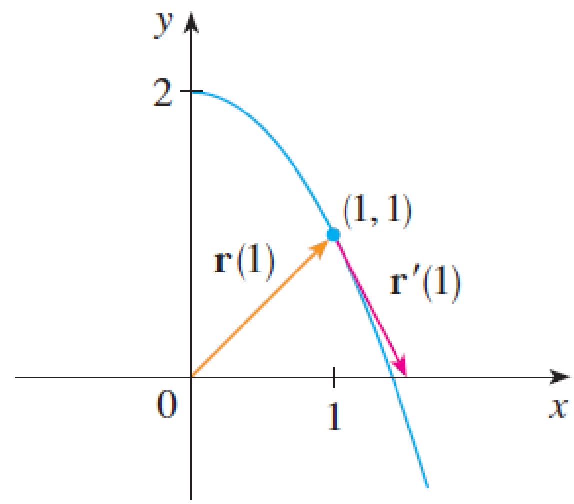
Closing Tue: 10.1/13.1, 10.2/13.2
Closing Thu: 10.3
Closing Next Tue: 13.3(part 1)

*Entry Task*:
$x = t$, $y = 2 - t^2$ (shown below)
Find $\vec{\boldsymbol{r}}(1)$ and $\vec{\boldsymbol{r}}'(1)$




Midterm 1 is Tuesday, Feb. 2 it covers
12.1-12.6, 10.1-10.3, 13.1-13.2 and 13.3(part 1)

**10.2/13.2 Calculus on Parametric Curves (Continued)**

Recall:
For 2D

$$\frac{dy}{dx} = \frac{dy/dt}{dx/dt} \quad \text{and} \quad \frac{d^2y}{dx^2} = \frac{\frac{d}{dt}\left(f'(x)\right)}{dx/dt}$$

For 3D
$\vec{\boldsymbol{r}}'(t) = \langle x'(t), y'(t), z'(t) \rangle$
= tangent (velocity) vector

$|\vec{\boldsymbol{r}}'(t)|$ = speed

**Today**:
Arc Length followed by polar coordinates.

## Distance Traveled on a Curve

The dist. traveled from *t = a* to *t = b* is given by

$$\int_a^b \sqrt{\left(x'(t)\right)^2 + \left(y'(t)\right)^2 + \left(z'(t)\right)^2}\,dt$$

$$= \int_a^b |\vec{\boldsymbol{r}}'(t)|dt$$

(Note: 2D is same without the z'(t)).
If the curve is "traversed once" we call this **arc length**.

The distance/arc length from 0 to *t* is often written as

$$s(t) = \int_0^t |\vec{\boldsymbol{r}}'(u)|du = \text{distance}$$

We call this the **distance/arc length function**.
Note:

$$\frac{ds}{dt} = |\vec{\boldsymbol{r}}'(t)| = \text{speed}$$

*Example*: x = cos(t), y = sin(t)

(a) Find the distance traveled by this object from t = 0 to t = 6π.
(b) Find the arc length of the path over which this object is traveling.

*Example*: x = 3 + 2t, y = 4 – 5t

(a) Find the arc length function from 0 to t.
(b) Reparameterize in terms of arc length.