Name: ____________________________

Instructor: ________________________

Math 20550, Practice Exam 3
April 23, 2019

- The Honor Code is in effect for this examination. All work is to be your own.
- No calculators.
- The exam lasts for 1 hour and 15 minutes.
- Be sure that your name is on every page in case pages become detached.
- Be sure that you have all 9 pages of the test.
- Each multiple choice question is 6 points. Each partial credit problem is 12 points. You will receive 4 extra points.

PLEASE MARK YOUR ANSWERS WITH AN X, not a circle!

1.	(a)	(b)	(c)	(d)	(e)
2.	(a)	(b)	(c)	(d)	(e)
3.	(a)	(b)	(c)	(d)	(e)
4.	(a)	(b)	(c)	(d)	(e)
5.	(a)	(b)	(c)	(d)	(e)
6.	(a)	(b)	(c)	(d)	(e)
7.	(a)	(b)	(c)	(d)	(e)
8.	(a)	(b)	(c)	(d)	(e)
9.	(a)	(b)	(c)	(d)	(e)
10.	(a)	(b)	(c)	(d)	(e)

Please do NOT write in this box.

Multiple Choice	______
11.	______
12.	______
13.	______
Extra Points.	4
Total:	______

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Multiple Choice

1.(6 pts) Find the volume of the solid that lies under $z = x^3 + y^3$ and above the region in the xy-plane bounded by $y = x^2$ and $x = y^2$.

(a) $\frac{3}{16}$ (b) $\frac{1}{9}$ (c) $\frac{1}{16}$ (d) $\frac{1}{18}$ (e) $\frac{5}{18}$

2.(6 pts) Let E be the part of the ball $x^2 + y^2 + z^2 \leq 9$ that lies in the first octant. Determine which integral computes the mass of E if the density is $\delta(x, y, z) = x^2 + y^2$.

(a) $\int_0^{\pi/2} \int_0^{\pi/2} \int_0^3 \rho^4 \sin^3\phi \, d\rho \, d\phi \, d\theta$

(b) $\int_0^{\pi/2} \int_0^{\pi/4} \int_0^3 \rho^3 \sin^2\phi \cos\phi \, d\rho \, d\phi \, d\theta$

(c) $\int_0^{\pi/2} \int_0^{\pi/2} \int_0^3 \rho^2 \cos\phi \, d\rho \, d\phi \, d\theta$

(d) $\int_0^{\pi/2} \int_0^{\pi/2} \int_0^3 \rho^3 \sin^2\phi \, d\rho \, d\phi \, d\theta$

(e) $\int_0^{\pi/2} \int_0^{\pi/4} \int_0^3 \rho^4 \sin\phi \cos\phi \, d\rho \, d\phi \, d\theta$

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3.(6 pts) Which of the following computes $\iiint_E y\,\mathrm{d}V$, where E is the solid that lies between cylinders $x^2+y^2=1$ and $x^2+y^2=4$ above the xy-plane and below the plane $z=x+4$?

(a) $\int_0^{2\pi}\int_1^2\int_0^{r\cos\phi+4} r^2\sin\phi\,\mathrm{d}z\mathrm{d}r\mathrm{d}\phi$

(b) $\int_0^{2\pi}\int_1^2\int_0^{r} r\sin\phi\,\mathrm{d}z\mathrm{d}r\mathrm{d}\phi$

(c) $\int_0^{2\pi}\int_1^2\int_0^{r\cos\phi+4} r\sin\phi\,\mathrm{d}z\mathrm{d}r\mathrm{d}\phi$

(d) $\int_0^{2\pi}\int_1^2\int_0^{r} r^2\sin\phi\,\mathrm{d}z\mathrm{d}r\mathrm{d}\phi$

(e) $\int_0^{2\pi}\int_1^2\int_0^{r\sin\phi}(r\cos\phi+4)\,\mathrm{d}z\mathrm{d}r\mathrm{d}\phi$

4.(6 pts) Evaluate $\int_C 4\,\mathrm{d}s$, where C is the helix $x=2\sin t$, $y=2\cos t$, $z=3t$, $0\le t\le 2\pi$.

(a) $4\sqrt{13}\pi$ (b) $8\sqrt{13}$ (c) $8\sqrt{13}\pi^2$ (d) $\sqrt{13}$ (e) $8\sqrt{13}\pi$

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5.(6 pts)Use Fundamental Theorem of line integrals to evaluate $\int_C \mathbf{F} \cdot d\mathbf{r}$, where

$$\mathbf{F}(x, y) = 2x\mathbf{i} + 2y\mathbf{j}$$

and C is given by $\mathbf{r}(t) = \langle t^2 \cos(\pi t), 2^{t-1}\sqrt{t} \rangle$, $1 \le t \le 2$.

(a) 3 (b) 18 (c) 24 (d) 22 (e) 0

6.(6 pts) Find the curl of the vector field

$$\mathbf{F}(x, y, z) = xz^2\mathbf{i} + \cos(yz)\mathbf{j} + (x + yz)\mathbf{k}.$$

(a) $\frac{1}{2}z^2(x^2 + y^2) + xz + \frac{1}{z}\sin(yz)$ (b) $(z + y\sin(yz))\mathbf{i} + (2xz - 1)\mathbf{j}$

(c) $y + z^2$ (d) $z^2\mathbf{i} + y\mathbf{k}$

(e) $(y + z\sin(yz))\mathbf{i} + (z^2 - y)\mathbf{j} + (-z\sin(yz) - z^2)\mathbf{k}$

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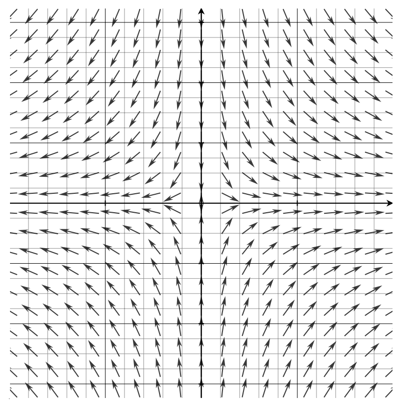
7.(6 pts) Which of the following could be the vector field depicted below?



(a) $\mathbf{F} = x\mathbf{i} + \mathbf{j}$ (b) $\mathbf{F} = x\mathbf{i} - y\mathbf{j}$ (c) $\mathbf{F} = x^2\mathbf{i} + y^2\mathbf{j}$

(d) $\mathbf{F} = y\mathbf{i} - x\mathbf{j}$ (e) $\mathbf{F} = -x^2\mathbf{i} - y^2\mathbf{j}$

8.(6 pts) Compute the Jacobian $\dfrac{\partial(x,y)}{\partial(u,v)}$ of the map $x = 5v\sin u$, $y = 4v\cos u$.

(a) $9v$ (b) $-20v\sin u\cos u$ (c) $20v$

(d) $9v^2$ (e) v

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9.(6 pts) Evaluate the line integral $\displaystyle\int_C xy\,\mathrm{d}x$, where C is the part of $y = x^2$ form $(0,0)$ to $(2,4)$.

(a) 4 (b) -4 (c) 0 (d) 2 (e) -2

10.(6 pts) Evaluate $\int_C \mathbf{F}\cdot d\mathbf{r}$, where $\mathbf{F}(x,y) = xy\mathbf{i} + e^{x^3}\mathbf{j}$ and C is the line segment from $(2,0)$ to $(4,0)$.

(a) -2 (b) 2 (c) 4 (d) -4 (e) 0

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Partial Credit

You must show your work on the partial credit problems to receive credit!

11.(12 pts.) Let $\mathbf{F} = (x + yz)\mathbf{i} + xz\mathbf{j} + (z + xy)\mathbf{k}$ be a vector field.
(a) Find a function $f(x, y, z)$ such that $\mathbf{F} = \nabla f$.
(b) Compute $\int_C \mathbf{F} \cdot \mathrm{d}\mathbf{t}$, where C is the curve $\mathbf{r}(t) = \langle t, e^t, te^{t^3} \rangle$, $0 \leq t \leq 1$.

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12.(12 pts.) Use the transformation $x = u + v$, $y = v$ to compute $\iint_D 2\mathrm{d}A$ where D is the region bounded by $x^2 - 2xy + 2y^2 = 1$.

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13.(12 pts.) Use Green's Theorem to compute $\int_C (e^x - y)\mathrm{d}x + (5x + \cos y)\mathrm{d}y$, where C is the curve $x^2 - 2xy + 2y^2 = 1$ with positive orientation.