1. Let
$$g(r, s, t) = e^r \sin(st).$$

Compute the third partial derivative g_{rst}.

Solution: We compute

$$g_r = e^r \sin(st),$$
$$g_{rs} = te^r \cos(st),$$
$$g_{rst} = e^r \cos(st) - ste^r \sin(st).$$

2. Let

$$z = x^2 y + 3xy^4, \qquad\qquad x = \sin 2t, \qquad\qquad y = \cos t.$$

Compute $\frac{dz}{dt}$ when $t = 0$.

Solution: We compute using the chain rule that

$$\frac{dz}{dt} = \frac{\partial z}{\partial x}\frac{dx}{dt} + \frac{\partial z}{\partial y}\frac{dy}{dt}$$
$$= (2xy + 3y^4)(2\cos 2t) + (x^2 + 12xy^3)(-\sin t).$$

Next, when $t = 0$, we compute that $x = 0$ and $y = 1$. Plugging these values in, we find that

$$\frac{dz}{dt} = (3)(2) + (0)(0) = 6.$$