I. ***Addition Formula***

1. Find the values of $\sin 75^0$, $\sin 15^0$, $\cos 75^0$ and $\cos 15^0$.

2. Find the value of $\tan 75^0$ and hence prove that $\tan 75^0 + \cot 75^0 = 4$.

3. Prove that $\tan 15^0 + \cot 15^0 = 4$.

4. If $\sin A = \frac{4}{5}$ and $\sin B = \frac{12}{13}$, A and B are acute angles, find $\cos(A-B)$.

5. If $\tan A = 2$ and $\tan B = 1$, where A and B are acute angles , find the value of $\cos(A-B)$.

6. If $\sin A = \frac{2}{5}$ and $\sin B = \frac{1}{2}$, A is in first quadrant and B is in second quadrant, find $\operatorname{cosec}(A+B)$ and $\tan(A-B)$.

7. If $\cos A = \frac{-12}{13}$ and $\cot B = \frac{24}{7}$, A is in second quadrant and B is in first quadrant, find $\sin(A+B)$ and $\cos(A+B)$.

8. If $\sin A = \frac{-3}{5}$ and $\sin B = \frac{20}{29}$, A is in third quadrant and B is in second quadrant, find $\cos(A+B)$ and $\sin(A-B)$.

9. If $\tan A = \frac{3}{4}$ and $\tan B = \frac{-5}{4}$, find the value of $\tan(A+B)$.

10. If $\tan A = \frac{18}{17}$ and $\tan B = \frac{1}{35}$ then show that $A - B = 45^0$

11. If $\tan A = \frac{1}{2}$ and $\tan B = \frac{1}{3}$, where A and B are acute angles, then show that $A + B = \frac{\pi}{4}$

12. If $\tan A = \frac{m}{m+1}$ and $\tan B = \frac{1}{2m+1}$ then show that $A + B = 45^0$.

13. If $A + B = 45^0$, prove that $(1+\tan A)(1+\tan B) = 2$

14. Express $\sqrt{3}\cos x + \sin x$ in the form $R\sin(x+\alpha)$, where α is acute.

15. Express $5\sin x - 12\cos x$ in the form $R\sin(x-\alpha)$.

16. Express $3\cos\theta + 4\sin\theta$ in the form $R\sin(\theta+\alpha)$.

17. Express $4\cos x + 3\sin x$ in the form $\mathrm{R}\sin(\mathrm{x}+\alpha)$, where α is acute.

18. Prove that $\sin(A+B)\cdot\sin(A-B) = \cos^2 B - \cos^2 A$

19. Prove that $\sin(A+B)\cdot\sin(A-B) = \sin^2 A - \sin^2 B$

20. Prove that $\dfrac{\cos A - \sin A}{\cos A + \sin A} = \tan(45^0 - A)$.

II. *T-Functions of related angles*

1. Show that $\sin 120 \cos 330 + \cos 240 \sin 330 = 1$.

2. Show that $\sin 780 \sin 480 + \cos 120 \sin 30 = \dfrac{1}{2}$.

3. Show that $\sin 600 \cos 330 + \cos 120 \sin 150 = -1$.

4. Find the value of $\mathrm{cosec}(-225) + \sec 135$.

5. Evaluate $\dfrac{\sec(-840)}{\sin(-390)}$.

6. Prove that $\dfrac{\cos(90+\mathrm{A})\sec(360+\mathrm{A})\tan(180-\mathrm{A})}{\sec(\mathrm{A}-720)\sin(540+\mathrm{A})\cot(\mathrm{A}-90)} = 1$.

7. Prove that $\dfrac{\cos(90+\mathrm{A})\sec(-\mathrm{A})\tan(180-\mathrm{A})}{\sec(360+\mathrm{A})\sin(180+\mathrm{A})\cot(\mathrm{A}-90)} = 1$.

8. Prove that $\dfrac{\sin(180+\mathrm{A})\cos(90-\mathrm{A})\tan(270+\mathrm{A})}{\sec(540-\mathrm{A})\cos(360+\mathrm{A})} = -\sin\mathrm{A}\cos\mathrm{A}$.

9. Prove that $\sin\mathrm{A} + \sin(120+\mathrm{A}) + \sin(240+\mathrm{A}) = 0$.

10. Prove that $\cos\mathrm{A} + \cos\left(\mathrm{A} + \dfrac{2\pi}{3}\right) + \cos\left(\mathrm{A} - \dfrac{2\pi}{3}\right) = 0$.

11. Prove that $2\tan 10^0 + \tan 40^0 = \tan 50^0$.

12. Show that $\cos\dfrac{\pi}{8} + \cos\dfrac{3\pi}{8} + \cos\dfrac{5\pi}{8} + \cos\dfrac{7\pi}{8} = 0$.

III. *T-functions of Multiple and Submultiples angles*

1. If $\sin A = 0.8$, A is acute, find $\cos 2A$.

2. If $\sin\theta = a$, find $\sin 3\theta$.

3. If $\sin A = \frac{3}{5}$, A is acute, find $\sin 2A$, $\sin 3A$ and $\cos 3A$.

4. If $\sin A = \frac{4}{5}$, A is acute, find $\sin 3A$.

5. If $\tan A = 3$, find the value of $\tan 2A$.

6. If $\tan A = 0.38$, find the values of $\sin 2A$, $\cos 2A$ and $\tan 2A$.

7. If $\cos A = \frac{3}{5}$, A is acute, find $\sin\frac{A}{2}$.

8. Evaluate (i) $\frac{2\tan 15^\circ}{1+\tan^2 15^\circ}$ (ii) $\frac{2\tan 15^\circ}{1-\tan^2 15^\circ}$ (iii) $\frac{1-\tan^2 15^\circ}{1+\tan^2 15^\circ}$.

9. Evaluate $\tan 22\frac{1}{2}^\circ$.

10. Show that $\sin 18^\circ = \frac{\sqrt{5}-1}{4}$.

11. Prove that (i) $\frac{\sin 2A}{1+\cos 2A} = \tan A$. (ii) $\cos ecA - \cot A = \tan\frac{A}{2}$. (iii) $\frac{\sin\alpha}{1+\cos\alpha} = \tan\frac{\alpha}{2}$.

12. Prove that $\frac{\sin 2A}{1-\cos 2A}\cdot\frac{1-\cos A}{\sin A} = \tan\left(\frac{A}{2}\right)$.

13. Prove that (i) $\frac{1+\cos\theta+\sin\theta}{1-\cos\theta+\sin\theta} = \cot\frac{\theta}{2}$. (ii) $\frac{1+\sin\theta-\cos\theta}{1+\sin\theta+\cos\theta} = \tan\frac{\theta}{2}$.

14. Prove that (i) $\tan A + \cot A = 2\cos ecA$. (ii) $\cot A - \tan A = 2\cot 2A$.

15. Show that (i) $\frac{\sin 3A}{\sin A} + \frac{\cos 3A}{\cos A} = 4\cos 2A$. (ii) $\frac{\sin 3x}{\sin x} - \frac{\cos 3x}{\cos x} = 2$.

16. Prove that $\cos^4 A - \sin^4 A = \cos 2A$.

IV. *Product Formula*

1. Prove that $\dfrac{\sin x+\sin 2x}{\cos x+\cos 2x}=\tan\dfrac{3x}{2}$.

2. Prove that $\dfrac{\sin x+\sin 3x}{\cos x+\cos 3x}=\tan 2x$.

3. Prove that $\dfrac{\sin 9A-\sin 7A}{\cos 9A+\cos 7A}=\tan A$.

4. Prove that $\dfrac{\sin 4A+\sin 2A}{\cos 4A+\cos 2A}=\tan 3A$.

5. Prove that $\dfrac{\sin 2\alpha+\sin 5\alpha-\sin\alpha}{\cos 2+\cos 5\alpha+\cos\alpha}=\tan 2\alpha$.

6. Prove that $\dfrac{\sin 6A+\cos 5A-\sin 4A}{\cos 4A-\cos 6A+\sin 5A}=\cot 5A$.

7. Prove that $\dfrac{\sin A+\sin 3A+\sin 5A}{\cos A+\cos 3A+\cos 5A}=\tan 3A$

8. Prove that $\sin\theta+\sin 3\theta+\sin 5\theta+\sin 7\theta=4\cos\theta\cos 2\theta\sin 4\theta$.

9. Prove that $\cos\theta+\cos 3\theta+\cos 5\theta+\cos 7\theta=4\cos\theta\cos 2\theta\cos 4\theta$.

10. Prove that $\cos 3A+\cos 5A+\cos 9A+\cos 17A=4\cos 4A\cos 6A\cos 7A$.

11. Prove that $\sin 50^\circ-\sin 70^\circ+\sin 10^\circ=0$.

12. Show that $\cos 55^\circ+\cos 65^\circ+\cos 175^\circ=0$.

13. Prove that $\cos 80^\circ+\cos 40^\circ-\cos 20^\circ=0$.

V. *Converse of Product formula*

1. Show that $\sin 10^\circ\sin 50^\circ\sin 70^\circ=\dfrac{1}{8}$.

2. Prove that $\cos 20^\circ\cos 40^\circ\cos 80^\circ=\dfrac{1}{8}$.

3. Prove that $\cos 20^\circ\cos 40^\circ\cos 60^\circ\cos 80^\circ=\dfrac{1}{16}$.

4. Prove that $\sin 20^\circ\sin 40^\circ\sin 60^\circ\sin 80^\circ=\dfrac{3}{16}$.

5. Prove that $\dfrac{\sin 11A\cdot\sin A+\sin 7A\cdot\sin 3A}{\cos 11A\cdot\sin A+\cos 7A\cdot\cos 3A}=\tan 8A$.