1) Draw representatives of the following vectors on the grid provided.

a) $3\vec{v}$
b) $0.5\vec{v}$
c) $-2\vec{v}$
d) $-\vec{v}$
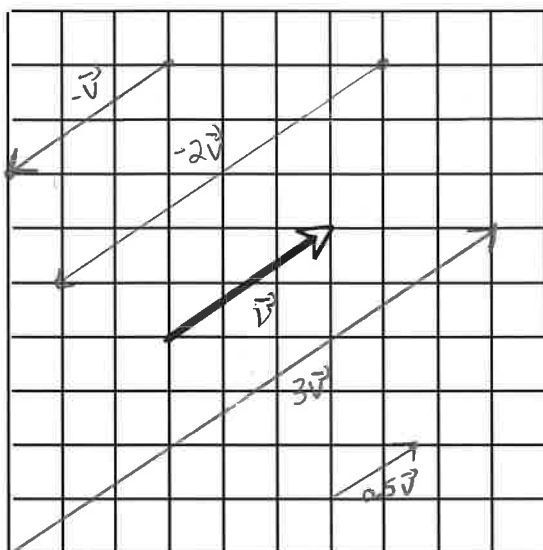
2) Simplify each of the following algebraically.

a) $\vec{a} + 2\vec{a} + 4\vec{a}$

$$= 7\vec{a}$$

b) $7\vec{u} + 5\vec{v} - 2\vec{u} + 8\vec{v}$

$$= 5\vec{u} + 13\vec{v}$$

c) $2(\vec{u} + \vec{v}) - 3(\vec{u} - 2\vec{v})$

$$= 2\vec{u} + 2\vec{v} - 3\vec{u} + 6\vec{v}$$
$$= -\vec{u} + 8\vec{v}$$

d) $7\vec{u} + 5\vec{v} - 2(\vec{u} - \vec{v}) + 2\vec{u}$

$$= 7\vec{u} + 5\vec{v} - 2\vec{u} + 2\vec{v} + 2\vec{u}$$
$$= 7\vec{u} + 7\vec{v}$$

e) $-3(\vec{u} + \vec{v}) + 2(\vec{u} - \vec{v})$

$$= -3\vec{u} - 3\vec{v} + 2\vec{u} - 2\vec{v}$$
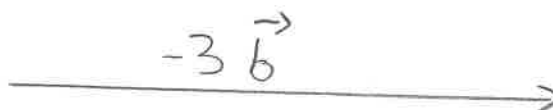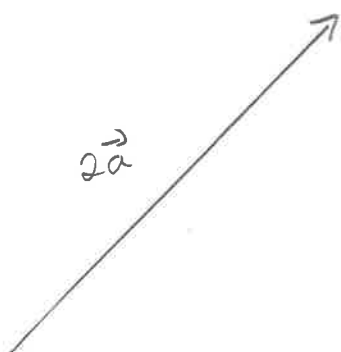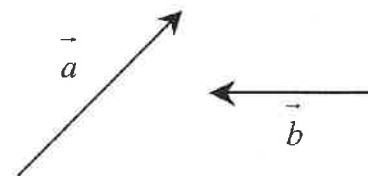$$= -\vec{u} - 5\vec{v}$$

f) $6(\vec{u} + 2\vec{v}) - 5(\vec{u} - 3\vec{v})$

$$= 6\vec{u} + 12\vec{v} - 5\vec{u} + 15\vec{v}$$
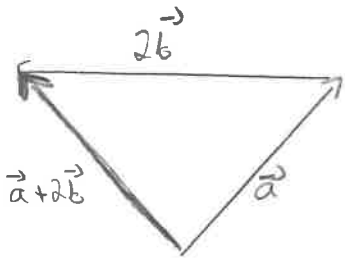$$= \vec{u} + 27\vec{v}$$

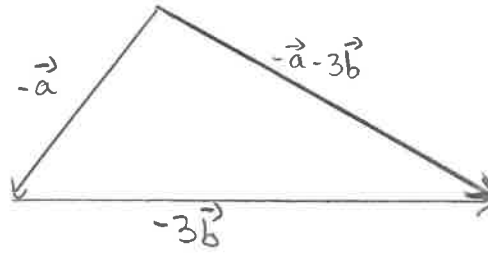**3)** For the vectors $\vec{a}$ and $\vec{b}$ shown, draw and label...

a) $2\vec{a}$

b) $-3\vec{b}$

c) $\vec{a} + 2\vec{b}$

$2\vec{b}$

$\vec{a} + 2\vec{b}$ $\vec{a}$
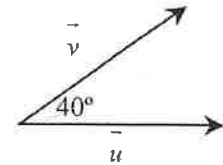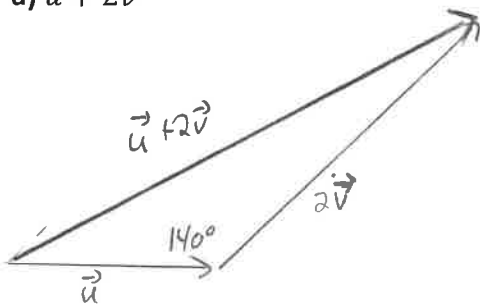
d) $-\vec{a} - 3\vec{b}$
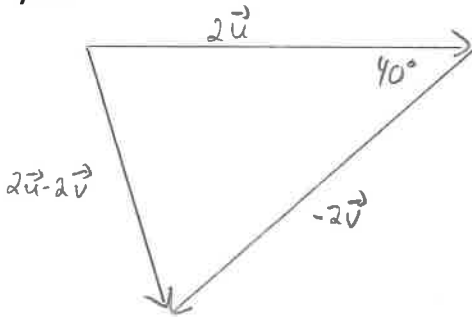
$-\vec{a}$ $-\vec{a} - 3\vec{b}$

$-3\vec{b}$

4) Two vectors $\vec{u}$ and $\vec{v}$ make an angle of 40° with each other.
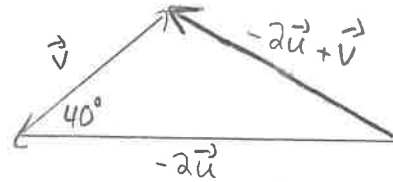Construct each vector sum or difference.

a) $\vec{u} + 2\vec{v}$

$\vec{u} + 2\vec{v}$

$2\vec{v}$

$140°$

$\vec{u}$

$\vec{v}$

$40°$

$\vec{u}$

) $2\vec{u} - 2\vec{v}$

$2\vec{u}$

$40°$

$2\vec{u} - 2\vec{v}$

$-2\vec{v}$

c) $-2\vec{u} + \vec{v}$

$\vec{v}$

$40°$

$-2\vec{u} + \vec{v}$

$-2\vec{u}$

5) In parallelogram ABCD, opposite sides are parallel and equal, $\overrightarrow{BP} = \overrightarrow{PA}$, and $\overrightarrow{AQ} = \overrightarrow{QD}$. Let $\overrightarrow{BP} = \vec{u}$ and $\overrightarrow{AQ} = \vec{v}$. Express the following vectors in terms of $\vec{u}$ and $\vec{v}$.
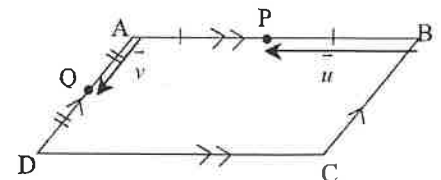
a) $\overrightarrow{AD}$

$= 2\vec{v}$

b) $\overrightarrow{PA}$

$= \vec{u}$

c) $\overrightarrow{CD}$

$= 2\vec{u}$

$\overrightarrow{PQ}$

$= \vec{u} + \vec{v}$

e) $\overrightarrow{BD}$

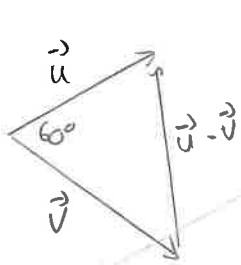$= 2\vec{v} + 2\vec{u}$

f) $\overrightarrow{PD}$

$= \vec{u} + 2\vec{v}$

g) $\overrightarrow{AC}$

$= 2\vec{v} - 2\vec{u}$

6) Given that $|\vec{u}| = 8$ and $|\vec{v}| = 10$ and the angle between $\vec{u}$ and $\vec{v}$ is 60° determine:
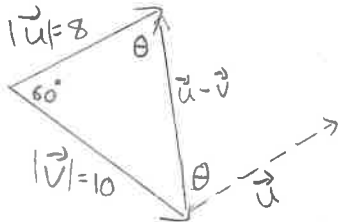
a) $|\vec{u} - \vec{v}|$

$|\vec{u}-\vec{v}|^2 = 8^2 + 10^2 - 2(8)(10)\cos(60°)$

$|\vec{u}-\vec{v}| = \sqrt{84}$

$|\vec{u} - \vec{v}| = 2\sqrt{21}$

b) the direction of $\vec{u} - \vec{v}$ relative to $\vec{u}$

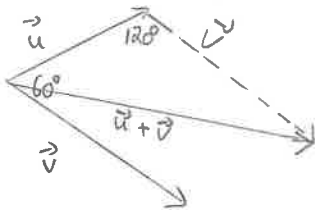$\dfrac{\sin\theta}{10} = \dfrac{\sin 60}{2\sqrt{21}}$

$\theta \approx 70.9°$

70.9° between $\vec{u}$ and $\vec{u}-\vec{v}$

c) the unit vector in the direction of $\vec{u} + \vec{v}$

$|\vec{u}+\vec{v}|^2 = 8^2 + 10^2 - 2(8)(10)\cos(120)$

$|\vec{u}+\vec{v}| = \sqrt{244}$

$|\vec{u}+\vec{v}| = 2\sqrt{61}$

unit vector: $\dfrac{1}{2\sqrt{61}}(\vec{u} + \vec{v})$

d) $|5\vec{u} + 2\vec{v}|$

$|5\vec{u}| = 40$

$|2\vec{v}| = 20$

$|5\vec{u}+2\vec{v}|^2 = 40^2 + 20^2 - 2(40)(20)\cos(120)$

$|5\vec{u}+2\vec{v}| = \sqrt{2800}$

$|5\vec{u}+2\vec{v}| = 20\sqrt{7}$

7) $|\vec{v}| = 2$. Draw the following factors and express each of them as a scalar multiple of $\vec{v}$.

a) A vector in the same direction as $\vec{v}$ with tice its magnitude
b) a vector in the same direction as $\vec{v}$ with one half its magnitude
c) a vector in the opposite direction as $\vec{v}$ with two-thirds its magnitude
d) a vector in the opposite direction as $\vec{v}$ with tice its magnitude
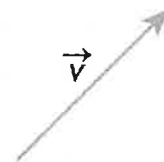**e)** a unit vector in the same direction as $\vec{v}$

a) $2\vec{v}$

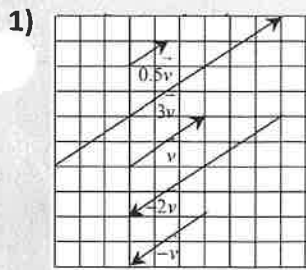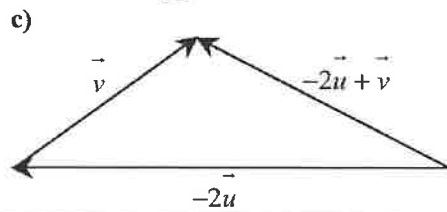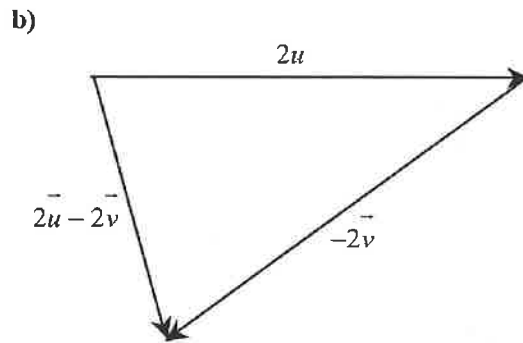b) $0.5\vec{v}$

c) $-\frac{2}{3}\vec{v}$

d) $-2\vec{v}$

e) $\frac{1}{|\vec{v}|}\vec{v}$

Answers:

1)

2)a) $7\vec{a}$ **b)** $5\vec{u} + 13\vec{v}$ **c)** $-\vec{u} + 8\vec{v}$ **d)** $7\vec{u} + 7\vec{v}$ **e)** $-\vec{u} - 5\vec{v}$ **f)** $\vec{u} + 27\vec{v}$

3)a)

$\vec{a}$

$2\vec{a}$

b)

$-3\vec{b}$

$\vec{b}$

c)

$2\vec{b}$

$\vec{a} + 2\vec{b}$

$\vec{a}$

d)

$-\vec{a}$

$-\vec{a} - 3\vec{b}$

$-3\vec{b}$

4. a)

$\vec{u} + 2\vec{v}$

$2\vec{v}$

$140°$

u

b)

$2u$

$2\vec{u} - 2\vec{v}$

$-2\vec{v}$

c)

$\vec{v}$

$-2\vec{u} + \vec{v}$

$-2\vec{u}$
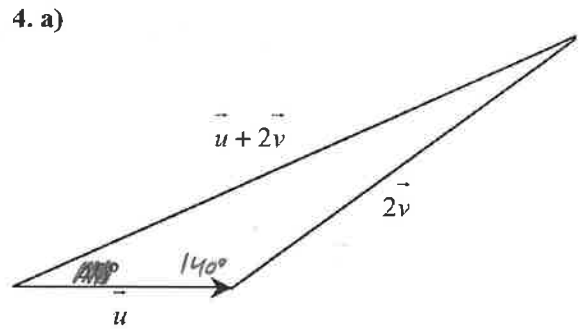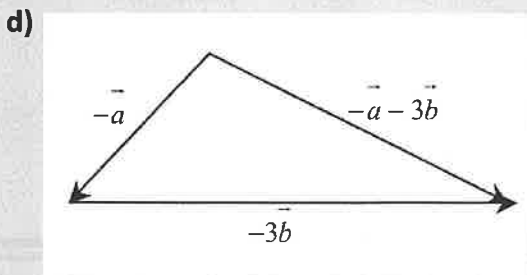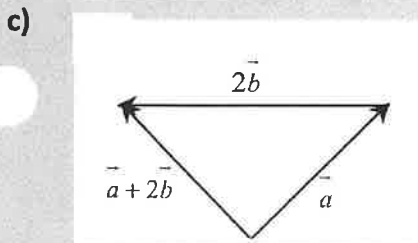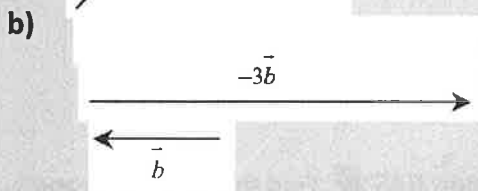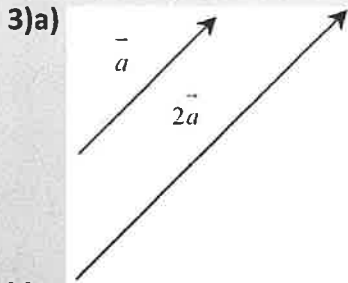
5)a) $2\vec{v}$ **b)** $\vec{u}$ **c)** $2\vec{u}$ **d)** $\vec{u} + \vec{v}$ **e)** $2\vec{u} + 2\vec{v}$ **f)** $\vec{u} + 2\vec{v}$ **g)** $2\vec{v} - 2\vec{u}$

6)a) $2\sqrt{21}$ **b)** $71°$ **c)** $\frac{1}{2\sqrt{6}}(\vec{u} + \vec{v})$ **d)** $20\sqrt{7}$

7) a.

$2\vec{v}$

b.

$\frac{1}{2}\vec{v}$

c.

$-\frac{2}{3}\vec{v}$

d.

$-2\vec{v}$

e.

$\frac{1}{|\vec{v}|}\vec{v}$