Answer on Question #73380, Physics / Mechanics | Relativity

Question. Two particle A and B executing SHM along same straight line with same amplitude and same mean position. A start its motion from mean position and move toward positive extreme while B starts from negative extreme position. Angular frequency of A is ω_A and that of B is ω_B choose the incorrect statement

A) if $\omega_A = 2\omega_B$ then when they meet first their velocity will be zero.

B) if $\omega_A > 2\omega_B$ then when they meet first time their velocity are in same direction.

C) if $\omega_A < 2\omega_B$ then when they meet their velocity will be in same direction.

D) their velocity when they meet does not depend on ω.

Solution.

A) if $\omega_A = 2\omega_B$ then when they meet first their velocity will be zero.

Assume that

$$x_A(t) = \sin(\omega_A t),$$

$$x_B(t) = \sin\left(\omega_B t - \frac{\pi}{2}\right)$$

So

$$v_A(t) = \frac{dx_A(t)}{dt} = \omega_A \cos(\omega_A t),$$

$$v_B(t) = \frac{dx_B(t)}{dt} = \omega_B \cos\left(\omega_B t - \frac{\pi}{2}\right),$$

If $x_A(t) = x_B(t)$ and $\omega_A = 2\omega_B$ then

$$\sin(\omega_A t) = \sin\left(\omega_B t - \frac{\pi}{2}\right) \rightarrow \sin(2\omega_B t) = \sin\left(\omega_B t - \frac{\pi}{2}\right) \rightarrow$$

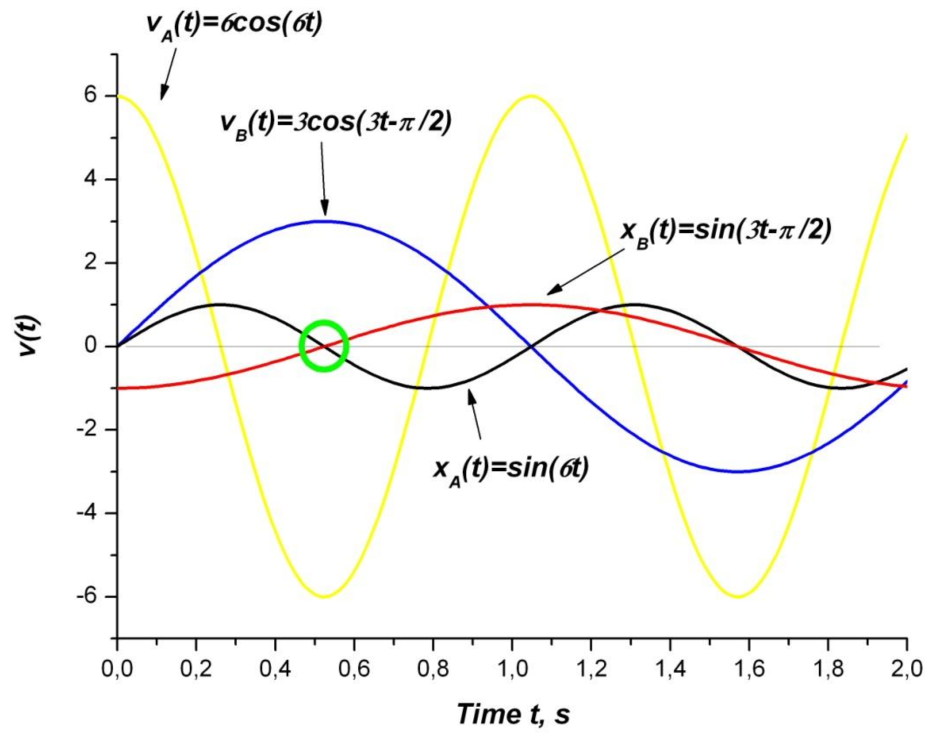
$$\sin(2\omega_B t) - \sin\left(\omega_B t - \frac{\pi}{2}\right) = 0$$

The solution of this equation is $\omega_B t = \frac{2\pi n}{3} + \frac{\pi}{2}, n \in Z$. Hence

$$v_A(t) = \omega_A \cos(\omega_A t) = 2\omega_B \cos(2\omega_B t) = -2\omega_B.$$

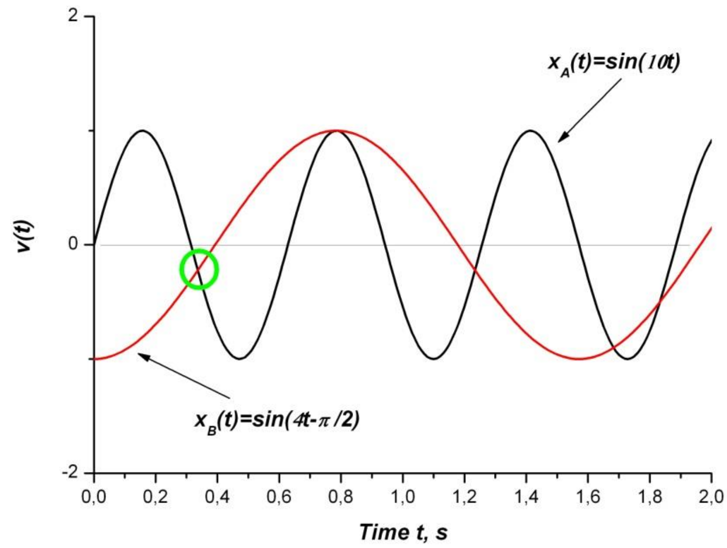
$$v_B(t) = \omega_B \cos\left(\frac{\pi}{2} - \frac{\pi}{2}\right) = \omega_B.$$

In fig. $\omega_B = 3\,rad/s^2$ and $\omega_A = 6\,rad/s^2$.



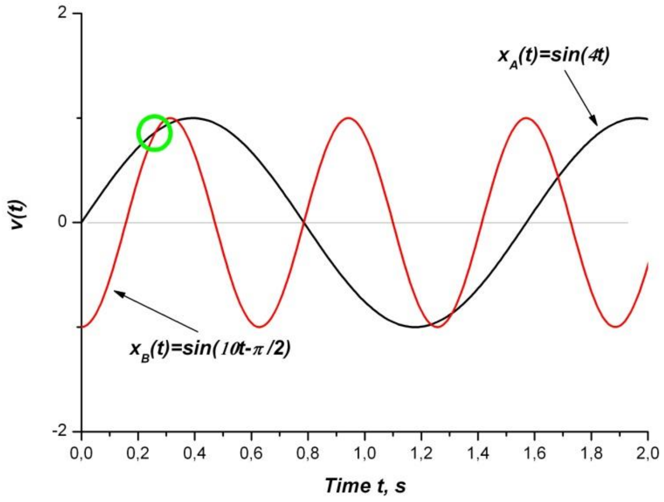
Answer. The statement is incorrect.

B) If $\omega_A > 2\omega_B$ then when they meet first time their velocity are in same direction.



Answer. The statement is incorrect.

C) if $\omega_A < 2\omega_B$ then when they meet their velocity will be in same direction.



Answer. The statement is correct.

D) Their velocity when they meet does not depend on ω.

The velocity when they meet depend on ω (see A)).

Answer. The statement is incorrect.

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