Particle Slowing Down and Speeding Up?
Graphing or Sign Analysis

Speeding Up

Particle is moving in the same direction as it is being pulled.

v(t) and a(t) have the same sign.

$v(t) > 0 \; and \; a(t) > 0$ or $v(t) < 0 \; and \; a(t) < 0$

Slowing Down

Particle is moving in the opposite direction as it is being pulled.

v(t) and a(t) have the opposite sign.

$v(t) > 0 \; and \; a(t) < 0$ or $v(t) < 0 \; and \; a(t) > 0$

Determine the time t in which the particle is slowing down and speeding up by graphing the velocity function $v(t)$ and the acceleration function $a(t)$ on the same cartesian coordinate system or by using sign analysis on $v(t)$ and $a(t)$.

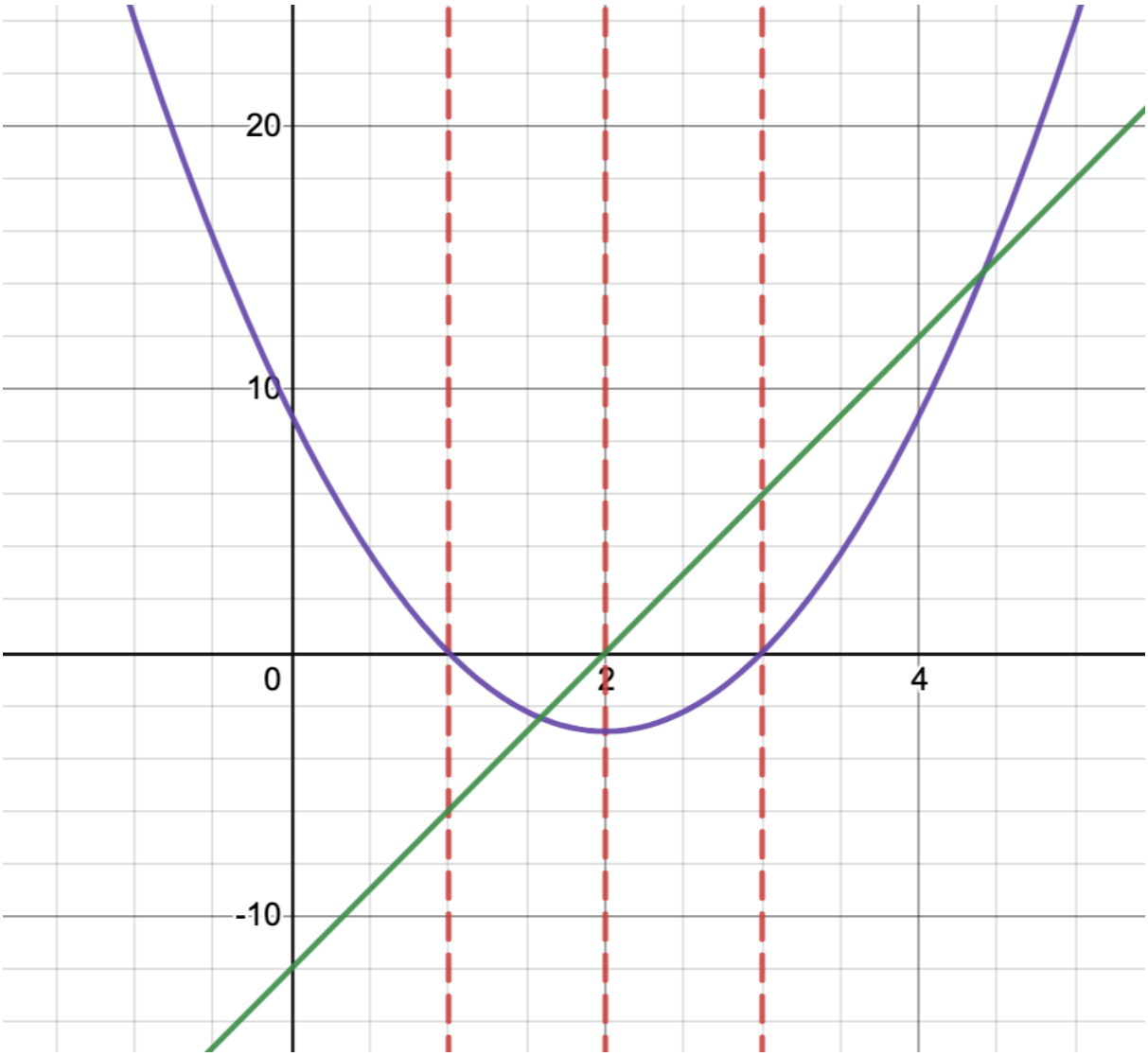
Example In Video

$s(t) = t^3 - 12t^2 + 36t$ over $0 \leq t \leq 8$

1. $s(t) = t^3 - 6t^2 + 9t$ for $t \geq 0$
2. $s(t) = \frac{t}{1+t^2}$ for $t \geq 0$
3. $s(t) = t^3 - 12t + 3$ for $t \geq 0$
4. $s(t) = t^3 - 4t^2 + 3$ for $t \geq 0$
5. $s(t) = 5t^3 - 4t^2 + 7$ for $t \geq 0$

Answers

1. $v(t) = 3t^2 - 12t + 9$ and $a(t) = 6t - 12$ and $t \geq 0$



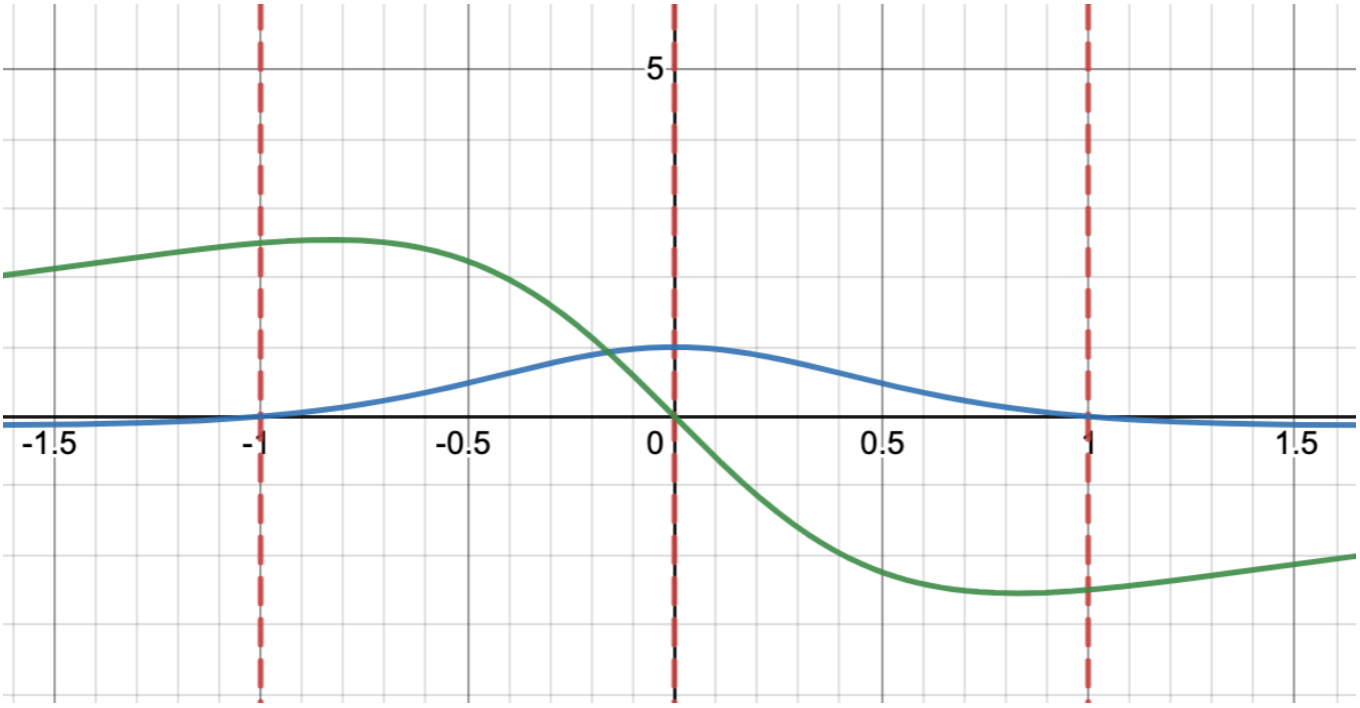
Slowing Down

$[0,1) \cup (2,3)$

Speeding Up

$(1,2) \cup (3,\infty)$

2. $v(t) = \frac{1-t^2}{(1+t^2)^2}$ and $a(t) = -\frac{2t(3+2t^2)}{(1+t^2)^2}$ and $t \geq 0$



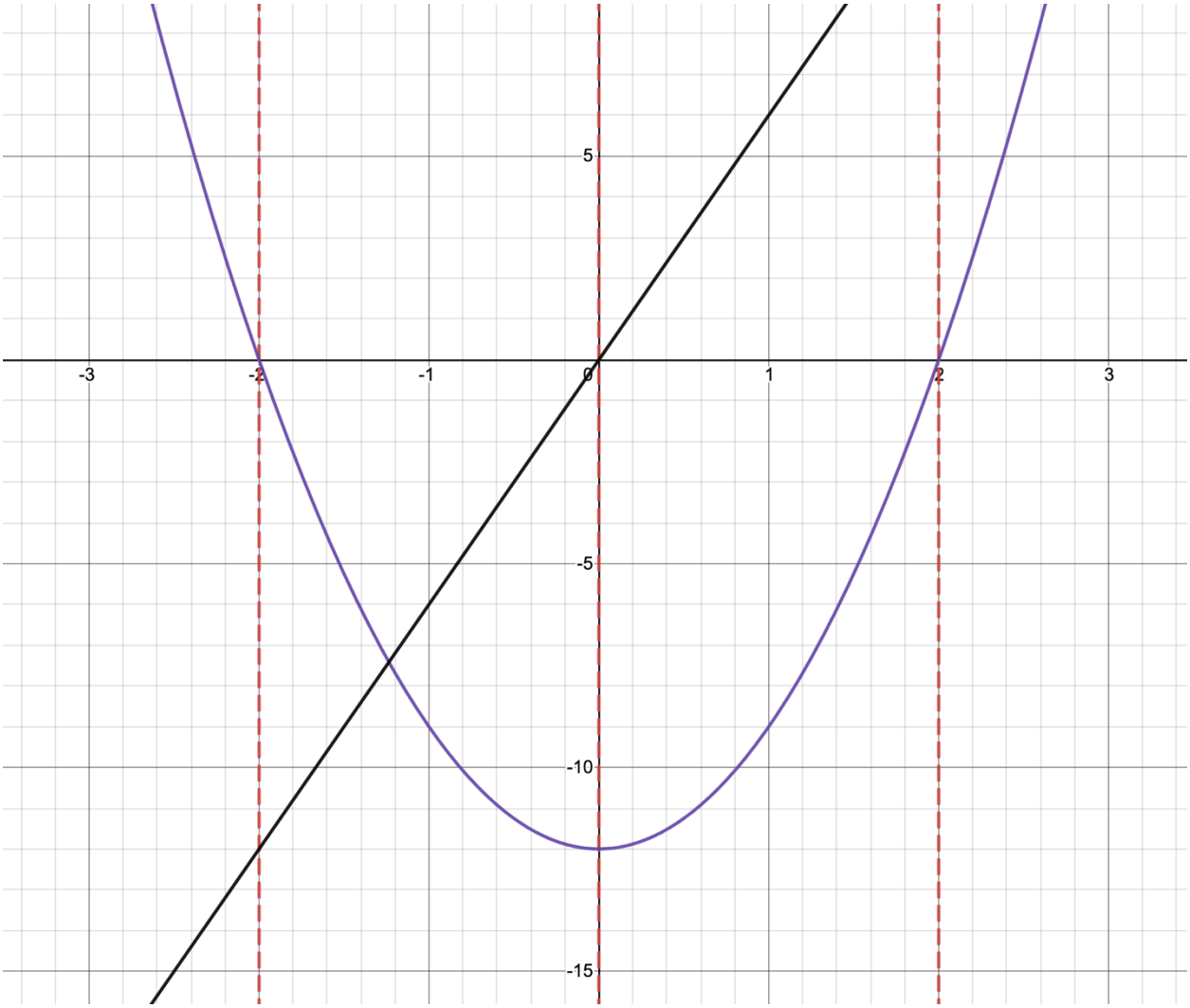
Slowing Down

$[0,1)$

Speeding Up

$(1,\infty)$

3. $v(t) = 3t^2 - 12$ and $a(t) = 6t$ and $t \geq 0$



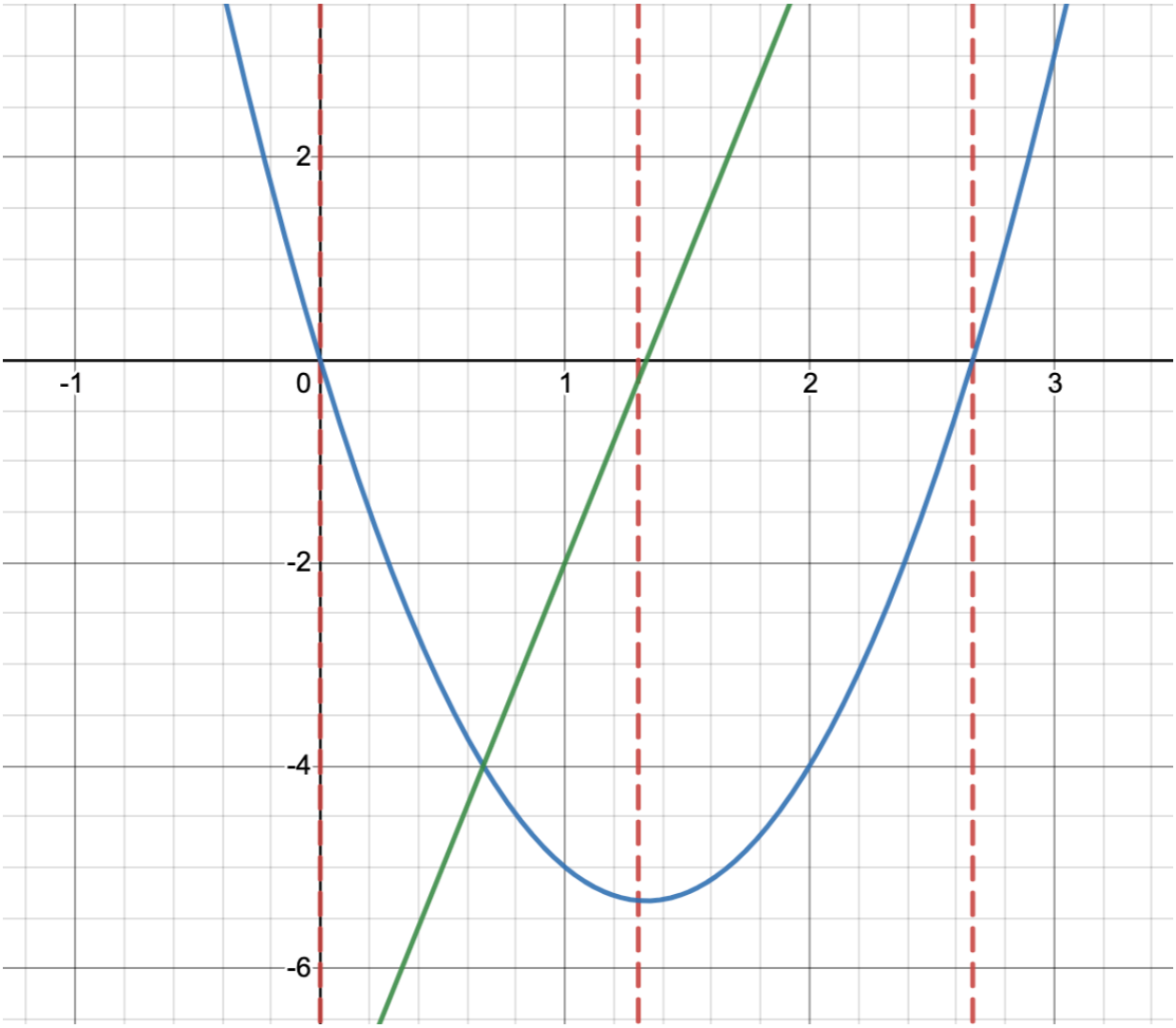
Slowing Down

$[0,2)$

Speeding Up

$(2, \infty)$

4. $v(t) = 3t^2 - 8t$ and $a(t) = 6t - 8$ and $t \geq 0$



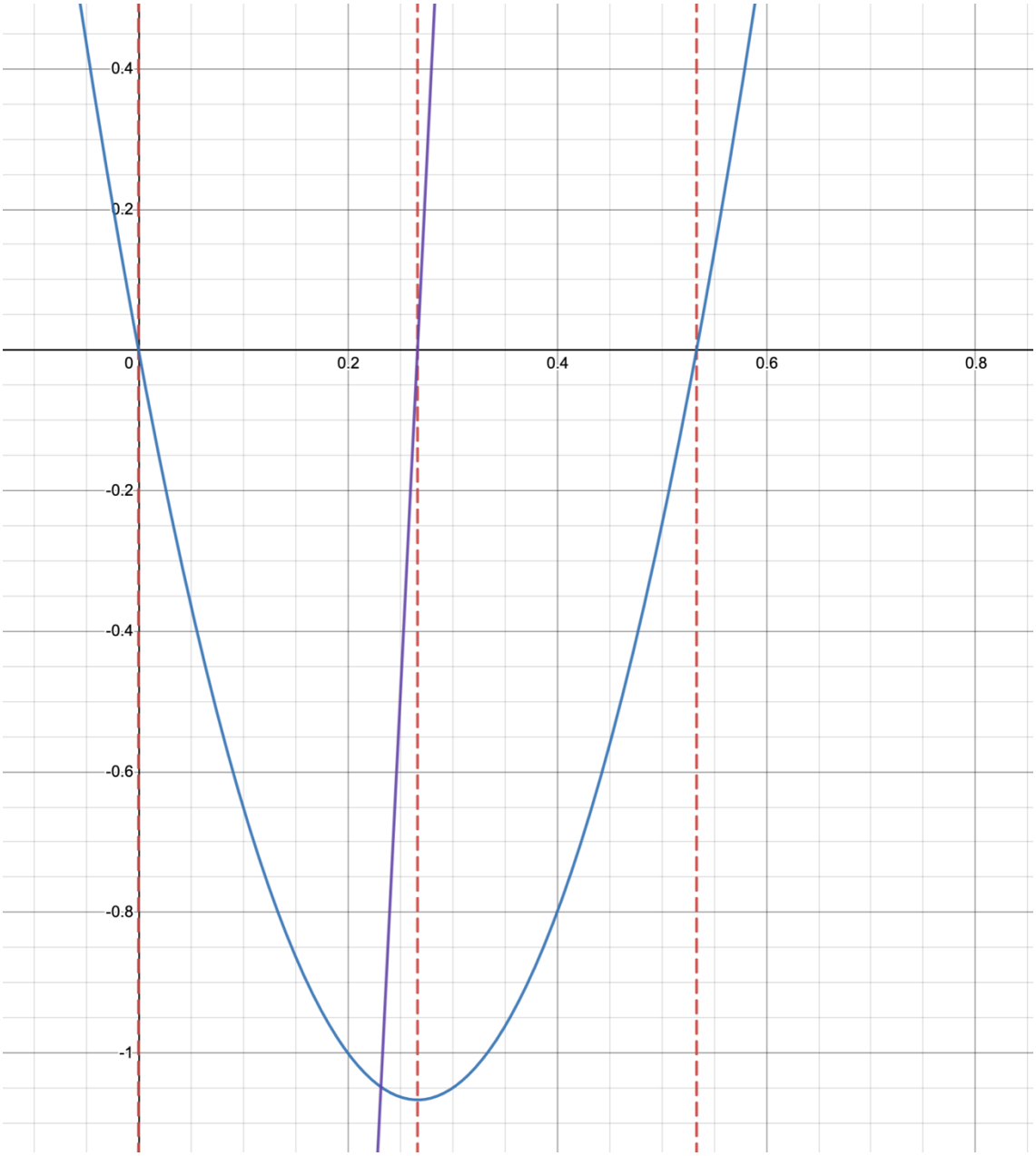
Slowing Down

$(4/3, 8/3)$

Speeding Up

$[0, 4/3) \cup (8/3, \infty)$

5. $v(t) = 15t^2 - 8t$ and $a(t) = 30t - 8$ and $t \geq 0$



Slowing Down

$(4/15, 8/15)$

Speeding Up

$[0, 4/15) \cup (8/15, \infty)$