Math 2222 Test #1 Your Name:_____

Feb. 16, 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

Name_____

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

Scalar:_____

Vector:_____

2a. (8 pts.) How much work is done if you pull a suitcase 10 m along horizontal ground exerting a force of 300 N at an angle of 60 degrees above the horizontal?

Work=_____

(b) (2 pts.) Suppose you're worried that the suitcase strap isn't strong enough to withstand a force of 300 N. What could you do to reduce the force necessary to move the same suitcase the same distance in part (a)?

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3. Consider the vector function $\mathbf{r}(t) = \langle \ln t, t^2, \sqrt{5-t} \rangle$.

(a) (4 pts.) Find the domain of this vector function.

Domain:_____

(b) (4 pts.) Find the tangent vector $\mathbf{r}'(t)$.

$\mathbf{r}'(t) =$_____

(c) (4 pts.) The point $(0, 1, 2)$ lies on the curve defined by this vector function. Find t corresponding to this point.

$t=$_____

(d) (8 pts.) Find an equation of the tangent line to the curve at the point $(0, 1, 2)$.

Equation:_____

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4. (8 pts.) A particle travels along the curve defined by $\mathbf{r}(t) = \langle t, \tan t, 2\sqrt{t} \rangle$. Set up, but **DO NOT EVALUATE**, an integral to calculate the distance (arc length) the particle travels from $t = 1$ to $t = 4$. Your answer should be an integral in terms of (only) the variable t with suitable limits of integration.

Answer:_____

5. (8 pts.) Find the length of the polar curve $r = 3\sin\theta$ from $\theta = 0$ to $\theta = \pi/3$.

Answer:_____

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6. Suppose a particle moves through space so that its position function is $\mathbf{r}(t) = \langle 5t, \sin 2t, \cos 2t \rangle$.

(a) (9 pts.) Calculate the velocity, the acceleration, and the speed.

Velocity=_____

Acceleration=_____

Speed=_____

(b) (8 pts.) Calculate the unit tangent vector $\mathbf{T}(t)$ and the principal unit normal vector $\mathbf{N}(t)$.

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

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

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6. (parts (a) and (b) are on the previous page)

(c) (9 pts.) Calculate the tangential and normal components of acceleration a_T and a_N and the curvature κ.

$a_T =$_____

$a_N =$_____

$\kappa =$_____

7. (8 pts.) Find a **unit** vector orthogonal to both of the vectors $\langle 0, -1, 3\rangle$ and $\langle -2, -1, 1\rangle$.

Answer:_____

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8. (12 pts.) If the acceleration of a moving particle is given by $\mathbf{a}(t) = \langle \cos 2t, e^{-t}, 3t^2 \rangle$, its initial velocity is $\langle 2, 2, 1 \rangle$, and its initial position is $\langle 1, 4, 2 \rangle$, find the position vector as a function of t. (You should show your work.)