Question 02 *Car A has an acceleration of* $2\ m/s^2$ due east and car B, $4\ m/s^2$ due north. What is the acceleration of car B with respect to car A?

Solution It is a two dimensional motion. Therefore,

$$\mathbf{a}_{BA} = \text{acceleration of car } B \text{ with respect to car } A$$
$$= \mathbf{a}_B - \mathbf{a}_A$$

Here, $\mathbf{a}_B =$ acceleration of car B
$= 4\ \text{m/s}^2$ (due north)

and $\mathbf{a}_A =$ acceleration of car A
$= 2\ \text{m/s}^2$ (due east)

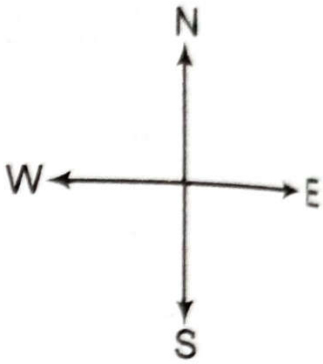

Fig. 6.40

$$|\mathbf{a}_{BA}| = \sqrt{(4)^2 + (2)^2} = 2\sqrt{5}\ \text{m/s}^2$$

and $$\alpha = \tan^{-1}\left(\frac{4}{2}\right) = \tan^{-1}(2)$$

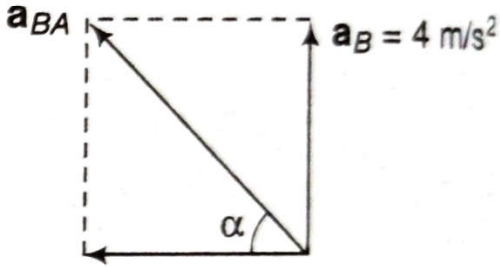

Fig. 6.41

Thus, $\mathbf{a}_{BA}$ is $2\sqrt{5}\ \text{m/s}^2$ at an angle of $\alpha = \tan^{-1}(2)$ from west towards north.