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1. Express the plane vector
$$\boldsymbol{A} = y\boldsymbol{i} - 2x\boldsymbol{j}$$
in polar coordinates, using the polar basis vectors.

2. Determine $\boldsymbol{A}\cdot\nabla\phi$ and $\boldsymbol{A}\times\nabla\phi$ in location (1,0,1), with scalar function $\phi(x, y, z) = 2z - xy$ and vector $\boldsymbol{A} = x\boldsymbol{i} + yz\boldsymbol{j} + \boldsymbol{k}$.

3. Let us consider functions
$$\begin{aligned} F(x, y, z) &= x^2 z + e^{y/x} \\ G(x, y, z) &= 2z^2 y - xy^2. \end{aligned}$$
What are $\nabla(F + G)$ and $\nabla(FG)$ in coordinate point $(1, 0, -2)$?

4. We know that the gradient of the function ϕ is
$$\nabla\phi = 2xyz^3\boldsymbol{i} + x^2z^3\boldsymbol{j} + 3x^2yz^2\boldsymbol{k}$$
and that $\phi(1, -2, 2) = 4$. What is the function ϕ?

5. Determine the derivative of the function $P = 4e^{2x-y+z}$ along the direction of the vector $-3\boldsymbol{i} + 5\boldsymbol{j} + 6\boldsymbol{k}$ in coordinate point $(1, 1, -1)$.