Differentiation – Related Rates of Change

1 The sides of a square are increasing at a constant rate of $0.1\,\text{cm}\,\text{s}^{-1}$. Find the rate at which the area of the square is increasing when each side of the square is of length 10 cm.

2 A circular oil-slick is increasing in area at a constant rate of $3\,\text{m}^2\,\text{s}^{-1}$. Find the rate of increase of the radius of the slick at the instant when the area is $1200\,\text{m}^2$.

3 You are told that $A = 14x^2$ and that x is increasing at $0.5\,\text{cm}\,\text{s}^{-1}$. Find the rate of change of A at the instant when $x = 8$ cm.

4 Each edge of a contracting cube is decreasing at a rate of $0.06\,\text{cm}\,\text{s}^{-1}$. Find the rate of decrease of (a) the volume (b) the outer surface area of the cube when the edges of the cube are each 4 cm.

5 The volume of an expanding sphere is increasing at a rate of $24\,\text{cm}^3\,\text{s}^{-1}$. Find the rate of increase of (a) the radius (b) the surface area when the radius of the sphere is 20 cm.

6 Given that $y = (3t-1)^2$ and $t = 4x^{\frac{1}{4}}$, find the value of $\frac{dy}{dx}$ when $x = 81$.

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When the depth of liquid in a container is x cm, the volume of liquid is $x(x^2 + 25)\,\text{cm}^3$. Liquid is added to the container at a constant rate of $2\,\text{cm}^3\,\text{s}^{-1}$. Find the rate of change of the depth of liquid at the instant when $x = 11$.