

# 16 – Velocity & Acceleration

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## Definition: Velocity & Acceleration

Assume  $s(t)$  gives the position of an object at time  $t$  (e.g. its height or distance from a fixed point).

- The **velocity** of the object at time  $t$  is  $s'(t)$ .
- The **acceleration** of the object at time  $t$  is  $s''(t)$ .

1. If a projectile is shot vertically upward from a point  $2m$  above ground level with with an initial velocity of  $24.5 m/s$ , then its height in meters after  $t$  seconds is given by  $h(t) = 2 + 24.5t - 4.9t^2$ .

(a) What is the velocity of the object after 2 seconds?

(b) What will be the velocity of the object at the instant when it reaches its maximum height?

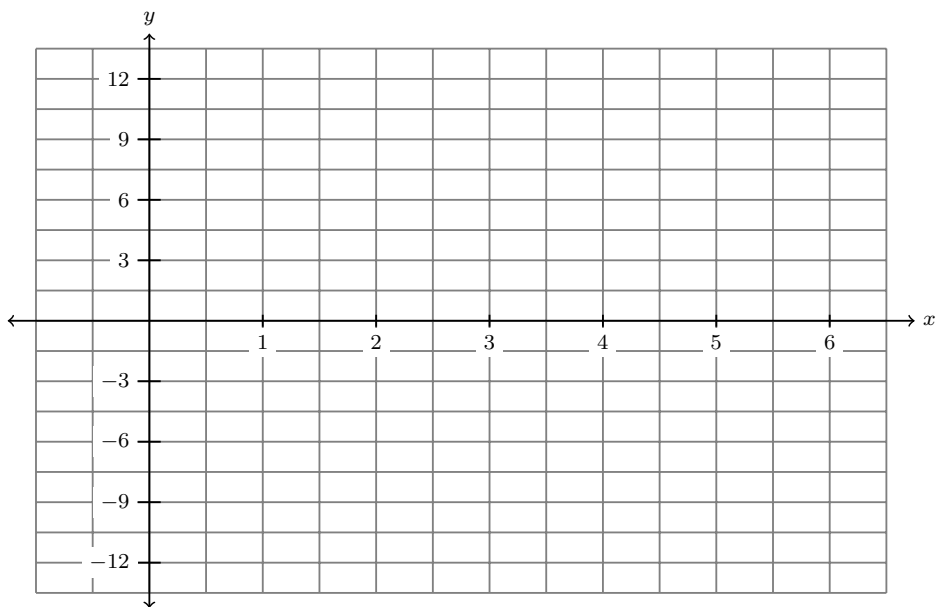
(c) When does the projectile reach its maximum height, and what is the maximum height?

2. The position of a particle moving up and down is given by  $s(t) = t^3 - 6t^2 + 9t$ , where  $s$  is in meters and  $t$  is in seconds.

(a) Find the velocity function for the particle.

(b) Find the acceleration function for the particle.

(c) Graph the position, velocity, and acceleration functions (with respect to time) for  $0 \leq t \leq 5$ .



(d) When is the particle moving up? Down? When is the particle at rest?

(e) When is the particle speeding up? Slowing down? *Hint: this can be tricky. Speed is different than velocity. Think of an object moving up and down on a spring—can you imagine different times when it is speeding up?*