

Example 2

A marketing director of a company found that the revenue, € R , from selling a fixed number of produced items at € P each is given by the formula

$$R = 30P - 2P^2.$$

- Find $\frac{dR}{dP}$ and explain what this means.
- Calculate $\frac{dR}{dP}$ when $P = 10$.
- For what selling prices is revenue rising?

(i)	$\frac{dR}{dP} = 30 - 4P$
(ii)	$\frac{dR}{dP}_{P=10} = 30 - 4(10) = -10$
When Revenue is rising $\frac{dR}{dP} > 0$ ie change in Revenue with Price is positive	$\Rightarrow 30 - 4P > 0$ $30 > 4P$ $\frac{30}{4} > P$ $\boxed{€7.50 > P}$

12. A particle moving in a straight line is x cm from the point O at time t seconds ($t \geq 0$), where $x = t^3 - 11t^2 + 24t - 3$.
- Find its initial position and velocity.
 - Find its velocity at any time.
 - At what times is the particle stationary?
 - What is the position of the particle when it is stationary?
 - For how long is the particle's ~~velocity negative~~?
 - Find its acceleration at any time.
 - When is the particle's acceleration zero, and what is its velocity and position at that time?

$\frac{dx}{dt}$ $\frac{dv}{dt}$ $\frac{da}{dt}$	(ii) DISTANCE (vi) VELOCITY (vi) ACCELERATION	$x = t^3 - 11t^2 + 24t - 3$ cm $v = 3t^2 - 22t + 24$ cm/s $a = 6t - 22$ cm/s ²
"Initial" means $t=0$ (i)	$x = ?$ When $t=0$ $v = ?$ When $t=0$	$x = -3$ cm $v = 24$ cm/s
"Stationary" means $v=0$ (ii)	$v=0, t=?$	$3t^2 - 22t + 24 = 0$ $(3t-4)(t-6) = 0 \Rightarrow t = \frac{4}{3}$ s or $t=6$ s
Use $t = \frac{4}{3}$ & $t=6$ (iv)	$v=0, x=?$	$x = (\frac{4}{3})^3 - 11(\frac{4}{3})^2 + 24(\frac{4}{3}) - 3 = 11.8$ cm $x = (6)^3 - 11(6)^2 + 24(6) - 3 = -39$ cm
v negative when (v)	$v < 0 \Rightarrow 3t^2 - 22t + 24 < 0$ (inside values) $\frac{4}{3} < t < 6$	
$a=0, t=?, x=?$ How long? (vii)	$a=0, t=?$	$6t - 22 = 0 \Rightarrow 6t = 22 \Rightarrow t = \frac{22}{6}$ s $x = (\frac{22}{6})^3 - 11(\frac{22}{6})^2 + 24(\frac{22}{6}) - 3 \Rightarrow x = 18.6$ cm $v = 3(\frac{22}{6})^2 - 22(\frac{22}{6}) + 24 \Rightarrow v = -\frac{42}{3}$ cm/s