

## QUES 02:-

The trajectory of a projectile in a vertical plane is  $y = \alpha x - \beta x^2$ , where  $\alpha$  and  $\beta$  are constants and  $x$  &  $y$  are respectively the horizontal and vertical distances of the projectile from the point of projection. The angle of projection  $\theta$  and the maximum height attained  $H$  are respectively given by [Feb. 26, 2021 (II)]

- (a)  $\tan^{-1} \alpha, \frac{4\alpha^2}{\beta}$       (b)  $\tan^{-1} \beta, \frac{\alpha^2}{2\beta}$   
(c)  $\tan^{-1} \left( \frac{\beta}{\alpha} \right), \frac{\alpha^2}{\beta}$       (d)  $\tan^{-1} \alpha, \frac{\alpha^2}{4\beta}$

(d) Given :  $y = \alpha x - \beta x^2$

For maximum height, maximum value of  $y$

$$\frac{dy}{dx} = 0 \Rightarrow \frac{d(\alpha x - \beta x^2)}{dx} = 0 \Rightarrow \alpha - 2\beta x = 0$$

$$\therefore x = \frac{\alpha}{2\beta}$$

$$\therefore y = \alpha \left( \frac{\alpha}{2\beta} \right) - \beta \left( \frac{\alpha^2}{4\beta^2} \right)$$

$$\Rightarrow \left( \frac{\alpha^2}{2\beta} \right) - \left( \frac{\alpha^2}{4\beta} \right) \Rightarrow \frac{\alpha^2}{4\beta}$$

$$\text{So, } H_{\max} = \frac{\alpha^2}{4\beta}$$

Hence option (d) is correct answer.