**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

$$\mathbf{F} = y(z+1)\hat{\mathbf{i}} - yz\hat{\mathbf{j}} + xz\hat{\mathbf{k}} \, ,$$

and $S$ is the hemisphere

$$(x-1)^2 + y^2 + z^2 = 9,$$

with

$$z \geq 0,$$

oriented upward.

(8 marks)

(b) What would be the value of this integral if $S$ is instead the upward-oriented circular disc given by

$$(x-1)^2 + y^2 \leq 9,$$

lying in the plane $z = 0$?

(2 marks)