Exercise 1
Use Chain Rule to express $\frac{\partial z}{\partial r}$ and $\frac{\partial z}{\partial \theta}$ as functions of $r$ and $\theta$ in the following cases:
(i) $z = xe^y$, $x = r\cos\theta$, $y = r\sin\theta$;
(ii) $z = \frac{x}{y}$, $x = r\cos\theta$, $y = r\sin\theta$;
(iii) $z = x^2 + y^2 + u^2$, $x = r\cos\theta$, $y = r\sin\theta$, $u = r$.

Exercise 2
Find the gradient of the function:
(i) $f(x, y) = x + y^2$;
(ii) $f(x, y) = e^{x-y}$;
(ii) $f(x, y, z) = x(\cos y + \sin z)$;

Exercise 3
Find the derivative of the function $f$ at the point $P_0$ in the direction of the vector $a$ (i.e. in the direction of the corresponding unit vector $u$):
(i) $f(x, y) = x + y$, $P_0(1, 0)$, $a = (1, -1)$;
(ii) $f(x, y) = x^2 + y^2$, $P_0(-1, 1)$, $a = (-1, 2)$;
(iii) $f(x, y, z) = 2e^x\cos(yz)$, $P_0(0, 0, 0)$, $a = (1, -1, 1)$. 