This Exam contains 5 problems. The problems are worth 12 points each. Each part of a problem counts equally. On problems 3, 4 and 5 you can get partial credit. Hence explain yourself carefully on these problems.

NO CALCULATOR.
2 TWO-SIDED 3in. BY 5in. NOTECARD OK.
CHECK YOUR SECTION IN THE TABLE

<table>
<thead>
<tr>
<th>Section</th>
<th>Time</th>
<th>Exam rm.</th>
<th>Professor</th>
<th>GSI</th>
<th>MY SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>8-9</td>
<td>Aud NS</td>
<td>Fornaess</td>
<td>Li</td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>9-10</td>
<td>Aud NS</td>
<td>Fornaess</td>
<td>Ahn</td>
<td></td>
</tr>
<tr>
<td>40</td>
<td>10-11</td>
<td>1800 Chem</td>
<td>D’Souza</td>
<td>Chung</td>
<td></td>
</tr>
<tr>
<td>50</td>
<td>11-12</td>
<td>1800 Chem</td>
<td>D’Souza</td>
<td>Bosler</td>
<td></td>
</tr>
<tr>
<td>60</td>
<td>12-1</td>
<td>1210 Chem</td>
<td>D’Souza</td>
<td>Henry</td>
<td></td>
</tr>
<tr>
<td>70</td>
<td>1-2</td>
<td>170 Denn</td>
<td>Ruan</td>
<td>Fleming</td>
<td></td>
</tr>
<tr>
<td>80</td>
<td>2-3</td>
<td>182 Denn</td>
<td>Ruan</td>
<td>da Cunha</td>
<td></td>
</tr>
<tr>
<td>90</td>
<td>3-4</td>
<td>1400 Chem</td>
<td>DeLand</td>
<td>Kneezel</td>
<td></td>
</tr>
</tbody>
</table>
SCORING PAGE.

<table>
<thead>
<tr>
<th>Problem</th>
<th>Points</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td>60</td>
<td></td>
</tr>
</tbody>
</table>
Problem 1. TRUE FALSE QUESTIONS. NO PARTIAL CREDIT. 
CIRCLE TRUE OR FALSE. IF YOU THINK A QUESTION DOESN’T MAKE SENSE, CIRCLE FALSE 
(a) \[ \int \frac{1}{1-x^2} \, dx = \arctan(-x) + C \] TRUE/FALSE 
(b) \[ \int \cos(\cos x) \, dx = -\frac{\sin(\cos x)}{\sin x} + C \] TRUE/FALSE 
(c) The double integral of the function \( f(x,y) = x^2 - y \) over the triangle with corners \( (0,0), (1,0), (0,1) \) is equal to \[ \int_0^1 \int_0^1 (-y + x^2) \, dy \, dx \] TRUE/FALSE 
(d) Suppose that \( \vec{F} \) and \( \vec{G} \) are conservative vector fields on \( \mathbb{R}^3 \). Then \( \vec{F} + \vec{G} \) is also conservative. TRUE/FALSE 
(e) The integral of the function \( f(x,y) = x^2y^2 \) over the disc \( x^2 + y^2 \leq 1 \) is equal to \[ 4 \int_0^{\sqrt{1-x^2}} \int_0^1 x^2y^2 \, dx \, dy \] TRUE/FALSE 
(f) The area of the disc \( x^2 + y^2 \leq 1 \) is equal to \( \int_C y \, dx + 2x \, dy \) where \( C \) is the circle \( x^2 + y^2 = 1 \) counterclockwise. TRUE/FALSE 
WORKSPACE:
Problem 2. NO PARTIAL CREDIT

(a) The point \((x, y) = (-2, 2)\) Find the corresponding coordinates \((r, \theta)\).

(b) The point \((r, \theta) = (2, -2\pi/3)\). Find \((x, y)\).

(c) The point \((\rho, \theta, \phi) = (2, \pi/4, \pi/3)\). Find the corresponding coordinates \((x, y, z)\).

(d) The point \((x, y, z) = (0, 2\sqrt{3}, 2))\). Find the corresponding coordinates \((\rho, \theta, \phi)\).

(e) The point \((r, \theta, z) = (2, 2\pi/3, 1)\). Find \((x, y, z)\).

(f) \((x, y, z) = (3, -3, -7)\). Find \((r, \theta, z)\).

ANSWERS:

a: 

b: 

c: 

d: 

e: 

f: 

WORKSPACE:
Problem 3. YOU CAN MAKE 0, 2 OR 4 POINTS ON EACH PART. 2 POINTS WILL ONLY BE AWARDED IN CASE OF A SMALL MISTAKE. THE THREE PARTS OF THE PROBLEM ARE UNRELATED

(a) Evaluate \( \int \int_D dxdy \)
where \( D \) is the region bounded by \( x = y \) and \( x = y^2 - 2 \).

(b) Evaluate \( \int \int_D \sin(x^2 + y^2)dA \)
where \( D \) is the region between the two circles \( x^2 + y^2 = 1 \) and \( x^2 + y^2 = 4 \).

(c) Evaluate \( \int \int \int_E x(y^2 + z^2)dV \)
where \( E \) is the region bounded by the cylinder \( y^2 + z^2 = 1 \) and the planes \( x = 1, x = 2 \).

ANSWERS:
a: 
b: 
c: 

WORKSPACE:
Problem 4. IF YOUR ANSWER IS CORRECT YOU GET FULL SCORE. IF ANSWER IS WRONG YOU CAN GET PARTIAL CREDIT IF YOU EXPLAIN YOURSELF CAREFULLY

(a) Evaluate \[ \int \int \int_E (x^2 + y^2 + z^2)^5 \, dV \]
where \( E \) is the ball with center the origin and radius 2.

(b) Find the volume of the solid that lies above the cone \( z = \sqrt{x^2 + y^2} \) and below the sphere centered at the origin with radius 3.

(c) Find the gradient vector field of the function \( f(x,y,z) = xe^{xyz} \).

(d) Evaluate the line integral \( \int_C \vec{F} \cdot d\vec{r} \) where \( \vec{F} = \langle x, z, y^2 \rangle \) and \( \vec{r}(t) = \langle \sin t, t, t^3 \rangle, 0 \leq t \leq \pi/4 \).

ANSWERS:
a: 

b: 

c: 

d: 

WORKSPACE:
Problem 5. IF YOUR ANSWER IS CORRECT YOU GET FULL SCORE. IF YOUR ANSWER IS WRONG YOU CAN GET PARTIAL CREDIT IF YOU EXPLAIN YOURSELF CAREFULLY

(a) Find the integral \( \int_C (2x + y)dx + (x + 2y)dy \) where \( C \) is the curve \( \vec{r}(t) = \langle \cos^3(t), e^{\sin(t)} \rangle \) with \( 0 \leq t \leq \pi \). [Hint: Write the integral as \( \int_C \vec{F} \cdot d\vec{r} \) and find \( f \) so that \( \nabla f = \vec{F} \).]

(b) Find \( \int_C (2y - e^{\arctan(x)})dx + (e^3 + \cos(sin(y)))dy \) where \( C \) is the boundary of the square \( 0 \leq x \leq 1, 0 \leq y \leq 1 \).

ANSWERS:

a:

b:

WORKSPACE: