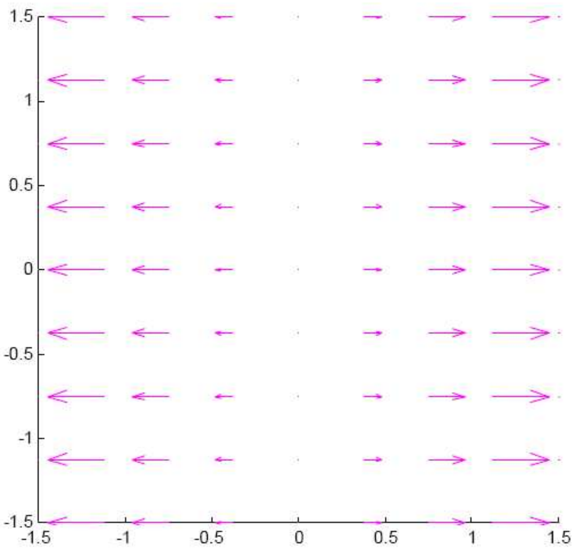
# Classroom Voting Questions: Multivariable Calculus

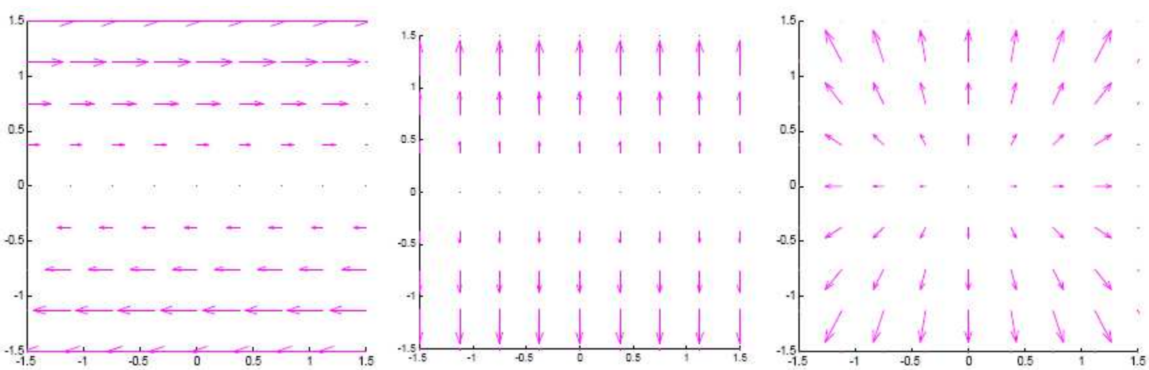
## 18.3 Gradient Fields and Path-Independent Fields

1. The vector field shown is the gradient vector field of $f(x, y)$. Which of the following are equal to $f(1, 1)$?




   (a) $f(1, -1)$
   (b) $f(-1, 1)$
   (c) both of the above
   (d) none of the above

2. Which of the vector fields below is not path independent?

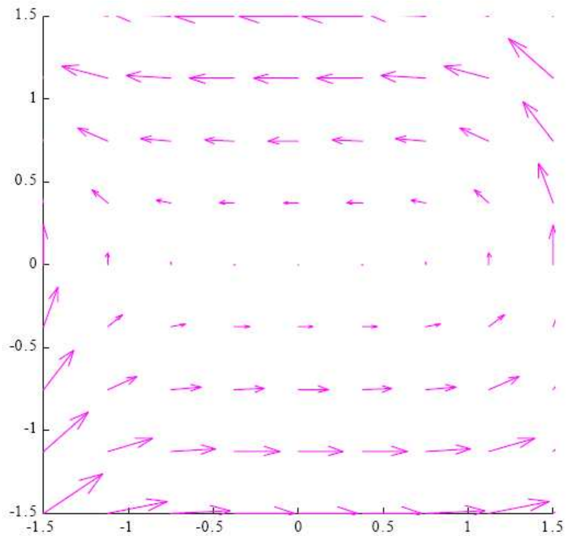


   (a) the one on the left

(b) the one in the middle

(c) the one on the right

3. Which of the following explains why this vector field is not a gradient vector field?



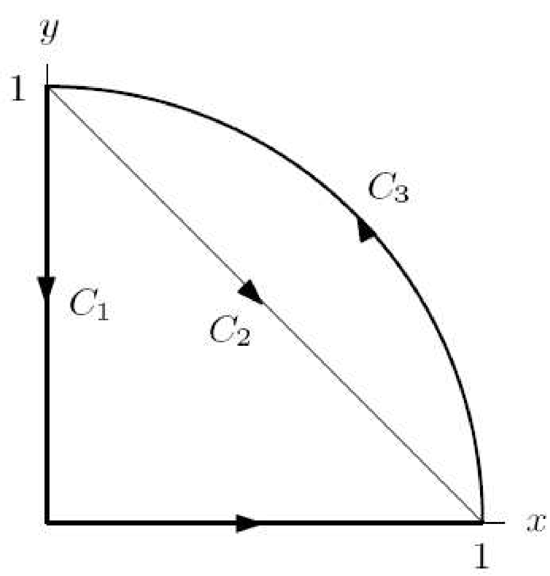

(a) The line integral from (-1,1) to (1,1) is negative.

(b) The circulation around a circle centered at the origin is zero.

(c) The circulation around a circle centered at the origin is not zero.

(d) None of the above.

4. The line integral of $\vec{F} = \nabla f$ along one of the paths shown below is different from the integral along the other two. Which is the odd one out?

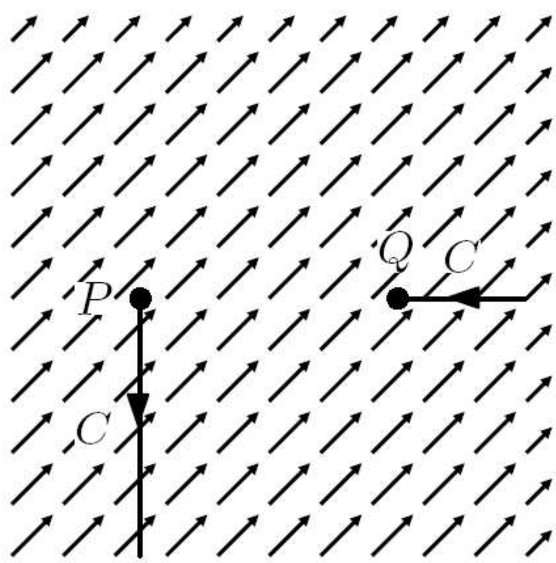


(a) $C_1$

(b) $C_2$

(c) $C_3$

5. The figure below shows the vector field $\nabla f$, where $f$ is continuously differentiable in the whole plane. The two ends of an oriented curve $C$ from $P$ to $Q$ are shown, but the middle portion of the path is outside the viewing window. The line integral $\int_C \nabla f \cdot d\vec{r}$ is




(a) Positive

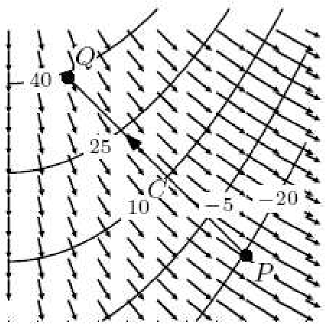
(b) Negative

(c) Zero

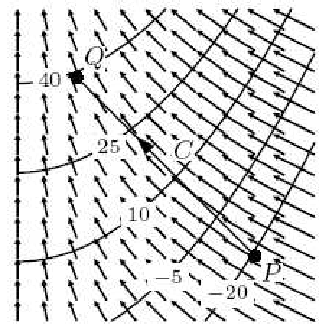
(d) Can't tell without further information

6. Which of the diagrams contain all three of the following: a contour diagram of a function $f$, the vector field $\nabla f$ of the same function, and an oriented path $C$ from $P$ to $Q$ with $\int_C \nabla F \cdot d\vec{r} = 60$?

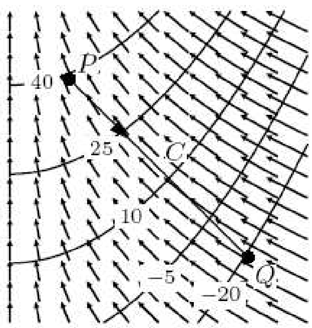
(I)



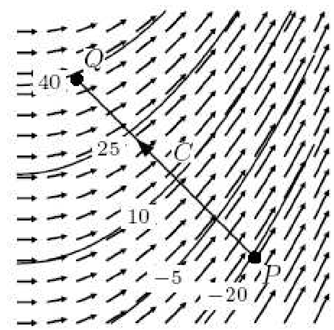

(II)




(III)




(IV)




(a) I
(b) II
(c) III
(d) IV

7. If $f$ is a smooth function of two variables that is positive everywhere and $\vec{F} = \nabla f$, which of the following can you conclude about $\int_C \vec{F} \cdot d\vec{r}$?

(a) It is positive for all smooth paths $C$.
(b) It is zero for all smooth paths $C$.
(c) It is positive for all closed smooth paths $C$.
(d) It is zero for all closed smooth paths $C$.

8. What is the potential function for the vector field $\vec{F} = 2y\hat{i} + 2x\hat{j}$?

(a) $f(x,y) = 4xy$
(b) $f(x,y) = 2x^2 + 2y^2$
(c) $f(x,y) = 2xy$
(d) This is not a conservative vector field.