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1. Evaluate $\frac{d}{du}\left(\hat{A} \wedge \left(\hat{A} \wedge \frac{d\hat{A}}{du}\right)\right)$
2. Evaluate $\frac{d}{du}\left(\bar{A} \cdot \left(\frac{d\bar{A}}{du} \wedge \frac{d^2\bar{A}}{du^2}\right)\right)$
3. Find $\frac{d\bar{R}}{dt}, \frac{d^2\bar{R}}{dt^2}, \left|\frac{d\bar{R}}{dt}\right|, \left|\frac{d^2\bar{R}}{dt^2}\right|$ $at\ t = 0$ for the following:
   i. $\bar{R} = e^t\hat{\imath} + \ln(t^2+1)\,\hat{\jmath} - \tan(t)\,\hat{k}$
   ii. $\bar{R} = \sin t\ \hat{\imath} + \cos t\,\hat{\jmath} + t\,\hat{k}$
4. Find the velocity and acceleration of a particle which moves along the curve
   $x = 2\sin 3t\ , y = 2\cos 3t\ ,\ z = 8t$
   at any time $t > 0$.find the magnitude of the velocity and acceleration.
5. A particle moves along a curve whose parametric equations are
   $x = \mathrm{e}^{-t}\ , y = 2\cos 3t\ ,\ z = 2\sin 3t$
   where t is the time.
   (a) Determine its velocity and acceleration at any time.
   (b) Find the magnitude of the velocity and acceleration at $t = 0$.
6. A particle moves along a curve whose parametric equations are
   $x = 2t^2\ , y = t^2 - 4t\ ,\ z = 3t - 5$
   where t is the time. Find the component of its velocity and acceleration at time $t = 1$ in the direction $\hat{\imath} - 3\hat{\jmath} + 2\,\hat{k}$.
7. A particle moves so that its position vector is given by $\bar{r} = \cos\omega t\ \hat{\imath} + \sin\omega t\ \hat{\jmath}$, where ω is a constant. Show that:
   (a) The velocity of the particle is perpendicular to $\bar{r}$.
   (b) The acceleration of the particle is directed towards the origin and has magnitude directly proportional to the distance from the origin.
   (c) $\bar{r} \wedge \bar{v}$ is a constant vector.

8. Find a unit tangent vector to any point on the curve
$x = a\cos\omega t \ , y = a\sin\omega t \ , \ z = bt$
where a, b, c are constants

9. Find $\frac{d}{ds}\left(\bar{A}\cdot\frac{d\bar{B}}{ds} - \bar{B}\cdot\frac{d\bar{A}}{ds}\right)$, if $\bar{A}$ and $\bar{B}$ are differentiable vector functions of s.

10. If $\bar{A}(t) = 3t^2\hat{\imath} - (t+4)\hat{\jmath} + (t^2 - 2t)\hat{k}$
$\bar{B}(t) = \sin t\,\hat{\imath} + 3e^{-t}\hat{\jmath} - 3\cos t\,\hat{k}$
find $\frac{d^2}{dt^2}(\bar{A}\times\bar{B}) \quad at \ \ t = 0.$

11. A partial of mass 2 kg moves along the curve

$x = \frac{3}{2}\,t^2 + 2 \ , y = 3t^2 + 7 \ , \ z = t^2 + 5$

where t is the time.

(a) Find the component of the vector $4\hat{\imath} + 4\hat{\jmath} + 7\,\hat{k}$ in the direction of the tangent to the particle path.

(b) Determine the work done on the particle as it moves from $t = 2$ to $t = 4$.

(c) Calculate the moment about the origin due to the force acting on the particle at $t = 1$.