

Q1.

Find the separation vector  $\mathbf{r}$  from the source point (2, 9, -7) to the field point (-4, 5, 6). Determine its magnitude ( $r$ ), and construct the unit vector  $\hat{\mathbf{r}}$ .

Q 2.

- A. Find the gradient of  $T(x, y) = \sin(x) \cos(y)$ .
- B. Use Mathematica to plot the contours of  $T(x, y)$  in the range  $-2 \leq x \leq 2$  and  $-2 \leq y \leq 2$ . Label the x-axis and the y-axis.
- C. Pick three points on different contours and draw the gradient of T at these points.
- D. Is the gradient perpendicular to the contours and pointing towards the steepest ascent of  $T(x, y)$ ?

Q3.

- A. Find the curl of  $\vec{v}(x, y) = \sin(y) \hat{x} + \sin(x) \hat{y}$ .
- B. Use Mathematica to plot a vector plot of  $\vec{v}(x, y)$  in the range  $-2 \leq x \leq 2$  and  $-2 \leq y \leq 2$ . Label the x-axis and the y-axis.
- C. Pick three points such that their curl is negative, zero, and positive, respectively. Mark the points in your vector plot and find their curl.
- D. What can you say about your calculations and the rotation of the vector  $\vec{v}$  around the point you picked?