4.2 Parametric Functions Modeling Planar Motion

AP Precalculus

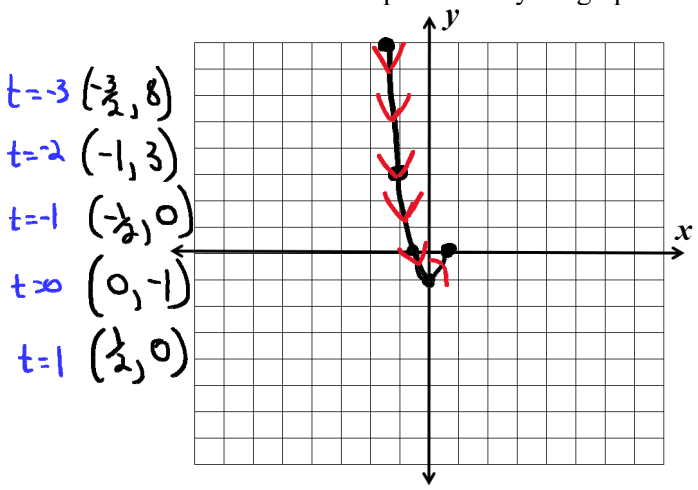
Solutions

4.2 Practice

For each parametric function, answer each part that follows. A graphing calculator should only be used to check your answers.

1. $f(x) = \left(\frac{1}{2}t, t^2 - 1\right)$ for $-3 \le t \le 1$

   a. Graph the curve represented by the given parametric function. Indicate the direction of movement of the particle on your graph.



   b. Find the horizontal relative extrema.

   Min of $-\frac{3}{2}$ at $t = -3$.

   Max of $\frac{1}{2}$ at $t = 1$.

   c. Find the vertical relative extrema.

   Min of -1 at $t = 0$.

   Max of 8 at $t = -3$.

   d. Find the x-intercept(s). Show your work.

$t^2 - 1 = 0$

$t^2 = 1$

$t = \pm 1$

   $\left(-\frac{1}{2}, 0\right)$ at $t = -1$.

   $\left(\frac{1}{2}, 0\right)$ at $t = 1$.

   e. Find the y-intercept(s). Show your work.

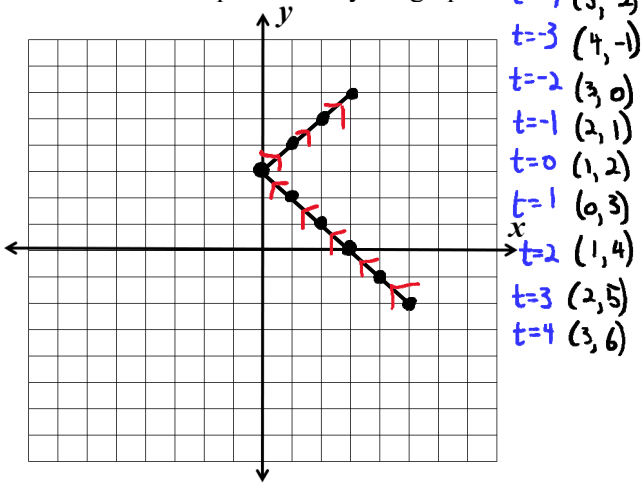
$\frac{1}{2}t = 0$

$t = 0$

   $(0, -1)$ at $t = 0$.

2. $f(x) = (|t - 1|, t + 2)$ for $-4 \le t \le 4$

   a. Graph the curve represented by the given parametric function. Indicate the direction of movement of the particle on your graph.



   b. Find the horizontal relative extrema.

   Min of 0 at $t = 1$.

   Max of 5 at $t = -4$.

   c. Find the vertical relative extrema.

   Min of -2 at $t = -4$.

   Max of 6 at $t = 4$.

   d. Find the x-intercept(s). Show your work.

$t + 2 = 0$

$t = -2$

   (3,0) at $t = -2$.

   e. Find the y-intercept(s). Show your work.

$|t - 1| = 0$

$t - 1 = 0$

$t = 1$

   $(0, 3)$ at $t = 1$.

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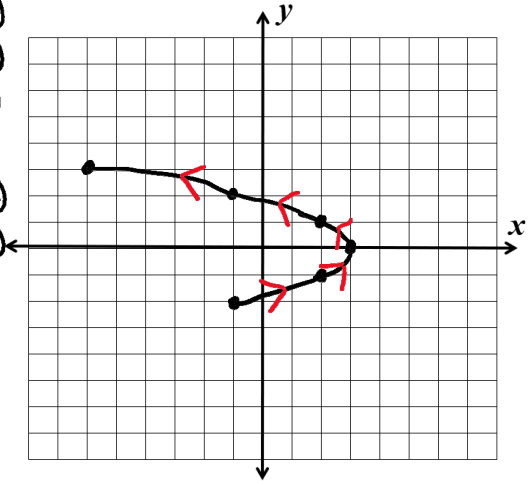
3. $f(x) = (-(t+1)^2 + 3, t+1)$ for $-3 \le t \le 2$

a. Graph the curve represented by the given parametric function. Indicate the direction of movement of the particle on your graph.

$t=3\ (-1,-2)$
$t=2\ (2,-1)$
$t=1\ (3,0)$
$t=0\ (2,1)$
$t=1\ (-1,2)$
$t=2\ (-6,3)$



b. Find the horizontal relative extrema.

Min of -6 at $t = 2$.

Max of 3 at $t = -1$.

c. Find the vertical relative extrema.

Min of -2 at $t = -3$.

Max of 3 at $t = 2$.

d. Find the x-intercept(s). Show your work.

$t+1=0$

$t=-1$

$(3, 0)$ at $t = -1$.

e. Find the y-intercept(s). Show your work.

Calculator active.

$-(t+1)^2+3=0$

$-(t+1)^2=-3$

$(t+1)^2=3$

$t+1=\pm\sqrt{3}$

$t=-1\pm\sqrt{3}$

$t\approx -2.732$

$t\approx 0.732$

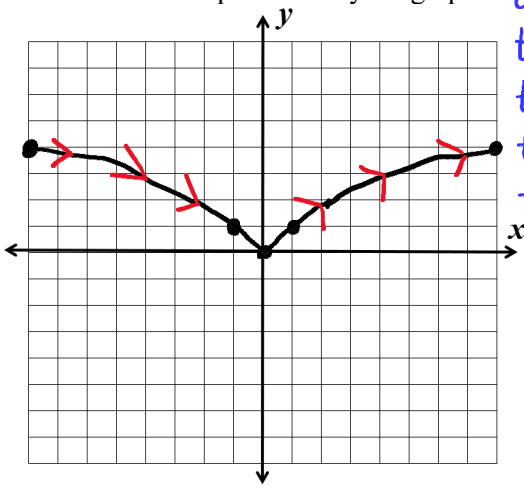
$(0, -1.732)$ at $t = -2.732$.

$(0,1.732)$ at $t = 0.732$.

4. $f(x) = (t^3, t^2)$ for $-2 \le t \le 2$

a. Graph the curve represented by the given parametric function. Indicate the direction of movement of the particle on your graph.

$t=-2\ (-8,4)$
$t=-1\ (-1,1)$
$t=0\ (0,0)$
$t=1\ (1,1)$
$t=2\ (8,4)$



b. Find the horizontal relative extrema.

Min of -8 at $t = -2$.

Max of 8 at $t = 2$.

c. Find the vertical relative extrema.

Min of 0 at $t = 0$.

Max of 4 at $t = -2$ and $t = 2$.

d. Find the x-intercept(s). Show your work.

$t^2=0$

$t=0$

$(0,0)$ at $t = 0$.

e. Find the y-intercept(s). Show your work.

$t^3=0$

$t=0$

$(0,0)$ at $t = 0$.

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For each parametric function, find the x- and y-intercepts algebraically.

5. $f(t) = (t^2, t^4 - 1)$

a. x-intercept(s).

$t^4 - 1 = 0$ $\quad x = (-1)^2 = 1$

$t^4 = 1$ $\quad x = (1)^2 = 1$

$t = \pm 1$

$(1, 0)$

b. y-intercept(s).

$t^2 = 0$ $\quad y = (0)^4 - 1$

$t = 0$

$(0, -1)$

6. $f(t) = (\ln(2t), t^2)$

a. x-intercept(s).

$t^2 = 0$

$t = 0$

No x-intercept

$\ln(0) =$ undefined

b. y-intercept(s).

$\ln(2t) = 0$ $\quad y = (\frac{1}{2})^2 = \frac{1}{4}$

$2t = e^0$

$t = \frac{1}{2}$

$\left(0, \frac{1}{4}\right)$

7. $f(t) = (-(t+2)^2 + 4, t + 1)$

a. x-intercept(s).

$t + 1 = 0$ $\quad x = -(-1+2)^2 + 4$

$t = -1$ $\quad x = -(1)^2 + 4 = 3$

$(3, 0)$

b. y-intercept(s).

$-(t+2)^2 + 4 = 0$ $\quad y = -4 + 1 = -3$

$(t+2)^2 = 4$ $\quad y = 0 + 1 = 1$

$t + 2 = \pm 2$

$t = -4, \; t = 0$

$(0, -3)$

$(0, 1)$

Find the horizontal and vertical extrema of each parametric function.

8. $x(t) = 2t + 1, y(t) = 3 - 2t$

a. Find the horizontal extrema.

$x(t)$ is linear, so there are no extrema.

b. Find the vertical extrema.

$y(t)$ is linear, so there are no extrema.

9. $x(t) = t, y(t) = 4$

a. Find the horizontal extrema.

$x(t)$ is linear, so there are no extrema.

b. Find the vertical extrema.

Max and min have a value of 4.

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