3. Problems on Trains

Time, Speed & Distance — Study Notes (Part 3 of 6)

The Key Idea

With trains, the LENGTH of the train counts as extra distance that must be covered. Train problems fall into two categories:

- Crossing a STATIONARY object — a lamp post, pole, platform, or bridge.
- Crossing a MOVING object — a person, or another train.

The Four Cases (Train of length L, speed S)

a) Point object, stationary (pole, person standing) — Distance = L Time = L / S

b) Object with length L1, stationary (platform, bridge) — Distance = L+L1 Time = (L+L1) / S

c) Point object, moving at S1 (a walking/running person) — Time = L / (S ± S1)

d) Object with length L1, moving at S1 (another train) — Time = (L+L1) / (S ± S1)

💡 *Use + when the two objects move in OPPOSITE directions, and − when they move in the SAME direction.*

Worked Examples — Stationary Objects

Consider Train A: length 45 m, speed 45 m/sec.

Example 1 — Crossing a Lamp Post

The height of the lamp post is irrelevant; its length is negligible, so Distance = length of train = 45 m.
Time = 45 / 45 = 1 sec

Example 2 — Crossing a Platform (135 m long)

Distance = length of train + length of platform = 45 + 135 = 180 m
Time = 180 / 45 = 4 sec

Worked Examples — Moving Objects

Example 3 — Crossing a Man (walking, negligible length)

If the man is stationary relative to the ground, this reduces to Distance = 45 m, Time = 45/45 = 1 sec.
If the man walks toward the train, add his speed to the relative speed; if he walks the same way, subtract it.

Example 4 — Crossing Train B (length 135 m, speed 45 m/sec, opposite direction)

Distance = Length A + Length B = 45 + 135 = 180 m
Relative Speed (opposite direction) = 45 + 45 = 90 m/sec
Time = 180 / 90 = 2 sec

Special Case — Finding an Unknown Train's Length

Example 5

A person sitting in an 80 m train travelling at 54 km/hr sees another train (90 km/hr, SAME direction) pass in 15 seconds. Find the other train's length.
Relative Speed = (90 − 54) × 5/18 = 36 × 5/18 = 10 m/sec

Distance = 80 + L, Time = Distance / Relative Speed → 15 = (80+L)/10 → L = 70 m

Drill — Bridges and Opposing Walkers

Example 6 — Crossing a Bridge

A 90 m train at 18 km/hr crosses a 270 m bridge. Find the time taken.
Total distance = 90 + 270 = 360 m. Speed = 18 × 5/18 = 5 m/sec.
Time = 360 / 5 = 72 sec

Example 7 — Train vs. Man Walking Toward It

A 90 m train at 40 km/hr crosses a man walking at 5 km/hr in the opposite direction. Find the time.
Relative Speed = 40 + 5 = 45 km/hr = 45 × 5/18 = 12.5 m/sec.
Time = 90 / 12.5 = 7.2 sec

✎ Practice Questions

1. A train 250 m long, running at 72 km/hr, crosses a platform 150 m long. Find the time taken.
2. A train crosses a 200 m long bridge in 30 seconds while travelling at 45 km/hr. Find the length of the train.
3. A train crosses a man walking at 6 km/hr (opposite direction) in 5 seconds. The train is 200 m long. Find the speed of the train.
4. Two trains, each 150 m long, cross each other (opposite directions) in 6 seconds. If their speeds are in the ratio 2:1, find the speed of each train.
5. Two identical trains, each with 12 bogies, cross each other in 2 minutes. If Train A's bogies are increased to 16, how much longer would the crossing take (all bogies of equal length, same speeds)?

✓ Answer Key

1. 20 seconds
2. 175 m
3. 138 km/hr
4. Faster train: 120 km/hr, Slower train: 60 km/hr
5. 20 seconds (compared to the original 120 seconds)