

## 1 Use What You Know on the Helix

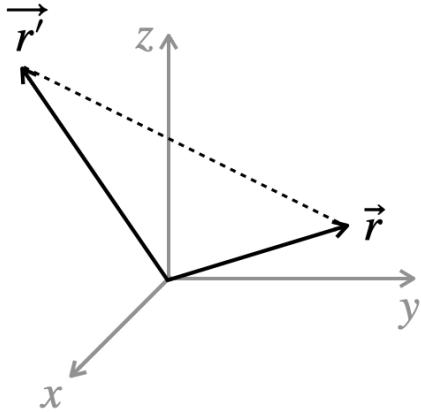
- (a) Evaluate  $d\vec{r}$  along the helical path  $z = 7\phi$ .
- (b) Evaluate  $|d\vec{r}|$  along the helical path  $z = 7\phi$ .

## 2 Distance Formula in Curvilinear Coordinates

*Review from the Theoretical Mechanics Paradigm*

The distance  $|\vec{r} - \vec{r}'|$  between the point  $\vec{r}$  and the point  $\vec{r}'$  is a coordinate-independent, physical and geometric quantity. But, in practice, you will need to know how to express this quantity in different coordinate systems.

- (a) Find the distance  $|\vec{r} - \vec{r}'|$  between the point  $\vec{r}$  and the point  $\vec{r}'$  in rectangular coordinates.



- (b) Show that this same distance written in cylindrical coordinates is:

$$|\vec{r} - \vec{r}'| = \sqrt{s^2 + s'^2 - 2ss' \cos(\phi - \phi') + (z - z')^2}$$

Hint: You may want to use the textbook: GMM: Change of Coordinates

- (c) Show that this same distance written in spherical coordinates is:

$$|\vec{r} - \vec{r}'| = \sqrt{r'^2 + r^2 - 2rr' [\sin \theta \sin \theta' \cos(\phi - \phi') + \cos \theta \cos \theta']}$$

Hint: You may want to use the textbook: GMM: Change of Coordinates

- (d) Now assume that  $\vec{r}'$  and  $\vec{r}$  are in the  $x$ - $y$  plane. Simplify the previous two formulas.