

**Vector Functions and Curves**  
*One variable functions*

**Question**

A particle is travelling along the curve  $y = x^2$ ,  $z = x^3$  and has constant vertical speed  $w = dz/dt = 3$ . When the particle is at the point  $(2, 4, 8)$ , find both its velocity and acceleration.

**Answer**

When the  $x$ -coordinate of the particle is  $x$  its position

$$\underline{r} = x\underline{i} + x^2\underline{j} + x^3\underline{k},$$

and so has a velocity

$$\underline{v} = \frac{dx}{dt}[\underline{i} + 2x\underline{j} + 3x^2\underline{k}].$$

As  $w = \frac{dz}{dt} = 3x^2 \frac{dx}{dt} = 3$ , when  $x = 2$

$$12 \frac{dx}{dt} = 3$$

$$\text{so } \frac{dx}{dt} = \frac{1}{4}$$

$\Rightarrow$

$$\underline{v} = \frac{1}{4}\underline{i} + \underline{j} + 3\underline{k}.$$