Name: _____

Instructor: _____

Math 20550. Exam 3
November 19, 2015

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- 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)
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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

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Multiple Choice

1.(6 pts) Compute the Jacobian $\left(\dfrac{\partial(x,y)}{\partial(u,v)}\right)$ of the transformation T given by $x = e^{u-v}$, $y = e^{u+v}$.

(a) 2 (b) $2e^{2v}$ (c) $e^{u^2-v^2}$ (d) $2e^{uv}$ (e) $2e^{2u}$

2.(6 pts) Calculate the line integral $\int_C (y^2 + x)\,dx + 4xy\,dy$ where C is the arc of $x = y^2$ from $(1, 1)$ to $(4, 2)$.

(a) 30 (b) 35 (c) 0 (d) 20 (e) 25

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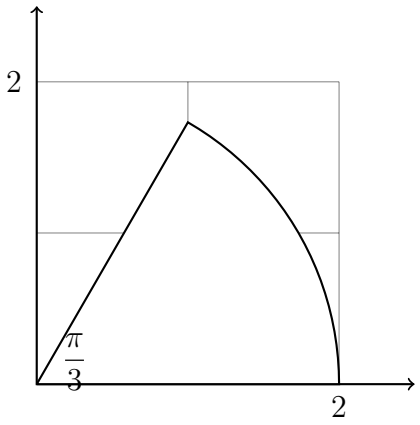
3.(6 pts) Calculate the line integral $\int_C (2x + y)\, ds$ where C is the quarter of the circle $x^2 + y^2 = 4$ in the first quadrant.

(a) 0 (b) 12 (c) 8 (d) 4 (e) -8

4.(6 pts) Let S is the sector with sector angle $\dfrac{\pi}{3}$ of a disk of radius 2 centered at origin as shown in the picture below.



The integral $\iint_S \dfrac{x^2 + y^2}{x^2} dA$ is equal to

(a) $\displaystyle\int_0^{\frac{\pi}{3}} \int_0^1 \frac{1}{\cos^2\theta}\, dr d\theta$ (b) $\displaystyle\int_0^{\frac{\pi}{3}} \int_0^2 \frac{r}{\cos^2\theta}\, dr d\theta$ (c) $\displaystyle\int_0^{\frac{\pi}{3}} \int_0^2 \frac{1}{\cos^2\theta}\, dr d\theta$

(d) $\displaystyle\int_0^{\frac{\pi}{3}} \int_0^1 \frac{\theta}{\cos^2\theta}\, dr d\theta$ (e) $\displaystyle\int_0^{\frac{\pi}{3}} \int_0^2 \frac{r^3}{\cos^2\theta}\, dr d\theta$

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5.(6 pts) Evaluate the triple integral $\iiint_E x\,dV$, where E lies under the plane $z = 1$ and above the region in the xy-plane bounded by $x = 0$, $y = 0$, and $2x + y = 2$.

(a) $\frac{1}{6}$ (b) $\frac{1}{2}$ (c) $\frac{1}{4}$ (d) $\frac{1}{3}$ (e) 1

6.(6 pts) Find the x-coordinate center of mass of the cube

$$C = \{(x, y, z) : 0 \leq x \leq 1, 0 \leq y \leq 1, 0 \leq z \leq 1\}$$

whose density is $\rho(x, y, z) = 2x + 3y^2$. The total mass of the cube equals 2.

(a) $\bar{x} = \frac{7}{12}$ (b) $\bar{x} = \frac{5}{6}$ (c) $\bar{x} = 1$ (d) $\bar{x} = \frac{5}{12}$ (e) $\bar{x} = \frac{1}{2}$

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7.(6 pts) Let $\mathbf{F}(x, y) = \langle y, 4x \rangle$. Calculate $\int_C \mathbf{F} \cdot d\mathbf{r}$ where C is the curve $\mathbf{r}(t) = \langle t^2, t \rangle$, $0 \leq t \leq 1$.

(a) -4 (b) 2 (c) 4 (d) -2 (e) $\frac{4}{3}$

8.(6 pts) Evaluate $\int_C \mathbf{F} \cdot d\mathbf{r}$, where $\mathbf{F} = (y^2 \cos(xy^2) + 3x^2)\mathbf{i} + (2xy \cos(xy^2) + 2y)\mathbf{j}$ is a conservative vector field, and C is any curve from the point $(-1, 0)$ to $(1, 0)$.

(a) 0 (b) -1 (c) 2 (d) π (e) 1

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9.(6 pts) Let E be the solid region in the first octant that lies under the paraboloid $z = 4 - x^2 - y^2$. Which of the following evaluates $\iiint_E x\, dV$ in cylindrical coordinates? (The first octant contains the points (x, y, z) such that $x \geq 0$, $y \geq 0$ and $z \geq 0$.)

(a) $\displaystyle\int_0^{\frac{\pi}{2}} \int_0^4 \int_0^{4-r^2} r\cos\theta\, dz\, dr\, d\theta$

(b) $\displaystyle\int_0^{\frac{\pi}{2}} \int_0^2 \int_0^{4-r^2} r^2\cos\theta\, dz\, dr\, d\theta$

(c) $\displaystyle\int_0^{\frac{\pi}{2}} \int_0^4 \int_0^{4-r^2} r^3\sin\theta\, dz\, dr\, d\theta$

(d) $\displaystyle\int_0^{\frac{\pi}{2}} \int_0^2 \int_0^{4-r^2} r\cos\theta\, dz\, dr\, d\theta$

(e) $\displaystyle\int_0^{\frac{\pi}{2}} \int_0^4 \int_0^{4-r^2} r^2\cos\theta\, dz\, dr\, d\theta$

10.(6 pts) Let E be the solid region that lies above the cone $z = \sqrt{x^2 + y^2}$ and below the plane $z = 2$.

Which of the following evaluates $\iiint_E z\, dV$ in spherical coordinates?

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

(b) $\displaystyle\int_0^{2\pi} \int_{\frac{\pi}{4}}^{\frac{\pi}{2}} \int_0^{\frac{2}{\cos\phi}} \rho\cos\phi\, d\rho\, d\phi\, d\theta$

(c) $\displaystyle\int_0^{2\pi} \int_0^{\frac{\pi}{4}} \int_0^{\frac{2}{\cos\phi}} \rho^3\cos^2\phi\, d\rho\, d\phi\, d\theta$

(d) $\displaystyle\int_0^{2\pi} \int_0^{\frac{\pi}{4}} \int_0^{\frac{2}{\cos\phi}} \rho\cos\phi\, d\rho\, d\phi\, d\theta$

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

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Partial Credit

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

11.(12 pts.) Let $\mathbf{F} = (y^2\cos(xy) + e^x)\mathbf{i} + \big(\sin(xy) + xy\cos(xy) + \frac{1}{y}\big)\mathbf{j}$. Find a function $f(x, y)$ such that $\nabla f = \mathbf{F}$.

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12.(12 pts.) Find the mass of the solid between spheres $x^2+y^2+z^2 = 1$ and $x^2+y^2+z^2 = 4$ whose density is $\rho(x, y, z) = x^2 + y^2 + z^2$.

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13.(12 pts.) Compute $\iint_R \frac{1}{2}\, dA$ where R is the region bounded by $2x^2 + 2xy + y^2 = 8$ using the change of variables given by $x = u + v$ and $y = -2v$.

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Multiple Choice	_____
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13.	_____
Extra Points.	4
Total:	_____