

## Previous Year Questions

QD) Let A & B denote the statements

$$A: \cos x + \cos B + \cos Y = 0$$

$$B: \sin x + \sin B + \sin Y = 0$$

$$\text{If } \cos(B-Y) + \cos(Y-x) + \cos(x-B) = -\frac{3}{2},$$

then :-

- ① Both A & B are true    ② Both A & B are false
- ③ A is true & B is false    ④ A is false & B is true

$$\text{Now } \cos(B-Y) + \cos(Y-x) + \cos(x-B) = -\frac{3}{2}$$

$$\Rightarrow 2\cos(B-Y) + 2\cos(Y-x) + 2\cos(x-B) = -3$$

$$\Rightarrow 1+1+1 + 2(\cos B \cos Y + \sin B \sin Y) + 2(\cos Y \cos x + \sin Y \sin x) + 2(\cos x \cos B + \sin x \sin B) = 0$$

$$\Rightarrow (\sin^2 x + \cos^2 x) + (\sin^2 B + \cos^2 B) + (\sin^2 Y + \cos^2 Y)$$

$$+ 2\cos x \cos B + 2\cos B \cos Y + 2\cos Y \cos x$$

$$+ 2\sin x \sin B + 2\sin B \sin Y + 2\sin Y \sin x = 0$$

$$\Rightarrow (\sin^2 x + \sin^2 B + \sin^2 Y + 2\sin x \sin B + 2\sin B \sin Y + 2\sin Y \sin x) + (\cos^2 x + \cos^2 B + \cos^2 Y + 2\cos x \cos B + 2\cos B \cos Y + 2\cos Y \cos x) = 0$$

$$\Rightarrow (\sin x + \sin B + \sin Y)^2 + (\cos x + \cos B + \cos Y)^2 = 0$$

Only possible when,

$$\sin x + \sin B + \sin Y = 0 \quad \text{and} \quad \cos x + \cos B + \cos Y = 0$$

$\therefore$  Both A & B are true.

Q2) The possible value of  $\theta \in (0, \pi)$  such that  $\sin(\theta) + \sin(4\theta) + \sin(7\theta) = 0$  are

D)  $\frac{2\pi}{9}, \frac{\pi}{4}, \frac{4\pi}{9}, \frac{\pi}{2}, \frac{3\pi}{4}, \frac{8\pi}{9}$

②  $\frac{\pi}{4}, \frac{5\pi}{12}, \frac{\pi}{2}, \frac{2\pi}{3}, \frac{3\pi}{4}, \frac{8\pi}{9}$

③  $\frac{2\pi}{9}, \frac{\pi}{4}, \frac{\pi}{2}, \frac{2\pi}{3}, \frac{3\pi}{4}, \frac{35\pi}{36}$

④  $\frac{2\pi}{9}, \frac{\pi}{4}, \frac{\pi}{2}, \frac{2\pi}{3}, \frac{3\pi}{4}, \frac{8\pi}{9}$

$$\text{L.H.S} \quad \sin\theta + \sin 4\theta + \sin 7\theta = 0$$

$$\Rightarrow 2\sin\left(\frac{\theta+7\theta}{2}\right)\cos\left(\frac{7\theta-\theta}{2}\right) + \sin 4\theta = 0$$

$$\Rightarrow 2\sin 4\theta \cos 3\theta + \sin 4\theta = 0$$

$$\Rightarrow \sin 4\theta (2\cos 3\theta + 1) = 0$$

$$\sin 4\theta = 0$$

$\Rightarrow \theta = 0, \frac{\pi}{4}, \frac{\pi}{2}, \frac{3\pi}{4}, \pi$  but  $0 \notin \pi$  are not included.

$$2\cos 3\theta + 1 = 0$$

$$\Rightarrow \cos 3\theta = -\frac{1}{2}$$

$$\Rightarrow 3\theta = \frac{2\pi}{3}, \frac{4\pi}{3}, \frac{8\pi}{3}, \frac{10\pi}{3}$$

$$\Rightarrow \theta = \frac{2\pi}{9}, \frac{4\pi}{9}, \frac{8\pi}{9}, \frac{10\pi}{9} \quad \text{but but } \frac{10\pi}{9} \notin (0, \pi)$$

$$\text{Ans. } \theta = \frac{\pi}{4}, \frac{\pi}{2}, \frac{3\pi}{4}, \frac{2\pi}{9}, \frac{4\pi}{9}, \frac{8\pi}{9}$$