Math 2222 Test #1 Your Name:_____

Sep. 21, 2015 Instructor's Name and Class Time:_____

Directions:

(1) All cell phones and other electronic noisemaking devices must be turned completely off and put away for the duration of the exam.
(2) No calculators, books, or other materials are permitted.
(3) Show **ALL** your work! Correct answer which are not properly justified will not receive full credit.
(4) Failure to follow directions specific to a problem will result in the loss of points.
(5) Write your answer in the space provided. If that is not convenient for a particular answer, circle or box your answer.
(6) If you work a problem two different ways, clearly indicate which one you want us to grade, preferably by crossing out the one you do not want us to look at. If you use two methods, one of which is wrong, and neither method is crossed out, you will not receive full credit.
(7) Answers must be exact (like $\sqrt{2}$) not approximate (like 1.414), unless a problem specifically indicates otherwise.
(8) Simplify where appropriate. Quantities such as $\sqrt{9}$ and $\cos\pi$ should be calculated.
(9) If you need extra room, you may used the back of the previous page. However, you must indicate you are doing so by clearly writing "BPP" on the relevant problem.
(10) This packet has seven sheets of paper, including this cover page. Do NOT remove the staple or remove any sheet from this packet.
(11) Once this exam begins, you will have 50 minutes to complete your solutions.

$$L = \int_\alpha^\beta \sqrt{(f(\theta))^2 + (f'(\theta))^2}\, d\theta$$

$$\mathbf{N} = \frac{\mathbf{T}'}{|\mathbf{T}'|}; \quad \mathbf{B} = \mathbf{T} \times \mathbf{N}$$

$$\kappa(t) = \frac{|\mathbf{T}'(t)|}{|\mathbf{r}'(t)|} = \frac{|\mathbf{v} \times \mathbf{a}|}{|\mathbf{v}|^3}; \quad a_N = \frac{|\mathbf{v} \times \mathbf{a}|}{|\mathbf{v}|}$$

DO NOT OPEN THIS EXAM UNTIL TOLD TO DO SO

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1. (8 pts) Find the scalar component of $\mathbf{b}$ in the direction of $\mathbf{c}$ ($\text{scal}_{\mathbf{c}}\mathbf{b}$) and the orthogonal projection of $\mathbf{b}$ onto $\mathbf{c}$ ($\text{proj}_{\mathbf{c}}\mathbf{b}$) , where $\mathbf{b} = \langle 2, -4, 4\rangle$ and $\mathbf{c} = \langle 3, 0, -4\rangle$.

Scalar:_____

Vector:_____

2a. (4 pts.) For the points $A(-1, 2, -3), B(2, 0, 5), C(3, 0, 6)$, and $D(0, 2, -2)$, show that quadrilateral ABCD is a parallelogram.

b. (8 pts.) For the same four points, find the area of parallelogram ABCD.

Answer:_____

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3. (8 pts.) Find an equation of the line through the point $(2, 0, 3)$ and parallel to the line $\mathbf{r}(t) = \langle 3 + t, -5, 7 - 2t \rangle$.

Answer:_____

4. (8 pts.) A particle travels along the curve defined by $\mathbf{r}(t) = \langle 2t, -\sin(t), \cos(t) \rangle$. Calculate the distance (arc length) the particle travels from $t = 0$ to $t = 2\pi$.

Answer:_____

5. (4 pts.) The curve below represents the motion of a particle with position function $\mathbf{r}(t)$ (the arrow represents the direction in which the particle is moving). In addition, you are told that the particle is slowing down (its speed is decreasing). Circle the vector that could represent the acceleration at the indicated point.

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6. (6 pts.) Given that vectors $\langle 1, -1, 2\rangle$ and $\langle 6, 0, b\rangle$ are orthogonal, find b.

$b =$_____

7. (8 pts.) Set up, but **DO NOT EVALUATE**, an integral to calculate the length of the polar curve $r = 2\tan(3\theta)$ from $\theta = 0$ to $\theta = \pi/12$. Your answer should be an integral in terms of (only) the variable θ with suitable limits of integration.

Answer:_____

8. (8 pts.) Evaluate the definite integral $\displaystyle\int_0^1 (e^{2t}\mathbf{i} - \frac{t}{t^2+1}\mathbf{k})\, dt$.

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9. Suppose a particle moves through space so that its position function is $\mathbf{r}(t) = \langle t^2/2, \ln(t), t\sqrt{2} \rangle$ (for $t > 0$).

(a) (8 pts.) Calculate the velocity and the acceleration.

Velocity=_____

Acceleration=_____

(b) (4 pts.) Show that the speed is $(t^2 + 1)/t$.

(c) (4 pts.) Calculate the unit tangent vector $\mathbf{T}(t)$. (You should simplify your answer for full credit.)

$\mathbf{T}(t) =$_____

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9. (parts (a), (b), and (c) are on the previous page)

(d) (8 pts.) Calculate the tangential and normal components of acceleration a_T and a_N. (You do not need to simplify your answers.)

$a_T =$_____

$a_N =$_____

(e) (6 pts.) Calculate the curvature for any t. (You do not need to simplify your answer.)

curvature=_____

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10. (8 pts.) If the velocity of a moving particle is given by $\mathbf{v}(t) = \langle \sin(t), e^{-2t}, 2t \rangle$ and its initial position is $\langle 3, 2, 1 \rangle$, find the position vector and the acceleration vector in terms of t.