Name (print):

CALCULUS 132:	MISSION 4 (65PTS)

Show work. Your work should be single-sided and clearly labeled. Number the pages in your solution. You will be given a folder to turn in your work, please print your full name in large font on the outside so it is easy for you to pick back up after grading. Thanks.

Recommended Practice Problems: (these are not collected)
Stewart §10.1 #'s 5, 7, 8, 9, 10, 17, 21, 28, 29, 33, 34, 35, 37, 51
Stewart §10.2 #'s 1, 3, 5, 7, 9, 11, 17, 31, 33, 37, 39, 41, 43, 45, 59, 71, 74
Stewart §10.3 #'s 1, 3, 5, 7, 9, 15, 17, 21, 23, 33, 35, 37, 41, 45, 54, 55, 59, 63, 67, 69, 71
Stewart §10.4 #'s 1, 3, 5, 7, 9, 11, 19, 21, 23, 29, 31, 33, 35, 39, 41, 47, 49
Stewart §10.5 #'s 3, 5, 7, 11, 17, 18, 19, 20, 23, 25, 27, 29, 33, 39, 43
Stewart §10.6 #'s 9, 11, 19, 23, 28, 30

Problem 126 For each pair of points P, Q find the vector $\overrightarrow{PQ} = Q - P$ and calculate $\overrightarrow{PQ} \bullet \overrightarrow{PQ}$ and find the distance $d(P,Q) = \sqrt{\overrightarrow{PQ} \bullet \overrightarrow{PQ}}$ between the given points.

(a.) $P = (1, 3)$ and $Q = (8, 8)$

(b.) $P = (-3, 1)$ and $Q = (5, -2)$

Problem 127 For the given pair $\vec{A}, \vec{B}$ calculate $\vec{A} \bullet \vec{B}$ and find the $\angle(\vec{A}, \vec{B})$.

(a.) $\vec{A} = \langle 1, 3 \rangle$ and $\vec{B} = \langle -1, 2 \rangle$

(b.) $\vec{A} = \langle 1, 2 \rangle$ and $\vec{B} = \langle 2, -1 \rangle$

(c.) $\vec{A} = \langle 1, 1 \rangle$ and $\vec{B} = \langle 2, 0 \rangle$

Problem 128 For each $\vec{A}$, find its unit-vector $\hat{A}$, standard angle, and magnitude A.

(a.) $\vec{A} = \langle -1, -3 \rangle$

(b.) $\vec{A} = \langle 2, 4 \rangle$

(c.) $\vec{A} = \langle -3, 4 \rangle$

Problem 129 Let $\vec{R}(t) = \langle t^2, t^3 \rangle$ for $t \in \mathbb{R}$.

(a.) Calculate $\frac{d\vec{R}}{dt}$

(b.) Calculate $\frac{d\vec{R}}{dt} \bullet \vec{R}$

Problem 130 Let $\vec{R}(t) = \langle \cos(t^2), \sin(t^2) \rangle$ for $t \in \mathbb{R}$.

(a.) Calculate $\frac{d\vec{R}}{dt}$

(b.) Calculate $\frac{d\vec{R}}{dt} \bullet \vec{R}$

Problem 131 Stewart §10.1 # 11

Problem 132 Stewart §10.1 # 15

Problem 133 Stewart §10.1 # 19

Problem 134 Stewart §10.1 # 45 (use technology to graph)

Problem 135 Stewart §10.1 # 46c

Problem 136 Consider a path parametrized by $x = 1/t$ and $y = t^2 + 1$ and find the

(a.) Find the Cartesian equation for the path

(b.) Cartesian equation of the tangent line to the path at $t = 1$.

(c.) the parametrization of the colliding tangent line at $t = 1$

Problem 137 Consider a line-segment L which goes from $(3, 5)$ to $(-2, 13)$.

(a.) Find the parametric equations for L by using a parameter t which ranges over $0 \leq t \leq 1$.

(b.) Find a vector-valued function of time $t \in [0, 1]$ which parametrizes L; provide a formula for $\vec{r} : [0, 1] \to L$ serves as a parametrization of L.

Problem 138 Find a parametrization of the piecewise linear path from $P = (0, 0)$ to $Q = (1, 2)$ to $R = (4, -3)$. Create formulas which put P at $t = 0$, then Q at $t = 1/2$ then R at $t = 1$.

Problem 139 In each case find a vector parametrization of the given curve. That is, provide a formula for $\vec{r} : I \subseteq \mathbb{R} \to C$ serves as a parametrization of C.

(a.) C is given by $x^2 - 2x + y^2 - 6y = 6$ which has $x \geq 1$.

(b.) $x^2 - 4y^2 = 1$ which has $x > 0$ and $y \geq 0$.

(c.) $x - y = 1$ bounded by $x^2 + y^2 = 4$

Problem 140 Let $\vec{v}(t) = \langle \sin(t), t^3 \rangle$ denote the velocity of some particle at time t. You are given that the particle is at $(2, 1)$ at time zero.

(a) the acceleration as a function of time t

(b) the position as a function of time t

Problem 141 Stewart §10.2 # 4

Problem 142 Stewart §10.2 # 8

Problem 143 Stewart §10.2 # 10

Problem 144 Stewart §10.2 # 13

Problem 145 Consider the curve C with parametrization $\vec{r}(t) = \langle 2 + 3\sin t, 2\cos t \rangle$ for $0 \leq t \leq 2\pi$. Calculate $\dfrac{d^2y}{dx^2}$ as a function of time t for the given curve and analyze where C is concave up or down. Sketch the curve and check that your calculus gives reasonable results.

Problem 146 Stewart §10.2 # 18

Problem 147 Stewart §10.2 # 29

Problem 148 Stewart §10.2 # 34

Problem 149 Stewart §10.2 # 42

Problem 150 Stewart §10.2 # 44

Problem 151 Stewart §10.2 # 48

Problem 152 Stewart §10.2 # 51

Problem 153 Stewart §10.2 # 57

Problem 154 Suppose $x = e^t$ and $y = \sin(t)$ for $0 \leq t \leq \pi$

(a.) all horizontal tangents

(b.) all vertical tangents

(c.) an integral representation for the arclength of C. Use technology to calculate the integral.

(d.) an integral representation for surface area of of the surface obtained by rotating the given path around the x-axis. Use technology to calculate the integral.

Problem 155 Stewart §10.2 # 48

Problem 156 Stewart §10.2 # 70

Problem 157 Stewart §10.3 # 2

Problem 158 Stewart §10.3 # 4

Problem 159 Stewart §10.3 # 6

Problem 160 Stewart §10.3 # 11

Problem 161 Stewart §10.3 # 16

Problem 162 Stewart §10.3 # 33

Problem 163 Stewart §10.3 # 35

Problem 164 Stewart §10.3 # 43

Problem 165 Stewart §10.3 # 57

Problem 166 Stewart §10.3 # 61

Problem 167 Stewart §10.3 # 65

Problem 168 Find the equation of the tangent line to $r^2 - 3r + 2 = 0$ at the point $(2, 0)$.

Problem 169 Stewart §10.4 # 6

Problem 170 Stewart §10.4 # 13

Problem 171 Stewart §10.4 # 17

Problem 172 Consider the polar curve $r = 1 + \sin(\theta)$. Find:

(a) a plot of this curve

(b) the area enclosed by the curve

(c) an integral which represents the arclength of the curve (DO NOT ATTEMPT this integral!)

Problem 173 Consider the polar curve $r = \sin(3\theta)$. Find:

(a) a plot of this curve

(b) the area enclosed by the curve

(c) an integral which represents the arclength of the curve (DO NOT ATTEMPT this integral!)

Problem 174 Consider the polar curve $r = \theta^2$ for $0 \leq \theta \leq \pi$. Find:

(a) a plot of this curve

(b) the area enclosed by the curve and the x-axis

(c) the arclength of the curve.

Problem 175 Stewart §10.4 # 27

Problem 176 Consider the area bounded outside $r = 1$ and inside $r = 2\cos(2\theta)$. Sketch these curves and find the area.

Problem 177 Calculate the area of the intersection of the areas bounded by $r = 2\sin(\theta)$, $r = 2\cos(\theta)$ and $r = 1$.

Problem 178 Find the slope of the curve with parametric polar equations $r = t^2$ and $\theta = e^t$ at the point where $t = \ln(2)$.

Problem 179 Stewart §10.4 # 37

Problem 180 Stewart §10.4 # 45

Problem 181 Stewart §10.4 # 51

Problem 182 If $\vec{A}$ and $\vec{B}$ are functions from $\mathbb{R}$ to $\mathbb{R}^2$ which are both differentiable functions of time t then we should prove in lecture that

$$\frac{d}{dt}(\vec{A} \bullet \vec{B}) = \frac{d\vec{A}}{dt} \bullet \vec{B} + \vec{A} \bullet \frac{d\vec{B}}{dt}$$

The equation of a particle moving on a circle at position $\vec{r}$ which has center $\vec{c}$ and radius R is given by $\|\vec{r} - \vec{c}\| = R$. Show that a particle moving in a circle as above has:

(a.) velocity $\vec{v} = \frac{d\vec{r}}{dt}$ is perpendicular to $\vec{r} - \vec{c}$ at each time t,

(b.) and if v is constant then show $a = v^2/R$ and $\hat{a}$ is in the direction of $\vec{c} - \vec{r}$.

Problem 183 If v denotes speed of a particle then $v^2 = \dot{x}^2 + \dot{y}^2$ where $\dot{x} = \frac{dx}{dt}$ and $\dot{y} = \frac{dy}{dt}$. If $x = r\cos\theta$ and $y = r\sin\theta$ then show $v^2 = \dot{r}^2 + r^2\dot{\theta}^2$.

Problem 184 Stewart §10.5 # 15

Problem 185 Stewart §10.5 # 20

Problem 186 Stewart §10.5 # 61

Problem 187 Stewart §10.6 # 10

Problem 188 Stewart §10.6 # 12

Problem 189 Stewart §10.6 # 25

Problem 190 Stewart §10.6 # 29