8.4) Differentiating vectors

Worked example

A particle P of mass 1.6kg is acted on by a single force $\mathbf{F}$ N. Relative to a fixed origin O, the position vector of P at time t seconds is $\boldsymbol{r}$ metres, where

$$\boldsymbol{r} = 5t^3\boldsymbol{i} + 20t^{-\frac{1}{5}}\boldsymbol{j}, \qquad t \geq 0$$

Find:

(a) the speed of P when $t = 2$

(b) the acceleration of P as a vector when $t = 4$

(c) $\mathbf{F}$ when $t = 4$.

Your turn

A particle P of mass 0.8kg is acted on by a single force $\mathbf{F}$ N. Relative to a fixed origin O, the position vector of P at time t seconds is $\boldsymbol{r}$ metres, where

$$\boldsymbol{r} = 2t^3\boldsymbol{i} + 50t^{-\frac{1}{2}}\boldsymbol{j}, \qquad t \geq 0$$

Find:

(a) the speed of P when $t = 4$

(b) the acceleration of P as a vector when $t = 2$

(c) $\mathbf{F}$ when $t = 2$.

a) $96\ ms^{-1}$ (2 sf)

b) $(24\boldsymbol{i} + 6.6\boldsymbol{j})\ ms^{-2}$ (2 sf)

c) $(19\boldsymbol{i} + 5.3\boldsymbol{j})\ N$ (2 sf)