

AP Calculus AB
Rectilinear Motion

Name: Key

H. 1 3-18

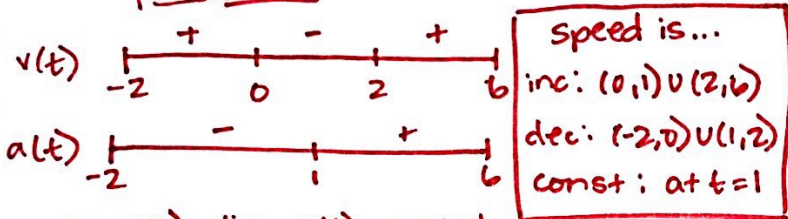
Given $s(t)$ describes the horizontal position of an object at time t , describe the motion of the object on the interval.

1) $s(t) = t^3 - 3t^2 + 4; [-2, 6]$

$v(t) = 3t^2 - 6t = 0$ $a(t) = 6t - 6 = 0$

$3t(t-2) = 0$
 $t=0$ $t=2$

$6t = 6$
 $t=1$



Speed is...
inc: $(0, 1) \cup (2, 6)$
dec: $(-2, 0) \cup (1, 2)$
const: at $t=1$

t	v(t)	dir	a(t)	speed
$(-2, 0)$	+	rt	-	↓
$t=0$	0	ch	-	0
$(0, 1)$	-	left	-	↑
$t=1$	0	left	0	const.
$(1, 2)$	-	left	+	↓
$t=2$	0	ch	+	0
$(2, 6)$	+	rt	+	↑

object changes direction at $t=0$ and $t=2$

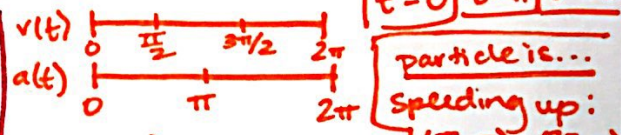
2) $s(t) = \sin t; [0, 2\pi]$

$v(t) = \cos t = 0$ $a(t) = -\sin t$

$t = \frac{\pi}{2}$ $t = \frac{3\pi}{2}$

$-\sin t = 0$
 $\sin t = 0$

$t=0$ $t=\pi$ $t=2\pi$



t	v(t)	dir	a(t)	speed
$(0, \pi/2)$	+	rt.	-	↓
$t=\pi/2$	0	ch.	-	0
$(\pi/2, \pi)$	-	left	-	↑
$t=\pi$	0	left	0	const.
$(\pi, 3\pi/2)$	-	left	+	↓
$t=3\pi/2$	0	ch.	+	0
$(3\pi/2, 2\pi)$	+	rt.	+	↑

particle is...
Speeding up: $(\pi/2, \pi) \cup (\pi/2, 2\pi)$
slowing down: $(0, \pi/2) \cup (\pi, 3\pi/2)$
constant: $t=\pi$
changing dir: $t=\pi/2$ $t=3\pi/2$

Given $s(t)$ describes the horizontal position of an object at time t , describe the motion of the object at the exact given time.

3) $s(t) = \sqrt[3]{t^2 + 2t + 1}; t=0$

$v(t) = (2t+2)(\frac{1}{3})(t^2+2t+1)^{-2/3}$
 $v(t) = \frac{2t+2}{3 \sqrt[3]{(t^2+2t+1)^2}} = \frac{2t+2}{3(t^2+2t+1)^{2/3}}$

$v(0) = \frac{2}{3}$

$a(t) = \frac{(3)(t^2+2t+1)^{2/3}(2) - (2t+2)(2t+2)(2)(t^2+2t+1)^{-1/3}}{9(t^2+2t+1)^{4/3}}$

object is moving right, speed is decreasing
 $a(0) = -\frac{2}{9}$

$v(t) = (t+1)(\cos t) - (\sin t)(1)$
 $v(\pi) = \frac{-1}{1+\pi}$

4) $s(t) = \frac{\sin t}{t+1}; t=\pi$

$a(t) = (t+1)^2(\cos t - t\sin t - \sin t - \cos t) - (\cos t + \cos t - \sin t)(2)(t+1)$

$a(\pi) = \frac{2}{(\pi+1)^2}$

particle is moving left and speed is decreasing