CSD1251/CSD1250 Week 8 Tutorial Problems

20th January – 26th February 2023

It is recommended to treat the attempt of these problems seriously, even though they are not graded. You may refer to the lecture slides if you are unsure of any concepts.

After attempting each problem, think about what you have learnt from the attempt as a means of consolidating what you have learnt.

Question 1

(a) If V is the volume of a cube with edge length x and the cube expands/shrinks as time passes, find $\frac{dV}{dt}$ in terms of $\frac{dx}{dt}$.

(b) Suppose the edge of an ice cube is decreasing at a rate of 0.01 cm/s, how fast is the volume of the ice cube decreasing when the edge length is 1.5 cm?

Answer: 0.0675 cm^3/s.

Question 2

Each side of a square is increasing at a rate of 4 cm/s. At what rate is the area of the square increasing when the area of the square is 25 cm^2?

Answer: 40 cm^2/s.

Question 3

A cylindrical tank with radius 5 m is being filled with water at a rate of 3 m^3/min. How fast is the height of the water increasing?

Answer: $\frac{3}{25\pi}$ m/min.

Question 4

If a spherical snowball melts so that its surface area decreases at a rate of 1 cm^2/min, find the rate at which the diameter decreases when the diameter is 10 cm.

Answer: $\dfrac{1}{20\pi}$ cm/min.

Question 5

A spotlight on the ground shines on a building 12 m away. If a man 2 m tall walks from the spotlight towards the building at a speed of 1.6 m/s, how fast is the length of his shadow on the building decreasing when he is 4 m from the building?

Answer: -0.6 m/s.

Question 6

Suppose $4x^2 + 9y^2 = 25$, where x and y are functions of t.

(a) If $\dfrac{dy}{dt} = \dfrac{1}{3}$, find $\dfrac{dx}{dt}$ when $x = 2$ and $y = 1$.

(b) If $\dfrac{dx}{dt} = 3$, find $\dfrac{dy}{dt}$ when $x = -2$ and $y = 1$.

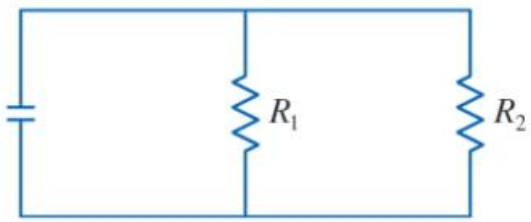
Answers: (a) $-\dfrac{3}{8}$, (b) $\dfrac{8}{3}$.

Question 7

If two resistors with resistances R_1 and R_2 are connected in **parallel** (see diagram below), then the total resistance R, measured in ohms (Ω), is given by

$$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}.$$

If R_1 and R_2 are increasing at rates of $0.3\,\Omega/\text{s}$ and $0.2\,\Omega/\text{s}$ respectively, how fast is R changing when $R_1 = 80\,\Omega$ and $R_2 = 100\,\Omega$?



Answer: $\dfrac{107}{810}\ \Omega/\text{s}$.