The point O is to be taken as the origin $O(0, 0)$.

■ A. Write the vector equation for the line through the points given.

[1] $A(2, 3)$, $B(7, 13)$

[2] $A(-5, 3)$, $B(2, -9)$

[3] $P(-17, -30)$, $Q(-3, -9)$

[4] $P(12, -13)$, $Q(3, -16)$

[5] $R(5, 7)$, $S(-8, -15)$

■ B. Answer the following

[1] If ABCD is a parallelogram where $A(3, 7)$, $B(5, 7)$, $C(5, 2)$. Find the coordinates of the point D.

[2] Points A, B, and C are collinear and the distance from A to C is 5 times the distance from A to B. If the coordinates of A and B are $A(-2, 5)$, $B(7, -11)$, find the coordinates of point C.

[3] Points A, B, and C are collinear and the distance from A to C is $\frac{1}{10}$ the distance from A to B. If the coordinates of A and B are $A(-2, 5)$, $B(7, -11)$, find the coordinates of point C.

[4] Find the unit vector of $\vec{v} = \begin{bmatrix} 3 \\ 7 \end{bmatrix}$

[5] Find the unit vector of $\vec{v} = \begin{bmatrix} -5 \\ 12 \end{bmatrix}$

■ C. Answer the following. Assume that $g = 10\ \frac{m}{s^2}$.

[1] A 2 kg block is carried to the top of a ramp of height 12m. What is the work done in lifting the block?

[2] A 2 kg block is carried to the top of a spiral staircase of height 15m. What is the potential energy of the block?

[3] A 6 kg block is carried to the top of a spiral staircase of height 10m. It is then droped. What is the velocity of the block when it hits the floor at the bottom of the stairs?

[08-02-18-T-Phy]

A. [1] $\vec{r} = \langle 2,3\rangle + t\langle 5,10\rangle$

$= \langle 2,3\rangle + t\langle 1,2\rangle$

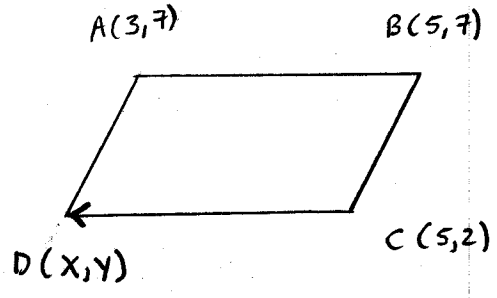
[2] $\vec{r} = \langle -5,3\rangle + t\langle 7,-12\rangle$

[3] $\vec{r} = \langle -17,-30\rangle + t\langle 14,21\rangle$

[4] $\vec{r} = \langle 12,-13\rangle + t\langle -9,-3\rangle$

[5] $\vec{r} = \langle 5,7\rangle + t\langle -13,-22\rangle$

B [1]



SOLN (one of many)

$\vec{OD} = \vec{OC} + \vec{CD}$

$\vec{CD} = \vec{BA}$, $\because$ ABCD parallelogram (opposite sides equal and parallel)

$\vec{OD} = \vec{OC} + \vec{BA}$

$= \begin{bmatrix} 5 \\ 2 \end{bmatrix} + \begin{bmatrix} -2 \\ 0 \end{bmatrix}$

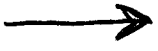
$\vec{OD} = \begin{bmatrix} 3 \\ 2 \end{bmatrix}$

$\therefore$ D (3,2)

[2] $\vec{OC} = \vec{OA} + 5\vec{AB}$

$= \langle -2,5\rangle + 5\langle 9,-16\rangle$

$= \langle 43,-75\rangle$



[3] $\vec{OC} = \vec{OA} + \frac{1}{10}\vec{AB}$

$= \langle -2, 5 \rangle + \frac{1}{10}\langle 9, -16 \rangle$

$= \langle -1.1, 3.4 \rangle$

[4] $\frac{\vec{v}}{|\vec{v}|} = \frac{\langle 3, 7 \rangle}{\sqrt{9+49}} = \left\langle \frac{3}{\sqrt{58}}, \frac{7}{\sqrt{58}} \right\rangle$

[5] $\hat{v} = \frac{\vec{v}}{|\vec{v}|} = \frac{\langle -5, 12 \rangle}{\sqrt{169}} = \left\langle \frac{-5}{13}, \frac{12}{13} \right\rangle$

C. [1] $W = \vec{F} \cdot \vec{d} = 2(kg)\left(10 \frac{m}{s^2}\right)(12\,m) = 240\ Nm = 240\ J$

[2] $U = mgh = (2\,kg)(10\ m\,s^{-2})(15\,m) = 300\ J$

[3] U at top $= mgh = (6\,kg)(10\ m\,s^{-2})(10\,m)$

$= 600\ J$

Droped. At bottom ($h=0$) all potential energy converted to kinetic energy.

So,

$mgh = \frac{1}{2}mv^2$

$\Rightarrow v^2 = 2gh\ \frac{m}{s^2} \cdot m$

$= \sqrt{2\left(10 \frac{m}{s^2}\right)(10\,m)}$

$= \sqrt{200}\ \frac{m}{s}$

$\therefore v = 10\sqrt{2}\ m/s$

$\approx 14.14\ \frac{m}{s}$