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# RS Aggarwal Solutions for Class 10 Maths Chapter 11 T-Ratios of Some Particular Angles

## Exercise 11

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**Evaluate each of the following:**
**(Question 1 to Question 9)**

**Question 1: sin 60° cos 30° + cos 60° sin 30°.**

**Solution:**
We know that,

sin 60° = √3/2 = cos 30°

and sin 30° = 1/2 = cos 60°

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

**Question 2:**
**cos 60° cos 30° − sin 60° sin 30°.**

**Solution:**
We know that,
cos 60° = 1/2 = sin 30°

and cos 30° = √3/2 = sin 60°

Now,
cos 60° cos 30° — sin 60° sin 30° = (1/2) × (√3/2) - (√3/2) × (1/2)

= (√3/4) - (√3/4)

= 0

**Question 3:**
**cos 45° cos 30° + sin 45° sin 30°.**
**Solution:**
We know that,

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cos 45° = 1/√2 = sin 45°

cos 30° = √3/2 and

sin 30° = 1/2

Now,
cos 45° cos 30° + sin 45° sin 30° = (1/√2)×(√3/2) + (1/√2)(1/2)

= (√3 / 2√2) + (1 / 2√2)

= (√3 + 1) / (2√2)

**Question 4:**

$$\frac{\sin 30^\circ}{\cos 45^\circ}+\frac{\cot 45^\circ}{\sec 60^\circ}-\frac{\sin 60^\circ}{\tan 45^\circ}+\frac{\cos 30^\circ}{\sin 90^\circ}$$

**Solution:**

We know that,

sin 30° = 1/2 , sin 60° = √3/2 , sin 90° = 1

cos 30° = √3/2 , cos 45° = 1/√2 , cos 60° = 1/2

sec 60° = 2, tan 45° = 1 and cot 45° = 1

Now,

$$\frac{\sin 30^\circ}{\cos 45^\circ}+\frac{\cot 45^\circ}{\sec 60^\circ}-\frac{\sin 60^\circ}{\tan 45^\circ}+\frac{\cos 30^\circ}{\sin 90^\circ}$$

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

$$=\left(\frac{\sqrt{2}+1-2\sqrt{3}}{2}\right)$$

**Question 5: $(5\cos^2 60°+4\sec^2 30°-\tan^2 45°)/(\sin^2 30°+\cos^2 30°)$**

**Solution:**

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We know that,

cos 30° = √3/2 => cos^2 30° = 3/4

cos 60° = 1/2 => cos^2 60° = 1/4

sec 30° =(2/√3) => sec^2 30° = 4/3

tan 45° = 1 => tan^2 45° = 1

sin 30° = 1/2 => sin^2 30° = 1/4

Now,

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

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

$$= \frac{5 \times \frac{1}{4} + 4 \times \frac{4}{3} - 1}{\frac{1}{4} + \frac{3}{4}}$$

$$= \frac{\frac{5}{4} + \frac{16}{3} - 1}{\frac{1+3}{4}}$$

$$= \frac{\frac{15 + 64 - 12}{12}}{\frac{4}{4}}$$

= 67/12

**Question 6:**
**$2\cos^2 60° + 3\sin^2 45° - 3\sin^2 30° + 2\cos^2 90°$.**

**Solution:**

We know that,

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sin 45° = 1/√2 , cos 60° = 1/2

sin 30° = 1/2 and cos 90° = 0

Now,

$2\cos^2 60° + 3\sin^2 45° - 3\sin^2 30° + 2\cos^2 90°$

$$= 2\times\left(\frac{1}{2}\right)^2 + 3\times\left(\frac{1}{\sqrt{2}}\right)^2 - 3\times\left(\frac{1}{2}\right)^2 + 2(0)^2$$
$$= \frac{1}{2} + \frac{3}{2} - \frac{3}{4} \Rightarrow \frac{2+6-3}{4} = \frac{5}{4}$$

**Question 7:**
**$\cot^2 30° - 2\cos^2 30° - \frac{3}{4}\sec^2 45° + \frac{1}{4}\operatorname{cosec}^2 30°$.**

**Solution:**

We know that,

Cot 30° = √3, cos 30° = √3/2

Sec 45° = √2 , cosec 30° = 2

Now,

$\cot^2 30° - 2\cos^2 30° - \frac{3}{4}\sec^2 45° + \frac{1}{4}\operatorname{cosec}^2 30°$

$$= \left(\sqrt{3}\right)^2 - 2\times\left(\frac{\sqrt{3}}{2}\right)^2 - \frac{3}{4}\times\left(\frac{\sqrt{2}}{1}\right)^2 + \frac{1}{4}\times(2)^2$$
$$= 3 - 2\times\frac{3}{4} - \frac{3}{4}\times 2 + \frac{1}{4}\times 4$$
$$= 3 - \frac{3}{2} - \frac{3}{2} + 1$$

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= 1

**Question 8:**
**$(\sin^2 30° + 4\cot^2 45° - \sec^2 60°)(\text{cosec}^2 45° \sec^2 30°)$.**

**Solution:**
sin 30° = 1/2 ⇒ sin^2 30° = 1/4

cos 45° = 1/√2 = sin 45°

cot 45° = 1 ⇒ cot^2 45° = 1

cos 60° = 1/2 ⇒ sec 60° = 2 ⇒ sec^2 60° = 4

cos 30° = √3/2 ⇒ sec 30° = 2/√3 ⇒ sec^2 30° = 4/3

cosec 45° = 1/sin 45° = √2 ⇒ cosec^2 45° = 2

$(\sin^2 30° + 4\cot^2 45° - \sec^2 60°)(\text{cosec}^2 45° \sec^2 30°)$

$$= \left[\left(\frac{1}{2}\right)^2 + 4 \times (1)^2 - (2)^2\right]\left[\left(\sqrt{2}\right)^2 \times \left(\frac{2}{\sqrt{3}}\right)^2\right]$$

=1/4 x 8/3

= 2/3

**Question 9:**
**$4/\cot^2 30° + 1/\sin^2 30° - 2\cos^2 45° - \sin^2 0°$.**

**Solution:**
$4/\cot^2 30° + 1/\sin^2 30° - 2\cos^2 45° - \sin^2 0°$

$$= \frac{4}{\left(\sqrt{3}\right)^2} + \frac{1}{\left(\frac{1}{2}\right)^2} - 2 \times \left(\frac{1}{\sqrt{2}}\right)^2 - 0$$

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= 4/3 + 4/1 – 1 – 0

= 26/6

= 13/3

**Question 10:**
**Show that:**

(i) $\frac{1-\sin 60^\circ}{\cos 60^\circ} = \frac{\tan 60^\circ - 1}{\tan 60^\circ + 1}$

(ii) $\frac{\cos\ 30^\circ + \sin\ 60^\circ}{1\ +\ \sin\ 30^\circ + \cos\ 60^\circ} = \cos\ 30^\circ$

**Solution:**
(i)

$$\frac{1-\sin 60^\circ}{\cos 60^\circ}$$

$$= \frac{1-\frac{\sqrt{3}}{2}}{\frac{1}{2}} = \frac{2-\sqrt{3}}{1}$$

= 2 - √3

RHS:

$$\therefore \frac{\tan 60^\circ - 1}{\tan 60^\circ + 1} = \frac{\sqrt{3}-1}{\sqrt{3}+1}$$

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

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= (4 - 2√3)/2

= 2 - √3

(ii)

LHS:

$$\frac{\cos 30^\circ + \sin 60^\circ}{1 + \sin 30^\circ + \cos 60^\circ}$$

=

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

RHS:

$$\cos 30^\circ = \frac{\sqrt{3}}{2}$$

LHS = RHS

**Question 11:**
**Verify each of the following:**
**(i) sin 60° cos 30° − cos 60° sin 30° = sin 30°**
**(ii) cos 60° cos 30° + sin 60° sin 30° = cos 30°**
**(iii) 2 sin 30° cos 30° = sin 60°**
**(iv) 2 sin 45° cos 45° = sin 90°**

**Solution:**
(i) L.H.S. = sin 60° cos 30° — cos 60° sin 30°

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= (√3/2) × (√3/2) – (1/2)(1/2)

= (3/4) – (1/4)

= 2/4

1/2

R.H.S.:

sin 30° = 1/2

LHS = RHS

(ii)

L.H.S. = cos 60° cos 30° + sin 60° sin 30°

= (1/2) × (√3/2) + (√3/2)(1/2)

= (√3/4) + (√3/4)

= √3/2

R.H.S.

cos 30° = √3/2

L.H.S. = R.H.S.

(iii)

L.H.S. = 2 sin 30° cos 30°

= 2 × (1/2) × (√3/2)

= √3/2

R.H.S.

sin 60° = √3/2

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L.H.S. = R.H.S.

(iv)L.H.S. = 2 sin 45° cos 45°

= 2 × (1/√2) × (1/√2)

= (2 × 1/2)

= 1

R.H.S. = sin 90° = 1

L.H.S. = R.H.S.

**Question 12:**
**If A = 45°, verify that:**
**(i) sin 2A = 2 sin A cos A (ii) cos 2A = 2 cos$^2$ A − 1 = 1 − 2 sin$^2$ A**

**Solution:**
A = 45° then 2 A = 90°

(i)Sin 2A = sin90°
RHS:

2 sin 45° cos 45° = 2 × (1/√2) × (1/√2)

= 1

LHS:

sin 90° = 1

L.H.S. = R.H.S.

(ii) cos 2A = cos90° = 0

$$2\cos^2 A - 1 = 2\cos^2 45° - 1$$

$$= 2\left(\frac{1}{\sqrt{2}}\right)^2 - 1 = 1 - 1 = 0$$

$$1 - 2\sin^2 A = 1 - 2\sin^2 45° = 1 - 2 \times \left(\frac{1}{\sqrt{2}}\right)^2 = 1 - 1 = 0$$

$$\therefore \cos 2A = 2\cos^2 A - 1 = 1 - 2\sin^2 A$$

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**Question 13.**
**If A = 30°, verify that:**

(i) $\sin 2A = \frac{2\tan A}{1-\tan^2 A}$

(ii) $\cos 2A = \frac{1-\tan^2 A}{1+\tan^2 A}$

(iii) $\tan 2A = \frac{2\tan A}{1-\tan^2 A}$

**Solution:**

A = 30 ⇒ 2A = 60

(i)

$\sin 2A = \sin 60° = \frac{\sqrt{3}}{2}$

Also $\frac{2\tan A}{1+\tan^2 A} = \frac{2\tan 30°}{1+\tan^2 30} = \frac{2\times\frac{1}{\sqrt{3}}}{1+\left(\frac{1}{\sqrt{3}}\right)^2} = \frac{\frac{2}{\sqrt{3}}}{1+\frac{1}{3}}$

$= \frac{\frac{2}{\sqrt{3}}}{\frac{4}{3}} = \frac{2}{\sqrt{3}}\times\frac{3}{4} = \frac{\sqrt{3}}{2}$

Hence, $\sin 2A = \frac{2\tan A}{1+\tan^2 A}$

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(ii)

$$\cos 2A = \cos 60° = \frac{1}{2}$$

$$\text{Also, } \frac{1-\tan^2 A}{1+\tan^2 A} = \frac{1-\tan^2 30°}{1+\tan^2 30°} = \frac{1-\left(\frac{1}{\sqrt{3}}\right)^2}{1+\left(\frac{1}{\sqrt{3}}\right)^2}$$

$$= \frac{\left(1-\frac{1}{3}\right)}{\left(1+\frac{1}{3}\right)} = \frac{\left(\frac{2}{3}\right)}{\left(\frac{4}{3}\right)} = \left(\frac{2}{3}\times\frac{3}{4}\right) = \frac{1}{2}$$

$$\text{Hence, } \cos 2A = \frac{1-\tan^2 A}{1+\tan^2 A}$$

(iii)

tan2A = 2tan A/(1-tan^2A)

A = 30 degrees

Show that:

$$\tan 60° = \frac{2\tan 30°}{1-\tan^2 30°}$$

RHS:

$$\frac{2\tan 30°}{1-\tan^2 30°} = \frac{2\times\frac{1}{\sqrt{3}}}{1-\frac{1}{3}} = \frac{2/\sqrt{3}}{2/3}$$

=3/√3

= √3

= tan 60^0

= LHS

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**Question 14:**

**If A = 60° and B = 30°, verify that:**

**(i) sin (A + B) = sin A cos B + cos A sin B**

**(ii) cos (A + B) = cos A cos B − sin A sin B**

**Solution:**

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

If A = 60° and B = 30°, then

To verify: sin 90° = sin 60° cos 30° + cos 60° sin 30°

RHS: sin 60° cos 30° + cos 60° sin 30°

= (√3/2) × (√3/2) + (1/2)(1/2)

= (3/4) + (1/4)

= 4/4

=1

= sin 90°

= LHS

(ii) cos (A + B) = cos A cos B — sin A sin B

If A = 60° and B = 30°

Verify: cos (90°) = cos 60° cos 30° — sin60° sin 30°

R.H.S. = cos 60° cos 30° - sin 60° sin 30°

= (1/2) × (√3/2) - (√3/2)(1/2)

= (√3/4) - (√3/4)

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= 0

= cos 90°

= L.H.S.

**Question 15:**
**If A = 60° and B = 30°, verify that:**
**(i) sin (A – B) = sin A cos B – cos A sin B**
**(ii) cos (A – B) = cos A cos B + sin A sin B**
**(iii) tan (A – B) =** $\frac{tan\ A - tan\ B}{1 + tan\ A\ tan\ B}$

**Solution:**
(i) sin (A - B) = sin A cos B - cos A sin B

If A = 60° and B = 30°, then

LHS :

= sin(60°-30°)

= sin 30°

= 1/2

R.H.S. = sin 60° cos 30° - cos 60° sin 30°

= (√3/2) × (√3/2) - (1/2) (1/2)

= (3/4) - (1/4)

= 2/4

=1/2

L.H.S. = R.H.S.

(ii) cos (A - B) = cos A cos B + sin A sin B

If A = 60° and B = 30°, then

Verify: cos (30°) = cos 60° cos 30° + sin 60° sin 30°

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R.H.S. = cos 60° cos 30° + sin 60° sin 30°

= (1/2) × (√3/2) + (√3/2)(1/2)

= (√3/4) + (√3/4)

= √3/2

= cos 30°

= L.H.S.

(iii) If A = 60° and B = 30°, then

A-B = 30°

$$\tan(A-B) = \tan 30^\circ = \frac{1}{\sqrt{3}}$$

Now,

$$\frac{\tan A - \tan B}{1 + \tan A \tan B} = \frac{\tan 60^\circ - \tan 30^\circ}{1 + \tan 60^\circ \tan 30^\circ}$$

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

$$= \frac{\frac{3-1}{\sqrt{3}}}{1+1}$$

=1/√3

$$\tan(A-B) = \frac{tan\ A - tan\ B}{1 + tan\ A\ tan\ B}$$

Verified.

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**Question 16:**

**If A and B are acute angles such that tan A = 1/3, tan B = 1/2 and**

**tan (A + B) =** $\frac{tan\ A + tan\ B}{1 - tan\ A\ tan\ B}$**,**

**Show that A + B = 45°.**

**Solution:**

$$\tan(A+B) = \frac{\tan A + \tan B}{1 - \tan A \tan B}$$

$$\tan(A+B) = \frac{\left(\frac{1}{3} + \frac{1}{2}\right)}{1 - \frac{1}{3} \times \frac{1}{2}} \quad \left[\because \tan A = \frac{1}{3}, \tan B = \frac{1}{2}\right]$$

=( 5/6) /( 5/6)

= 1

This implies, tan(A + B) = 1

= tan $45^0$

Or A + B = $45^0$ . Proved

**Question 17:**

**Using the formula, tan 2A =** $\frac{2tanA}{1-tan^2A}$**, find the value of tan 60°, it being given that tan 30° = 1/√3.**

**Solution:**

Put A = 30° => 2A = 60°

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$$\tan 60° = \frac{2\tan 30°}{1-\tan^2 30°}$$

$$= \frac{2\times\frac{1}{\sqrt{3}}}{1-\left(\frac{1}{\sqrt{3}}\right)^2}$$

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

= √3

The value of tan 60° is √3.

**Question 18:**

**Using the formula, $cos\ A = \sqrt{\frac{1+\cos 2A}{2}}$ , find the value of cos 30°, it being given that cos 60° = 1/2.**

**Solution:**
Put A = 30° then 2 A = 60°

$$cos\ A = \sqrt{\frac{1+\cos 2A}{2}}$$

$$\cos 30° = \sqrt{\frac{1+\cos 60°}{2}} = \sqrt{\frac{1+\frac{1}{2}}{2}} = \sqrt{\frac{3}{2}\over 2}$$

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

The value of cos 30° is √3/2.

**Question 19:**

**Using the formula, $sin\ A = \sqrt{\frac{1-\cos 2A}{2}}$ , find the value of sin 30°, it being given that cos 60° = 1/2.**

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**Solution:**
Put A = 30° then 2 A = 60°

$$sin\ A = \sqrt{\frac{1 - \cos 2A}{2}}$$

Squaring both side, we get

$$\boldsymbol{sin\text{^}2\ A} = \frac{1 - \cos 2A}{2}$$

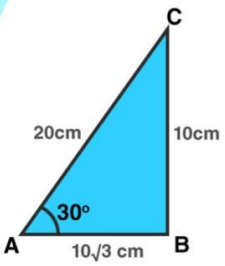
And,

$$\sin^2 30° = \frac{1-\cos 60°}{2} = \frac{1-\frac{1}{2}}{2} = \frac{1}{4}$$

Sin $30^0$ = 1/2

**Question 20:**
**In the adjoining figure, ΔABC is a right-angled triangle in which ∠B = 90°, ∠A = 30° and AC = 20 cm. Find (i) BC, (ii) AB.**

**Solution:**
Draw a right angled ΔABC using given instructions:




Here sin 30 = BC/AC

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½ = BC/20

Or BC = 10 cm

By Pythagoras theorem:

(AB)^2 = (AC)^2 – (BC)^2

=(20)^2 – (10)^2

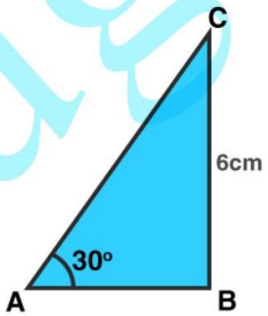
= 300

AB = 10 √3 cm

**Question 21:**
**In the adjoining figure, Δ ABC is a right-angled at B and ∠A = 30°. If BC = 6 cm, Find (i) AB, (ii) AC.**

**Solution:**

Draw a right angled ΔABC using given instructions:




Here sin 30 = BC/AC

½ = 6/AC

Or AC = 12cm

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By Pythagoras theorem:

(AB)^2 = (AC)^2 – (BC)^2

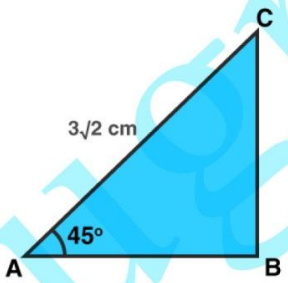
=(12)^2 – (6)^2

= 108

AB = 6 √3 cm

**Question 22:**
**In the adjoining figure, ΔABC is a right-angled at B and ∠A = 45°. If AC = 3√2 cm, Find (i) BC, (ii) AB.**

**Solution:**
From right angled ΔABC,




(i)

$$\frac{BC}{AC} = \sin 45^\circ$$

$$\frac{BC}{3\sqrt{2}} = \frac{1}{\sqrt{2}}$$

Or BC = 3

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(ii) By Pythagoras theorem

$(AB)^2 = (AC)^2 - (BC)^2$

$= (3\sqrt{2})^2 - (3)^2$

$= 18 - 9$

$= 9$

AB = 3 cm

**Question 23:**
**If sin (A + B) = 1 and cos (A − B) = 1, 0° ≤ (A + B) ≤ 90° and A > B, then find A and B.**

**Solution:**
sin (A + B)= 1 or sin (A + B) = sin90° [As sin90° = 1)

A + B = 90° ...(1)

Again, Cos(A-B) = 1

= cos 0°

A – B = 0 ...(2)

Adding (1) and (2), we get
2A = 90° or A = 45°
Putting A = 45° in (1) we get
45° + B = 90° or B = 45°
Hence, A = 45° and B = 45°.

**Question 24:**
**If sin (A − B) = 1/2 and cos (A + B) = 1/2, 0° < (A + B) < 90° and A > B, then find A and B.**

**Solution:**
sin (A - B)= 1/2

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or sin (A - B) = sin 30°

A - B = 30° ...(1)

Again, Cos(A+B) = 1/2

= cos 60°

A + B = 60° ...(2)
Solving (1) and (2), we get
2A = 90° or A = 45°
Putting A = 45° in (1), we get
45° – B = 30° or B = 45 – 30° = 15°
Therefore, A = 45°, B = 15°.

**Question 25:**
**If tan (A – B) = 1/√3 and tan (A + B) = √3, 0° < (A + B) < 90° and A > B, then find A and B.**

**Solution:**
tan (A - B)= 1/√3

or tan(A - B) = tan 30°

A - B = 30° ...(1)

Again, tan(A+B) = √3

= tan 60°

A + B = 60° ...(2)
Solving (1) and (2), we get
2A = 90° or A = 45°
Putting A = 45° in (1), we get
45° – B = 30° or B = 45° – 30° = 15°

Therefore, A = 45°, B = 15°

**Question 26:**
**If 3x = cosec θ and 3/x = cot θ, find the value of 3(x^2 – 1/x^2).**

**Solution:**

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Given: 3x = cosec θ and 3/x = cot θ

We know that: cose^2 θ – cot^2 θ = 1

Substituting the values, we get

(3x)^2 – (3/x)^2 = 1

$$9\left(x^2-\frac{1}{x^2}\right)=1$$

$$\left(x^2-\frac{1}{x^2}\right)=\frac{1}{9}$$

**Question 27:**

**If sin(A+B) = sinA cosB+cosA sinB and cos(A-B)=cosA cosB+sinA sinB,**

**find the values of (i) sin75° and (ii) cos15°.**

**Solution:**

Given: sin (A + B) = sin A cos B + cos A sin B and

cos (A - B) = cos A cos B + sin A sin B
(i) To find: sin 75°
Put A = 30° and B = 45°, then
sin 75° = sin 30° cos 45° + cos 30° sin 45°
= (1/2) × (1/√2) + (√3/2) × (1/√2)
= (1/2√2) + (√3/2√2)
= (1+√3)/2√2

(ii) Find cos 75°
Put A = 45° and B = 30°, then
cos 15° = cos 45° cos 30° + sin 45° sin 30°
= (1/√2) × (√3/2) + (1/√2) × (1/2)
= (√3 / 2√2) + (1/2√2)
= (1+√3)/2√2