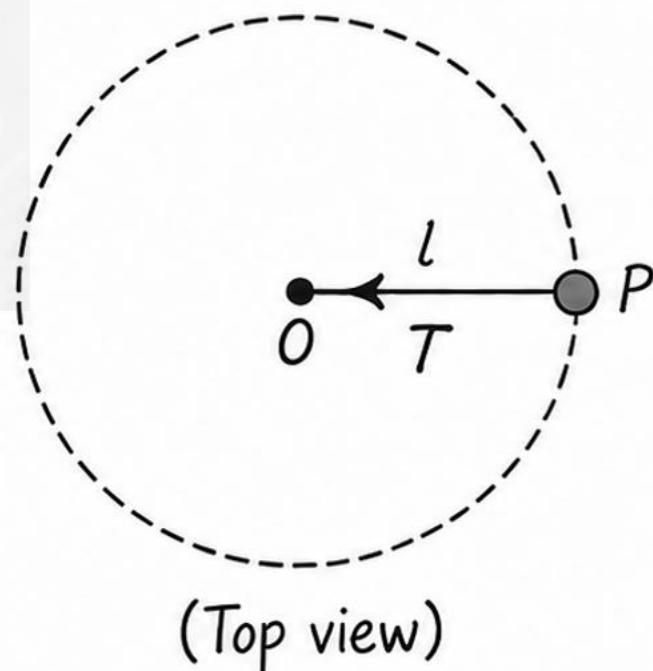
- (i) T (ii) $T - mv^2/l$ (iii) $T + mv^2/l$ (iv) 0

Answer: The vertical forces, weight and normal reaction, balance. Tension is the only horizontal force and points toward the peg.

$$F_{\text{net}} = T = \frac{mv^2}{l}$$

Correct option: (i) T

Centripetal force is the name for the net inward force.
It is not an extra force to add to or subtract from tension.



EXERCISE SOLUTION: QUESTION 4.5

Question 4.5: A constant retarding force of 50 N acts on a body of mass 20 kg initially moving at 15 m s^{-1} . How long does it take to stop?

Solution:

Take the initial direction of motion as positive.

$$\begin{array}{ll} m = 20 \text{ kg} & v = 0 \\ u = 15 \text{ m s}^{-1} & F = -50 \text{ N} \end{array}$$

Apply Newton's second law.

$$a = \frac{F}{m} = \frac{-50}{20} = -2.5 \text{ m s}^{-2}$$

Use the constant-acceleration velocity equation.

$$v = u + at$$

$$0 = 15 - 2.5t$$

$$t = \frac{15}{2.5} = 6.0 \text{ s}$$

$$\text{Stopping time} = 6.0 \text{ s}$$

The negative acceleration means the force opposes the motion.

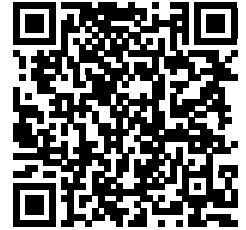


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