

Name: \_\_\_\_\_

**Math 2030, Fall 2017, Quiz 3**  
**19 September 2017**  
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*No calculators needed or allowed.*

Let  $\vec{r}(t) = (2t, t + \frac{1}{t}, t^2)$ .

1. Compute  $\vec{v}(t)$ .
2. Compute the tangent line  $\vec{l}(t)$  at  $t = 1$ .
3. Compute  $\vec{a}(t)$ .
4. Show that  $\text{proj}_{\vec{v}}(\vec{a}) = \text{proj}_{\vec{T}}(\vec{a})$ .  
Hint: there is a nonzero constant  $c$  such that  $\vec{v} = c\vec{T}$ . Substitute this into the formula for  $\text{proj}_{\vec{v}}(\vec{a})$ .
5. Decompose  $a(1)$  into tangential and normal components.
6. Compute  $ds/dt$  at  $t = 1$ .
7. Compute the curvature  $\kappa$  and radius of curvature  $R$  at  $t = 1$ .
8. Compute the osculating circle at  $t = 1$ , or at least say as much about it as you can.