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MAT102
17/ENG05/007
MECHATRONICS
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(1) Answer

Position or Vector

$r = x_i + y_j + z_k$

$r = 7t^2 + (6t^2 - 4t) + (t - 5)$

$r = 13t^2 - 3t - 5$

$\therefore$ velocity $= \frac{dr}{dt} = 26t - 3$

2 $A = i + 2j - 4k$, $B = 2i - 3j + k$, $C = 4j - 3k$

$A \times (B \times C)$

$$(B \times C) = \begin{vmatrix} i & j & k \\ 2 & -3 & 1 \\ 0 & 4 & -3 \end{vmatrix} = i(9 - 4) - j(-6 - 0) + k(8 + 0)$$

$5i + 6j + 8k = (B \times C)$

$$A \times (B \times C) = \begin{vmatrix} i & j & k \\ 1 & 2 & -4 \\ 5 & 6 & 8 \end{vmatrix} = i(16 + 24) - j(8 + 20) + k(6 - 10)$$

$= 40i + (-28j) + (-4k)$

$= 40i - 28j - 4k$

3 $R = 4\sin 3t\, i + 4e^{3t}\, j + 7t^3 k$, find the integral of R

Solution

$\int 4\sin 3t\, i + 4e^{3t}\, j + 7t^3 k\ dx$

$= -\frac{1}{3} \times 4\cos 3t\, i + \frac{1}{3} \times 4 e^{3t}\, j + \frac{7t^4}{4} k$

$= -\frac{4}{3}\cos 3t\, i + \frac{4}{3} e^{3t}\, j + \frac{7}{4} t^4 k + C$

4 $A = 7i + 2j - k$, $B = 2i + j + 4k$, $C = i + j + k$

$(A + C) \cdot (B - A)$

$A + C = 8i + 3j$

$B - A = i + 3k$

$(A + C) \cdot (B - A) = 8i + 0 + 0 = 8i$

5 $x = t$, $y = t^2$, $z = t^3$

$r = xi + yj + zk$

$r = t + t^2 + t^3$

$\frac{dr}{dt} = 1 + 2t + 3t^2$

$\frac{dr}{dt}$ at $t = 1$ $= 1i + 2(1)j + 3(1)^2 k$

$\left|\frac{dr}{dt}\right| = i + 2j + 3k = \sqrt{1^2 + 2^2 + 3^2} = \sqrt{14} = 3.74$

Unit tangent vector = $\frac{dr/dt}{|dr/dt|}$ = $\frac{i+2j+3k}{3.74}$