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1. Evaluate the following:

(i) sin 60° cos 30° + sin 30° cos 60°

(ii) 2 tan² 45° + cos² 30° – sin² 60

(iii) $$\frac{\cos 45^\circ}{\sec 30^\circ + \text{cosec } 30^\circ}$$

(iv) $$\frac{\sin 30^\circ + \tan 45^\circ - \text{cosec } 60^\circ}{\sec 30^\circ + \cos 60^\circ + \cot 45^\circ}$$

(v) $$\frac{5\cos^2 60^\circ + 4\sec^2 30^\circ - \tan^2 45^\circ}{\sin^2 30^\circ + \cos^2 30^\circ}$$

Solution:

(i) sin 60° cos 30° + sin 30° cos 60°

First, find the values of the given trigonometric ratios

sin 30° = 1/2

cos 30° = √3/2

sin 60° = 3/2

cos 60°= 1/2

Now, substitute the values in the given problem

sin 60° cos 30° + sin 30° cos 60° = √3/2 ×√3/2 + (1/2) ×(1/2) = 3/4+1/4 = 4/4 =1

(ii) 2 $\tan^2$ 45° + $\cos^2$ 30° – $\sin^2$ 60

We know that, the values of the trigonometric ratios are:

sin 60° = √3/2

cos 30° = √3/2

tan 45° = 1

Substitute the values in the given problem

2 $\tan^2$ 45° + $\cos^2$ 30° – $\sin^2$ 60 = $2(1)^2 + (\sqrt{3}/2)^2 - (\sqrt{3}/2)^2$

2 $\tan^2$ 45° + $\cos^2$ 30° – $\sin^2$ 60 = 2 + 0

2 $\tan^2$ 45° + $\cos^2$ 30° – $\sin^2$ 60 = 2

(iii) cos 45°/(sec 30°+cosec 30°)

We know that,

cos 45° = 1/√2

sec 30° = $2/\sqrt{3}$

cosec 30° = 2

Substitute the values, we get

$$\frac{\cos 45°}{\sec 30°+\text{cosec } 30°} = \frac{\frac{1}{\sqrt{2}}}{\frac{2}{\sqrt{3}}+2} = \frac{\frac{1}{\sqrt{2}}}{\frac{2+2\sqrt{3}}{\sqrt{3}}}$$

$$= \frac{1}{\sqrt{2}} \times \frac{\sqrt{3}}{2+2\sqrt{3}}$$

$$= \frac{1}{\sqrt{2}} \times \frac{\sqrt{3}}{2(1+\sqrt{3})} = \frac{\sqrt{3}}{2\sqrt{2}(1+\sqrt{3})} = \frac{\sqrt{3}}{2\sqrt{2}(\sqrt{3}+1)}$$

Now, rationalize the terms we get,

$$= \frac{\sqrt{3}}{2\sqrt{2}(\sqrt{3}+1)} \times \frac{\sqrt{3}-1}{\sqrt{3}-1} = \frac{3-\sqrt{3}}{2\sqrt{2}\,(3-1)} = \frac{3-\sqrt{3}}{2\sqrt{2}\,(2)}$$

Now, multiply both the numerator and denominator by $\sqrt{2}$, we get

$$= \frac{3-\sqrt{3}}{2\sqrt{2}\,(2)} \times \frac{\sqrt{2}}{\sqrt{2}} = \frac{3\sqrt{2}-\sqrt{3}\sqrt{2}}{8} = \frac{3\sqrt{2}-\sqrt{6}}{8}$$

Therefore, cos 45°/(sec 30°+cosec 30°) = $(3\sqrt{2} - \sqrt{6})/8$

(iv) $\dfrac{\sin 30° + \tan 45° - \text{cosec } 60°}{\sec 30° + \cos 60° + \cot 45°}$

We know that,

sin 30° = 1/2

tan 45° = 1

cosec 60° = $2/\sqrt{3}$

sec 30° = $2/\sqrt{3}$

cos 60° = 1/2

cot 45° = 1

Substitute the values in the given problem, we get

$$\frac{\sin 30°+\tan 45°-\text{cosec } 60°}{\sec 30°+\cos 60°+\cot 45°}=\frac{\frac{1}{2}+1-\frac{2}{\sqrt{3}}}{\frac{2}{\sqrt{3}}+\frac{1}{2}+1}=\frac{\frac{\sqrt{3}+2\sqrt{3}-4}{2\sqrt{3}}}{\frac{4+\sqrt{3}+2\sqrt{3}}{2\sqrt{3}}}$$

Now, cancel the term 2√3, in numerator and denominator, we get

$$=\frac{\sqrt{3}+2\sqrt{3}-4}{4+\sqrt{3}+2\sqrt{3}}=\frac{3\sqrt{3}-4}{3\sqrt{3}+4}$$

Now, rationalize the terms

$$=\frac{3\sqrt{3}-4}{3\sqrt{3}+4}\times\frac{3\sqrt{3}-4}{3\sqrt{3}-4}$$

$$=\frac{27-12\sqrt{3}-12\sqrt{3}+16}{27-12\sqrt{3}+12\sqrt{3}+16}=\frac{27-24\sqrt{3}+16}{11}=\frac{43-24\sqrt{3}}{11}$$

Therefore,

$$\frac{\sin 30°+\tan 45°-\text{cosec } 60°}{\sec 30°+\cos 60°+\cot 45°}=\frac{43-24\sqrt{3}}{11}$$

(v) $\dfrac{5\cos^2 60°+4\sec^2 30°-\tan^2 45°}{\sin^2 30°+\cos^2 30°}$

We know that,

cos 60° = 1/2

sec 30° = 2/√3

tan 45° = 1

sin 30° = 1/2

cos 30° = √3/2

Now, substitute the values in the given problem, we get

$(5\cos^2 60° + 4\sec^2 30° – \tan^2 45°)/(\sin^2 30° + \cos^2 30°)$

$= 5(1/2)^2+4(2/\sqrt{3})^2-1^2/(1/2)^2+(\sqrt{3}/2)^2$

= (5/4+16/3-1)/(1/4+3/4)

= (15+64-12)/12/(4/4)

= 67/12

2. Choose the correct option and justify your choice :

(i) $2\tan 30°/1+\tan^2 30°$ =

(A) sin 60° (B) cos 60° (C) tan 60° (D) sin 30°

(ii) $1-\tan^2 45°/1+\tan^2 45°$ =

(A) tan 90° (B) 1 (C) sin 45° (D) 0

(iii) sin 2A = 2 sin A is true when A =

(A) 0° (B) 30° (C) 45° (D) 60°

(iv) $2\tan 30°/1-\tan^2 30°$ =

(A) cos 60° (B) sin 60° (C) tan 60° (D) sin 30°

Solution:

(i) (A) is correct.

Substitute the of tan 30° in the given equation

tan 30° = $1/\sqrt{3}$

$2\tan 30°/1+\tan^2 30° = 2(1/\sqrt{3})/1+(1/\sqrt{3})^2$

$= (2/\sqrt{3})/(1+1/3) = (2/\sqrt{3})/(4/3)$

$= 6/4\sqrt{3} = \sqrt{3}/2 = \sin 60°$

The obtained solution is equivalent to the trigonometric ratio sin 60°

(ii) (D) is correct.

Substitute the of tan 45° in the given equation

tan 45° = 1

$1-\tan^2 45°/1+\tan^2 45° = (1-1^2)/(1+1^2)$

= 0/2 = 0

The solution of the above equation is 0.

(iii) (A) is correct.

To find the value of A, substitute the degree given in the options one by one

sin 2A = 2 sin A is true when A = 0°

As sin 2A = sin 0° = 0

2 sin A = 2 sin 0° = 2 × 0 = 0

or,

Apply the sin 2A formula, to find the degree value

sin 2A = 2sin A cos A

⇒2sin A cos A = 2 sin A

⇒ 2cos A = 2 ⇒ cos A = 1

Now, we have to check, to get the solution as 1, which degree value has to be applied.

When 0 degree is applied to cos value, i.e., cos 0 =1

Therefore, ⇒ A = 0°

(iv) (C) is correct.

Substitute the of tan 30° in the given equation

tan 30° = $1/\sqrt{3}$

$2\tan 30°/1-\tan^2 30° = 2(1/\sqrt{3})/1-(1/\sqrt{3})^2$

$= (2/\sqrt{3})/(1-1/3) = (2/\sqrt{3})/(2/3) = \sqrt{3} = \tan 60°$

The value of the given equation is equivalent to tan 60°.

3. If tan (A + B) = √3 and tan (A – B) = 1/√3 ,0° < A + B ≤ 90°; A > B, find A and B.

Solution:

tan (A + B) = √3

Since √3 = tan 60°

Now substitute the degree value

⇒ tan (A + B) = tan 60°

(A + B) = 60° … (i)

The above equation is assumed as equation (i)

tan (A – B) = 1/√3

Since 1/√3 = tan 30°

Now substitute the degree value

⇒ tan (A – B) = tan 30°

(A – B) = 30° … equation (ii)

Now add the equation (i) and (ii), we get

A + B + A – B = 60° + 30°

Cancel the terms B

2A = 90°

A= 45°

Now, substitute the value of A in equation (i) to find the value of B

45° + B = 60°

B = 60° – 45°

B = 15°

Therefore A = 45° and B = 15°

4. State whether the following are true or false. Justify your answer.

(i) sin (A + B) = sin A + sin B.

(ii) The value of sin θ increases as θ increases.

(iii) The value of cos θ increases as θ increases.

(iv) sin θ = cos θ for all values of θ.

(v) cot A is not defined for A = 0°.

Solution:

(i) False.

Justification:

Let us take A = 30° and B = 60°, then

Substitute the values in the sin (A + B) formula, we get

sin (A + B) = sin (30° + 60°) = sin 90° = 1 and,

sin A + sin B = sin 30° + sin 60°

= 1/2 + √3/2 = 1+√3/2

Since the values obtained are not equal, the solution is false.

(ii) True.

Justification:

According to the values obtained as per the unit circle, the values of sin are:

sin 0° = 0

sin 30° = 1/2

sin 45° = 1/√2

sin 60° = √3/2

sin 90° = 1

Thus the value of sin θ increases as θ increases. Hence, the statement is true

(iii) False.

According to the values obtained as per the unit circle, the values of cos are:

cos 0° = 1

cos 30° = √3/2

cos 45° = 1/√2

cos 60° = 1/2

cos 90° = 0

Thus, the value of cos θ decreases as θ increases. So, the statement given above is false.

(iv) False

sin θ = cos θ, when a right triangle has 2 angles of (π/4). Therefore, the above statement is false.

(v) True.

Since cot function is the reciprocal of the tan function, it is also written as:

cot A = cos A/sin A

Now substitute A = 0°

cot 0° = cos 0°/sin 0° = 1/0 = undefined.

Hence, it is true