Time distance and speed

THEORY OF TSD

Concept of Motion

Motion/movement occurs when a body of any shape or size changes its position with respect to any external stationary point.

CONVERSION BETWEEN kmph to m/s

1 Km/h = 1000 m/h = 1000/3600 m/s = 5/18 m/s.

Hence, to convert y km/h into m/s multiply by 5/18

This, y km/h = 5y/18 m/s.

And vice versa : y m/s = 18 y/5 km/h. To convert from m/s to kmph, multiply by 18/5.

Relative Speed: Same Direction and Opposite Direction

Normally, when we talk about the movement of a body, we mean the movement of the body with respect to a stationary point. However, there are times when we need to determine the movement and its relationship with respect to a moving point/body. In such instances, we have to take into account the movement of the body/point with respect to which we are trying to determine relative motion.

Relative movement, therefore, can be viewed as the movement of one body relative to another moving body.

The following formulae apply for the relative speed of two **independent** bodies with respect to each other:

Case I: Two bodies are in opposite directions at speed S_1 and S_2 respectively.

The relative speed is defined as $S_1 + S_2$

Case II: Two bodies are moving in the same direction.

The relative speed is defined as

a. $S_1 – S_2$ when S_1 is greater than S_2.
b. $S_2 – S_1$ when S1 is lesser than S_2.

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In other words, the relative speed can also be defined as the positive value of the difference between the speeds, that is, I $S_1 – S_2$ I.

AN APPLICATION OF ALLEGATION IN TIME SPEED AND DISTANCE

Consider the following situation:
Suppose a car goes from A to B at an average speed of S_1 and then comes back from B to A at an average speed of S_2. If you had to find out the average speed of the whole journey, what would you do?

The normal short cut given for this situation gives the average speed as:

$$2S_1 S_2/S_1 + S_2$$

Application of time, speed and distance

Trains
Trains are a special case in questions related to time, speed and distance because they have their own theory and distinct situations.

The basic relation for trains problems is the same: Speed x Time = Distance

The following things need to be kept in mind before solving questions on trains

a) When the train is crossing a moving object, the speed has to be taken as the **relative speed** of the train with respect to the object. All rules for relative speed will apply for calculating the relative speed.
b) The distance to be covered when crossing an object whenever a train crosses an object will be equal to: **Length of train + Length of object**

Thus, the following cases will yield separate equations, which will govern the crossing an object by train:
For each of the following situations the following notations have been used:

S_T = speed of train S_O = speed of object t = time

L_T = length of train L_O = Length of object

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Case I: Train crossing a stationary object without length:

$$S_T \times t \; L_T$$

Case II: Train crossing a stationary object with length:

$$S_T \times t = (L_T + L_O)$$

Case III: Train crossing a moving object without length:

- In opposite direction: $(S_T + S_O) \times t = L_T$
- In same direction: $(S_T - S_O) \times t = L_T$

Case IV: Train crossing a moving object with length:

- In opposite direction: $(S_T + S_O) \times t = (L_T + L_O)$
- In same direction: $(S_T – S_O) \times t = (L_T + L_O)$