# Classroom Voting Questions: Multivariable Calculus

## 20.2 The Divergence Theorem

1. Given a small cube resting on the $xy$ plane with corners at $(0,0,0)$, $(a,0,0)$, $(a,a,0)$, and $(0,a,0)$, which vector field will produce positive flux through that cube?

   (a) $\vec{F} = 3\hat{i}$
   (b) $\vec{F} = x\hat{i} - y\hat{j}$
   (c) $\vec{F} = 2\hat{i} + 3\hat{j} + \hat{k}$
   (d) $\vec{F} = z\hat{k}$

2. Let $\vec{F} = (5x+7y)\hat{i} + (7y+9z)\hat{j} + (9z+11x)\hat{k}$. This vector field produces the largest flux through which of the following surfaces?

   (a) $S_1$, a sphere of radius 2 centered at the origin.
   (b) $S_2$, a cube of side 2 centered at the origin, with sides parallel to the axes.
   (c) $S_3$, a sphere of radius 1 centered at the origin.
   (d) $S_4$, a pyramid contained inside $S_3$.

3. True or False? The vector field $\vec{F}$ is defined everywhere in a region $W$ bounded by a surface $S$. If $\nabla \cdot \vec{F} > 0$ at all points of $W$, then the vector field $\vec{F}$ points outward at all points of $S$.

   (a) True, and I am very confident
   (b) True, but I am not very confident
   (c) False, but I am not very confident
   (d) False, and I am very confident

4. True or False? The vector field $\vec{F}$ is defined everywhere in a region $W$ bounded by a surface $S$. If $\nabla \cdot \vec{F} > 0$ at all points of $W$, then the vector field $\vec{F}$ points outward at some points of $S$.

   (a) True, and I am very confident
   (b) True, but I am not very confident

(c) False, but I am not very confident

(d) False, and I am very confident

5. True or False? The vector field $\vec{F}$ is defined everywhere in a region $W$ bounded by a surface $S$. If $\int_S \vec{F} \cdot d\vec{A} > 0$, then $\nabla \cdot \vec{F} > 0$ at some points of $W$.

   (a) True, and I am very confident

   (b) True, but I am not very confident

   (c) False, but I am not very confident

   (d) False, and I am very confident

6. Which of the following vector fields produces the largest flux out of the unit sphere centered at the origin?

   (a) $\vec{F_1} = (e^z + x^3)\hat{i} + e^x\hat{j} + y^3\hat{k}$

   (b) $\vec{F_2} = (z^2 + \cos y)\hat{i} - y^3\hat{j} + x^3y^3\hat{k}$

   (c) $\vec{F_3} = z^2\hat{i} - (x^2 + z^2)\hat{j} + (z^3 + zy^2)\hat{k}$

   (d) $\vec{F_4} = (x^4 - y^4)\hat{i} - (z^4 - 2x^3y)\hat{j} + (y^4 - 2x^3z)\hat{k}$