21-P-KM-AG-002

A particle travels along a path defined by $(X-t)\hat{\imath}+(Yt^3+t)\hat{\jmath}+(Zt^2+5)\hat{k}$. What is its velocity? What is its acceleration? What is its jerk (the rate of change of acceleration)?

ANSWER:

Take the first derivative of position to find velocity.

$$velocity=\frac{d}{dt}\left((X-t)\hat{\imath}+(Yt^3+t)\hat{\jmath}+(Zt^2+5)\hat{k}\right)=(-1)\hat{\imath}+(3Yt^2+1)\hat{\jmath}+(2Zt)\hat{k}$$

Take the derivative of velocity (otherwise known as the second derivative of position) to find acceleration.

$$acceleration=\frac{d}{dt}\left((-1)\hat{\imath}+(3Yt^2+1)\hat{\jmath}+(2Zt)\hat{k}\right)=0\hat{\imath}+6Yt\hat{\jmath}+2Z\hat{k}$$

Take the derivative of acceleration (otherwise known as the third derivative of position or the second derivative of velocity) to find jerk.

$$jerk=\frac{d}{dt}\left(0\hat{\imath}+6Yt\hat{\jmath}+2Z\hat{k}\right)=0\hat{\imath}+6Y\hat{\jmath}+0\hat{k}$$