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Class: 11
Subject: Math
Topic: Trigo
No. of Questions: 25

1. If for real values of x, cosx = x + 1/x, then

(A) x > 90
(B) x < 90
(C) x = 90
(D) no value of x is possible

Sol. D

Let f(x) = cos x
f(x) $\in$ [– 1, 1]
For all x $\in$ R,

Let g(x) = x + $\frac{1}{x}$

g(x) $\in$ (– ∞ , – 2] $\cup$ [2, ∞]

$\because$ No value of x is possible where f(x) = g(x)

2. What is the value of $\sqrt{3}$ cosec 20^o – sec 20^o?

(A) 1
(B) 2
(C) 3
(D) 4

Sol. D

$$\sqrt{3}\ \text{cosec } 20^o - \sec 20^o = \frac{\sqrt{3}}{\sin 20^\circ} - \frac{1}{\cos 20^\circ}\ \frac{\sqrt{30}\cos 20^\circ - \sin 20^\circ}{\sin 20^\circ \cos 20^\circ} = 4$$

$$\left(\frac{\frac{\sqrt{3}}{2}\cos 20^\circ - \frac{1}{2}\sin 20^\circ}{2\sin 20^\circ \cos 20^\circ}\right)$$

$$= 4\left(\frac{\sin 60^0 \cos 20^\circ - \cos 60^\circ \sin 20^\circ}{\sin 40^\circ}\right)$$

$$= \left(\frac{\sin(60^\circ - 20^\circ)}{\sin 40^\circ}\right) = 4$$

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3. What is the value of $\tan 9^o - \tan 27^o - \tan 63^o + \tan 81^o$?

(A) 1
(B) 2
(C) 3
(D) 4

Sol. D

We have, $\tan 9^o - \tan 27^o - \tan 63^o + \tan 81^o = \tan 9^o + \tan 81^o - \tan 27^o - \tan 63^o$

$= \tan 9^o + \tan(90^o - 9^o) - \tan 27^o - \tan(90^o - 27^o)$

$= \tan 9^o + \cot 9^o - (\tan 27^o + \cot 27^o)$ ………(1)

Also, $\tan 9^o + \cot 9^o = \frac{1}{\sin 9^\circ \cos 9^\circ} = \frac{2}{\sin 18^\circ}$ (why?) ……..(2)

Similarly, $\tan 27^o + \cot 27^o = \frac{1}{\sin 27^\circ \cos 27^\circ} = \frac{2}{\sin 54^\circ} = \frac{2}{\cos 36^\circ}$ (why?) …….(3)

Using (2) and (3) in (1), we get

$\tan 9^o - \tan 27^o - \tan 63^o + \tan 81^o = \frac{2}{\sin 18^\circ} - \frac{2}{\cos 36^\circ} = \frac{2\times 4}{\sqrt{5}-1} - \frac{2\times 4}{\sqrt{5}+1} = 4$

4. What is the value of $\frac{\sec 8\theta - 1}{\sec 4\theta - 1}$?

(A) $\frac{\tan 8\theta}{\tan 4\theta}$

(B) $\frac{\tan 8\theta}{\tan 2\theta}$

(C) $\frac{\tan(8\theta)}{\tan(\theta)}$

(D) none of these

Sol. C

$\frac{\sec 8\theta - 1}{\sec 4\theta - 1} = \frac{(1-\cos 8\theta)\cos 4\theta}{\cos 8\theta(1-\cos 4\theta)} = \frac{2\sin^2 4\theta \cos 4\theta}{\cos 8\theta\, 2\sin^2 2\theta}$

$= \frac{\sin 4\theta(2\sin 4\theta \cos 4\theta)}{2\cos 8\theta \sin^2 2\theta}$

$= \frac{\sin 4\theta \sin 8\theta}{2\cos 8\theta \sin^2 2\theta}$

$= \dfrac{2\sin 2\theta \cos 2\theta \sin 8\theta}{2\cos 8\theta \sin^2 2\theta}$

$= \dfrac{\tan 8\theta}{\tan 2\theta}$

5. The value of x ∈ R, for which $2^{\sin x} + 2^{\cos x} \geq 2^{1-\frac{1}{\sqrt{2}}}$ does not hold true, is

(A) $\dfrac{\pi}{4}$
(B) $\dfrac{3\pi}{4}$
(C) $\dfrac{\pi}{2}$
(D) None of these

Sol. B

Use options to eliminate the wrong answers.

6. tan x is periodic with period

(A) $\dfrac{\pi}{2}$
(B) π
(C) 2π
(D) $\dfrac{3\pi}{2}$

Sol. B

As tan (π + x) = tan x for all x, therefore, tan x is periodic with period π as π is the smallest positive number to satisfy the property.

7. The period of tan(x + 3x + 5x + 7x) is

(A) π
(B) $\frac{\pi}{12}$
(C) $\frac{\pi}{16}$
(D) $\frac{\pi}{2}$

Sol. C

The equation is tan 16x.
Let f(x) = tan 16x and f(x + T) = tan (16x +16T)

f (x + T) = f(x) if function is periodic. Hence, 16x + 16T = nπ +16x and T = $\frac{\pi}{16}$ (if n = 1)

So, its period is $\frac{\pi}{16}$.

8. Which of the following is correct?

(A) tan1 = tan2
(B) tan1 = 2/3 tan2
(C) tan1 > tan2
(D) tan1 < sin2

Sol. C

As tan θ increases from 0 to ∞, θ varies from 0 to $\frac{\pi}{2}$ and 1c = $\frac{180}{\pi}$ degrees

9. The magnitude of a radian is

(A) 180°
(B) 58° 59′
(C) 57° 17′ 44.8″
(D) 60°

Sol. C

1 radian $= \frac{180}{\pi}$ degree $= \frac{180}{3.14}$

= 57· 17’ 44.8’’’

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10. For the trigonometric functions, which of the following statements is true?

(A) |cos x| is not a periodic function
(B) period of |cos x| is the same as that of cos x
(C) |cos x| and tan x both have period π
(D) tan x has period p, but |cos x| does not have period π

Sol. C

|cos x|, tan x both have period π.

11. The greatest value of sinx cosx is

(A) 1
(B) 2
(C) 1/2
(D) 1

Sol. C

sin 2x = 2 sin x cos x
$\therefore$ Option (3) is correct.

12. If sin 2θ = cos 4θ, then θ is equal to

(A) 12^o
(B) 15^o
(C) 18^o
(D) 21^o

Sol. B

According to the question, sin 2θ = cos 4θ It can be solved from the options. Take θ = 15^0, sin 30^0 = cos 60^0 which are exactly equal.

13. If θ is an acute angle and $\sin\theta = \frac{p-6}{8-p}$, then p must satisfy

(A) $6 \le p < 8$
(B) $6 \le p < 7$
(C) $3 \le p \le 4$
(D) $4 \le p < 7$

Sol. B

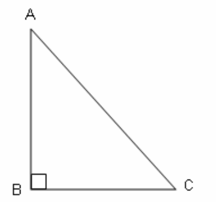
θ is an acute angle, $\theta < 90^o$
$\therefore$ Only 2nd value satisfies the value of p.

14. In a right angled triangle ABC, if $\angle B = 90^o$ and AB : AC = $\sqrt{3}$: 2, find the measure of $\angle A$.

(A) 75^o
(B) 60^o
(C) 45^o
(D) 30^o

Sol. D

In ΔABC,



$\frac{AB}{AC} = \frac{\sqrt{3}}{2}$ ….(i)

$\cos A = \frac{\text{base}}{\text{hypotenuse}} = \frac{AB}{AC}$ [$\because$ For angle A, opposite side BC is perpendicular, so AB is the base]

$\Rightarrow \cos A = \frac{\sqrt{3}}{2}$ by equation (i)

Also, $\cos 30^o = \frac{\sqrt{3}}{2}$, thus $\angle A = 30^o$

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15. If u = $\sin^6 x + \cos^6 x$, then maximum and minimum values of u are

(A) ± 1/4
(B) ± 1
(C) 1 and 1/4
(D) 1/4 and – 1

Sol. C

As sin x and cos x have even powers. $\therefore$ The value can't be negative.
Hence, (3) option is correct.

16. If A = $\frac{\pi}{8}$, then (cos3A cos2A + sin2A sin3A) sin A is equal to

(A) $\frac{1}{\sqrt{2}}$
(B) $\sqrt{2}$
(C) $\frac{1}{2\sqrt{2}}$
(D) None of these

Sol. C

As A = $\frac{\pi}{8}$ then cos 3A cos 2 A + sin 2 A sin 3 A can be written as

cos (3A – 2A) = cos A So, equation becomes cos A sin A. So, cos A sin A = $\frac{1}{2}$ sin 2 A where A = $\frac{\pi}{8}$

So, it becomes $\frac{1}{2}\sin\frac{\pi}{4} = \frac{1}{2} \times \frac{1}{\sqrt{2}} = \frac{1}{2\sqrt{2}}$

17. If $\cot^2\theta = \cot(\theta - \alpha)\cot(\theta - \beta)$, then $\cot 2\theta$ is equal to

(A) $\cot\alpha + \cot\beta$
(B) $1/2(\cot\alpha + \cot\beta)$
(C) $1/2(\tan\alpha + \tan\beta)$
(D) None of these

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Sol. B

It can be solved using the options. Let θ = 30o, α = 60o, β = 60^o

Hence, cot 2θ = cot 60^o = 1/$\sqrt{3}$ Now go with the options.

18. The value of sin36^0.sin72^0.sin108^0.sin144^0 is

(A) 1/16
(B) 3/16
(C) 5/16
(D) None of these

Sol. C

sin 36^o = $\frac{\sqrt{10-2\sqrt{5}}}{4}$

cos 36^o = $\frac{\sqrt{5}+1}{4}$

sin 18^o = $\frac{\sqrt{5}-1}{4}$

19. $\tan\frac{2\pi}{5} - \tan\frac{\pi}{15} - \sqrt{3}\tan\frac{2\pi}{5}\tan\frac{\pi}{15}$ is equal to

(A) $-\sqrt{3}$
(B) $1-\sqrt{3}$
(C) 1
(D) $\sqrt{3}$

Sol. D

We have $\dfrac{\tan\frac{6\pi}{15}-\tan\frac{\pi}{15}}{1+\tan\frac{6\pi}{15}\tan\frac{6\pi}{15}} = \tan\frac{\pi}{3}$

$\Rightarrow \tan\frac{6\pi}{15} - \tan\frac{\pi}{15} = \sqrt{3} + \sqrt{3}\tan\frac{6\pi}{15}\tan\frac{\pi}{15}$

$\Rightarrow \tan\frac{6\pi}{15} - \tan\frac{\pi}{15} - \sqrt{3}\tan\frac{6\pi}{15}\tan\frac{\pi}{15} = \sqrt{3}$

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20. If $\tan\theta_1 = k\tan\theta_2$, then $\frac{\cos(\theta_1 - \theta_2)}{\cos(\theta_1 + \theta_2)}$ equals

(A) $\frac{1+k}{1-k}$

(B) $\frac{1-k}{1+k}$

(C) $\frac{k+1}{k-1}$

(D) $\frac{k-1}{k+1}$

Sol. A

Use formula cos(A – B) and cos(A + B) and $\frac{\sin\theta_1}{\cos\theta_1} = k\frac{\sin\theta_2}{\cos\theta_2}$.

21. If $\cot x = -\frac{5}{12}$, x lies in second quadrant find the values of other five trigonometric functions.

Sol:

$\text{Cot}\, x = -\frac{5}{12}$

$\tan x = -\frac{12}{5}$

$\text{Sec}^2 x = 1 + \tan^2 x$

$\text{Sec}\, x = \pm\frac{13}{5}$

$\text{Sec}\, x = -\frac{13}{5}$ [$\because$ x lies in IInd quad.

$\text{Cos}\, x = -\frac{5}{13}$

$\text{Sin}\, x = \tan x.\ \text{Cos}\, x$

$= \frac{-12}{5} \times \left(\frac{-5}{13}\right) \quad = \frac{12}{13}$

$\text{Cosec}\, x = \frac{13}{12}$

22. Prove that $\frac{\sin 5x - 2\sin 3x + \sin x}{\cos 5x - \cos x} = \tan x$

Sol :

$$\text{L. H. S} = \frac{\text{Sin } 5x + \text{Sin} x - 2 \text{ Sin } 3x}{\text{Cos } 5x - \text{Cos } x}$$

$$= \frac{2\text{Sin } 3x. \text{ Cos } 2x - 2 \text{ Sin } 3x}{- 2 \text{ Sin } 3x. \text{ Sin } 2x}$$

$$= \frac{2 \text{ Sin } 3x (\text{Cos } 2x - 1)}{-2 \text{ Sin } 3x. \text{ Sin } 2x}$$

$$= \frac{-(1 - \text{Cos } 2x)}{-\text{Sin } 2x}$$

$$= \frac{2 \text{ Sin}^2 x}{2 \text{ Sin } x. \text{ Cos } x}$$

$$= \frac{\text{Sin } x}{\text{Cos } x} = \tan x$$

23. Prove that sin x + sin 3x + sin 5x + sin 7x = 4 cos x. cos 2x. sin 4x

Sol:

$$\text{L. H. S.} = \text{Sin } x + \text{Sin } 3x + \text{Sin } 5x + \text{Sin } 7x$$

$$= \text{Sin } x + \text{Sin } 7x + \text{Sin } 3x + \text{Sin } 5x$$

$$= 2 \text{ Sin } \left(\frac{x+7x}{2}\right). \text{ Cos } \left(\frac{x-7x}{2}\right) + 2 \text{ Sin } \left(\frac{3x+5x}{2}\right) \text{ Cos } \left(\frac{3x-5x}{2}\right)$$

$$= 2 \text{ Sin } 4x. \text{ Cos } 3x + 2 \text{ Sin } 4x. \text{ Cos } x$$

$$= 2 \text{ Sin } 4x [\text{Cos } 3x + \text{Cos } x]$$

$$= 2 \text{ Sin } 4x \left[2 \text{ Cos } \left(\frac{3x+x}{2}\right). \text{ Cos } \left(\frac{3x-x}{2}\right)\right]$$

$$= 2 \text{ Sin } 4x [2 \text{ Cos } 2x. \text{ Cos } x]$$

$$= 4 \text{ Cos } x. \text{ Cos } 2x. \text{ Sin } 4x$$

24. Prove that $\cos^2 x + \cos^2\left(x+\frac{\pi}{3}\right) + \cos^2\left(x-\frac{\pi}{3}\right) = \frac{3}{2}$

Sol:

$$\text{L. H. S} = \frac{1+\text{Cos } 2x}{2} + \frac{1+\text{Cos}\left(2x+\frac{2\pi}{3}\right)}{2} + \frac{1+\text{Cos}\left(2x-\frac{2\pi}{3}\right)}{2}$$

$$= \frac{1}{2}\left[1+1+1+\text{Cos } 2x + \text{Cos}\left(2x+\frac{2\pi}{3}\right) + \text{Cos}\left(2x-\frac{2\pi}{3}\right)\right]$$

$$= \frac{1}{2}\left[3 + Cos2x + Cos\left(2x+\frac{2\pi}{3}\right) + Cos\left(2x-\frac{2\pi}{3}\right)\right]$$

$$= \frac{1}{2}\left[3 + Cos2x + 2Cos\left(\frac{2x+\frac{2\pi}{3}+2x-\frac{2\pi}{3}}{2}\right).\text{Cos}\left(\frac{2x+\frac{2\pi}{3}-2x+\frac{2\pi}{3}}{3}\right)\right]$$

$$= \frac{1}{2}\left[3 + \text{Cos } 2x + 2\text{ Cos } 2x.\text{ Cos }\frac{4\pi}{6}\right]$$

$$= \frac{1}{2}\left[3 + \text{Cos } 2x + 2\text{ Cos } 2x.\text{ Cos }\frac{2\pi}{3}\right]$$

$$= \frac{1}{2}\left[3 + \text{Cos } 2x + 2\text{ Cos } 2x.\text{ Cos}\left(\pi-\frac{\pi}{3}\right)\right]$$

$$= \frac{1}{2}\left[3 + \text{Cos } 2x + 2\text{ Cos } 2x.\left(\frac{-1}{2}\right)\right]$$

$$= \frac{3}{2}.$$

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25. Prove that cos 2x. cos $\frac{x}{2}$ – cos 3x. cos $\frac{9x}{2}$ = sin 5x sin $\frac{5x}{2}$

Sol:

$$\text{L. H. S} = \frac{1}{2}\left[2\text{ Cos } 2x \text{ Cos } \frac{x}{2} - 2\text{Cos } 3x. \text{ Cos } \frac{9x}{2}\right]$$

$$= \frac{1}{2}\left[\text{Cos }\left(2x+\frac{x}{2}\right) + Cos\left(2x-\frac{x}{2}\right) - Cos\left(\frac{9x}{2}+3x\right) - Cos\left(\frac{9x}{2}-3x\right)\right]$$

$$= \frac{1}{2}\left[Cos\frac{5x}{2} + \cancel{Cos}\frac{\cancel{3x}}{\cancel{2}} - Cos\frac{15x}{2} - \cancel{Cos}\frac{\cancel{3x}}{\cancel{2}}\right]$$

$$= \frac{1}{2}\left[Cos\frac{5x}{2} - Cos\frac{15x}{2}\right]$$

$$= \frac{1}{2}\left[-2Sin\left(\frac{\frac{5x}{2}+\frac{15x}{2}}{2}\right).Sin\left(\frac{\frac{5x}{2}-\frac{15x}{2}}{2}\right)\right]$$

$$= -\text{ Sin } 5x. \text{ Sin }\left(\frac{-5x}{2}\right)$$

$$= \text{Sin } 5x. \text{ Sin } \frac{5x}{2}.$$