

## Quiz 4

MATH 261, CALCULUS III, FALL 2017

CLASS TIME:

NAME:

**Instructions:** Solve as many of these problems as you can. Circle the correct answer, and show your work!

**Problem 1.** A particle moves with acceleration  $\vec{a}(t) = e^t \vec{k}$  and initial velocity and position

given by  $\vec{v}(0) = 0$  and  $\vec{r}(0) = \vec{j} + \vec{k}$  respectively. Where is the particle at time  $t = 2$ ?

- (a)  $(0, 1, e^2 - 2)$
- (b)  $(0, 1, e^2)$
- (c)  $(0, 1, e - 1)$
- (d)  $(1, 1, e^2 - 2)$
- (e)  $(1, 1, e^2)$ .

Solution: (a) First find  $v(t) = \int a(t) dt + C = (0, 0, e^t) + C$ . Since  $v(0) = (0, 0, 0)$ , we must have  $C = (0, 0, -1)$ . So  $v(t) = (0, 0, e^t - 1)$ . Next, find  $r(t) = \int v(t) dt = (0, 0, e^t - t) + C$ , and since  $r(0) = (0, 1, 1)$  we must have  $C = (0, 1, 0)$  so  $r(t) = (0, 1, e^t - t)$ . The problem asks for  $r(2)$  which is just  $(0, 1, e^2 - 2)$ .

**Problem 2.** A particle moves along according to  $\vec{r}(t) = \langle 5t, 1 - 3t, 5 + 4t \rangle$  for  $t \geq 0$ . What is the  $x$  coordinate of the particle after it has traveled a distance of 2 units along the curve?

- (a) 10
- (b)  $\sqrt{2}$
- (c)  $5\sqrt{2}$
- (d)  $\frac{1}{10}$
- (e)  $\frac{5\sqrt{2}}{2}$ .

Solution: (b) Compute the distance traveled after the particle has moved along the curve at time  $t_o$ , i.e.  $s = \int_0^{t_o} |r'(t)| dt = \int_0^{t_o} \sqrt{50} dt = \sqrt{50}t_o$ . Then when  $s = 2$ , we have  $t_o = 2/\sqrt{50}$ . Then the problem is asking for the  $x$  coordinate of  $r(t_o) = r(2/\sqrt{50})$ . This is  $\sqrt{2}$ .