in metres

The vertical displacement (height) of a ball is modelled by $h(t) = -t^3 + 8t^2$ where $t$ is the time in seconds after the ball has been thrown.

a) Find the initial height of the ball.

When $t = 0$, $h(0) = -0^3 + 8 \times 0^2 = 0$ m

b) Find the highest point reached by the ball
(When the velocity = 0)  velocity = $h'(t)$

$0 = h'(t) = -3t^2 + 16t = -3t(t - \frac{16}{3})$

either $-3t = 0$ or $t - \frac{16}{3} = 0$

$t = 0$ or $\frac{16}{3}$ seconds

when $t = \frac{16}{3}$ sec

$h(\frac{16}{3}) = -(\frac{16}{3})^3 + 8(\frac{16}{3})^2$
$= 75.85$ m (2dp)

c) When does the ball land on the ground?

The ball lands when $h(t) = 0$

$0 = -t^3 + 8t^2$

$0 = -t^2(t - 8)$

either $-t^2 = 0$ or $t - 8 = 0$

$t = 0$ or $t = 8$ sec

Answer: $t = 8$ seconds

d) What is the acceleration of the ball when the object is at rest? (when $v = 0$)

acceleration = $h''(t)$

$h'(t) = -3t^2 + 16t$

$h''(t) = -6t + 16$

Answer
From question b)
when $v = 0$,
$t = 0$ or $\frac{16}{3}$

when $t = \frac{16}{3}$

$h''(t) = -6(\frac{16}{3}) + 16$
$= -32$ ms$^{-2}$
16

when $t = 0$

$h''(t) = -6(0) + 16$
$= 16$ ms$^{-2}$