
Question 1. (10 marks)

Important: marks will only be awarded for fully worked solutions, showing all steps.

- (a) Use Stokes theorem to evaluate

$$\iint_S \nabla \times \mathbf{F} \cdot d\mathbf{S} ,$$

where

$$\mathbf{F} = y(z+1)\hat{\mathbf{i}} - x\hat{\mathbf{j}} + z^3\hat{\mathbf{k}} ,$$

and S is the half-ellipsoid $x^2 + y^2 + 2z^2 = 9$, with $z \geq 0$, oriented upward.

(8 marks)

- (b) What would be the value of this integral if S is instead the *downward-oriented* hemisphere $x^2 + y^2 + z^2 = 9$, with $z \leq 0$?

(2 marks)
