(a) Verify that

$$\mathbf{F} = (3x^2 - 3yz + 2xz)\mathbf{i} + (3y^2 - 3xz + z^2)\mathbf{j} + (3z^2 - 3xy + x^2 + 2yz)\mathbf{k}$$

represents a conservative field of force. Find a scalar $\phi$ such that $\mathbf{F} = grad\phi$.
Evaluate

$$\oint_C \mathbf{F}.dr$$

where $C$ is any path joining $(1, -2, 3)$ to $(3, 2, -1)$.

(b) Verify Green's theorem in the plane for the integral

$$\oint_C (3x^2 - 8y^2)dx + (4y - 6xy)dy$$

where $C$ is the boundary of the region bounded by $x = 0, y = 0$ and $x + y = 1$.