

# HYPERBOLIC FUNCTIONS

## PREVIOUS EAMCET BITS

1.  $\sinh^{-1} 2 + \sinh^{-1} 3 = x \Rightarrow \cosh x =$  [EAMCET 2009]

- 1)  $\frac{1}{2}(3\sqrt{5} + 2\sqrt{10})$    2)  $\frac{1}{2}(3\sqrt{5} - 2\sqrt{10})$    3)  $\frac{1}{2}(12 + 2\sqrt{50})$    4)  $\frac{1}{2}(12 - 2\sqrt{50})$

Ans: 3

Sol.  $\cosh x = \cosh(\sinh^{-1} 2 + \sinh^{-1} 3)$

$$= \frac{1}{2}(12 + 2\sqrt{50})$$

2.  $\frac{1 + \tanh(x/2)}{1 - \tanh(x/2)}$  [EAMCET 2008]

- 1)  $e^{-x}$    2)  $e^x$    3)  $2e^{x/2}$    4)  $2e^{-x/2}$

Ans: 2

Sol. 
$$\frac{1 + \tanh\left(\frac{x}{2}\right)}{1 - \tanh\left(\frac{x}{2}\right)} = \frac{\cosh\left(\frac{x}{2}\right) + \sinh\left(\frac{x}{2}\right)}{\cosh\left(\frac{x}{2}\right) - \sinh\left(\frac{x}{2}\right)} = \frac{\left[\cosh\left(\frac{x}{2}\right) + \sinh\left(\frac{x}{2}\right)\right]^2}{\cosh^2\left(\frac{x}{2}\right) - \sinh^2\left(\frac{x}{2}\right)}$$

$$= \cosh^2\left(\frac{x}{2}\right) + \sinh^2\left(\frac{x}{2}\right) + 2\cosh\left(\frac{x}{2}\right)\sinh\left(\frac{x}{2}\right) = \cosh x + \sinh x = e^x$$

3.  $\operatorname{sech}^{-1}(\sin \theta) =$  [EAMCET 2007]

- 1)  $\log \tan \frac{\theta}{2}$    2)  $\log \sin \frac{\theta}{2}$    3)  $\log \cos \frac{\theta}{2}$    4)  $\log \cot \frac{\theta}{2}$

Ans: 4

Sol.  $\operatorname{sech}^{-1}(\sin \theta) = \log \left( \frac{1 + \sqrt{1 - \sin^2 \theta}}{\sin \theta} \right)$

$$= \log \left( \frac{1 + \cos \theta}{\sin \theta} \right) = \log(\cot \theta / 2)$$

4.  $e^{\log(\cosh^{-1} 2)} =$  [EAMCET 2006]

- 1)  $\log(2 - \sqrt{3})$    2)  $\log(\sqrt{3} - 2)$    3)  $\log(2 + \sqrt{3})$    4)  $\log(2 + 5)$

Ans: 3

Sol.  $e^{\log_e f(x)} = f(x)$

$$e^{\log_e \cosh^{-1}(2)} = \cosh^{-1}(2)$$

$$= \log \left\{ 2 + \sqrt{2^2 - 1} \right\}$$

$$= \log(2 + \sqrt{3})$$

5.  $2 \tanh^{-1} \frac{1}{2} =$  [EAMCET 2005]

- 1) 0                      2)  $\log 2$                       3)  $\log 3$                       4)  $\log 4$

Ans: 3

Sol.  $\tanh^{-1} x = \frac{1}{2} \log \frac{1+x}{1-x}$

$$\therefore 2 \tanh^{-1} x = \log \frac{1 + \frac{1}{2}}{1 - \frac{1}{2}} = \log 3$$

6.  $x = \log \left[ \cot \left( \frac{\pi}{4} + \theta \right) \right] \Rightarrow \sinh x =$  [EAMCET 2004]

- 1)  $\tan 2\theta$                       2)  $-\tan 2\theta$                       3)  $\cot 2\theta$                       4)  $-\cot 2\theta$

Ans: 2

Sol.  $\sinh x = \frac{\cot \left( \frac{\pi}{4} + \theta \right) - \tan \left( \frac{\pi}{4} + \theta \right)}{2} = -\tan 2\theta$

7.  $\sinh^{-1} (2^{3/2}) = \dots\dots$  [EAMCET 2003]

- 1)  $\log(2 + \sqrt{18})$                       2)  $\log(3 + \sqrt{8})$                       3)  $\log(3 - \sqrt{8})$                       4)  $\log(\sqrt{8} + \sqrt{27})$

Ans: 2

Sol.  $\sinh^{-1} (2^{3/2}) = \log(\sqrt{8} + \sqrt{1+8}) = \log(3 + \sqrt{8})$

8.  $\sin ix =$  [EAMCET 2002]

- 1)  $i \sin x$                       2)  $\sin(ix)$                       3)  $-\sin x$                       4)  $i \sin(ix)$

Ans: 1

Sol.  $\sinh(ix) = \frac{e^{ix} - e^{-ix}}{2} = \frac{(\cos x + i \sin x) - (\cos x - i \sin x)}{2} = i \sin x$

9.  $\sec^2(\tan^{-1} 2) + \operatorname{cosec}^2(\cot^{-1} 3) =$  [EAMCET 2001]

- 1) 5                      2) 10                      3) 15                      4) 20

Ans: 3

Sol. Let  $\tan^{-1}(2) = \alpha$  and  $\cot^{-1}(3) = \beta$

$\tan \alpha = 2; \cot \beta = 3$

$\Rightarrow \sec \alpha = \sqrt{5}; \operatorname{cosec} \beta = \sqrt{10}$

$\therefore \sec^2 \alpha + \operatorname{cosec}^2 \beta = 5 + 10 = 15$

10.  $\cosh 2 + \sinh 2 =$  [EAMCET 2000]

- 1)  $1/e$                       2)  $e$                       3)  $1/e^2$                       4)  $e^2$

Ans: 4

Sol.  $\cosh 2 + \sinh 2 = \frac{e^2 + e^{-2}}{2} + \frac{e^2 - e^{-2}}{2} = e^2$

11. If  $\cosh^{-1} x = \log_e(2 + \sqrt{3})$ , then  $x =$  [EAMCET 2000]

- 1) 2                      2) 1                      3) 3                      4) 5

Ans: 1

Sol.  $\log\left[x + \sqrt{x^2 - 1}\right] = \log(2 + \sqrt{3})$

$$\log\left[x + \sqrt{x^2 - 1}\right] = \log\left[2 + \sqrt{(2)^2 - 1}\right]$$

$\therefore x = 2$

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