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1. The Power P dissipated in a resistor is given as in equation (1)

$P = \frac{E^2}{R}$

if E = 200 volts and R = 8 Ohms. Find the change in p resulting from drop of 5 volts in E and increase of 0.2 ohm in R

Soln

$P = E^2/R \quad \ldots (1)$

$dp = \frac{dP}{dE} dE + \frac{dP}{dR} dR \quad \ldots (2)$

$\frac{dP}{dE} = \frac{2E}{R} \quad \ldots (3)$

$dE = -5\text{volts} = \frac{-5}{200} \times 100\% = -2.5\% \text{ of } E = \frac{+2.5E}{100} \quad (4)$

$\frac{dP}{dR} = \frac{-E^2}{R^2} \quad \ldots (5)$

$dR = +0.2\text{ohms} = \frac{0.2}{8} \times 100\% = 2.5\% \text{ of } R = \frac{+2.5R}{100} \quad \ldots (6)$

Subitituting eqn (3), (4), (5) and (6) into Eqn (2)

Equation (2) becomes

$dp = \frac{2E}{R}\left(\frac{-2.5E}{100}\right) + \left(\frac{-E^2}{R}\right)\left(\frac{+2.5R}{100}\right)$

$dp = \frac{E^2}{R}\left(\frac{-2.5 \times 2}{100} - \frac{2.5}{100}\right)$

$dp = \frac{E^2}{R}\left(\frac{-5-2.5}{100}\right) = \frac{E^2}{R}\left(\frac{-7.5}{100}\right)$

But $P = E^2/R$

$\therefore dP = \frac{-7.5}{100} P$

However $E = 200$ Volts

$R = 8$ ohms

$\therefore$ The actual change in P with respect to 5volts drop is

E and an Increase of 0.2ohms in R is

$$dP = \frac{-7.5}{100} P = \frac{-7.5}{100} \times \frac{E^2}{R}$$

$$dP = \frac{-7.5}{100} \times \frac{200^2}{8} = -375 \text{ watts}$$

There was a a 375 watt decreased in the Power P disipated by the resistor.

2. The deflection y at the center of a circular plate suspended at the edge and Uniformly loaded is given in Equation (2)

$$y = \frac{kwd^4}{t^3}$$

Where w = total load d = diameter of plate, t = thickness and k is a constant

Caculate the approximate percentage change in y if w is Increased by 4 per cent

$$y = \frac{kwd^4}{t^3} \quad \ldots (2)$$

Recall

$$dy = \frac{dy}{dw} dw + \frac{dy}{dd} dd + \frac{dy}{dt} dt \quad \ldots (6)$$

$$\frac{\delta y}{\delta w} = \frac{kd^4}{t^3}(1) = \frac{kd^4}{t^3} \quad \ldots (4)$$

$$dw = +\frac{3}{100} \times w = +\frac{300}{100} \quad \ldots (3)$$

$$\frac{dy}{dd} = \frac{4kwd^3}{t^3} \quad \ldots (6)$$

$$dd = +\frac{2.5}{100} \times d = \frac{+2.5d}{100} \quad \ldots (7)$$

$$\frac{dy}{dt} = -\frac{3kwd^4}{t^4} \quad \ldots (8)$$

$$dt = +\frac{4}{100} \times t = \frac{+4t}{100} \quad \ldots (9)$$

By subtituting eqns (4), (5), (6), (7), (8) and (9) into eq (2)

$$dy = \frac{kd^4}{t^3}\left(+\frac{3w}{100}\right) + \frac{4kwd^3}{t^3}\left(+\frac{2.5d}{100}\right) + \left(\frac{-3kwd^4}{t^3}\right)\left(\frac{+4t}{100}\right)$$

$$dy = \frac{kwd^4}{t^3}\left(\frac{3}{10} + \frac{10}{100} - \frac{12}{100}\right)$$

But $y = \frac{kwd^4}{t^3}$

$$\therefore dy = y\left(\frac{3+10-12}{100}\right)$$

$$dy = + \cancel{\frac{6.5}{100}}\, \cancel{y} = +\frac{1}{100}$$

Therefore there was an approximate percentage Increase in the deflection y where w is Increased by 3 percent d is Increased by 2.5 percent and t is Increased by 4 percent