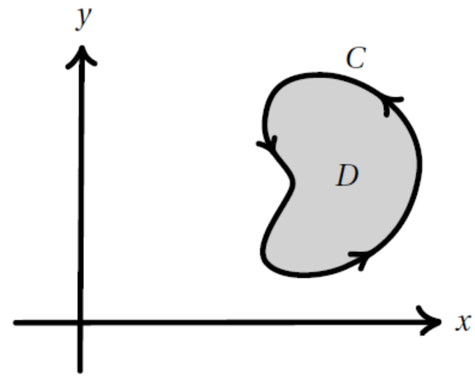
Question 1

. Consider the region D in the plane bounded by the curve C as shown at right. For each part, circle the best answer. **(1 point each)**



(a) For $\mathbf{F}(x, y) = \langle x+1, y^2 \rangle$, the integral $\int_C \mathbf{F} \cdot d\mathbf{r}$ is

negative	zero	positive

(b) The integral $\int_C (-y\,dx + 2\,dy)$ is

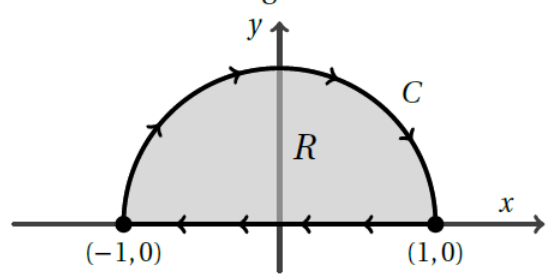
negative	zero	positive

(c) The integral $\iint_D (y - x)\,dA$ is

negative	zero	positive

Question 2

Let $\mathbf{F}(x, y) = \left\langle x-1,\ \cos y + 2x - e^{y^2} \right\rangle$. Let R denote the solid semi-disk shown below right. Let C denote the boundary of the region R.



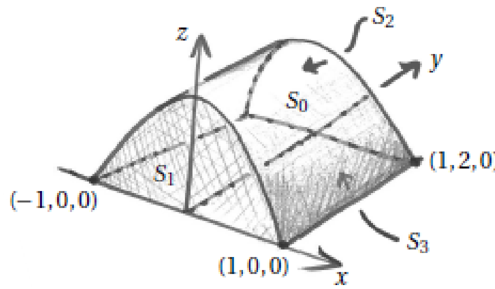
(a) Use Green's Theorem to evaluate $\int_C \mathbf{F} \cdot d\mathbf{r}$ where C has the orientation shown. **(3 points)**

$\int_C \mathbf{F} \cdot d\mathbf{r} =$

(b) Let D denote the part of the curve C above consisting *only* of the semicircle (*not* the line segment) with the orientation shown. Compute $\int_D \mathbf{F} \cdot d\mathbf{r}$. **(3 points)**

Question 3

. Let E be the solid region shown below, where ∂E is decomposed into the four subsurfaces S_i indicated; here the top S_0 is where $z + x^2 = 1$, the front S_1 is in the xz-plane, the back is S_2, and the bottom is S_3.



(a) Give a parameterization of S_0 and use it to directly compute the flux of $\mathbf{F} = \langle 1,\ 0,\ z+2 \rangle$ through S_0 with respect to the upwards normals. **(5 points)**

$\iint_{S_0} \mathbf{F} \cdot d\mathbf{S} =$

(b) The flux of F through exactly two of S_1, S_2, and S_3 is zero. Circle the one where the flux is **nonzero**:

S_1 S_2 S_3 **(1 point)**

Question 4

Let S be the surface in $\mathbb{R}^3$ which is the boundary of the solid cube $D = \{-1 \le x \le 1, -1 \le y \le 1, -1 \le z \le 1\}$. For $\mathbf{F}(x, y, z) = \langle yz^2 + e^z + x,\ ze^z + x + y,\ xe^x + xy + z\rangle$, compute $\iint_S \mathbf{F}\cdot\mathbf{n}\ dS$ by any valid method, where $\mathbf{n}$ is the outward-pointing unit normal vector field. **(4 points)**

$\iint_S \mathbf{F}\cdot\mathbf{n}\ dS =$

Question 5

Consider the vector field $\mathbf{F} = \langle -y,\ x + z,\ x^2 + z\rangle$ on $\mathbb{R}^3$.

(a) Circle the curl of $\mathbf{F}$: **(2 points)**

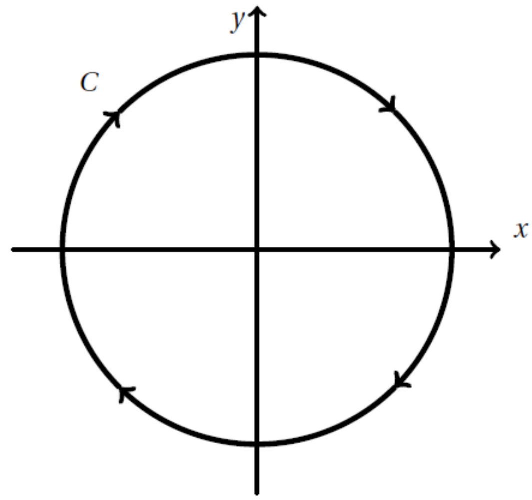
curl $\mathbf{F}$ = $\langle z, -y, x\rangle$ $\langle -1, 2x, 2\rangle$ $\langle 0, 1, 2x\rangle$ $\langle -1, -2x, 2\rangle$ $\langle -y, 2x, 2z\rangle$

(b) Suppose C is a closed curve in the plane P given by $x - z = 1$. Assuming C bounds a region R of area 10 in P, determine the absolute value of $\int_C \mathbf{F}\cdot d\mathbf{r}$. **(4 points)**

$\left|\int_C \mathbf{F}\cdot d\mathbf{r}\right| =$

Question 6

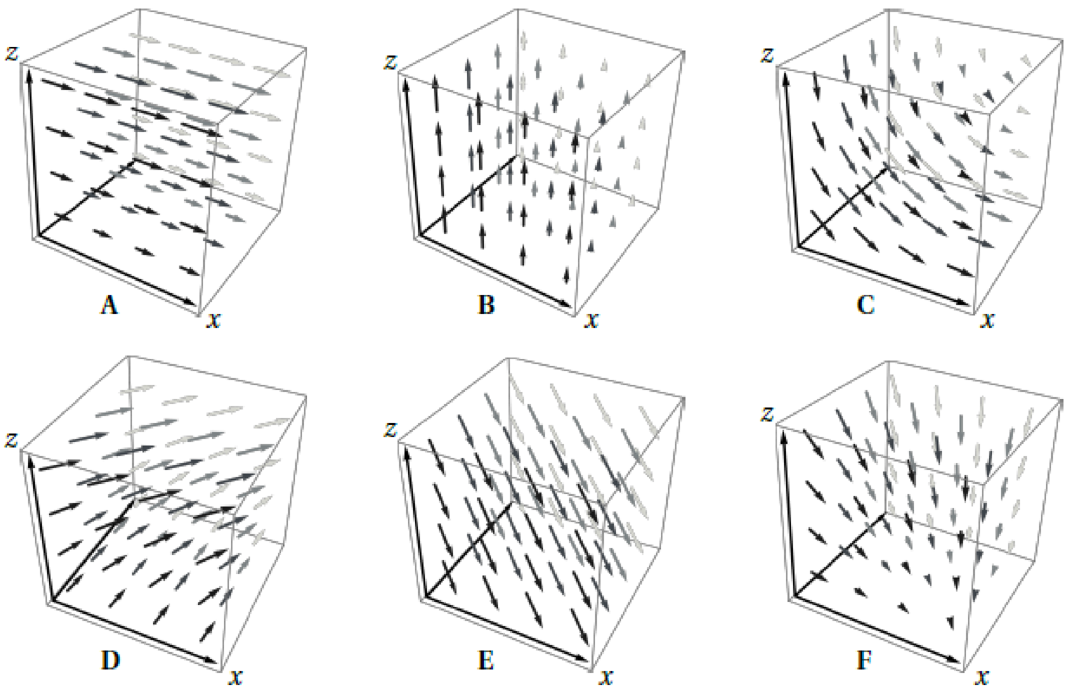
Let C be the circle of radius 1 centered at the origin and oriented as shown below right. Evaluate $\int_C \mathbf{F} \cdot d\mathbf{r}$ where $\mathbf{F}(x, y) = \left(e^x y^2 - x^2 y, 2e^x y + x y^2\right)$ by any valid method. **(3 points)**



$\int_C \mathbf{F} \cdot d\mathbf{r} =$

Question 7

Here are plots of six vector fields on the box where $0 \leq x \leq 1$, $0 \leq y \leq 1$, and $0 \leq z \leq 1$. For each part, circle the best answer. (**1 point each**)



(a) The vector field given by $\langle z, 1, 0 \rangle$ is: **A B C D E F**

(b) Exactly one of these vector fields has nonzero divergence. It is: **A B C D E F**

For this vector field, the divergence is generally: negative positive

(c) The vector field **A** is conservative: true false

(d) Exactly one of the vector fields is constant, that is, independent of position. It is: **A B C D E F**

(e) The vector field curl **C** is constant. The value of curl **C** is:

$\mathbf{i}$ $-\mathbf{i}$ $\mathbf{j}$ $-\mathbf{j}$ $\mathbf{k}$ $-\mathbf{k}$ $\mathbf{0}$