Name: ____________________________

Instructor: ________________________

Math 20550, Exam 3
November 20, 2014

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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)
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5.	(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
Total	________

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Multiple Choice

1.(6 pts) Evaluate the integral $\iint_D e^{-x^2-y^2}\,dA$ by changing to the polar coordinates, where $D = \{(x,y)|x^2+y^2 \leq 1\}$.

(a) πe (b) $\pi(1-e)$ (c) $\pi(1-e^{-1})$ (d) $\pi(e-1)$ (e) $\pi(e^{-1}-1)$

2.(6 pts) Which integral is equivalent to

$$\int_0^9 \int_{\sqrt{x}}^3 \frac{4}{y^3+1}\,dydx$$

(a) $\int_0^9 \int_0^{y^2} \frac{4}{y^3+1}\,dxdy$

(b) $\int_0^9 \int_{y^2}^3 \frac{4}{y^3+1}\,dxdy$

(c) $\int_0^9 \int_0^3 \frac{4}{y^3+1}\,dxdy$

(d) $\int_0^3 \int_{y^2}^9 \frac{4}{y^3+1}\,dxdy$

(e) $\int_0^3 \int_0^{y^2} \frac{4}{y^3+1}\,dxdy$

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3.(6 pts) Evaluate $\int\int\int_E zy dV$, where

$$E = \{(x, y, z) \,|\, 0 \le x \le 2, \quad 0 \le y \le \sqrt{4 - x^2}, \quad 0 \le z \le x\}.$$

(a) $\frac{16}{15}$ (b) 4 (c) 1 (d) 2 (e) $\frac{1}{2}$

4.(6 pts) A solid E lies within the cylinder $x^2 + y^2 = 1$, below the plane $z = 4$ and above $z = 1 - x^2 - y^2$. The density at any point is equal to its distance from the z axis. Find an integral that computes the mass of E.

(a) $\int_0^{2\pi} \int_0^1 \int_4^{1-r^2} r^2 \, dz \, dr \, d\theta$

(b) $\int_0^{2\pi} \int_0^1 \int_{1-r^2}^4 r^2 \, dz \, dr \, d\theta$

(c) $\int_0^{2\pi} \int_0^1 \int_{1-r^2}^1 r^2 \, dz \, dr \, d\theta$

(d) $\int_0^{2\pi} \int_0^1 \int_{1-r^2}^4 r \, dz \, dr \, d\theta$

(e) $\int_0^{2\pi} \int_0^1 \int_{4-r^2}^1 r^2 \, dz \, dr \, d\theta$

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5.(6 pts) Let E be the region between the spheres $x^2+y^2+z^2=z$ and $x^2+y^2+z^2=2z$. Which of the following represents $\int\int\int_E (x^2+y^2)\,dV$ in spherical coordinates?

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

(b) $\int_0^{2\pi}\int_0^{\pi/2}\int_1^2 \rho^4 \sin(\phi)\,d\rho\,d\phi\,d\theta$

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

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

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

6.(6 pts) Find $\int_C 2xy^3 ds$, where C is the upper half of the circle $x^2+y^2=4$.

(a) 2π (b) 4π (c) 0 (d) 8 (e) 4

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7.(6 pts) Calculate $\int_C \mathbf{F} \cdot d\mathbf{r}$ where $\mathbf{F} = xy\mathbf{i} + y\mathbf{j}$ and C is the CLOCKWISE boundary of the region bounded by $y = x^2$, $x = 2$, and $y = 0$.

(a) $\frac{8}{3}$ (b) -2 (c) 0 (d) 4 (e) $-\frac{8}{3}$

8.(6 pts) Calculate $\int_C ydx + 4xdy$ where C is the curve $\mathbf{r}(t) = \langle t^2, t\rangle$, $0 \leq t \leq 1$.

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

(d) 4 (e) -4

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9.(6 pts) Which one of the following vector fields is conservative?

(a) $\mathbf{F} = x\mathbf{i} + x\mathbf{j}$

(b) None of these vector fields are conservative.

(c) $\mathbf{F} = \big(\sin(y) + 2x\big)\mathbf{i} + \sin(y)\mathbf{j}$

(d) $\mathbf{F} = (3x^2 + xe^{xy})\mathbf{i} + (9y^8 + ye^{xy})\mathbf{j}$

(e) $\mathbf{F} = (3x^2 + ye^{xy})\mathbf{i} + (9y^8 + xe^{xy})\mathbf{j}$

10.(6 pts) Using the Fundamental Theorem of Line Integrals, evaluate

$$\int_C \big(e^x y + x^2\big)dx + \big(e^x + \cos(y)\big)dy$$

where C is any smooth curve from $(1,0)$ to $(0,\pi)$.

(a) $\frac{2}{3}$ (b) 0 (c) π (d) $\pi - \frac{1}{3}$ (e) $-\pi$

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Partial Credit

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

11.(12 pts.) (a) Find the tangent plane to the surface defined by $\mathbf{r}(u,v) = \langle \cos u, \sin u, v \rangle$ at the point $(1,0,2)$.

(b) Using the same surface, compute the surface area of this surface over the region where (u,v) range over $0 \leq u \leq 2\pi$ and $0 \leq v \leq u$.

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12.(12 pts.) Use the transformation $x = u^2$ and $y = v^2$ to find the area of the region bounded by the curves $\sqrt{x} + \sqrt{y} = 1$, x-axis and y-axis.

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13.(12 pts.) Let C be the helix given by the equation $\mathbf{r}(t) = \langle \cos t, \sin t, 8t \rangle$, $0 \le t \le \dfrac{\pi}{3}$. Find $\int_C \mathbf{F} \cdot d\mathbf{r}$ for $\mathbf{F} = \langle x^2, -xy, 0 \rangle$.

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