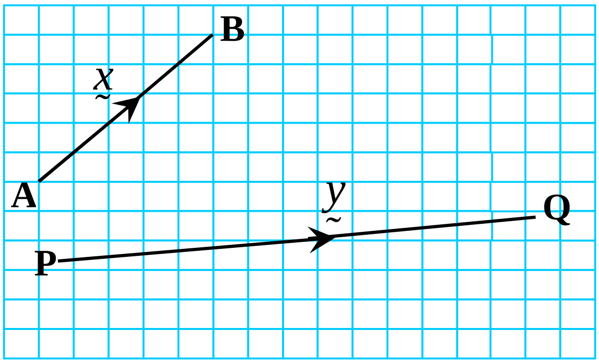
VECTORS

1.1 – 1.4: Introduction to the basic concepts of Vectors

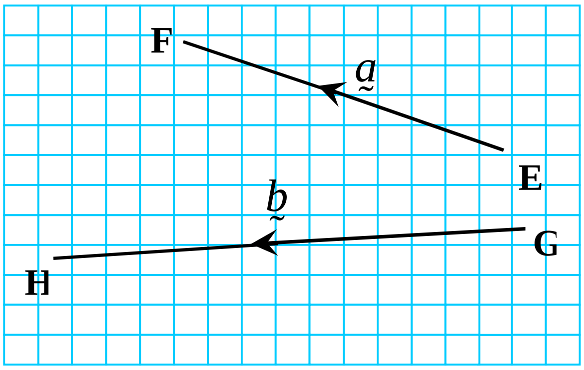
Task 1 : Write down all the vectors as shown in each of the following diagrams.

(1)



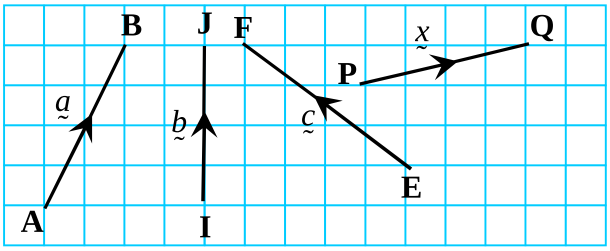
$\overrightarrow{AB}$ $\qquad$ $\underset{\sim}{y} =$

(2)



$\overrightarrow{GH} =$ $\qquad$ $\underset{\sim}{a} =$

(3)

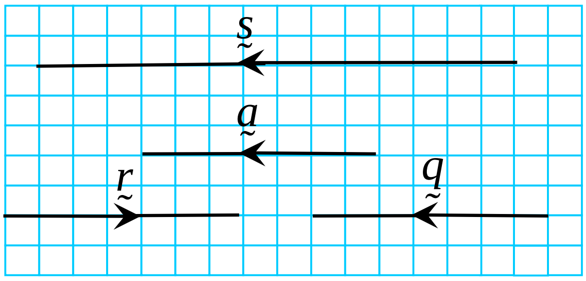


$\overrightarrow{AB} =$ $\qquad$ $\underset{\sim}{x} =$

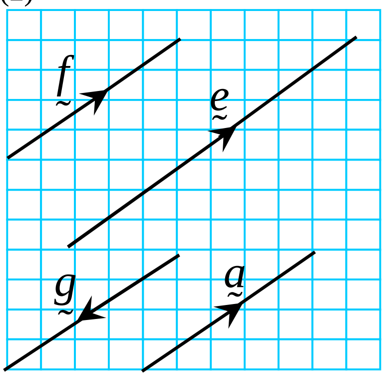
$\overrightarrow{EF} =$ $\qquad$ $\underset{\sim}{b} =$

Task 2 : Determine the vectors that are equal in each of the following diagrams.

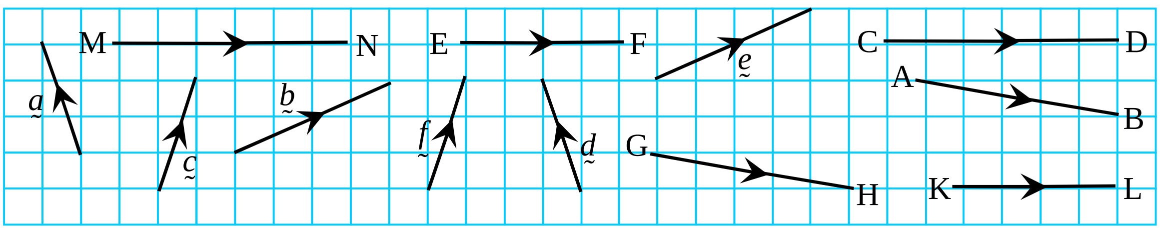
(1)



(2)

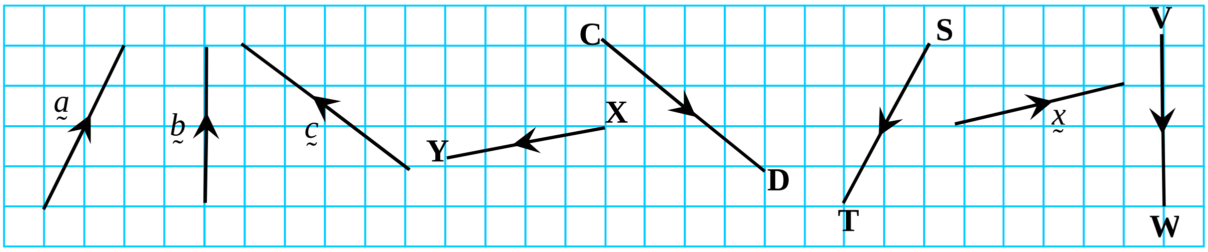


(3)



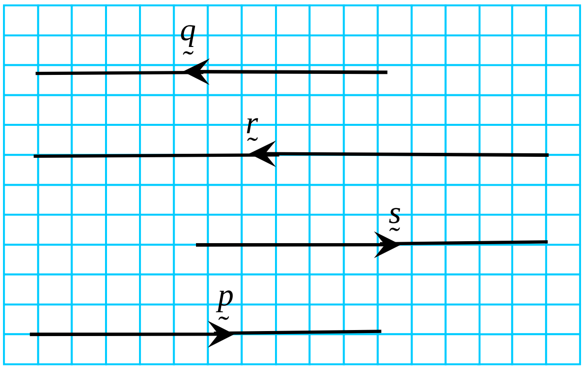
Task 3 : Determine the negative vectors as shown in the following diagrams.

(1)



$\overrightarrow{XY}$ = $\overrightarrow{ST}$ = $\overrightarrow{CD}$ = $\overrightarrow{VW}$ =

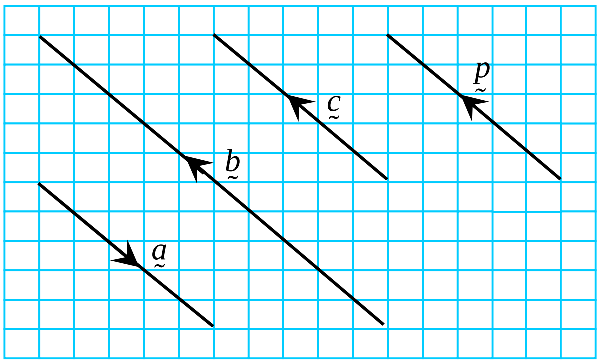
(2)



The negative vector of $\underset{\sim}{p}$:

$-\underset{\sim}{p} =$

(3)



The negative vector of $\underset{\sim}{c}$:

$-\underset{\sim}{c} =$

Answers :

Task 1 :

(1) $\overrightarrow{AB} = \underset{\sim}{x}$; $\underset{\sim}{y} = \overrightarrow{PQ}$

(2) $\overrightarrow{GH} = \underset{\sim}{b}$; $\underset{\sim}{a} = \overrightarrow{EF}$

(3) $\overrightarrow{AB} = \underset{\sim}{a}$; $\underset{\sim}{x} = \overrightarrow{PQ}$; $\overrightarrow{EF} = \underset{\sim}{c}$; $\underset{\sim}{b} = \overrightarrow{IJ}$

Task 2 :

(1) $\underset{\sim}{a} = \underset{\sim}{q}$

(2) $\underset{\sim}{a} = \underset{\sim}{f}$

(3) $\underset{\sim}{a} = \underset{\sim}{d}$; $\underset{\sim}{b} = \underset{\sim}{e}$; $\underset{\sim}{c} = \underset{\sim}{f}$; $\overrightarrow{AB} = \overrightarrow{GH}$; $\overrightarrow{CD} = \overrightarrow{MN}$; $\overrightarrow{EF} = \overrightarrow{KL}$

Task 3 :

(1) $\overrightarrow{XY} = -\underset{\sim}{x}$; $\overrightarrow{ST} = -\underset{\sim}{a}$; $\overrightarrow{CD} = -\underset{\sim}{c}$; $\overrightarrow{VW} = -\underset{\sim}{b}$

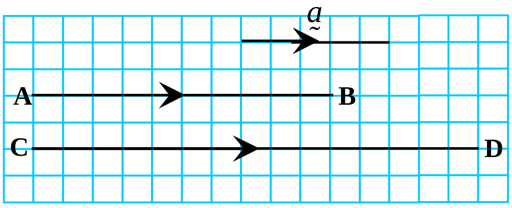
(2) $-\underset{\sim}{p} = \underset{\sim}{q}$

(3) $-\underset{\sim}{c} = \underset{\sim}{a}$

1.5 Multiplication of Vectors by Scalars

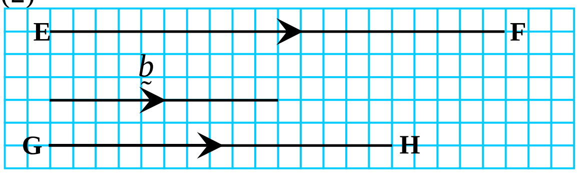
Task 1 : State the following vectors in terms of $\underset{\sim}{a}$.

(1)



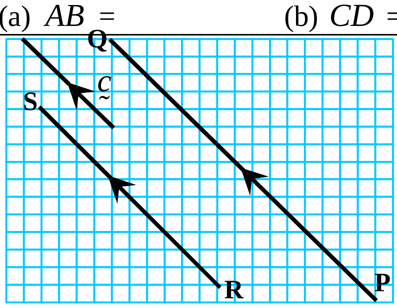
(a) $\overrightarrow{AB}$ = (b) $\overrightarrow{CD}$ =

(2)



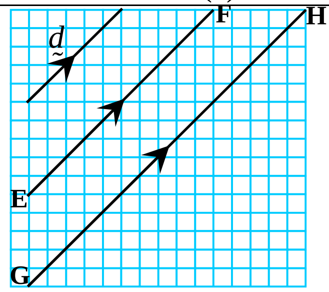
(a) $\overrightarrow{EF}$ = (b) $\overrightarrow{GH}$ =

(3)



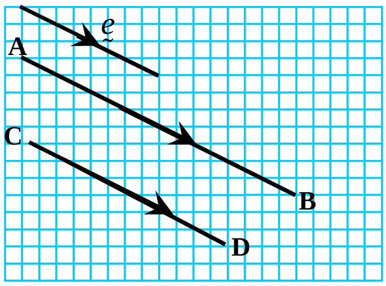
(a) $\overrightarrow{PQ}$ = (b) $\overrightarrow{RS}$ =

(4)



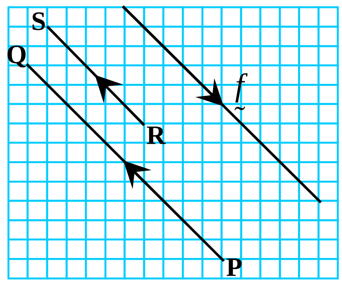
(a) $\overrightarrow{EF}$ = (b) $\overrightarrow{GH}$ =

(5)



(a) $\overrightarrow{AB}$ = (b) $\overrightarrow{CD}$ =

(6)

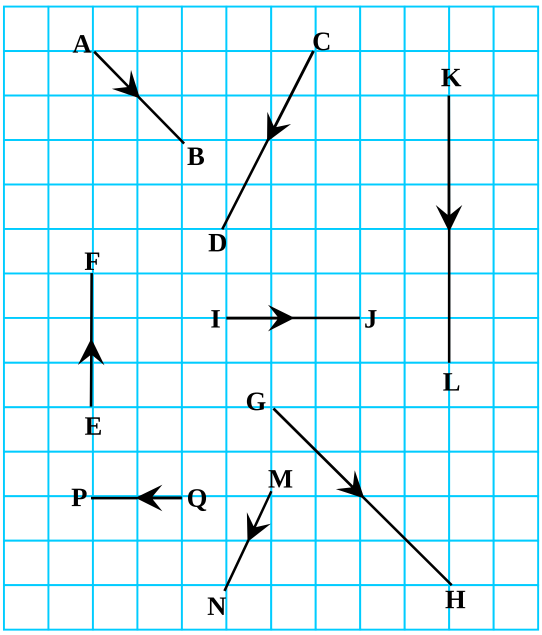


(a) $\overrightarrow{PQ}$ = (b) $\overrightarrow{RS}$ =

Answers: (1) (a) $\overrightarrow{AB}=2\underset{\sim}{a}$ (b) $\overrightarrow{CD}=3\underset{\sim}{a}$ (2) (a) $\overrightarrow{EF}=2\underset{\sim}{b}$ (b) $\overrightarrow{GH}=\frac{3}{2}\underset{\sim}{b}$ (3) (a) $\overrightarrow{PQ}=3\underset{\sim}{c}$ (b) $\overrightarrow{RS}=2\underset{\sim}{c}$

(4) (a) $\overrightarrow{EF}=2\underset{\sim}{d}$ (b) $\overrightarrow{GH}=3\underset{\sim}{d}$ (5) (a) $\overrightarrow{AB}=2\underset{\sim}{e}$ (b) $\overrightarrow{CD}=\frac{3}{2}\underset{\sim}{e}$ (6) (a) $\overrightarrow{PQ}=-2\underset{\sim}{f}$ (b) $\overrightarrow{RS}=-\frac{1}{2}\underset{\sim}{f}$

Task 2 : In each diagram below, determine the vectors that are parallel and state their relationships.



(1) $\overrightarrow{AB}$ and ________ are parallel vectors.

$\overrightarrow{AB}$ =

(2) $\overrightarrow{CD}$ and ________ are parallel vectors.

$\overrightarrow{CD}$ =

(3) $\overrightarrow{EF}$ and ________ are parallel vectors.

$\overrightarrow{EF}$ =

(4) $\overrightarrow{IJ}$ and ________ are parallel vectors.

$\overrightarrow{IJ}$ =

Answers : (1) $\overrightarrow{GH}$; $\overrightarrow{AB}=\frac{1}{2}\overrightarrow{GH}$ (2) $\overrightarrow{MN}$; $\overrightarrow{CD}=2\overrightarrow{MN}$ (3) $\overrightarrow{KL}$; $\overrightarrow{EF}=-\frac{1}{2}\overrightarrow{KL}$ (4) $\overrightarrow{QP}$; $\overrightarrow{IJ}=-\frac{3}{2}\overrightarrow{QP}$

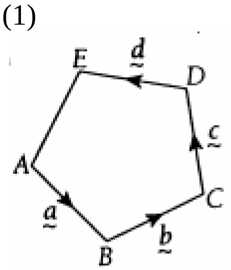
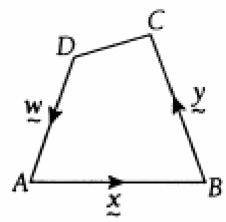
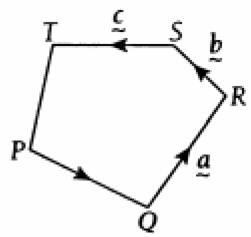
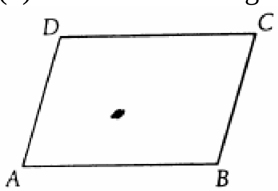
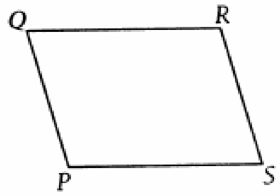
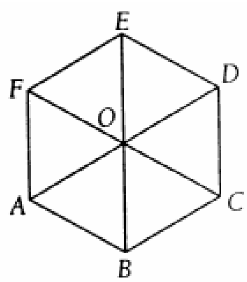
VECTORS

2.1 – 2.4 Addition and Subtraction of Vectors.

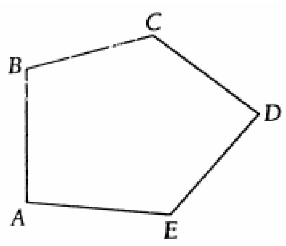
Task 1 : Determine the resultant vector of two or more parallel vectors by addition and subtraction operations.

(1) $2\underset{\sim}{a}+\underset{\sim}{a}+\frac{1}{2}\underset{\sim}{a}$ $\frac{7}{2}\underset{\sim}{a}$	(2) $\frac{1}{2}\underset{\sim}{x}+2\underset{\sim}{x}+\frac{1}{3}\underset{\sim}{x}$ $\frac{17}{6}\underset{\sim}{x}$	(3) $5\underset{\sim}{y}+\frac{1}{2}\underset{\sim}{y}+\frac{3}{4}\underset{\sim}{y}$ $\frac{25}{4}\underset{\sim}{y}$
(4) $5\underset{\sim}{b}-3\underset{\sim}{b}$ $2\underset{\sim}{b}$	(5) $7\underset{\sim}{a}-3\underset{\sim}{a}-\frac{1}{2}\underset{\sim}{a}$ $\frac{7}{2}\underset{\sim}{a}$	(6) $12\underset{\sim}{b}-2\underset{\sim}{b}-5\underset{\sim}{b}$ $5\underset{\sim}{b}$
(7) $2\underset{\sim}{a}+\frac{1}{3}\underset{\sim}{b}+\frac{1}{2}\underset{\sim}{a}+\underset{\sim}{b}$ $\frac{5}{2}\underset{\sim}{a}+\frac{4}{3}\underset{\sim}{b}$	(8) $\underset{\sim}{a}+2\underset{\sim}{b}+3\underset{\sim}{a}+\frac{1}{4}\underset{\sim}{b}$ $4\underset{\sim}{a}+\frac{9}{4}\underset{\sim}{b}$	(9) $4\underset{\sim}{u}+\frac{1}{2}\underset{\sim}{v}+\frac{1}{5}\underset{\sim}{u}+\frac{1}{6}\underset{\sim}{v}$ $\frac{21}{5}\underset{\sim}{u}+\frac{2}{3}\underset{\sim}{v}$
(10) $6\underset{\sim}{x}-4\underset{\sim}{y}-\underset{\sim}{x}+2\underset{\sim}{y}$ $5\underset{\sim}{x}-2\underset{\sim}{y}$	(11) $4\underset{\sim}{u}+5\underset{\sim}{v}-2\underset{\sim}{u}-3\underset{\sim}{v}$ $2\underset{\sim}{u}+2\underset{\sim}{v}$	(12) $6\underset{\sim}{s}-8\underset{\sim}{t}-9\underset{\sim}{s}-2\underset{\sim}{t}$ $-3\underset{\sim}{s}-10\underset{\sim}{t}$

Task 2 : Determine the resultant vector of two or more non-parallel vectors by addition and subtraction operations.

(1)  (a) $\underset{\sim}{a}+\underset{\sim}{b}=$ (b) $\underset{\sim}{b}+\underset{\sim}{c}=$ (c) $\underset{\sim}{c}+\underset{\sim}{d}=$ (d) $\overrightarrow{AB}+\overrightarrow{BD}=$	(2)  (a) $\underset{\sim}{x}+\underset{\sim}{y}=$ (b) $\underset{\sim}{w}+\underset{\sim}{x}=$ (c) $\overrightarrow{DC}+\overrightarrow{CB}=$ (d) $\overrightarrow{BC}+\overrightarrow{CA}=$
(3)  (a) $\underset{\sim}{a}+\underset{\sim}{b}=$ (b) $\underset{\sim}{b}+\underset{\sim}{c}=$ (c) $\overrightarrow{QP}+\overrightarrow{PT}=$ (d) $\overrightarrow{RT}+\overrightarrow{TQ}=$	(4) ABCD in the diagram is a parallelogram.  (a) $\overrightarrow{AB}+\overrightarrow{AD}=$ (b) $\overrightarrow{BA}+\overrightarrow{BC}=$ (c) $\overrightarrow{DA}+\overrightarrow{DC}=$ (d) $\overrightarrow{CB}+\overrightarrow{CD}=$
(5) PQRS in the diagram is a parallelogram.  (a) $\overrightarrow{PQ}+\overrightarrow{PS}=$ (b) $\overrightarrow{SP}+\overrightarrow{SR}=$ (c) $\overrightarrow{QP}+\overrightarrow{QR}=$ (d) $\overrightarrow{RQ}+\overrightarrow{RS}=$	(6) ABCDEF in the diagram is a regular Hexagon  (a) $\overrightarrow{AB}+\overrightarrow{AF}=$ (b) $\overrightarrow{OC}+\overrightarrow{OE}=$ (c) $\overrightarrow{FA}+\overrightarrow{FE}=$ (d) $\overrightarrow{CB}+\overrightarrow{CD}=$

(7) ABCDE in the diagram is a pentagon.



(a) $\overrightarrow{AB}+\overrightarrow{BC}+\overrightarrow{CD}$

=

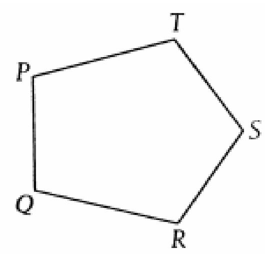
(b) $\overrightarrow{AC}+\overrightarrow{CD}+\overrightarrow{DE}$

=

(c) $\overrightarrow{CD}+\overrightarrow{DA}+\overrightarrow{AE}$

=

(8) PQRST in the diagram is a pentagon.



(a) $\overrightarrow{PQ}+\overrightarrow{QR}+\overrightarrow{RT}$

=

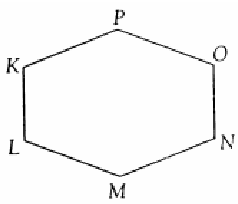
(b) $\overrightarrow{RS}+\overrightarrow{ST}+\overrightarrow{TQ}$

=

(c) $\overrightarrow{TP}+\overrightarrow{PR}+\overrightarrow{RQ}$

=

(9) KLMNOP in the diagram is a hexagon.



(a) $\overrightarrow{PO}+\overrightarrow{ON}+\overrightarrow{NM}+\overrightarrow{ML}$

=

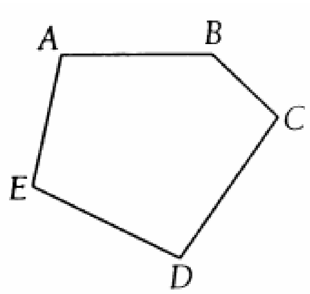
(b) $\overrightarrow{KM}+\overrightarrow{MN}+\overrightarrow{NP}+\overrightarrow{PL}$

=

(c) $\overrightarrow{MN}+\overrightarrow{NL}+\overrightarrow{LP}+\overrightarrow{PN}$

=

(10) ABCDE in the diagram is a pentagon.



(a) $\overrightarrow{AD}-\overrightarrow{CD}$

=

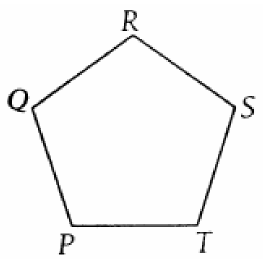
=

(b) $\overrightarrow{CB}-\overrightarrow{EB}$

=

=

(11) PQRST in the diagram is a pentagon.

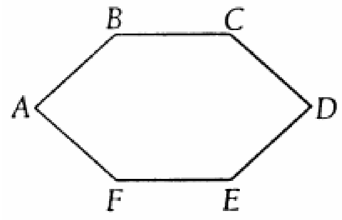


(a) $\overrightarrow{PS}-\overrightarrow{TS}$

(b) $\overrightarrow{RQ}-\overrightarrow{PQ}$

(c) $\overrightarrow{SP}-\overrightarrow{TP}$

(12) ABCDEF in the diagram is a hexagon.



(a) $\overrightarrow{AD}-\overrightarrow{DC}$

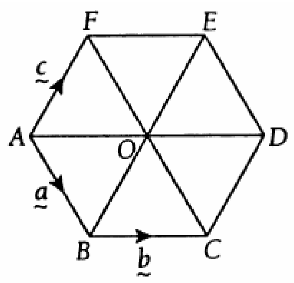
=

=

(b) $\overrightarrow{BC}-\overrightarrow{DC}-\overrightarrow{ED}$ =

(c) $\overrightarrow{CA}-\overrightarrow{FA}-\overrightarrow{EF}$ =

(13) ABCDEF in the diagram is a regular hexagon with centre O.



(a) $\underset{\sim}{a}-\underset{\sim}{b}$ =

(b) $\underset{\sim}{b}-2\underset{\sim}{a}$ =

(c) $\underset{\sim}{b}-\underset{\sim}{c}$ =

(d) $\underset{\sim}{a}-2\underset{\sim}{b}$ =

(e) $\underset{\sim}{a}-\underset{\sim}{c}$ =

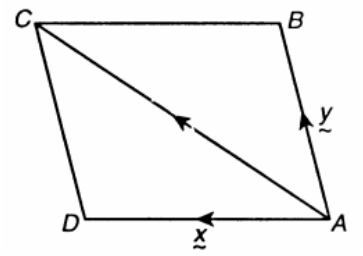
(f) $\underset{\sim}{c}-2\underset{\sim}{b}$ =

VECTORS

2.5 Represent Vectors as Linear Combination of other Vectors.

Task 1 : Express the following vectors in terms of $\underset{\sim}{x}$ and $\underset{\sim}{y}$.

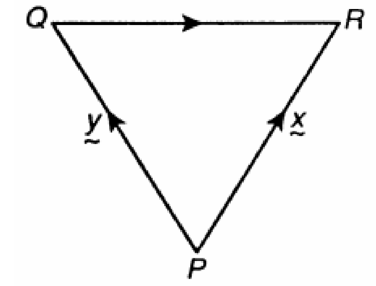
(1)



ABCD is a parallelogram.

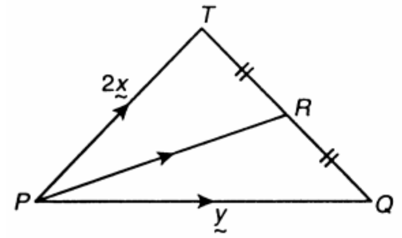
$\overrightarrow{AC}$ =

(2)



$\overrightarrow{QR}$ =

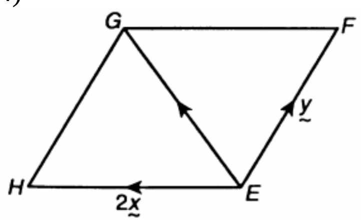
(3)



$\overrightarrow{TQ}$ =

$\overrightarrow{PR}$ =

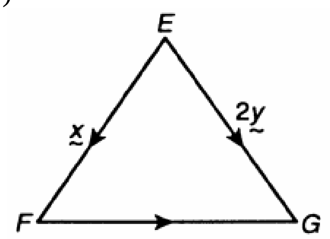
(4)



EFGH is a parallelogram.

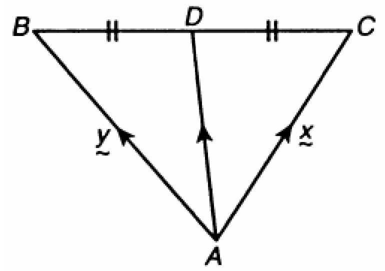
$\overrightarrow{EG}$ =

(5)



$\overrightarrow{FG}$ =

(6)



$\overrightarrow{BC}$ =

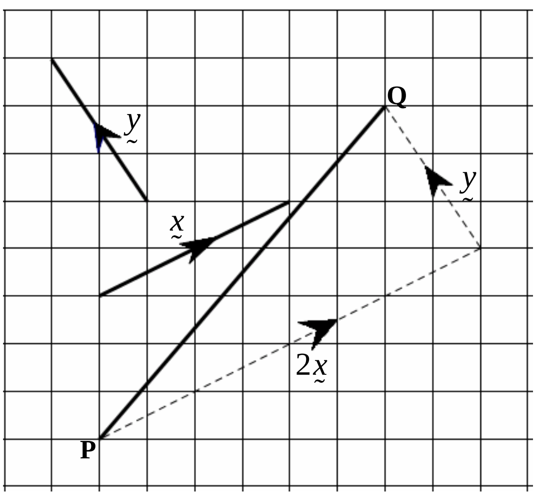
$\overrightarrow{AD}$ =

Answers : (1) $\overrightarrow{AC} = \underset{\sim}{x} + \underset{\sim}{y}$ (2) $\overrightarrow{QR} = -\underset{\sim}{y} + \underset{\sim}{x}$ (3) $\overrightarrow{TQ} = -2\underset{\sim}{x} + \underset{\sim}{y}$; $\overrightarrow{PR} = \underset{\sim}{x} + \frac{1}{2}\underset{\sim}{y}$

(4) $\overrightarrow{EG} = 2\underset{\sim}{x} + \underset{\sim}{y}$ (5) $\overrightarrow{FG} = -\underset{\sim}{x} + 2\underset{\sim}{y}$ (6) $\overrightarrow{BC} = -\underset{\sim}{y} + \underset{\sim}{x}$; $\overrightarrow{AD} = \frac{1}{2}\underset{\sim}{y} + \frac{1}{2}\underset{\sim}{x}$

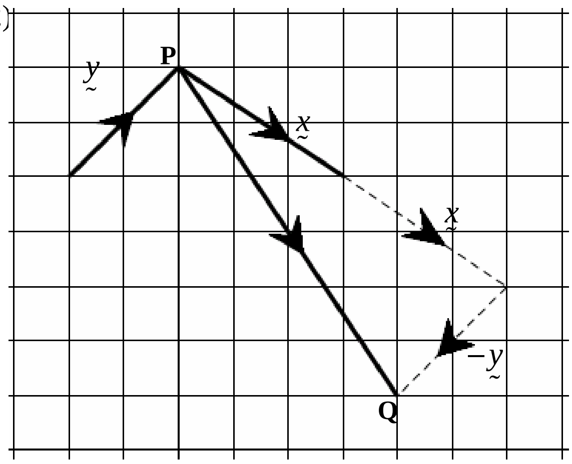
Task 2 : For each of the following diagrams, express the vector $\overrightarrow{PQ}$ in terms of $\underset{\sim}{x}$ and $\underset{\sim}{y}$.

(1)



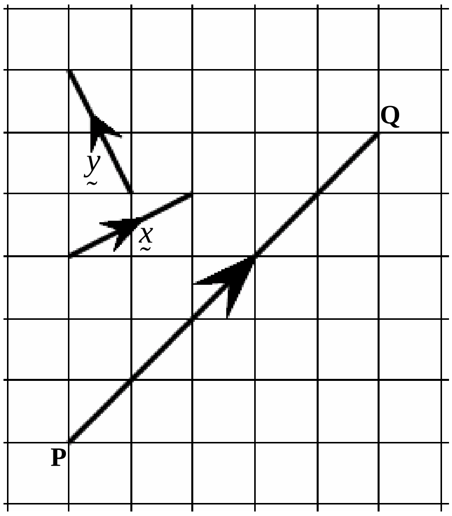
$\overrightarrow{PQ}$ =

(2)



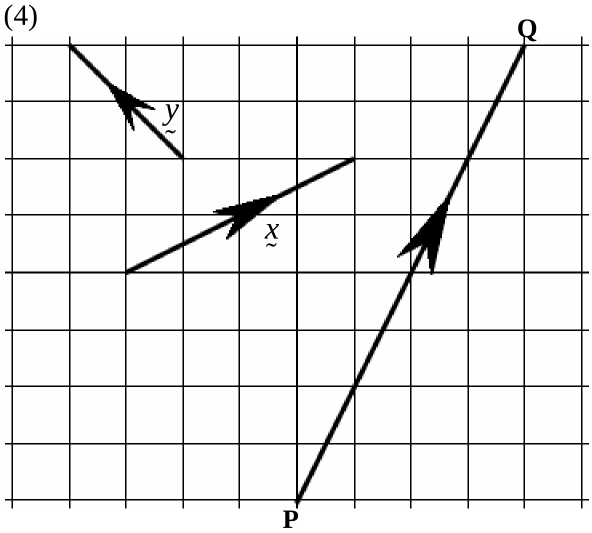
$\overrightarrow{PQ}$ =

(3)



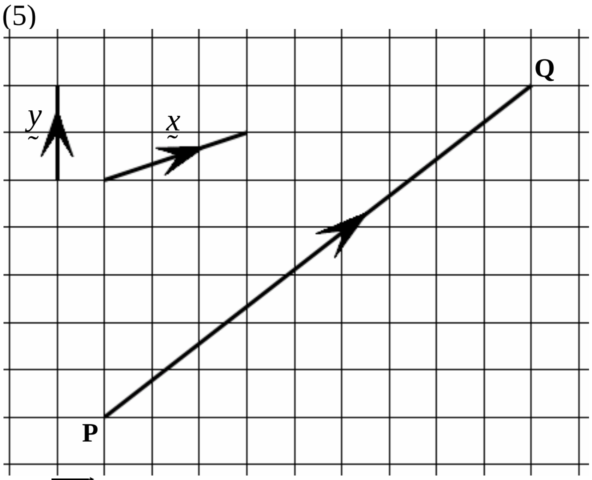
$\overrightarrow{PQ}$ =

(4)



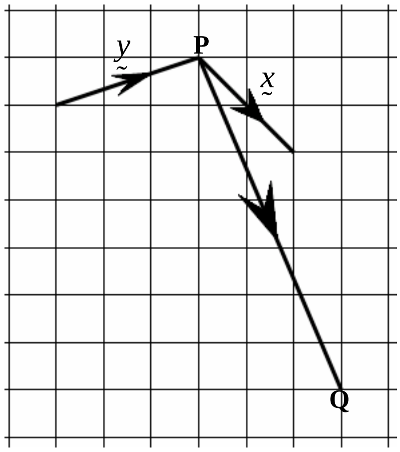
$\overrightarrow{PQ}$ =

(5)



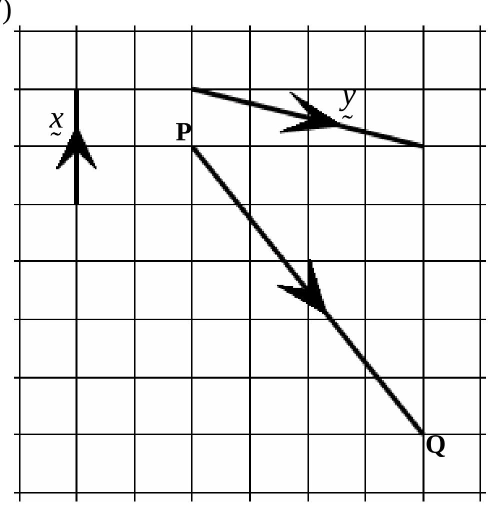
$\overrightarrow{PQ}$ =

(6)



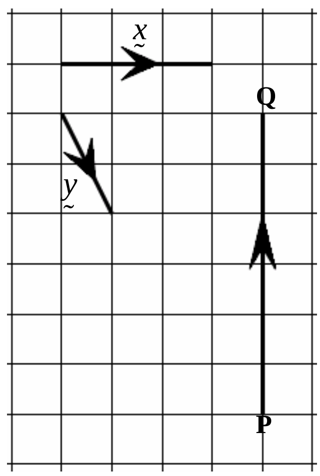
$\overrightarrow{PQ}$ =

(7)



$\overrightarrow{PQ}$ =

(8)



$\overrightarrow{PQ}$ =

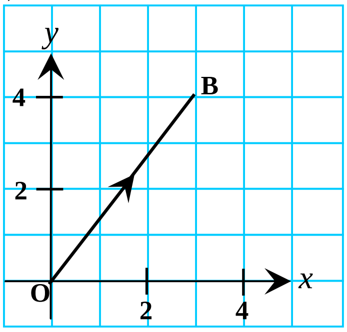
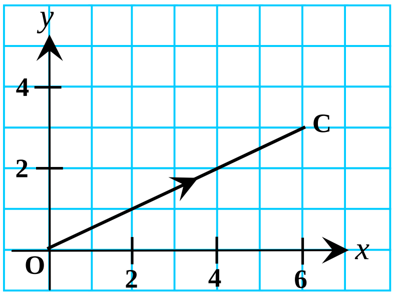
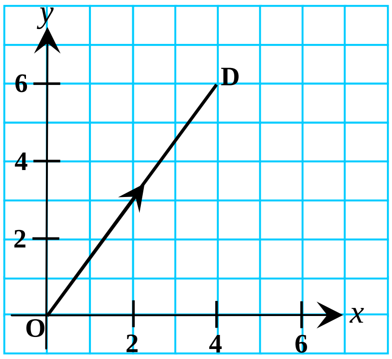
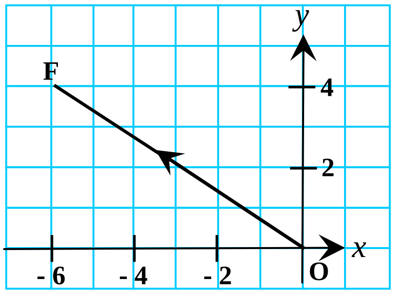
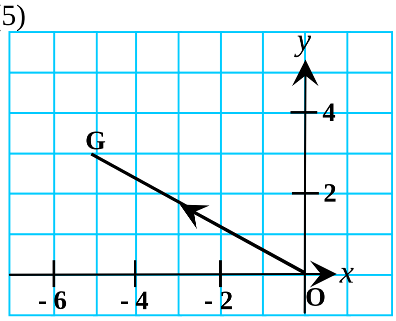
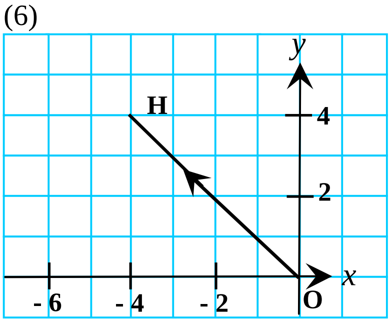
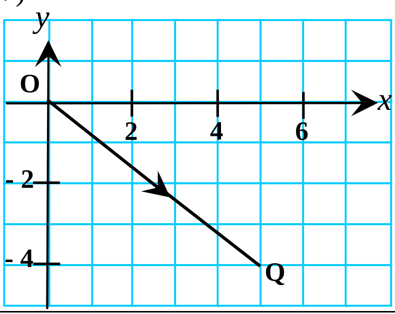
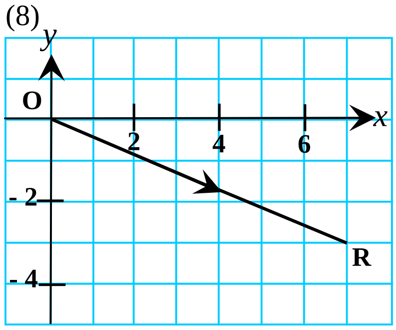
Answers : (1) $\overrightarrow{PQ} = 2\underset{\sim}{x} + \underset{\sim}{y}$ (2) $\overrightarrow{PQ} = \underset{\sim}{x} - \underset{\sim}{y}$ (3) $\overrightarrow{PQ} = 3\underset{\sim}{x} + \underset{\sim}{y}$ (4) $\overrightarrow{PQ} = 2\underset{\sim}{x} + 2\underset{\sim}{y}$

(5) $\overrightarrow{PQ} = 3\underset{\sim}{x} + 2\underset{\sim}{y}$ (6) $\overrightarrow{PQ} = 2\underset{\sim}{x} - \underset{\sim}{y}$ (7) $\overrightarrow{PQ} = -2\underset{\sim}{x} + \underset{\sim}{y}$ (8) $\overrightarrow{PQ} = \underset{\sim}{x} - 3\underset{\sim}{y}$

VECTORS

3.1 Express Vectors in Cartesian Plane in the form of $x\underset{\sim}{i}+y\underset{\sim}{j}$ or $\begin{pmatrix} x \\ y \end{pmatrix}$.

Task : Express the following vectors in the form of $x\underset{\sim}{i}+y\underset{\sim}{j}$ or $\begin{pmatrix} x \\ y \end{pmatrix}$.

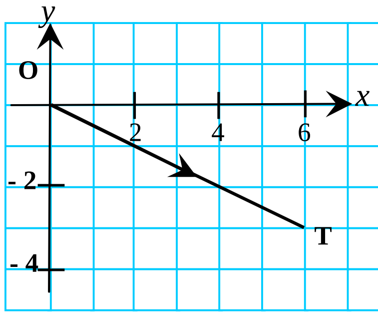
(1)  $B($, $)$ $\overrightarrow{OB}=\begin{pmatrix} \ \\ \ \end{pmatrix}$ $\overrightarrow{OB}=$	(2)  $C($, $)$ $\overrightarrow{OC}=\begin{pmatrix} \ \\ \ \end{pmatrix}$ $\overrightarrow{OC}=$
(3)  $D($, $)$ $\overrightarrow{OD}=\begin{pmatrix} \ \\ \ \end{pmatrix}$ $\overrightarrow{OD}=$	(4)  $F($, $)$ $\overrightarrow{OF}=\begin{pmatrix} \ \\ \ \end{pmatrix}$ $\overrightarrow{OF}=$
(5)  $G($, $)$ $\overrightarrow{OG}=\begin{pmatrix} \ \\ \ \end{pmatrix}$ $\overrightarrow{OG}=$	(6)  $H($, $)$ $\overrightarrow{OH}=\begin{pmatrix} \ \\ \ \end{pmatrix}$ $\overrightarrow{OH}=$
(7)  $Q($, $)$ $\overrightarrow{OQ}=\begin{pmatrix} \ \\ \ \end{pmatrix}$ $\overrightarrow{OQ}=$	(8)  $R($, $)$ $\overrightarrow{OR}=\begin{pmatrix} \ \\ \ \end{pmatrix}$ $\overrightarrow{OR}=$

Answers : (1) (3 , 4) ; $\begin{pmatrix} 3 \\ 4 \end{pmatrix}$; $3\underset{\sim}{i}+4\underset{\sim}{j}$ (2) (6 , 3) ; $\begin{pmatrix} 6 \\ 3 \end{pmatrix}$; $6\underset{\sim}{i}+3\underset{\sim}{j}$ (3) (4 , 6) ; $\begin{pmatrix} 4 \\ 6 \end{pmatrix}$; $4\underset{\sim}{i}+6\underset{\sim}{j}$

(4) (–6 , 4) ; $\begin{pmatrix} -6 \\ 4 \end{pmatrix}$; $-6\underset{\sim}{i}+4\underset{\sim}{j}$ (5) (–5 , 3) ; $\begin{pmatrix} -5 \\ 3 \end{pmatrix}$; $-5\underset{\sim}{i}+3\underset{\sim}{j}$ (6) (–4 , 4) ; $\begin{pmatrix} -4 \\ 4 \end{pmatrix}$; $-4\underset{\sim}{i}+4\underset{\sim}{j}$

(7) (5 , –4) ; $\begin{pmatrix} 5 \\ -4 \end{pmatrix}$; $5\underset{\sim}{i}-4\underset{\sim}{j}$ (8) (7 , –3) ; $\begin{pmatrix} 7 \\ -3 \end{pmatrix}$; $7\underset{\sim}{i}-3\underset{\sim}{j}$

(9)

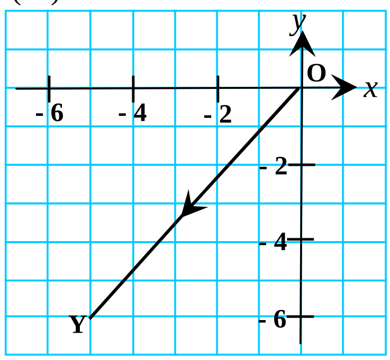


T(,)

$\overrightarrow{OT} = \begin{pmatrix} \\ \\ \end{pmatrix}$

$\overrightarrow{OT} =$

(10)

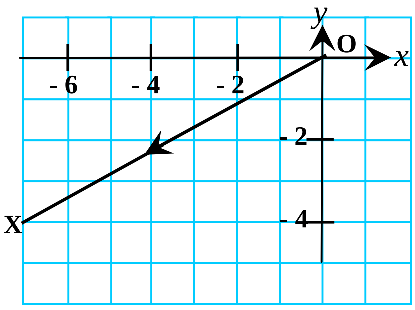


Y(,)

$\overrightarrow{OY} = \begin{pmatrix} \\ \\ \end{pmatrix}$

$\overrightarrow{OY} =$

(11)

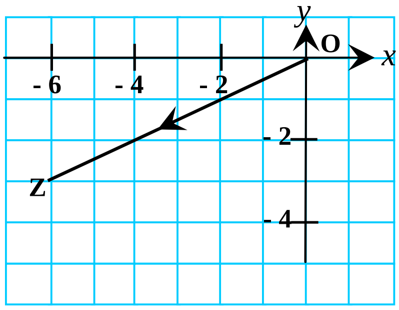


X(,)

$\overrightarrow{OX} = \begin{pmatrix} \\ \\ \end{pmatrix}$

$\overrightarrow{OX} =$

(12)

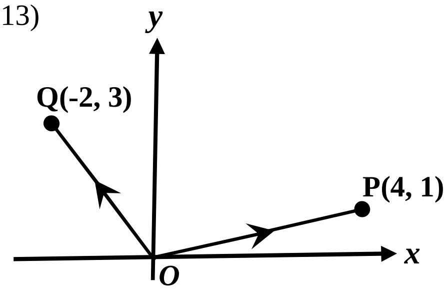


Z(,)

$\overrightarrow{OZ} = \begin{pmatrix} \\ \\ \end{pmatrix}$

$\overrightarrow{OZ} =$

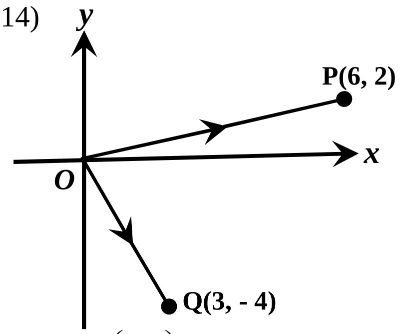
(13)



$\overrightarrow{OP} = \begin{pmatrix} \\ \\ \end{pmatrix} =$

$\overrightarrow{OQ} = \begin{pmatrix} \\ \\ \end{pmatrix} =$

(14)



$\overrightarrow{OP} = \begin{pmatrix} \\ \\ \end{pmatrix} =$

$\overrightarrow{OQ} = \begin{pmatrix} \\ \\ \end{pmatrix} =$

(15) $O(0, 0)$, $A(1, 4)$ and $B(-5, 2)$.

$\overrightarrow{OA} = \begin{pmatrix} \\ \\ \end{pmatrix} =$

$\overrightarrow{OB} = \begin{pmatrix} \\ \\ \end{pmatrix} =$

(16) $O(0, 0)$, $A(4, -8)$ and $B(-3, -6)$.

$\overrightarrow{OA} = \begin{pmatrix} \\ \\ \end{pmatrix} =$

$\overrightarrow{OB} = \begin{pmatrix} \\ \\ \end{pmatrix} =$

Answers : (9) $(6, -3)$; $\begin{pmatrix} 6 \\ -3 \end{pmatrix}$; $6\underset{\sim}{i} - 3\underset{\sim}{j}$ (10) $(-5, -6)$; $\begin{pmatrix} -5 \\ -6 \end{pmatrix}$; $-5\underset{\sim}{i} - 6\underset{\sim}{j}$ (11) $(-7, -4)$; $\begin{pmatrix} -7 \\ -4 \end{pmatrix}$; $-7\underset{\sim}{i} - 4\underset{\sim}{j}$ (12) $(-6, -3)$; $\begin{pmatrix} -6 \\ -3 \end{pmatrix}$; $-6\underset{\sim}{i} - 3\underset{\sim}{j}$ (13) $\begin{pmatrix} 4 \\ 1 \end{pmatrix} = 4\underset{\sim}{i} + \underset{\sim}{j}$; $\begin{pmatrix} -2 \\ 3 \end{pmatrix} = -2\underset{\sim}{i} + 3\underset{\sim}{j}$ (14) $\begin{pmatrix} 6 \\ 2 \end{pmatrix} = 6\underset{\sim}{i} + 2\underset{\sim}{j}$; $\begin{pmatrix} 3 \\ -4 \end{pmatrix} = 3\underset{\sim}{i} - 4\underset{\sim}{j}$ (15) $\begin{pmatrix} 1 \\ 4 \end{pmatrix} = \underset{\sim}{i} + 4\underset{\sim}{j}$; $\begin{pmatrix} -5 \\ 2 \end{pmatrix} = -5\underset{\sim}{i} + 2\underset{\sim}{j}$ (16) $\begin{pmatrix} 4 \\ -8 \end{pmatrix} = 4\underset{\sim}{i} - 8\underset{\sim}{j}$; $\begin{pmatrix} -3 \\ -6 \end{pmatrix} = -3\underset{\sim}{i} - 6\underset{\sim}{j}$

3.2 – 3.3Determine the Unit Vectors in the Direction of given Vectors.

Task 1 : For each of the following vectors in terms of $\underset{\sim}{i}$ and $\underset{\sim}{j}$, find the magnitude and the unit vector in the direction of the given vector.

(1) $\overrightarrow{OP} = 3\underset{\sim}{i} + 4\underset{\sim}{j}$ magnitude of $\overrightarrow{OP}$ $\left\lvert \overrightarrow{OP} \right\rvert =$ Unit vector in the direction of $\overrightarrow{OP}$ $\hat{\overrightarrow{OP}} =$ 5 ; $\frac{3}{5}\underset{\sim}{i} + \frac{4}{5}\underset{\sim}{j}$	(2) $\overrightarrow{OW} = 12\underset{\sim}{i} + 5\underset{\sim}{j}$ magnitude of $\overrightarrow{OW}$ $\left\lvert \overrightarrow{OW} \right\rvert =$ Unit vector in the direction of $\overrightarrow{OW}$ $\hat{\overrightarrow{OW}} =$ 13 ; $\frac{12}{13}\underset{\sim}{i} + \frac{5}{13}\underset{\sim}{j}$	(3) $\overrightarrow{AB} = 9\underset{\sim}{i} - 12\underset{\sim}{j}$ magnitude of $\overrightarrow{AB}$ $\left\lvert \overrightarrow{AB} \right\rvert =$ Unit vector in the direction of $\overrightarrow{AB}$ $\hat{\overrightarrow{AB}} =$ 15 ; $\frac{3}{5}\underset{\sim}{i} - \frac{4}{5}\underset{\sim}{j}$
(4) $\overrightarrow{PQ} = 15\underset{\sim}{i} - 8\underset{\sim}{j}$ magnitude of $\overrightarrow{PQ}$ $\left\lvert \overrightarrow{PQ} \right\rvert =$ Unit vector in the direction of $\overrightarrow{PQ}$ $\hat{\overrightarrow{PQ}} =$ 17 ; $\frac{15}{17}\underset{\sim}{i} - \frac{8}{17}\underset{\sim}{j}$	(5) $\underset{\sim}{a} = -4\underset{\sim}{i} + 3\underset{\sim}{j}$ magnitude of $\underset{\sim}{a}$ $\lvert \underset{\sim}{a} \rvert =$ Unit vector in the direction of $\underset{\sim}{a}$ $\underset{\sim}{\hat{a}} =$ 5 ; $-\frac{4}{5}\underset{\sim}{i} + \frac{3}{5}\underset{\sim}{j}$	(6) $\underset{\sim}{b} = -7\underset{\sim}{i} + 24\underset{\sim}{j}$ magnitude of $\underset{\sim}{b}$ $\lvert \underset{\sim}{b} \rvert =$ Unit vector in the direction of $\underset{\sim}{b}$ $\underset{\sim}{\hat{b}} =$ 25 ; $-\frac{7}{25}\underset{\sim}{i} + \frac{24}{25}\underset{\sim}{j}$

Task 2 : For each of the following vectors in the form $\begin{pmatrix} x \\ y \end{pmatrix}$, find the magnitude and the unit vector in the direction of the given vector.

(1) $\overrightarrow{PQ} = \begin{pmatrix} 8 \\ 6 \end{pmatrix}$ magnitude of $\overrightarrow{PQ}$ $\left\lvert \overrightarrow{PQ} \right\rvert =$ Unit vector in the direction of $\overrightarrow{PQ}$ $\hat{\overrightarrow{PQ}} =$ 10 ; $\begin{pmatrix} \frac{4}{5} \\ \frac{3}{5} \end{pmatrix}$	(2) $\overrightarrow{ST} = \begin{pmatrix} 15 \\ -8 \end{pmatrix}$ magnitude of $\overrightarrow{ST}$ $\left\lvert \overrightarrow{ST} \right\rvert =$ Unit vector in the direction of $\overrightarrow{ST}$ $\hat{\overrightarrow{ST}} =$ 17 ; $\begin{pmatrix} \frac{15}{17} \\ -\frac{8}{17} \end{pmatrix}$	(3)) $\overrightarrow{CD} = \begin{pmatrix} -6 \\ 8 \end{pmatrix}$ magnitude of $\overrightarrow{CD}$ $\left\lvert \overrightarrow{CD} \right\rvert =$ Unit vector in the direction of $\overrightarrow{CD}$ $\hat{\overrightarrow{CD}} =$ 10 ; $\begin{pmatrix} -\frac{3}{5} \\ \frac{4}{5} \end{pmatrix}$
(4) $\overrightarrow{VW} = \begin{pmatrix} -9 \\ -40 \end{pmatrix}$ magnitude of $\overrightarrow{VW}$ $\left\lvert \overrightarrow{VW} \right\rvert =$ Unit vector in the direction of $\overrightarrow{VW}$ $\hat{\overrightarrow{VW}} =$ 41 ; $\begin{pmatrix} -\frac{9}{41} \\ -\frac{40}{41} \end{pmatrix}$	(5) $\underset{\sim}{u} = \begin{pmatrix} -12 \\ -9 \end{pmatrix}$ magnitude of $\underset{\sim}{u}$ $\lvert \underset{\sim}{u} \rvert =$ Unit vector in the direction of $\underset{\sim}{u}$ $\underset{\sim}{\hat{u}} =$ 15 ; $\begin{pmatrix} -\frac{4}{5} \\ -\frac{3}{5} \end{pmatrix}$	(6) $\underset{\sim}{v} = \begin{pmatrix} -24 \\ 7 \end{pmatrix}$ magnitude of $\underset{\sim}{v}$ $\lvert \underset{\sim}{v} \rvert =$ Unit vector in the direction of $\underset{\sim}{v}$ $\underset{\sim}{\hat{v}} =$ 25 ; $\begin{pmatrix} -\frac{24}{25} \\ \frac{7}{25} \end{pmatrix}$

VECTORS

3.4 – 3.7 Addition, Subtraction and Multiplication of Vectors

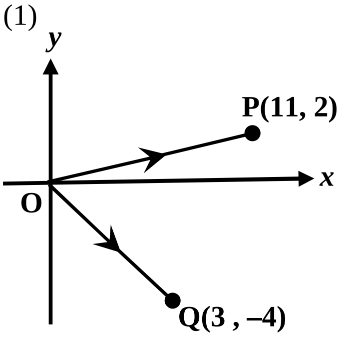
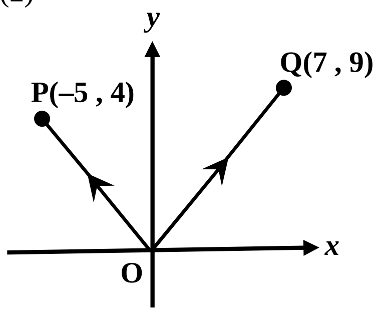
Task 1 : Given $\underset{\sim}{a} = 2\underset{\sim}{i} + 5\underset{\sim}{j}$, $\underset{\sim}{b} = \underset{\sim}{i} - 4\underset{\sim}{j}$ and $\underset{\sim}{c} = -3\underset{\sim}{i} + 7\underset{\sim}{j}$, find the following vectors in terms of $\underset{\sim}{i}$ and $\underset{\sim}{j}$.

(1) $2\underset{\sim}{b}$ $=$ $2\underset{\sim}{i} - 8\underset{\sim}{j}$	(2) $3\underset{\sim}{a}$ $=$ $6\underset{\sim}{i} + 15\underset{\sim}{j}$	(3) $4\underset{\sim}{c}$ $=$ $-12\underset{\sim}{i} + 28\underset{\sim}{j}$
(4) $\frac{1}{2}\underset{\sim}{a}$ $=$ $\underset{\sim}{i} + \frac{5}{2}\underset{\sim}{j}$	(5) $\underset{\sim}{a} + 3\underset{\sim}{b}$ $=$ $5\underset{\sim}{i} - 7\underset{\sim}{j}$	(6) $2\underset{\sim}{a} + \underset{\sim}{b}$ $=$ $5\underset{\sim}{i} + 6\underset{\sim}{j}$
(7) $\underset{\sim}{b} + \underset{\sim}{c}$ $=$ $-2\underset{\sim}{i} - 3\underset{\sim}{j}$	(8) $\frac{1}{2}\underset{\sim}{b} + \underset{\sim}{a}$ $=$ $\frac{5}{2}\underset{\sim}{i} + 3\underset{\sim}{j}$	(9) $\underset{\sim}{a} - 3\underset{\sim}{b}$ $=$ $-\underset{\sim}{i} + 17\underset{\sim}{j}$
(10) $4\underset{\sim}{b} - \underset{\sim}{c}$ $=$ $7\underset{\sim}{i} - 23\underset{\sim}{j}$	(11) $3\underset{\sim}{c} - 2\underset{\sim}{a}$ $=$ $-13\underset{\sim}{i} + 11\underset{\sim}{j}$	(12) $\underset{\sim}{b} - \frac{1}{2}\underset{\sim}{a}$ $=$ $-\frac{13}{2}\underset{\sim}{j}$

Task 2 : Given $\underset{\sim}{a} = \begin{pmatrix} 3 \\ 4 \end{pmatrix}$, $\underset{\sim}{b} = \begin{pmatrix} -2 \\ 5 \end{pmatrix}$ and $\underset{\sim}{c} = \begin{pmatrix} 6 \\ -1 \end{pmatrix}$, express the following in the form of $\begin{pmatrix} x \\ y \end{pmatrix}$.

(1) $4\underset{\sim}{b}$ $=$ $\begin{pmatrix} -8 \\ 20 \end{pmatrix}$	(2) $2\underset{\sim}{c}$ $=$ $\begin{pmatrix} 12 \\ -2 \end{pmatrix}$	(3) $\frac{1}{2}\underset{\sim}{a}$ $=$ $\begin{pmatrix} \frac{3}{2} \\ 2 \end{pmatrix}$
(4) $2\underset{\sim}{a} + \underset{\sim}{b}$ $=$ $\begin{pmatrix} 4 \\ 13 \end{pmatrix}$	(5) $\underset{\sim}{b} + 3\underset{\sim}{c}$ $=$ $\begin{pmatrix} 16 \\ 2 \end{pmatrix}$	(6) $2\underset{\sim}{c} + \underset{\sim}{a}$ $=$ $\begin{pmatrix} 15 \\ 2 \end{pmatrix}$
(7) $3\underset{\sim}{a} - \underset{\sim}{b}$ $=$ $\begin{pmatrix} 11 \\ 7 \end{pmatrix}$	(8) $2\underset{\sim}{b} - \underset{\sim}{c}$ $=$ $\begin{pmatrix} -10 \\ 11 \end{pmatrix}$	(9) $\underset{\sim}{c} - 2\underset{\sim}{a}$ $=$ $\begin{pmatrix} 0 \\ -9 \end{pmatrix}$
(10) $3\underset{\sim}{c} - 2\underset{\sim}{b}$ $=$ $\begin{pmatrix} 22 \\ -13 \end{pmatrix}$	(11) $3\underset{\sim}{b} + \underset{\sim}{a}$ $=$ $\begin{pmatrix} -3 \\ 19 \end{pmatrix}$	(12) $4\underset{\sim}{a} - \underset{\sim}{c}$ $=$ $\begin{pmatrix} 6 \\ 17 \end{pmatrix}$

Task 3 : Write vector $\overrightarrow{PQ}$ in the form $\begin{pmatrix} x \\ y \end{pmatrix}$ and determine its magnitude. Hence, find the unit vector in the direction of vector $\overrightarrow{PQ}$.

(1)  $\begin{pmatrix} -8 \\ -6 \end{pmatrix}$; 10 ; $\begin{pmatrix} -\frac{4}{5} \\ -\frac{3}{5} \end{pmatrix}$	(2)  $\begin{pmatrix} 12 \\ 5 \end{pmatrix}$; 13 ; $\begin{pmatrix} \frac{12}{13} \\ \frac{5}{13} \end{pmatrix}$

Task 4 : Write vector $\overrightarrow{AB}$ in terms of $\underset{\sim}{i}$ and $\underset{\sim}{j}$ and find its magnitude. Hence, find the unit vector in the direction of vector $\overrightarrow{AB}$.

(1) $O(0 , 0)$, $A(4 , –30)$ and $B(–3 , –6)$.	(2) $O(0 , 0)$, $A(–5 , 2)$ and $B(3 , –4)$.
$-7\underset{\sim}{i}+24\underset{\sim}{j}$; 25 ; $-\frac{7}{25}\underset{\sim}{i}+\frac{24}{25}\underset{\sim}{j}$	$8\underset{\sim}{i}-6\underset{\sim}{j}$; 10 ; $\frac{4}{5}\underset{\sim}{i}-\frac{3}{5}\underset{\sim}{j}$

Task 5 : Given $\underset{\sim}{a}=3\underset{\sim}{i}+4\underset{\sim}{j}$, $\underset{\sim}{b}=2\underset{\sim}{i}-\underset{\sim}{j}$ and $\underset{\sim}{c}=-\underset{\sim}{i}+5\underset{\sim}{j}$, find in terms of $\underset{\sim}{i}$ and $\underset{\sim}{j}$, the unit vector in the direction of the vectors below.

(1) $2\underset{\sim}{a}-\underset{\sim}{b}-\underset{\sim}{c}$	(2) $3\underset{\sim}{a}-2\underset{\sim}{b}+\underset{\sim}{c}$
$5\underset{\sim}{i}+4\underset{\sim}{j}$; $\sqrt{41}$; $\frac{5}{\sqrt{41}}\underset{\sim}{i}+\frac{4}{\sqrt{41}}\underset{\sim}{j}$	$4\underset{\sim}{i}+19\underset{\sim}{j}$; $\sqrt{377}$; $\frac{4}{\sqrt{377}}\underset{\sim}{i}+\frac{19}{\sqrt{377}}\underset{\sim}{j}$