

# Ans. Key

## Math 2551 A1-3 Exercise 4

Section:

Name:

Student Number:

Let  $\mathbf{r}(t) = \sin t \mathbf{i} + \mathbf{j} + e^t \mathbf{k}$  be the position of a particle at any time  $t$ . Mark "True" or "False" for each of the following statements.

False (1)  $\mathbf{r}'(t)$  is parallel to  $\mathbf{r}(t)$ ;

True (2)  $\mathbf{r}'(t)$  is tangent to the curve traced out by  $\mathbf{r}(t)$ ;

False (3)  $\mathbf{r}'(t)$  is perpendicular to  $\mathbf{r}(t)$ ;

True (4)  $\frac{d}{dt}\left(\frac{\mathbf{r}}{|\mathbf{r}|}\right)$  is perpendicular to  $\mathbf{r}(t)$ .



$\mathbf{r}'(t)$  gives the tangent direction of the curve at the point  $\mathbf{r}(t)$ , which isn't necessarily parallel to the vector  $\mathbf{r}(t)$ , see the picture.  $\mathbf{r}'(t)$  isn't perpendicular to  $\mathbf{r}(t)$  for all  $t$  unless the length of  $\mathbf{r}(t)$  doesn't change, so (3) is false. In (4), note that  $\left|\frac{\mathbf{r}(t)}{|\mathbf{r}(t)|}\right| = 1$  for all  $t$ , therefore  $\frac{d}{dt}\left(\frac{\mathbf{r}(t)}{|\mathbf{r}(t)|}\right) \perp \frac{\mathbf{r}(t)}{|\mathbf{r}(t)|}$ . The statement is true.