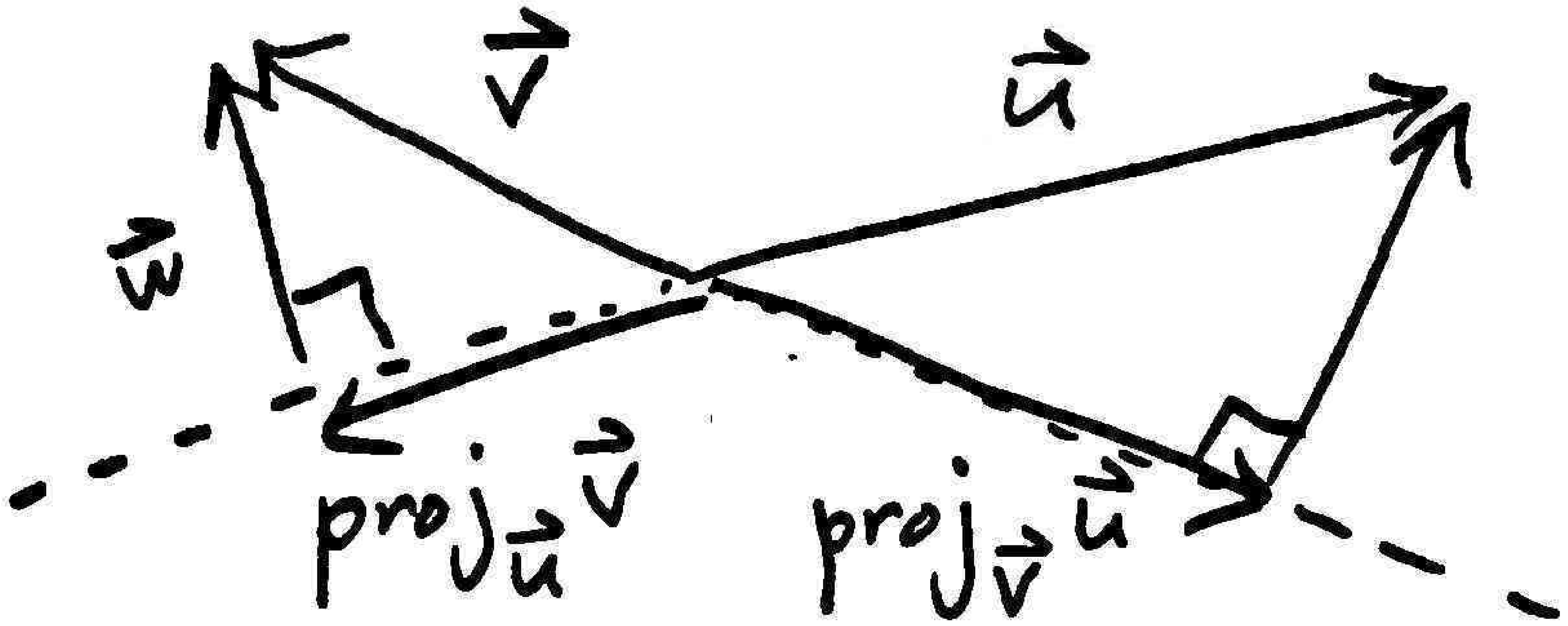
HW5

$\vec{u} = \langle 5, 1\rangle$

$\vec{v} = \langle -4, 2\rangle$

$$\text{proj}_{\vec{u}}\vec{v} = \frac{\vec{u}\cdot\vec{v}}{|\vec{u}|^2}\vec{u} = \frac{5(-4)+1(2)}{5^2+1^2}\langle 5, 1\rangle = \left\langle \frac{-90}{26}, \frac{-18}{26}\right\rangle$$

$$\text{proj}_{\vec{v}}\vec{u} = \frac{\vec{v}\cdot\vec{u}}{|\vec{v}|^2}\vec{v} = \frac{-4(5)+2(1)}{4^2+2^2}\langle -4, 2\rangle = \left\langle \frac{72}{20}, \frac{-36}{20}\right\rangle$$



The part of $\vec{v}$ perpendicular to $\vec{u}$ is

$$\vec{w} = \vec{v} - \text{proj}_{\vec{u}}\vec{v} = \left\langle \frac{-14}{26}, \frac{70}{26}\right\rangle.$$

HW6 ① $\underbrace{|\vec{u}\times\vec{v}|}_{7} = \underbrace{|\vec{u}|}_{5}\,|\vec{v}|\,\underbrace{\sin\underbrace{\angle(\vec{u},\vec{v})}_{\pi/6}}_{1/2}$

$\Rightarrow |\vec{v}| = 14/5$

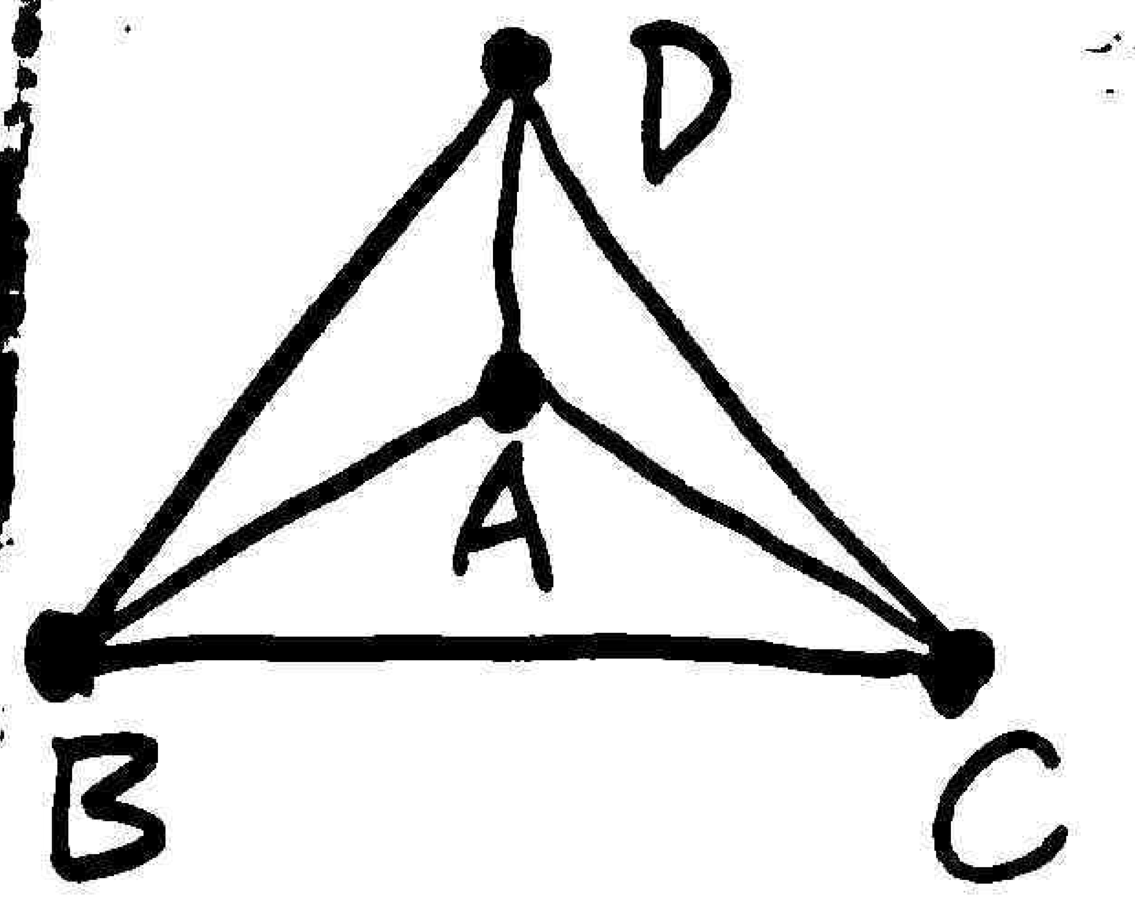
③ $\langle 1,2,3\rangle, \langle 0,7,1\rangle \perp \langle 1,2,3\rangle \times \langle 0,7,1\rangle$

$= \langle 2\cdot 1 - 3\cdot 7,\ 3\cdot 0 - 1\cdot 1,\ 1\cdot 7 - 2\cdot 0\rangle = \langle -19, -1, 7\rangle$

②

$\times$	$\vec{i}$	$\vec{j}$	$\vec{k}$
$\vec{i}$	$\vec{0}$	$\vec{k}$	$-\vec{j}$
$\vec{j}$	$-\vec{k}$	$\vec{0}$	$\vec{i}$
$\vec{k}$	$\vec{j}$	$-\vec{i}$	$\vec{0}$

HW7 $A=(0,1,0)$, $B=(3,3,3)$, $C=(5,0,0)$, $D=(0,0,4)$



total edge length $= |\overrightarrow{AB}| + |\overrightarrow{AC}| + |\overrightarrow{AD}| + |\overrightarrow{BC}| + |\overrightarrow{BD}| + |\overrightarrow{CD}| = \sqrt{22} + \sqrt{26} + \sqrt{17} + \sqrt{22} + \sqrt{19} + \sqrt{41} \approx 29.4$

$\overrightarrow{AB} = \langle 3-0, 3-1, 3-0 \rangle = \langle 3,2,3 \rangle \Rightarrow |\overrightarrow{AB}| = \sqrt{3^2+2^2+3^2} = \sqrt{22}$;

$\overrightarrow{AC} = \langle 5,-1,0 \rangle$; $\overrightarrow{AD} = \langle 0,-1,4 \rangle$; $\overrightarrow{BC} = \langle 2,-3,-3 \rangle$; $\overrightarrow{BD} = \langle -3,-3,1 \rangle$;

$\overrightarrow{CD} = \langle -5,0,4 \rangle$.

$$\text{surface area} = \frac{1}{2}\left(\overbrace{|\underbrace{\overrightarrow{AB} \times \overrightarrow{AC}}_{\langle -3,15,-13 \rangle}|}^{\triangle ABC} + \overbrace{|\underbrace{\overrightarrow{AB} \times \overrightarrow{AD}}_{\langle 11,-12,-3 \rangle}|}^{\triangle ABD} + \overbrace{|\underbrace{\overrightarrow{AC} \times \overrightarrow{AD}}_{\langle -4,-20,-5 \rangle}|}^{\triangle ACD} + \overbrace{|\underbrace{\overrightarrow{BC} \times \overrightarrow{BD}}_{\langle -12,7,-15 \rangle}|}^{\triangle BCD} \right)$$

$$= \frac{1}{2}\left(\sqrt{403} + \sqrt{274} + \sqrt{441} + \sqrt{418} \right) \approx 39.0$$

$$\text{volume} = \frac{1}{6} |\overrightarrow{AB} \cdot (\overrightarrow{AC} \times \overrightarrow{AD})| = \frac{1}{6} |-12-40-15| = \frac{67}{6} \approx 11.2$$

HW8 ① $x=t,\ y=t,\ z=t$ works.

② $(1,2,3) \in$ line $\parallel \langle 4-1, 5-2, 6-3 \rangle = \langle 3,3,3 \rangle$

$x = 1+3t,\quad y = 2+3t,\quad z = 3+3t$ works.

③ $(0,0,1) \in$ line $\parallel \langle 1,2,3 \rangle \times \langle 4,5,6 \rangle = \langle \overbrace{12-15}^{-3}, \overbrace{12-6}^{6}, \overbrace{5-8}^{-3} \rangle$

$x = 0-3t,\quad y = 0+6t,\quad z = 1-3t$ works.

(For ①, the symmetric equations for $x=y=z$ are

$$\frac{x-0}{1} = \frac{y-0}{1} = \frac{z-0}{1},$$ so $\langle x,y,z \rangle = \langle 0,0,0 \rangle + t\langle 1,1,1 \rangle$,

so $x = 0+1t,\quad y = 0+1t,\quad z = 0+1t$.)