Exercise 14.2

Q.1. **Find the cosines of the angle θ between $\underline{u}$ and $\underline{v}$**

(i) $\underline{u} = 2\underline{i} + 3\underline{j} + \underline{k}$, $\underline{v} = -\underline{i} + 2\underline{j} + 2\underline{k}$

Sol: $\underline{u}.\underline{v} = (2\underline{i} + 3\underline{j} + \underline{k}).(-\underline{i} + 2\underline{j} + 2\underline{k}) = (2)(-1) + (3)(2) + (1)(2) = -2 + 6 + 2 = 6$

$|\underline{u}| = \sqrt{(2)^2 + (3)^2 + (1)^2} = \sqrt{4+9+1} = \sqrt{14}$

$|\underline{v}| = \sqrt{(-1)^2 + (2)^2 + (2)^2} = \sqrt{1+4+4} = \sqrt{9} = 3$

$\cos\theta = \frac{\underline{u}.\underline{v}}{|\underline{u}||\underline{v}|} = \frac{6}{3\sqrt{14}} = \frac{2}{\sqrt{14}}$

(i) $\underline{u} = [-3,2,5]$, $\underline{v} = [1,6,-2]$

Sol: $\underline{u}.\underline{v} = [-3,2,5].[1,6,-2] = (-3)(1) + (2)(6) + (5)(-2)$

$= -3 + 12 - 10 = -1$

$|\underline{u}| = \sqrt{(-3)^2 + (2)^2 + (5)^2} = \sqrt{9+4+25} = \sqrt{38}$

$|\underline{v}| = \sqrt{(1)^2 + (6)^2 + (-2)^2} = \sqrt{1+36+4} = \sqrt{41}$

$\cos\theta = \frac{\underline{u}.\underline{v}}{|\underline{u}||\underline{v}|} = \frac{-1}{\sqrt{38}\sqrt{41}}$

Q.2. **If $\underline{a} + \underline{b} + \underline{c} = \underline{0}$ *and* $|\underline{a}| = 3, |\underline{b}| = 5$ *and* $|\underline{c}| = 7$. Find the angle between $\underline{a}$ and $\underline{b}$.**

Sol: Given $\underline{a} + \underline{b} + \underline{c} = 0$

$\Rightarrow \underline{c} = -(\underline{a} + \underline{b})$

$|c|^2 = (a+b)^2$

$|c|^2 = (a+b)^2$

$|\underline{c}|^2 = |\underline{a}|^2 + |\underline{b}|^2 + 2(\underline{a}.\underline{b})$

$(7)^2 = (3)^2 + (5)^2 + 2(\underline{a}.\underline{b})$

$49 = 9 + 25 + 2(\underline{a}.\underline{b})$

$49 - 34 = 2(\underline{a}.\underline{b})$

$\underline{a}.\underline{b} = \frac{15}{2}$

Using formula

$\underline{a}.\underline{b} = |\underline{a}||\underline{b}|\cos\theta$

$\frac{15}{2} = (3)(5)\cos\theta$

$\frac{15}{2} = 15\cos\theta \Rightarrow \cos\theta = \frac{1}{2} \Rightarrow \theta = \cos^{-1}\left(\frac{1}{2}\right)$

$\theta = 60° = \frac{\pi}{3}$ radian

Q.3. If $|\underline{a}| = 3, |\underline{b}| = 4$ and $|\underline{a}+\underline{b}| = 5$. **Find the angle between $\underline{a}$ and $\underline{b}$**

Sol: $|\underline{a}| = 3, |\underline{b}| = 4, |\underline{a}+\underline{b}| = 5$

$$|\underline{a}+\underline{b}|^2 = (\underline{a}+\underline{b})(\underline{a}+\underline{b}) = |\underline{a}|^2 + |\underline{b}|^2 + 2(\underline{a}.\underline{b})$$

$$(5)^2 = (3)^2 + (4)^2 + 2(\underline{a}.\underline{b})$$

$$25 = 9 + 16 + 2(\underline{a}.\underline{b})$$

$$25 - 25 = 2(\underline{a}.\underline{b}) \Rightarrow \underline{a}.\underline{b} = 0$$

Using formula $\underline{a}.\underline{b} = |\underline{a}||\underline{b}|\cos\theta$

$$0 = (3)(4)\cos\theta$$

$$0 = 12\cos\theta$$

$$\Rightarrow \cos\theta = 0^\circ \Rightarrow \theta = \cos^{-1}(0^\circ) \Rightarrow \theta = 90^\circ = \frac{\pi}{2} \text{ Radian}$$

Q.4. Calculate the projection of $\underline{a}$ along $\underline{b}$ and projection of $\underline{b}$ along $\underline{a}$ .when

i. $\underline{a} = 2\underline{i} + 3\underline{j} - \underline{k}$, $\underline{b} = \underline{i} - 2\underline{j} + 4\underline{k}$

Sol: $\underline{a}.\underline{b} = (2)(1) + 3(-2) + (-1)(4) = 2 - 6 - 4 = -8$

$$|\underline{a}| = \sqrt{(2)^2 + (3)^2 + (-1)^2} = \sqrt{4+9+1} = \sqrt{14}$$

$$|\underline{b}| = \sqrt{(1)^2 + (-2)^2 + (4)^2} = \sqrt{1+4+16} = \sqrt{21}$$

Projection of $\underline{a}$ along $\underline{b} = \frac{a.b}{|\underline{b}|} = \frac{-8}{\sqrt{21}}$

Projection of $\underline{b}$ along $\underline{a} = \frac{a.b}{|\underline{a}|} = \frac{-8}{\sqrt{14}}$

نوٹ:

Projection جس کے along لینی ہے اسی کی magnitude سے تقسیم کرتا ہے۔

$$\textit{Projection along } \underline{a} = \frac{a.b}{|\underline{a}|}$$

ii. $\underline{a} = 4\underline{i} - 2\underline{j} + 3\underline{k}$, $\underline{b} = \underline{i} + \underline{j} + \underline{k}$

Sol: $\underline{a} = 4\underline{i} - 2\underline{j} + 3\underline{k}$, $\underline{b} = \underline{i} + \underline{j} + \underline{k}$

$$\underline{a}.\underline{b} = (4)(1) + (-2)(1) + (3)(1) = 4 - 2 + 3 = 5$$

$$|\underline{a}| = \sqrt{(4)^2 + (-2)^2 + (3)^2} = \sqrt{16+4+9} = \sqrt{29}$$

$$|\underline{b}| = \sqrt{(1)^2 + (1)^2 + (1)^2} = \sqrt{1+1+1} = \sqrt{3}$$

Projection of $\underline{a}$ along $\underline{b} = \frac{a.b}{|\underline{b}|} = \frac{5}{\sqrt{3}}$

Projection of $\underline{b}$ along $\underline{a} = \frac{a.b}{|\underline{a}|} = \frac{5}{\sqrt{29}}$

Q.5. Find a real number α so that the vectors $\underline{u}$ and $\underline{v}$ are perpendicular:

i. $\underline{u} = \alpha\underline{i} + 3\underline{j} + \underline{k}$, $\underline{v} = \underline{i} - 2\underline{j} + \alpha\underline{k}$

Sol: $\underline{u}.\underline{v} = (\alpha)(1) + 3(-2) + 1(\alpha) = \alpha - 6 + \alpha$

Given $\underline{u}$ and $\underline{v}$ are perpendicular i.e $\underline{u}.\underline{v} = 0$

$$2\alpha - 6 = 0 \Rightarrow 2\alpha = 6 \Rightarrow \alpha = 3$$

ii. $\underline{u} = \alpha \underline{i} + 2\alpha \underline{j} - \underline{k}$, $\underline{v} = \underline{i} + \alpha \underline{j} + 3\underline{k}$

Sol: $\underline{u}.\underline{v} = (\alpha)(1) + (2\alpha)(\alpha) + (-1)(3) = \alpha + 2\alpha^2 - 3$

$= 2\alpha^2 + \alpha - 3$

Since $\underline{u}$ and $\underline{v}$ are perpendicular i.e. $\underline{u}.\underline{v} = 0$

$2\alpha^2 + \alpha - 3 = 0$

$2\alpha^2 + 3\alpha - 2\alpha - 3 = 0$

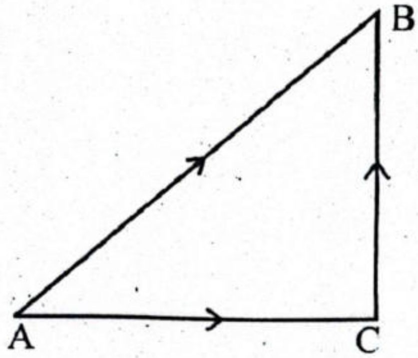
$\alpha(2\alpha + 3) - 1(2\alpha + 3) = 0$

$(2\alpha + 3)(\alpha - 1) = 0$

$2\alpha + 3 = 0 \Rightarrow \alpha = -\frac{3}{2}$ or $\alpha - 1 = 0 \Rightarrow \alpha = 1$

Q.6. Find the number z so that the triangle with vertices $A(3,0,-2), B(0,3,1)$ and $C(1,1,z)$ is a right triangle with right at C.

Sol: Vertices: $A(3,0,-2), B(0,3,1), C(1,1,z)$ right angle at C implies $\overrightarrow{AC} \perp \overrightarrow{CB}$. Therefore, $\overrightarrow{AC}.\overrightarrow{CB} = 0$



$\overrightarrow{AC} = (1-3)\underline{i} + (1-0)\underline{j} + (z+2)\underline{k} = -2\underline{i} + \underline{j} + (z+2)\underline{k}$

$\overrightarrow{CB} = (0-1)\underline{i} + (3-1)\underline{j} + (1-z)\underline{k} = -\underline{i} + 2\underline{j} + (1-z)\underline{k}$

$\overrightarrow{AC}.\overrightarrow{CB} = (-2\underline{i} + \underline{j} + (z+2)\underline{k}).(-\underline{i} + 2\underline{j} + (1-z)\underline{k}) = 0$

$2 + 2 + (z+2)(1-z) = 0$

$z - z^2 + 2 - 2z + 4 = 0$

$-z^2 - z + 6 = 0$

$z^2 + z - 6 = 0$

$z^2 + 3z - 2z - 6 = 0$

$z(z+3) - 2(z+3) = 0$

$(z-2)(z+3) = 0$

$z + 3 = 0$ *or* $z - 2 = 0$

$z = -3$ *or* $z = 2$

Q.7. if $\hat{a}$ and $\hat{b}$ are unit vectors and 2θ is the angle between them, show that $\sin\theta = \frac{1}{2}|\hat{a} - \hat{b}|$.

Sol: $|\hat{a}| = 1$, $|\hat{b}| = 1$, $\theta' = 2\theta$

$|\hat{a} - \hat{b}|^2 = (\hat{a} - \hat{b}).(\hat{a} - \hat{b}) = \hat{a}.\hat{a} + \hat{b}.\hat{b} - 2(\hat{a}.\hat{b}) = |\hat{a}|^2 + |\hat{b}|^2 - 2(\hat{a}.\hat{b}) = 1 + 1 - 2|\hat{a}||\hat{b}|\cos\theta'$

$= 2 - 2\cos(2\theta) = 2(1 - \cos 2\theta) = 2(2\sin^2\theta) = 4\sin^2\theta \Rightarrow |\hat{a} - \hat{b}| = 2\sin\theta \Rightarrow \sin\theta = \frac{1}{2}|\hat{a} - \hat{b}|$

Q.8. if $|\underline{a} + \underline{b}| = |\underline{a} - \underline{b}|$, then show that $\underline{a}$ and $\underline{b}$ are perpendicular.

Sol: Given $|\underline{a} + \underline{b}| = |\underline{a} - \underline{b}|$

$|\underline{a} + \underline{b}|^2 = |\underline{a} - \underline{b}|^2$

$$|\underline{a}|^2 + |\underline{b}|^2 + 2(\underline{a}.\underline{b}) = |\underline{a}|^2 + |\underline{b}|^2 - 2(\underline{a}.\underline{b})$$

$$4(a.b) = 0$$

$\underline{a}.\underline{b} = 0 \Rightarrow \underline{a}$ and $\underline{b}$ are perpendicular.

Q.9. **i. Show that the vectors $3\underline{i} - 2\underline{j} + \underline{k}$, $\underline{i} - 3\underline{j} + 5\underline{k}$ and $2\underline{i} + \underline{j} - 4\underline{k}$ form a right triangle.**

ii. Show that the set of points $P(4,-1,2), Q(1,3,-1)$ and $R(-2,4,6)$ form a right triangle.

i. $3\underline{i} - 2\underline{j} + \underline{k}$, $\underline{i} - 3\underline{j} + 5\underline{k}$ and $2\underline{i} + \underline{j} - 4\underline{k}$

Sol: $\underline{a} = 3\underline{i} - 2\underline{j} + \underline{k}$, $\underline{b} = \underline{i} - 3\underline{j} + 5\underline{k}$, $\underline{c} = 2\underline{i} + \underline{j} - 4\underline{k}$

Now, $\underline{b} + \underline{c} = \underline{i} - 3\underline{j} + 5\underline{k} + 2\underline{i} + \underline{j} - 4\underline{k} = 3\underline{i} - 2\underline{j} + \underline{k}$,

$\underline{b} + \underline{c} = \underline{a}$

So $\underline{a}, \underline{b}, \underline{c}$, are sides of triangle

Now, $\underline{a}.\underline{c} = (3\underline{i} - 2\underline{j} + \underline{k}).(2\underline{i} + \underline{j} - 4\underline{k}) = 3(2) + (-2)(1) + (1)(-4) = 6 - 2 - 4 = 6 - 6 = 0$

Since $\underline{a}$ and $\underline{c}$ are perpendicular and $\underline{a}, \underline{b}, \underline{c}$ are sides of triangle so given sides are of right triangle.

ii. $P(4,-1,2), Q(1,3,-1)$ and $R(-2,4,6)$

Sol: $P(4,-1,2), Q(1,3,-1), R(-2,4,6)$

$$\vec{PQ} = (1-4, 3-(-1), -1-2) = (-3,4,-3)$$

$$\vec{QR} = (-2-1, 4-3, 6-(-1)) = (-3,1,7)$$

$$\vec{PR} = (-2-4, 4-(-1), 6-2) = (-6,5,4)$$

$$\vec{PQ} + \vec{QR} = (-3,4,-3) + (-3,1,7) = (-6,5,4) \Rightarrow \vec{PQ} + \vec{QR} = \vec{PR}$$

Hence P, Q, R are points of triangle

Now $\vec{PQ}.\vec{QR} = (-3,4,-3)(-3,1,7)$

$$\vec{PQ}.\vec{QR} = (-3)(-3) + (4)(1) + (-3)(7) = 9 + 4 - 21 = -8$$

Also

$$\vec{PQ}.\vec{PR} = (-3,4,-3)(-6,5,4) = 18 + 20 - 12 = 26$$

$$\vec{QR}.\vec{PR} = (-3,1,7)(-6,5,4) = 18 + 5 + 28 = 51$$

None of product is zero.

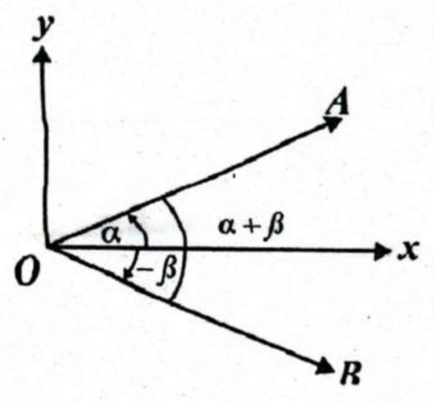
Hence P, Q, R is not right triangle.

Q.10. **Prove that the $\cos(\alpha + \beta) = \cos\alpha\cos\beta - \sin\alpha\sin\beta$**

Sol: $\cos(\alpha + \beta) = \cos\alpha\cos\beta - \sin\alpha\sin\beta$

Suppose $\vec{OA}$ and $\vec{OB}$ are unit vectors.

Then $\vec{OA} = \cos\alpha\,\underline{i} + \sin\alpha\,\underline{j}$



$and\ \overrightarrow{OB} = \cos(-\beta)\underline{i} + \sin(-\beta)\underline{j} = \cos\beta\,\underline{i} - \sin\beta\,\underline{j}$

$\overrightarrow{OA}.\overrightarrow{OB} = (\cos\alpha\underline{i} + \sin\alpha\underline{j}).(\cos\beta\underline{i} - \sin\beta\underline{j})$

$|\overrightarrow{OA}|.|\overrightarrow{OB}|\cos(\alpha+\beta) = \cos\alpha\cos\beta - \sin\alpha\sin\beta$

$\cos(\alpha+\beta) = \cos\alpha\cos\beta - \sin\alpha\sin\beta \qquad \left(|\overrightarrow{OA}| = |\overrightarrow{OB}| = 1\right)$

Q.11. Prove that in any triangle ABC

i. $b = c\cos A + a\cos C$

Sol: in any triangle $\overrightarrow{AB} + \overrightarrow{BA} + \overrightarrow{CA} = 0\ or\ \underline{a} + \underline{b} + \underline{c}\ or\ \underline{b} = \underline{a} + \underline{c}$

Take Dot product by $\underline{b}$

$-\underline{b}.\underline{b} = \underline{b}.\underline{a} + \underline{b}.\underline{c}$

$-\underline{b}^2 = |\underline{b}||\underline{a}|\cos(\pi - C) + |\underline{b}||\underline{c}|\cos(\pi - A)$

Note: $\cos(\pi - A) = -\cos A\ \ and\ \ \cos(\pi - C) = -\cos C$

$-\underline{b}^2 = ab(-\cos C) + bc(-\cos A) = -ab\cos C - bc\cos A$

Divide both sides by $-b$

$b = c\cos A + a\cos C$ Hence Proved.

ii. $c = a\cos B + b\cos A$

Sol: in any triangle $\overrightarrow{AB} + \overrightarrow{BA} + \overrightarrow{CA} = 0\ or\ \underline{a} + \underline{b} + \underline{c} = 0\ or - \underline{c} = \underline{a} + \underline{b}$

Taking Dot product by c

$-\underline{c}.\underline{c} = \underline{c}.\underline{a} + \underline{c}.\underline{b}$

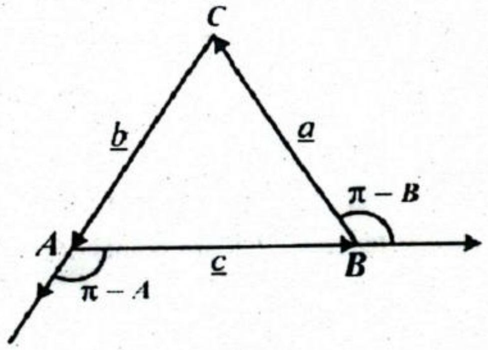
$-c^2 = |\underline{c}||\underline{a}|\cos(\pi - B) + cb\cos(\pi - A)$

$-\underline{c}^2 = ca(-\cos B) + cb(-\cos A)$

$-\underline{c}^2 = -ac\cos B + bc\cos A$

Divide by – c

$c = a\cos B + bCosA$



iii. $b^2 = c^2 + a^2 - 2ca\cos B$

Sol: **we know that in any triangle** $\overrightarrow{AB} + \overrightarrow{BA} + \overrightarrow{CA} = 0\ or\ \underline{a} + \underline{b} + \underline{c} = 0$

$or - \underline{b} = (\underline{a} + \underline{c})$ ______ (i)

Taking dot product by $-\underline{b}$

$-\underline{b}.(-\underline{b}) = (\underline{a} + \underline{c}).(-\underline{b})$

$\underline{b}.\underline{b} = (\underline{a} + \underline{c}).(\underline{a} + \underline{c})$ use – (i)

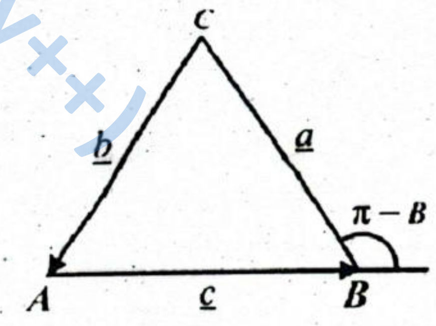
$b^2 = \underline{a}.\underline{a} + \underline{a}.\underline{c} + \underline{c}.\underline{a} + \underline{c}.\underline{c}$

$b^2 = \underline{a}^2 + 2\underline{a}.\underline{c} + \underline{c}^2$

$b^2 = \underline{a}^2 + \underline{c}^2 + 2|a||c|\cos(\pi - B)$

$b^2 = \underline{a}^2 + \underline{c}^2 + 2ac(-\cos B)$

$b^2 = \underline{a}^2 + \underline{c}^2 - 2ac\cos B$



iv. $c^2 = a^2 + b^2 - 2ab\cos C$

Sol: we know that in any triangle $\overrightarrow{AB}+\overrightarrow{BC}+\overrightarrow{CA}=0$ or $\underline{a}+\underline{b}+\underline{c}=0$

$or -\underline{c}=\underline{a}+\underline{b}$ ______ (i)

Taking dot product by $-\underline{c}$

$-\underline{c}.(-\underline{c})=(\underline{a}+\underline{b}).(-\underline{c})$

$c^2=(\underline{a}+\underline{b}).(\underline{a}+\underline{b})$ use – (i)

$c^2=\underline{a}.\underline{a}+\underline{a}.\underline{b}+\underline{b}.\underline{a}+\underline{b}.\underline{b}$

$c^2=\underline{a}^2+2\,\underline{a}.\underline{b}+\underline{b}^2$ $(\underline{a}.\underline{b}=\underline{b}.\underline{a})$

$c^2=\underline{a}^2+\underline{b}^2+2|\underline{a}||\underline{b}|\cos(\pi-C)$

$c^2=\underline{a}^2+\underline{b}^2+2ab(-\cos C)$

$c^2=\underline{a}^2+\underline{b}^2-2ab\cos C$

Hence Proved

Q.12. Show that for any vectors $\underline{a}$ *and* $\underline{b}$, $||\underline{a}|-|\underline{b}|| \le |\underline{a}+\underline{b}| \le |\underline{a}|+|\underline{b}|$

Sol: $|\underline{a}|=|\underline{a}+\underline{b}-\underline{b}|\le|\underline{a}+\underline{b}|+|-\underline{b}|$

$|\underline{a}|\le|\underline{a}+\underline{b}|+|\underline{b}|$

$|\underline{a}|-|\underline{b}|\le|\underline{a}+\underline{b}|$ ___ (I)

Similarly:

$|\underline{b}|=|\underline{b}+\underline{a}-\underline{a}|\le|\underline{a}+\underline{b}|+|-\underline{a}|$

$|\underline{b}|\le|\underline{a}+\underline{b}|+|\underline{a}|$

$|b|-|a|\le|a+b|$ ___ (II)

Combining both parts: $I\,\&\,II$

$||a|-|b||\le|a+b|\le|a|+|b|$

Q.13. Find the work done, if the point at which the constant force $\underline{F}=2\underline{i}+5\underline{j}+3\underline{k}$ is applied to an object, moves it from $P_1(2,-3,1)$ *to* $P_2(7,5,3)$.

Sol: Force $\underline{F}=2\underline{i}+5\underline{j}+3\underline{k}$

Initial point $P_1(2,-3,1)$

Final point $P_2(7,5,3)$

Displacement vector $\underline{d}=\overrightarrow{P_1P_2}=(7-2)\underline{i}+(5-(-3))\underline{j}+(3-1)\underline{k}$

$\underline{d}=5\underline{i}+8\underline{j}+2\underline{k}$

Work done $=\underline{F}.\underline{d}=(2)(5)+(5)(8)+(3)(2)=10+40+6=56$

Q.14. A particle, acted by constant forces $\underline{F_1}=3\underline{i}+4\underline{j}-3\underline{k}$ *and* $\underline{F_2}=\underline{i}+4\underline{j}-\underline{k}$, is displace from $A(2,1,3)$ *to* $B(5,4,4)$. Find the work done.

Sol: Constant forces:

$\underline{F_1}=3\underline{i}+4\underline{j}-3\underline{k}$

$\underline{F_2}=\underline{i}+4\underline{j}-\underline{k}$

Displacement from $A(2,1,3)$ *to* $B(5,4,4)$

Resultant force $\underline{F}=\underline{F_1}+\underline{F_2}$

$\underline{F}=(3+1)\underline{i}+(4+4)\underline{j}+(-3-1)\underline{k}$

$\underline{F}=4\underline{i}+8\underline{j}-4\underline{k}$

Displacement vector $\underline{d}=\overrightarrow{AB}$

$\underline{d}=(5-2)\underline{i}+(4-1)\underline{j}+(4-3)\underline{k}$

$\underline{d}=3\underline{i}+3\underline{j}+1\underline{k}$

Work done $=\underline{F}.\underline{d}$

$=(4)(3)+(8)(3)+(-4)(1)=12+24-4=32$

Q.15. **A particle is displaced from the point $A(5,-5,-7)$ to the point $B(6,2,-2)$ under the action of constant forces defined by $10\underline{i}-\underline{j}+11\underline{k}$, $4\underline{i}+5\underline{j}+9\underline{k}$ and $-2\underline{i}+\underline{j}-9\underline{k}$. Show that the total work done by the force is 102 units.**

Sol: Forces

$\underline{F_1}=10\underline{i}-\underline{j}+11\underline{k}$, $\underline{F_2}=4\underline{i}+5\underline{j}+9\underline{k}$, $\underline{F_3}=-2\underline{i}+\underline{j}-9\underline{k}$

Points:

$A(5,-5,-7)$, $B(6,2,-2)$

Resultant Force $\underline{F}$

$\underline{F}=(10+4-2)\underline{i}+(-1+5+1)\underline{j}+(11+9-9)\underline{k}$

$\underline{F}=12\underline{i}+5\underline{j}+11\underline{k}$

Displacement vector

$\underline{d}=(6-5)\underline{i}+(2-(-5))\underline{j}+(-2-(-7))\underline{k}$

$\underline{d}=1\underline{i}+7\underline{j}+5\underline{k}$

Work Done $=\underline{F}.\underline{d}$

Work done $=(12)(1)+(5)(7)+(11)(5)=12+35+55=102$ units.

Q.16. **A force of magnitude 6 units acting parallel to $4\underline{i}+3\underline{j}-\underline{k}$ displace the point of application from $A(2,-1,3)$ *to* $B(7,3,2)$ Find the work done.**

Sol: $\underline{v}=4\underline{i}+3\underline{j}-\underline{k}$

$|\underline{v}|=\sqrt{(4)^2+(3)^2+(-1)^2}=\sqrt{16+9+1}=\sqrt{26}$

$\underline{F}=6\left(\frac{4\underline{i}+3\underline{j}-\underline{k}}{\sqrt{26}}\right)=\frac{24}{\sqrt{26}}\underline{i}+\frac{18}{\sqrt{26}}\underline{j}-\frac{6}{\sqrt{26}}\underline{k}$

$A(2,-1,3)$ *to* $B(7,3,2)$

Displacement $\underline{d}=(7-2)\underline{i}+(3-(-1))\underline{j}+(2-3)\underline{k}\Rightarrow\underline{d}=5\underline{i}+4\underline{j}-1\underline{k}$

Work Done $=\underline{F}.\underline{d}$

$=\left(\frac{24}{\sqrt{26}}\right)(5)+\left(\frac{18}{\sqrt{26}}\right)(4)+\left(\frac{-6}{\sqrt{26}}\right)(-1)=\frac{120}{\sqrt{26}}+\frac{72}{\sqrt{26}}+\frac{6}{\sqrt{26}}=\frac{120+72+6}{\sqrt{26}}=\frac{198}{\sqrt{26}}$