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Biotcehnology
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$$A = 3i + 7j - 2k$$

$$B = i + 3j + 7k$$

$$C = 9i + 4j + 6k$$

i) angle between A & C

$$A \cdot C = |A||C| \cos \theta$$

$$A \cdot C = 27 + 28 - 12 = 43$$

$$|A| = \sqrt{3^2 + 7^2 + (-2)^2} = \sqrt{62}$$

$$|C| = \sqrt{9^2 + 4^2 + 6^2} = \sqrt{133}$$

$$\theta = \cos^{-1} \left(\frac{A \cdot C}{|A||C|} \right) = \cos^{-1} \left(\frac{43}{\sqrt{62} \times \sqrt{133}} \right)$$

$$\theta = \cos^{-1}(0.4735)$$

$$= 61.7362^\circ \approx 61.7$$

ii) angle between B and C

$$B \cdot C = 9 + 12 + 42 = 63$$

$$|B| = \sqrt{1^2 + 3^2 + 7^2} = \sqrt{59}$$

$$|C| = \sqrt{9^2 + 4^2 + 6^2} = \sqrt{133}$$

$$\theta = \cos^{-1} \left(\frac{63}{\sqrt{59} \times \sqrt{133}} \right) = \cos^{-1}(0.7112)$$

$$\theta = \cos^{-1} 44.6677^\circ \approx 44.7^\circ$$

iii) $A + B + C = 13i + 14j + 11k$

$$e_u = \frac{u}{|u|}$$

$$e_{(A+B+C)} = \frac{13i + 14j + 11k}{\sqrt{13^2 + 14^2 + 11^2}}$$

$$e_{(A+B+C)} = \frac{13i + 14j + 11k}{22.05}$$

$$z \quad r = -8t^2 i + (t^2 - 4t) j + (t+1) k$$

$$\text{velocity} = \frac{dr}{dt} = -16t i + (2t-4) j + k$$

$$\text{Acceleration} = \frac{d^2 r}{dt^2} = -16 i + 2 j$$

$$a = \frac{dv}{dt} \Big|_{t=1} = -16 i + 2 j$$

$$\begin{aligned} \text{Acceleration at } t=1 &= \sqrt{16^2 + 2^2} \\ &= \sqrt{260} \\ &= 2\sqrt{65} \end{aligned}$$

$$3(\bar{A} \times \bar{B}) = \begin{vmatrix} i & j & k \\ 4 & 2 & -4 \\ 8 & -9 & 1 \end{vmatrix}$$

$$= i \begin{vmatrix} 2 & -4 \\ -9 & 1 \end{vmatrix} - j \begin{vmatrix} 4 & -4 \\ 8 & 1 \end{vmatrix} + k \begin{vmatrix} 4 & 2 \\ 8 & -9 \end{vmatrix}$$

$$= i(2 - 4q) - j(4 + 32) + k(-4q - 16)$$

$$= i(2 - 4q) - 36j + (-4q - 16)k$$

$$(\bar{A} \times \bar{B}) \times c = \begin{vmatrix} i & j & k \\ (2-4q) & -36 & (-4q-16) \\ 1 & 4 & -3 \end{vmatrix}$$

$$= i[(-36 \times -3) - (-4q - 16 \times 4)] - j[(-3 \times 2 - 4q) - (1 \times -4)]$$

$$+ [(2 - 4q \times 4) - (-36 \times 1)] k$$

$$= i[108 - (-16q - 64)] - j[+6 + 12q + 4q + 16] + k[8 - 4q + 36]$$

$$= (172 + 16q)i - [10 + 16q]j + [44 - 16q]k$$

$$q = 2 \therefore (\bar{A} \times \bar{B}) \times c = (172 + 16(2))i - (10 + 16(2))j + (44 - 16(2))k$$

$$= 204i - 42j + 12k$$