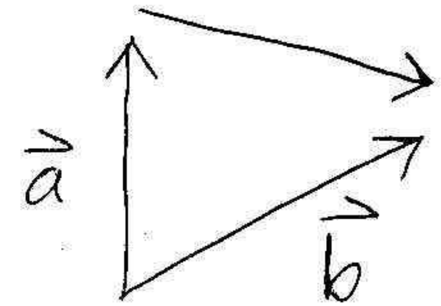
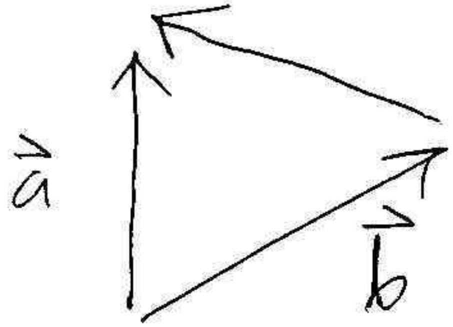
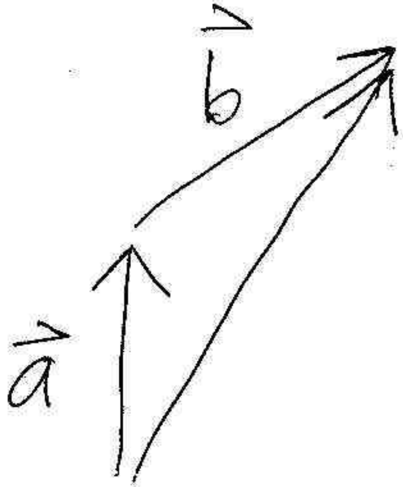
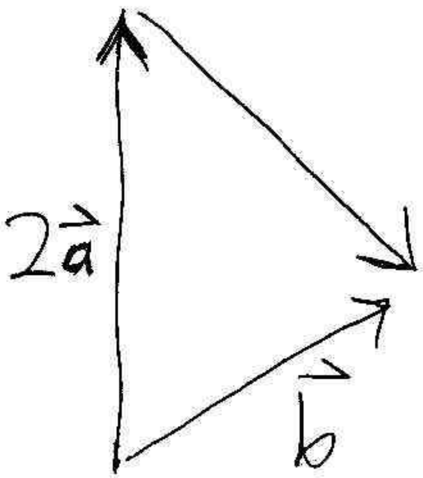
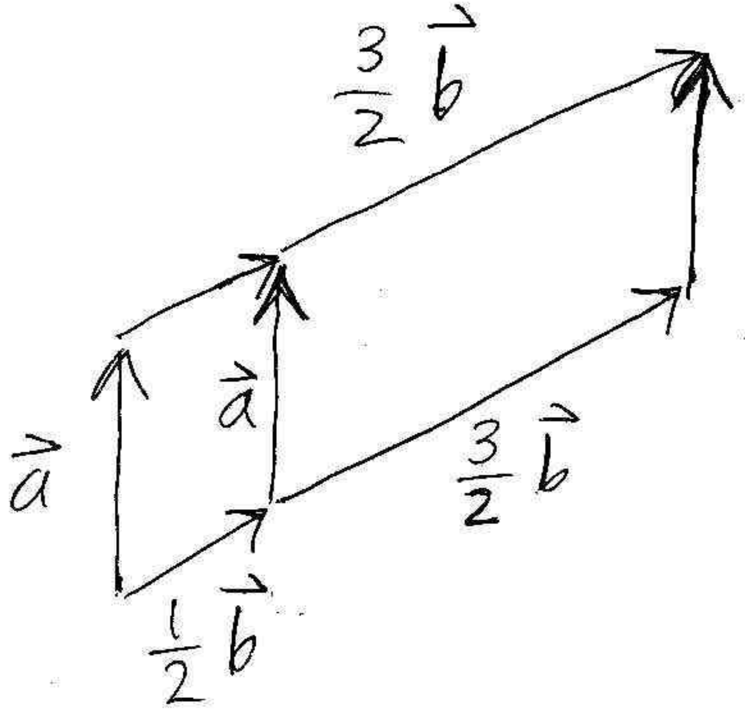
HW1 Label the unlabeled arrows.











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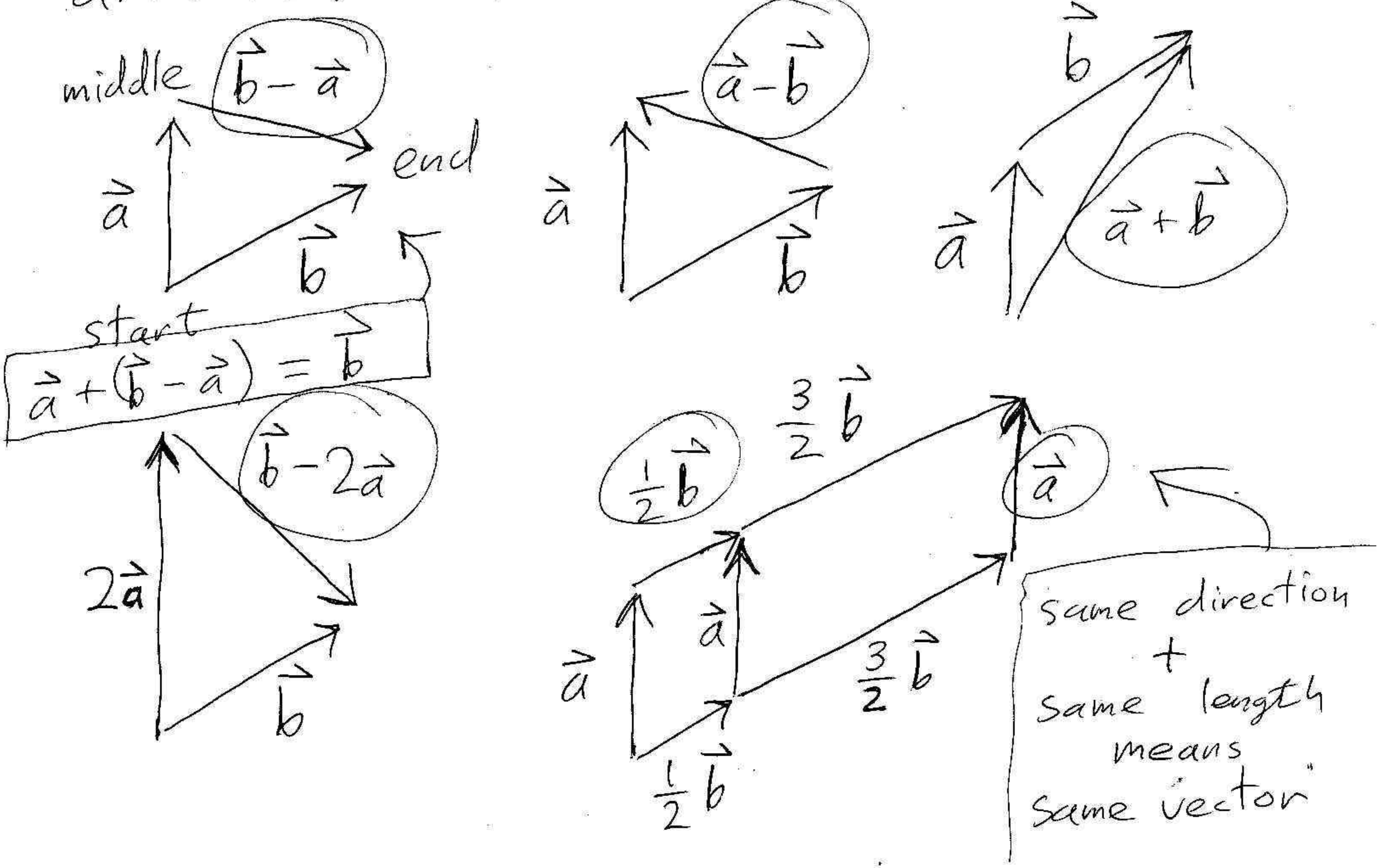


HW 2

1. Find the magnitude of each of these 5 vectors:

   $\vec{i}$, $-4\vec{j}$, $\vec{k}+\vec{j}$, $\langle 7, 2, 1 \rangle$, $\langle -3, 8, 6 \rangle$.

2. "I went 30 miles west, then 50 miles north, then 1 mile up."
   Describe the net displacement of the above path with a vector. (You decide how to define the coordinate system.)

3. Rotate $-2\vec{j}$ 60° clockwise.

4. Find a vector of length 5 parallel to your solution to 3.

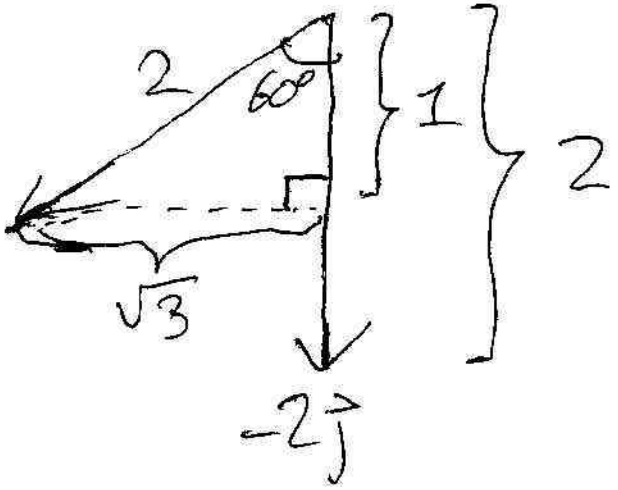
HW 2

(1) $1,\ 4,\ \sqrt{2},\ \sqrt{54},\ \sqrt{109}$.

(In general $|a\vec{\imath}+b\vec{\jmath}+c\vec{k}| = |\langle a,b,c\rangle| = \sqrt{a^2+b^2+c^2}$.)

(2) $\langle -30, 50, 1\rangle$ <u>if</u> $\vec{\imath} = 1$ mile east, $\vec{\jmath} = 1$ mile north, and $\vec{k} = 1$ mile up.

(3)



$-2\vec{\jmath}$ rotated $60°$ (clockwise) is

$-\vec{\imath}\cdot 2\sin 60° - \vec{\jmath}\cdot 2\cos 60°$,

or $\langle -\sqrt{3}, -1\rangle$.

(4) $(5/2)\langle -\sqrt{3}, -1\rangle$ or $\left\langle -\frac{5\sqrt{3}}{6}, -\frac{5}{2}\right\rangle$.

HW 3

① There are two unit vectors perpendicular to $\langle 3, 4\rangle$. Find them.

② If $\langle 1,2,4\rangle \perp \langle 5,4,x\rangle$, what is x?

③ If $|\vec{a}| = 8$, $\vec{a}\cdot\vec{b} = 5$, and $\angle(\vec{a},\vec{b}) = \pi/6$, then what is $|\vec{b}|$?

④ If $\angle(\vec{c},\vec{d}) = \frac{2\pi}{3}$, what can we say about $\vec{c}\cdot\vec{d}$?

⑤ Compute $\angle(\langle 3,4,5\rangle, \langle 4,5,-6\rangle)$ in radians to at least six significant figures.

HW3

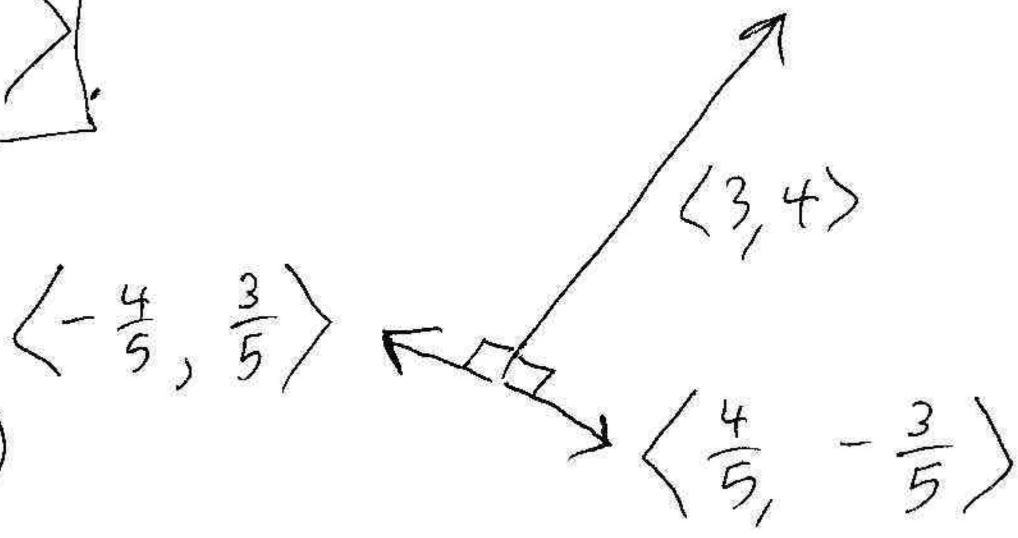
① We need $0 = \langle a, b \rangle \cdot \langle 3, 4 \rangle$
$= 3a + 4b.$

Choosing $a = 1$, we get $b = -3/4$.

But $|\langle a, b \rangle| = \sqrt{1^2 + (3/4)^2} = 5/4$.

To get a unit vector $\perp \langle 3, 4 \rangle$, we multiply $\langle a, b \rangle$ by $\frac{4}{5}$ to get $\boxed{\left\langle \frac{4}{5}, -\frac{3}{5} \right\rangle}$.

The other unit vector $\perp \langle 3, 4 \rangle$ is $\boxed{\left\langle -\frac{4}{5}, \frac{3}{5} \right\rangle}$.



(Sketch optional.)

(2) $0 = \langle 1, 2, 4 \rangle \cdot \langle 5, 4, x \rangle = 5 + 8 + 4x.$

So, $x = -13/4.$

(3) $|\vec{a}||\vec{b}| \cos \angle(\vec{a}, \vec{b}) = \vec{a} \cdot \vec{b}$

$$\Rightarrow 8 |\vec{b}| \underbrace{\cos \underbrace{\pi/6}_{30^\circ}}_{\sqrt{3}/2} = 5 \Rightarrow |\vec{b}| = \frac{5}{4\sqrt{3}}$$

(4) $2\pi/3 > \pi/2 = 90^\circ$, so $\cos \frac{2\pi}{3} < 0$,

so $\vec{c} \cdot \vec{d} < 0.$

(5) $$\cos^{-1} \frac{3 \cdot 4 + 4 \cdot 5 + 5 \cdot (-6)}{\sqrt{3^2+4^2+5^2}\sqrt{4^2+5^2+6^2}} \approx 1.53856$$

(That's about 88°.)

HW4

(1) Find the part of $\langle 0, 0, 14\rangle$ perpendicular to $\langle -1, -2, 3\rangle$.

(2) Given $\vec{u} = \langle 1, 2\rangle$ and $\vec{v} = \langle 3, 4\rangle$, find $\mathrm{proj}_{\vec{u}}\,\vec{v}$ and $\mathrm{proj}_{\vec{v}}\,\vec{u}$. Then sketch (and label) two vector addition triangles, one for each equation below:

$$\mathrm{proj}_{\vec{u}}\,\vec{v} + \mathrm{orth}_{\vec{u}}\,\vec{v} = \vec{v}$$

$$\mathrm{proj}_{\vec{v}}\,\vec{u} + \mathrm{orth}_{\vec{v}}\,\vec{u} = \vec{u}$$

HW4

(1) $\vec{u} = \langle -1, -2, 3 \rangle$. $\vec{v} = \langle 0, 0, 14 \rangle$.

$$\text{orth}_{\vec{u}} \vec{v} = \vec{v} - \frac{\vec{u}\cdot\vec{v}}{|\vec{u}|^2}\vec{u} = \langle 0,0,14\rangle - \frac{42}{14}\langle -1, -2, 3\rangle$$

$$= \langle 3, 6, 5 \rangle$$

(2) $$\text{proj}_{\vec{u}} \vec{v} = \frac{\vec{u}\cdot\vec{v}}{|\vec{u}|^2}\vec{u} = \frac{11}{5}\langle 1, 2\rangle \quad \text{or} \quad \langle 2.2, 4.4\rangle$$

$$\text{proj}_{\vec{v}} \vec{u} = \frac{\vec{u}\cdot\vec{v}}{|\vec{v}|^2}\vec{v} = \frac{11}{25}\langle 3, 4\rangle \quad \text{or} \quad \langle 1.32, 1.76\rangle$$