This review is **not** intended to be exhaustive! It only includes a few problems that I think are interesting or highlight a topic I wish to emphasize. There may be topics/problems on the exam which are not covered here. I strongly advise you to also review the previous year's exam, as well as our homework and quiz solutions. Good luck!

1. Let R be the region $R = \{(x, y) \mid 1 \leq x^2 + y^2 \leq 4,\ 0 \leq y \leq x\}$. Evaluate the double integral

$$\iint_R \arctan(y/x)\, dA.$$

2. Evaluate the integral $\iiint_E x\, dV$ where E is the solid region bounded $z = x^2 + y^2$ and $z = 1$.

3. [6 pts] Express the triple integral using cylindrical coordinates:

$$\int_0^1 \int_0^{\sqrt{1-z^2}} \int_z^{\sqrt{1-y^2}} x^2 y dx dy dz$$

4. Let V be the portion of the ball $x^2+y^2+z^2 \le 1$ between the planes $z=0$ and $z=-1/2$. Compute the volume of V.

5. Consider the double integral

$$\mathbf{I} = \int_1^2 \int_{1/y}^{y} (x^2+y^2)\,dx\,dy + \int_2^4 \int_{y/4}^{4/y} (x^2+y^2)\,dx\,dy$$

(a) [4 pts] Define $\mathbf{T}$ to be the transformation

$$\mathbf{T} = \begin{cases} x = \dfrac{u}{v} \\ y = uv \end{cases}$$

Sketch the region of integration R in the xy-plane. Also, sketch the region of integration S in the uv-plane which maps onto the region R under the transformation $\mathbf{T}$.

(b) [3 pts] Compute the Jacobian of the transformation $\mathbf{T}$.

(c) [4 pts] Set up, but do **not** evaluate, an expression for $\mathbf{I}$ as an iterated integral in terms of the variables u and v.

 Points earned: ______
out of a possible 11 points

6. Compute the work done by the vector field

$$\mathbf{F}(x, y, z) = \langle x, \sin(\sin y), \cos(\cos z)\rangle$$

along the curve parametrized by $\mathbf{r}(t) = \langle t, \sin t, \sin t\rangle$ as $0 \leq t \leq \pi$.

7. Consider the curve $C = \{\sqrt{x} + \sqrt{y} = 1\}$ starting at $(0, 1)$ and ending at $(1, 0)$. Evaluate

$$\int_C y dx - x dy.$$

8. Let D be the region

$$D = \{(x, y) \mid 1 \leq x^2 + y^2, \quad x^2 + 4y^2 \leq 16\}$$

Sketch the region D. State how Green's theorem applies to the region D.

9. Let D be the square with vertices $(0,1)$, $(1,0)$, $(0,-1)$, and $(-1,0)$. Evaluate

$$I = \iint_D e^{x+y}(x-y)^{2022} dA.$$

10. Find the area of the part of the surface $z = xy$ that lies within the cylinder $x^2 + y^2 = 1$.

11. Evaluate $\displaystyle\int_C y^3 dx - x^3 dy$ where C is the circle $x^2 + y^2 = 4$ oriented *clockwise*.