

Q- A 24-hour military clock has hour markings from 0 to 23. If the hands on this clock coincide at 00:00:00 (hours:minutes:seconds), determine the time when the hour and minute hands coincide again.

The hour hand will make one complete rotation in 24 hours = 86400 sec. hence its angular velocity will be

$$\omega_H = \frac{2\pi}{86400} \text{ rad/sec.}$$

And the minute hand makes one complete rotation in one hour hence its angular velocity will be

$$\omega_M = \frac{2\pi}{3600} \text{ rad/sec.}$$

Now let both the hands coincide when hour hand rotates by an angle  $\theta$  then the minute hand will rotate by an angle  $2\pi + \theta$  (one extra rotation) at time  $t$ .

Then this time  $t$  will be given by

$$\text{For hour hand} \quad \frac{2\pi}{86400} * t = \theta$$

$$\text{And for minute hand} \quad \frac{2\pi}{3600} * t = 2\pi + \theta$$

Subtracting the equations we get

$$\left( \frac{2\pi}{3600} - \frac{2\pi}{86400} \right) * t = 2\pi$$

$$\text{Or} \quad t = \frac{3600 * 86400}{86400 - 3600} = 3756.52 \text{ sec}$$

Hence the time in s will be  $t = 3600 + 2*60 + 36.5$

And thus the time will be  $t = 01:02:36.5 \text{ AM}$