Quiz 7

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***Abstract*—This document contains the solution of the question from NCERT 12th standard chapter 11 exercise 11.1 problem 3**

1 Exercise 11.1

1) If a line has direction ratios-18,12,-4 then what are its direction cosines?
The direction vector of the given line is,

$$\mathbf{m} = \begin{pmatrix} -18 \\ 12 \\ -4 \end{pmatrix} \tag{1.0.1}$$

The direction vector of X, Y and Z axes are,

$$\mathbf{e_1} = \begin{pmatrix} 1 \\ 0 \\ 0 \end{pmatrix}, \mathbf{e_2} = \begin{pmatrix} 0 \\ 1 \\ 0 \end{pmatrix}, \mathbf{e_3} = \begin{pmatrix} 0 \\ 0 \\ 1 \end{pmatrix} \tag{1.0.2}$$

respectively.
Let α, β, γ be the angles made by the line with the X, Y and Z axes.
The direction cosines are,

$$\cos\alpha = \frac{\mathbf{m}^\top \mathbf{e_1}}{\|\mathbf{m}\| \, \|\mathbf{e_1}\|} \tag{1.0.3}$$

$$= \frac{\begin{pmatrix} -18 & 12 & -4 \end{pmatrix} \begin{pmatrix} 1 \\ 0 \\ 0 \end{pmatrix}}{\sqrt{(-18)^2 + (12)^2 + (-4)^2}} \tag{1.0.4}$$

$$= \frac{-18}{\sqrt{484}} \tag{1.0.5}$$

$$= \frac{-9}{11} \tag{1.0.6}$$

$$\cos\beta = \frac{\mathbf{m}^\top \mathbf{e_2}}{\|\mathbf{m}\| \, \|\mathbf{e_2}\|} \tag{1.0.7}$$

$$= \frac{\begin{pmatrix} -18 & 12 & -4 \end{pmatrix} \begin{pmatrix} 0 \\ 1 \\ 0 \end{pmatrix}}{\sqrt{(-18)^2 + (12)^2 + (-4)^2}} \tag{1.0.8}$$

$$= \frac{12}{\sqrt{484}} \tag{1.0.9}$$

$$= \frac{6}{11} \tag{1.0.10}$$

$$\cos\gamma = \frac{\mathbf{m}^\top \mathbf{e_3}}{\|\mathbf{m}\| \, \|\mathbf{e_3}\|} \tag{1.0.11}$$

$$= \frac{\begin{pmatrix} -18 & 12 & -4 \end{pmatrix} \begin{pmatrix} 0 \\ 0 \\ 1 \end{pmatrix}}{\sqrt{(-18)^2 + (12)^2 + (-4)^2}} \tag{1.0.12}$$

$$= \frac{-4}{\sqrt{484}} \tag{1.0.13}$$

$$= \frac{-2}{11} \tag{1.0.14}$$

Hence the direction cosines of the line are,

$$\begin{pmatrix} \frac{-9}{11} & \frac{6}{11} & \frac{-2}{11} \end{pmatrix} \tag{1.0.15}$$