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Matric no: 19/Eng04/012
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(1) $m = pi - 6j - 3k$

$n = 4i - 3j - 7k$

$o = i - 3j + 2k$

(a) If they are perpendicular

$\therefore \vec{m} \cdot \vec{n} = \vec{m}_i \cdot \vec{n}_i + \vec{m}_j \cdot \vec{n}_j + \vec{m}_k \cdot \vec{n}_k$

$1 = p \times 4 + (-6)(-3) + (-3)(-7)$

$1 = 4p + 18 + 3$

$1 = 4p + 21$

$1 - 21 = 4p$

$4p = -20$

$p = \frac{-20}{4}$

$p = -5$

(b) $\bar{m} \cdot (\bar{n} \times \bar{o}) = \begin{vmatrix} -5 & -6 & -3 \\ 4 & -3 & -7 \\ 1 & -3 & 2 \end{vmatrix}$

$= -5\begin{vmatrix} -3 & -7 \\ -3 & 2 \end{vmatrix} - \left(-6\begin{vmatrix} 4 & -7 \\ 1 & 2 \end{vmatrix}\right) - 3\begin{vmatrix} 4 & -3 \\ 1 & -3 \end{vmatrix}$

$= -5((-3)(2) - (-3)(-7)) - (-6(4(2) - (-7)(1)) - 3(4(-3) - 1(-3))$

$= -5(-6-21) - (-6(8+7)) - 3(-12+3)$

$= -5(-27) - (-6(15)) - 3(-9)$

$= 135 - (-90) + 27$

$= 135 + 90 + 27$

$= 252$

② $9i + 4j + 5k$

$2i - j + 6k$

$\underline{\delta i + 2j - 3k}$

$10i - 3j + 8k$

Let the vector sum above be a

$a = 10i - 3j + 8k$

$|a| = \sqrt{(10)^2 + (-3)^2 + (8)^2}$

$= \sqrt{100 + 9 + 64}$

$= \sqrt{173}$

$\cos\alpha = \frac{a_i}{|a|} = \frac{10}{\sqrt{173}}$

$\cos\beta = \frac{-3}{\sqrt{173}}$

$\cos\gamma = \frac{8}{\sqrt{173}}$

the direct cosines are $\frac{10}{\sqrt{173}}, \frac{-3}{\sqrt{173}}, \frac{8}{173}$

unit vector

$u = \frac{a}{||a||} = \frac{\langle 10, -3, 8 \rangle}{\sqrt{173}}$

$= \left\langle \frac{10}{\sqrt{173}}, \frac{-3}{\sqrt{173}}, \frac{8}{\sqrt{173}} \right\rangle$

Habtel 2, Home Sciences, Home Sciences 17th february

(13) $F = 3ui + u^2 j + (u+2)k$

$v = 2ui - 3uj + (u-2)k$

find integral of $(F \times v)\,du$

$F \times v = 3u \times 2u + u^2 \times -3u + (u+2)(u-2)$

$= 6u^2 + (-3u^3) + u^2 - 2^2$

$= \cancel{6}\, 6u^2 - 3u^3 + u^2 - 4$

$= 7u^2 - 3u^3 - 4$

$= \int 7u^2 - 3u^3 - 4$

$= \frac{7u^{2+1}}{2+1} - \frac{3u^{3+1}}{3+1} - \frac{4u^{0+1}}{0+1}$

$= \frac{7u^3}{3} - \frac{3u^4}{4} - 4u + C,\ C \in R$