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DATE SUBMITTED: 06/4/2020

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DEPARTMENT: MECHANICAL.

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### Assignment

1.  $x = t^2$     $y = 6t^2 - 4t$     $z = t - 5$ .

v.e.  $v = (2t^2)i + (12t - 4)j + (1 - 5)k$

a. velocity  $= \frac{dv}{dt}$

$$\frac{dv}{dt} = [4t]i + [12t - 4]j + 0.$$

$$= [4t]i + [12t - 4]j + 0.$$

2.  $A = i + 2j - 4k$   
 find  $\bar{A} \times (\bar{B} \times \bar{C})$

$B = 2i - 3j + k$

$C = 4j - 3k$

Solution

$$\bar{B} \times \bar{C} = \begin{vmatrix} i & j & k \\ 2 & -3 & 1 \\ 0 & 4 & -3 \end{vmatrix}$$

$$i \begin{vmatrix} -3 & 1 \\ 4 & -3 \end{vmatrix} - j \begin{vmatrix} 2 & 1 \\ 0 & -3 \end{vmatrix} + k \begin{vmatrix} 2 & -3 \\ 0 & 4 \end{vmatrix}$$

$$i(9-4) - j(-6-0) + k(8-0)$$

$$i(5) - j(-6) + k(8)$$

$$25i + 6j + 8k.$$

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

$$i \begin{vmatrix} 2 & -4 \\ 6 & 8 \end{vmatrix} - j \begin{vmatrix} 1 & -4 \\ 5 & 8 \end{vmatrix} + k \begin{vmatrix} 1 & 2 \\ 5 & 6 \end{vmatrix}$$

$$i(16 - (-24)) - j(8 - (-20)) + k(6 - 10)$$

$$i(16 + 24) - j(8 + 20) + k(-4)$$

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

$$40i - 28j - 4k.$$

$$3i. R = 45t \cos 2t i + 4t^2 j + 7t^3 k.$$

$$\frac{dR}{dt} = 45 \cos 2t i + 8t j + 21t^2 k.$$

4.  $A = \begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{bmatrix}$  and  $B = \begin{bmatrix} 9 & 8 & 7 \\ 6 & 5 & 4 \\ 3 & 2 & 1 \end{bmatrix}$

$A+B = \begin{bmatrix} 1+9 & 2+8 & 3+7 \\ 4+6 & 5+5 & 6+4 \\ 7+3 & 8+2 & 9+1 \end{bmatrix} = \begin{bmatrix} 10 & 10 & 10 \\ 10 & 10 & 10 \\ 10 & 10 & 10 \end{bmatrix}$

$A-B = \begin{bmatrix} 1-9 & 2-8 & 3-7 \\ 4-6 & 5-5 & 6-4 \\ 7-3 & 8-2 & 9-1 \end{bmatrix} = \begin{bmatrix} -8 & -6 & -4 \\ -2 & 0 & 2 \\ 4 & 6 & 8 \end{bmatrix}$

$3A = 3 \begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{bmatrix} = \begin{bmatrix} 3 & 6 & 9 \\ 12 & 15 & 18 \\ 21 & 24 & 27 \end{bmatrix}$

$\frac{1}{2}A = \frac{1}{2} \begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{bmatrix} = \begin{bmatrix} 0.5 & 1 & 1.5 \\ 2 & 2.5 & 3 \\ 3.5 & 4 & 4.5 \end{bmatrix}$

$A \cdot B = \begin{bmatrix} 1 \cdot 9 + 2 \cdot 6 + 3 \cdot 3 & 1 \cdot 8 + 2 \cdot 5 + 3 \cdot 4 & 1 \cdot 7 + 2 \cdot 4 + 3 \cdot 3 \\ 4 \cdot 9 + 5 \cdot 6 + 6 \cdot 3 & 4 \cdot 8 + 5 \cdot 5 + 6 \cdot 4 & 4 \cdot 7 + 5 \cdot 4 + 6 \cdot 3 \\ 7 \cdot 9 + 8 \cdot 6 + 9 \cdot 3 & 7 \cdot 8 + 8 \cdot 5 + 9 \cdot 4 & 7 \cdot 7 + 8 \cdot 4 + 9 \cdot 3 \end{bmatrix}$

$= \begin{bmatrix} 30 & 29 & 23 \\ 72 & 67 & 53 \\ 108 & 100 & 83 \end{bmatrix}$

$(A+B) - (A-B) = \begin{bmatrix} 10 & 10 & 10 \\ 10 & 10 & 10 \\ 10 & 10 & 10 \end{bmatrix} - \begin{bmatrix} -8 & -6 & -4 \\ -2 & 0 & 2 \\ 4 & 6 & 8 \end{bmatrix} = \begin{bmatrix} 18 & 16 & 14 \\ 12 & 10 & 8 \\ 6 & 4 & 2 \end{bmatrix}$

$2A = 2 \begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{bmatrix} = \begin{bmatrix} 2 & 4 & 6 \\ 8 & 10 & 12 \\ 14 & 16 & 18 \end{bmatrix}$

5. Let  $\mathbf{r}(t) = 2t\mathbf{i} + 3t\mathbf{j}$   
point  $t=1$ .

$$v = 2t\mathbf{i} + 3t\mathbf{j} \text{ at } t=1$$

$$v = 2\mathbf{i} + 3\mathbf{j} \text{ at } t=1$$

$$\frac{d\mathbf{r}}{dt} = 2\mathbf{i} + 3\mathbf{j} + 3t\mathbf{k}$$

$$\text{at } t=1, \frac{d\mathbf{v}}{dt} = 2\mathbf{i} + 3\mathbf{j} + 3\mathbf{k}$$

$$\left| \frac{d\mathbf{v}}{dt} \right|_{t=1} = \sqrt{2^2 + 3^2 + 3^2} = \sqrt{22} = 4.69$$

$$\text{Hence, } T = \frac{2\mathbf{i} + 3\mathbf{j} + 3\mathbf{k}}{4.69}$$