The torque τ on a body about a given point is found to be equal to $\mathbf{A} \times \mathbf{L}$, where $\mathbf{A}$ is a constant vector and $\mathbf{L}$ is the angular momentum of the body about that point. From this it follows that **(1998, 2M)**

(a) $\frac{d\mathbf{L}}{dt}$ is perpendicular to $\mathbf{L}$ at all instants of time

(b) the component of $\mathbf{L}$ in the direction of $\mathbf{A}$ does not change with time

(c) the magnitude of $\mathbf{L}$ does not change with time

(d) $\mathbf{L}$ does not change with time

Sol:- Solution (A, B, C)

(a) $\vec{\tau} = \vec{A} \times \vec{L}$

$\vec{\tau} = \frac{d\vec{L}}{dt}$

$\Rightarrow$ and using vector properties $\vec{L}$ is $\perp^{rd}$ $\frac{d\vec{L}}{dt}$

(b) Let us say $\vec{L}$ have a component along $\vec{A}$ but the component is get cancelled out as $\vec{A} \times \vec{L}_{comp} = 0$ because $\vec{A}$ & component of $\vec{A}$ ($\vec{A}_{comp}$) are in same direction.

$$\frac{d\vec{L}_{comp}}{dt} = \vec{A} \times \vec{L}_{comp} = 0$$

(c) As $\frac{d\vec{L}}{dt}$ is $\perp^{rd}$ to $\vec{L}$ $\Rightarrow$ $\vec{\tau}$ is $\perp^{rd}$ to $\vec{L}$

$\Downarrow$

only direction of $\vec{L}$ will change but not it's ~~dir~~ magnitude.