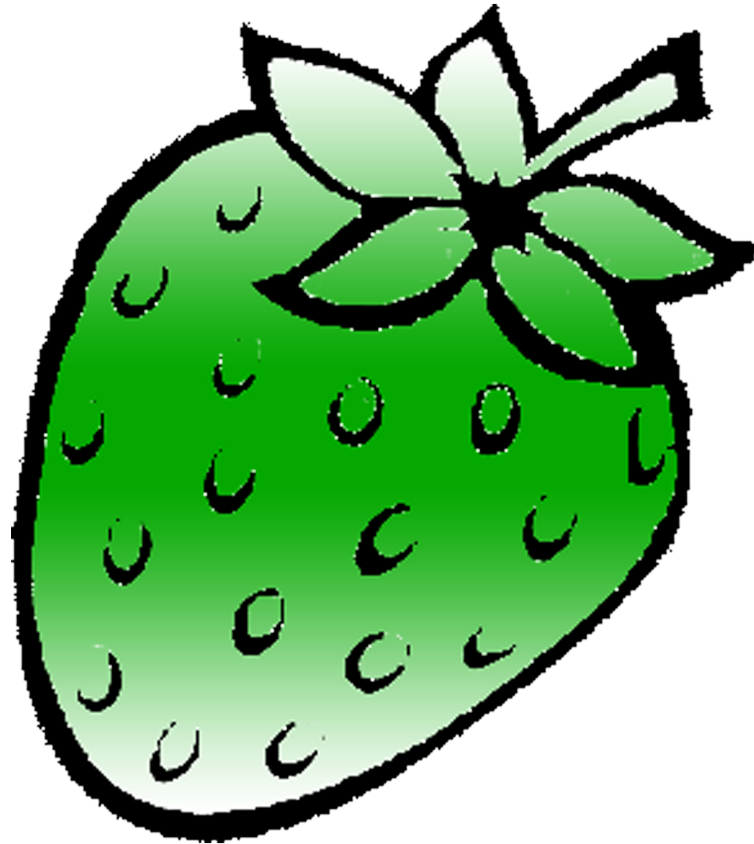


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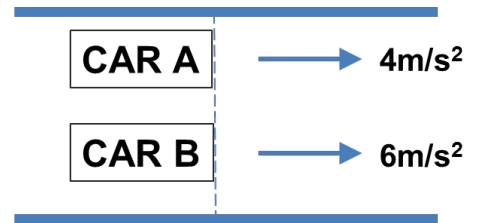
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# Kinematics of Particle

## Relative Velocity

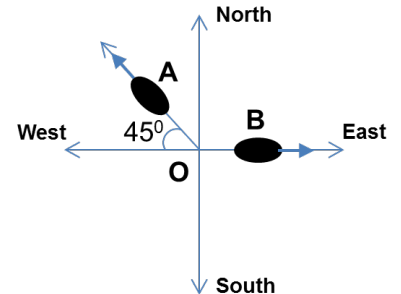
1. Two cars A and B start from rest from point O at the same instant and travel towards right along a straight road. Car A moves with an acceleration of  $4 \text{ m/s}^2$  and car B moves with an acceleration of  $6 \text{ m/s}^2$ . Find relative position, velocity and acceleration of car B w.r.t. A 5 sec from the start.

Ans. :  $25 \text{ m}$ ,  $10 \text{ m/s}$ ,  $2 \text{ m/s}^2$



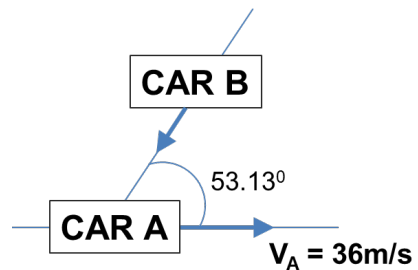
2. From point O a ship A travels in the North making an angle of  $45^\circ$  to the West with a velocity of  $18 \text{ km/hr}$  and ship B travels in the east with a velocity of  $9 \text{ km/hr}$ . Find the relative velocity of ship B w.r.t ship A.

Ans. :  $25.18 \text{ km/hr}$  at  $-30.36^\circ$



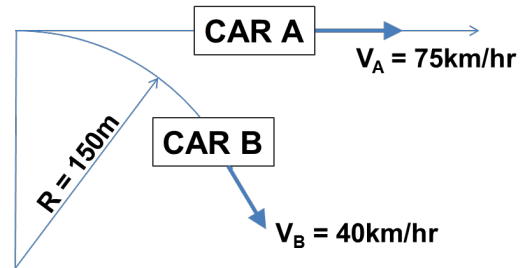
3. Cars A and B are at a distance  $35 \text{ m}$  as shown in the figure. Car A moves with a constant speed of  $36 \text{ kmph}$  and car B starts from rest with an acceleration of  $1.5 \text{ m/s}^2$ . determine:
- Position
  - Velocity
  - Acceleration of car B w.r.t. car A, 5 sec after car A crosses the intersection.

Ans. :  $42.3 \text{ m}$  at  $17.9^\circ$ ,  $15.69 \text{ m/s}$  at  $-22.48^\circ$ ,  $1.5 \text{ m/s}^2$  at  $-53.13^\circ$



4. Car A is travelling along a straight highway, while a truck B is moving along a circular curve of  $150 \text{ m}$  radius. The speed of car A is increased at the rate of  $1.5 \text{ m/s}^2$  and the speed of truck is being decreased at the rate of  $0.9 \text{ m/s}^2$ . For the position shown in figure, determine the velocity of A relative to B and the acceleration of A relative to B. At this instant the speed of A is  $75 \text{ km/hr}$  and that of B is  $40 \text{ km/hr}$ .

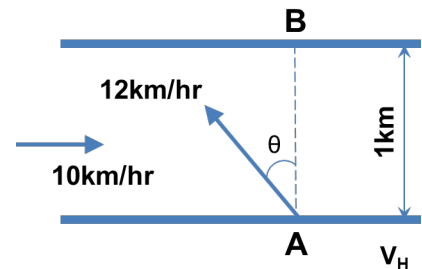
Ans. :  $12.51 \text{ m/s}$  at  $26.36^\circ$ ,  $2.7 \text{ m/s}^2$  at  $5.58^\circ$ .



5. A boy wants to swim across a river of  $1 \text{ km}$  width which is flowing at  $10 \text{ km/hr}$ . The boy wants to reach the other side of bank B and so swims at  $12 \text{ km/hr}$  at an angle  $\theta$  with respect to the river as shown in figure. Determine:

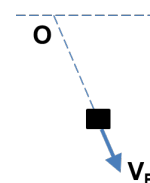
- The angle theta at which the boy should swim to reach B.
- The time taken to reach B.

Ans. :  $\theta = 56.44^\circ$ ,  $6.633 \text{ m/s}$ ,  $542.74 \text{ sec}$ .



6. A helicopter is moving horizontally at a height of  $360 \text{ m}$  above the ground. When the helicopter is at point O its speed is  $100 \text{ m/s}$  and it has an acceleration of  $4 \text{ m/s}^2$ . At the same instant a packet is released from the helicopter. After 3 seconds find the position, velocity and acceleration of the package w.r.t. the helicopter.

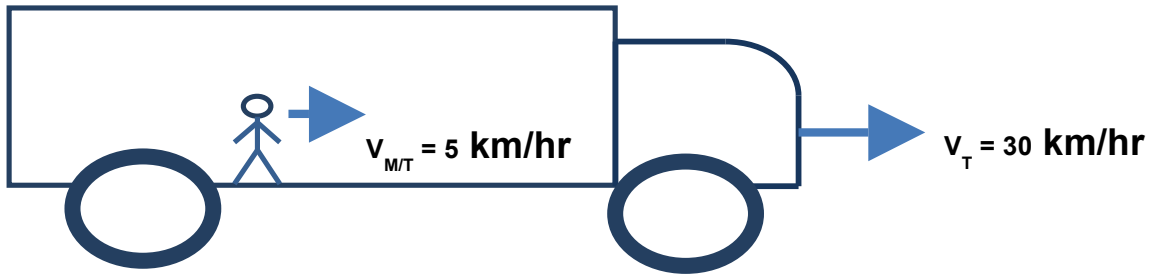
Ans. :  $47.67 \text{ m}$ ,  $31.78 \text{ m/s}$ ,  $10.59 \text{ m/s}^2$ .



$$s_M = s_T + s_{M/T}$$

$$v_M = v_T + v_{M/T}$$

$$a_M = a_T + a_{M/T}$$



SHM