1.(1 pt) Evaluate $\int\int_S \sqrt{1+x^2+y^2}\,dS$ where S is the helicoid: $\mathbf{r}(u,v) = u\cos(v)\mathbf{i} + u\sin(v)\mathbf{j} + v\mathbf{k}$, with $0 \le u \le 3, 0 \le v \le 1\pi$

2.(1 pt) Find the surface area of the part of the sphere $x^2+y^2+z^2 = 25$ that lies above the cone $z = \sqrt{x^2+y^2}$

3.(1 pt) A fluid has density 3 and velocity field $\mathbf{v} = -y\mathbf{i} + x\mathbf{j} + 1z\mathbf{k}$.
Find the rate of flow outward through the sphere $x^2+y^2+z^2 = 9$

4.(1 pt) Let S be the part of the plane $2x+1y+z=4$ which lies in the first octant, oriented upward. Find the flux of the vector field $\mathbf{F} = 2\mathbf{i} + 2\mathbf{j} + 3\mathbf{k}$ across the surface S.

5.(1 pt) Use Gauss's law to find the charge enclosed by the cube with vertices $(\pm1,\pm1,\pm1)$ if the electric field is $\mathbf{E}(x,y,z) = 2x\mathbf{i} + 5y\mathbf{j} + 1z\mathbf{k}$.

______ ε_0

6.(1 pt) The temperature u in a star of conductivity 3 is inversely proportional to the distance from the center: $u = \frac{1}{\sqrt{x^2+y^2+z^2}}$.
If the star is a sphere of radius 1, find the rate of heat flow outward across the surface of the star.

7.(1 pt) Use Stoke's theorem to evaluate $\int\int_S curl\mathbf{F}\cdot d\mathbf{S}$ where $\mathbf{F}(x,y,z) = -12yz\mathbf{i} + 12xz\mathbf{j} + 12(x^2+y^2)z\mathbf{k}$ and S is the part of the paraboloid $z = x^2+y^2$ that lies inside the cylinder $x^2+y^2=1$, oriented upward.

8.(1 pt) Use Stoke's Theorem to evaluate $\int_C \mathbf{F}\cdot d\mathbf{r}$ where $\mathbf{F}(x,y,z) = x\mathbf{i} + y\mathbf{j} + 1(x^2+y^2)\mathbf{k}$ and C is the boundary of the part of the paraboloid where $z = 1-x^2-y^2$ which lies above the xy-plane and C is oriented counterclockwise when viewed from above.

9.(1 pt) Use the divergence theorem to find the outward flux of the vector field $\mathbf{F}(x,y,z) = 3x^2\mathbf{i} + 5y^2\mathbf{j} + 1z^2\mathbf{k}$ across the boundary of the rectangular prism: $0 \le x \le 2, 0 \le y \le 2, 0 \le z \le 1$.

10.(1 pt) If a parametric surface given by $\mathbf{r_1}(u,v) = f(u,v)\mathbf{i} + g(u,v)\mathbf{j} + h(u,v)\mathbf{k}$ and $-4 \le u \le 4, -2 \le v \le 2$, has surface area equal to 3, what is the surface area of the parametric surface given by $\mathbf{r_2}(u,v) = 2\mathbf{r_1}(u,v)$ with $-4 \le u \le 4, -2 \le v \le 2$?

11.(1 pt) Suppose $\mathbf{F}$ is a radial force field, S_1 is a sphere of radius 7 centered at the origin, and the flux integral $\int\int_{S_1} \mathbf{F}\cdot dS = 4$.
Let S_2 be a sphere of radius 49 centered at the origin, and consider the flux integral $\int\int_{S_2} \mathbf{F}\cdot dS$.

(A) If the magnitude of $\mathbf{F}$ is inversely proportional to the square of the distance from the origin,what is the value of $\int\int_{S_2} \mathbf{F}\cdot dS$?

(B) If the magnitude of $\mathbf{F}$ is inversely proportional to the cube of the distance from the origin, what is the value of $\int\int_{S_2} \mathbf{F}\cdot dS$?

12.(1 pt)
In springtime, the average value over time of the divergence of the vector field which represents air flow is:

- A. zero
- B. positive
- C. negative