

# Mathematics

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## (Chapter 2)(Inverse Trigonometric Functions)

(Class XII)

### (Exemplar Problems)

#### Long Answer (L.A.)

#### Question 17:

Find the value of  $4\tan^{-1}\frac{1}{5} - \tan^{-1}\frac{1}{239}$ .

#### Answer 17:

Given that  $4\tan^{-1}\frac{1}{5} - \tan^{-1}\frac{1}{239}$

$$= 2 \cdot \left(2\tan^{-1}\frac{1}{5}\right) - \tan^{-1}\frac{1}{239}$$

$$= 2 \cdot \tan^{-1} \left[ \frac{2 \times \frac{1}{5}}{1 - \left(\frac{1}{5}\right)^2} \right] - \tan^{-1} \frac{1}{239}$$

$$\left[ \text{as } 2\tan^{-1}x = \tan^{-1} \frac{2x}{1-x^2} \right]$$

$$= 2 \cdot \tan^{-1} \left[ \frac{\frac{2}{5}}{\frac{25-1}{25}} \right] - \tan^{-1} \frac{1}{239}$$

$$= 2 \cdot \tan^{-1} \left( \frac{2}{5} \times \frac{25}{24} \right) - \tan^{-1} \frac{1}{239}$$

$$= 2 \cdot \tan^{-1} \frac{5}{12} - \tan^{-1} \frac{1}{239}$$



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$$= \tan^{-1} \left[ \frac{2 \times \frac{5}{12}}{1 - \left(\frac{5}{12}\right)^2} \right] - \tan^{-1} \frac{1}{239}$$

$$\left[ \text{as } 2\tan^{-1}x = \tan^{-1} \frac{2x}{1-x^2} \right]$$

$$= \tan^{-1} \left[ \frac{\frac{10}{12}}{\frac{144-25}{144}} \right] - \tan^{-1} \frac{1}{239}$$

$$= \tan^{-1} \left( \frac{10}{12} \times \frac{144}{119} \right) - \tan^{-1} \frac{1}{239}$$

$$= \tan^{-1} \frac{120}{119} - \tan^{-1} \frac{1}{239}$$

$$= \tan^{-1} \left[ \frac{\frac{120}{119} - \frac{1}{239}}{1 + \frac{120}{119} \times \frac{1}{239}} \right]$$



$$\left[ \text{as } \tan^{-1}x - \tan^{-1}y = \tan^{-1} \left( \frac{x-y}{1+xy} \right) \right]$$

$$= \tan^{-1} \left[ \frac{\frac{120 \times 239 - 119}{119 \times 239}}{\frac{119 \times 239 + 120}{119 \times 239}} \right]$$

$$= \tan^{-1} \left[ \frac{28561}{119 \times 239} \right]$$



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$$= \tan^{-1} \frac{28561}{28561}$$

$$= \tan^{-1} 1$$

$$= \frac{\pi}{4}$$

Hence, the value of  $4\tan^{-1} \frac{1}{5} - \tan^{-1} \frac{1}{239}$  is  $\frac{\pi}{4}$ .

