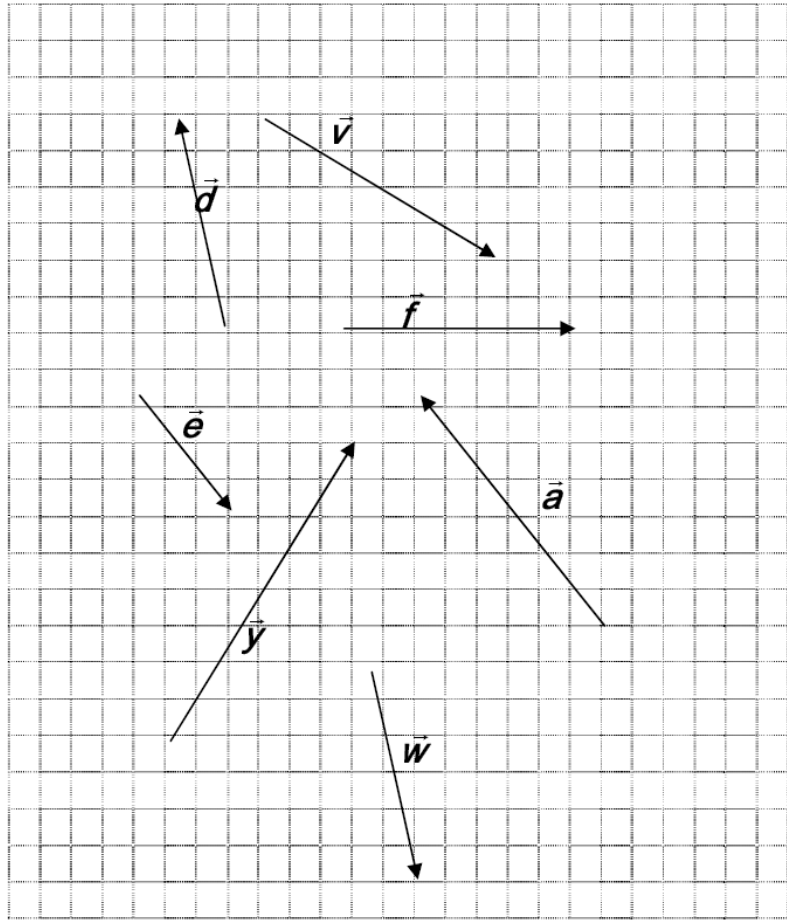**Question 1**

A) Identify two opposite vectors:

B) Identify two collinear vectors.

C) Identify two orthogonal vectors.

D) Identify a vector whose magnitude is 7 units.

E) Identify two vectors that form a vector basis.

Question 2

Given $\vec{u} = (a,b)$, $\vec{v} = (c,d)$ and k is a scalar number, verify is the following equations are true or false, and give the property that explains your answer.

a) $\dfrac{1}{k}(\vec{u} + \vec{v}) = \dfrac{\vec{u}}{k} + \dfrac{\vec{v}}{k}$

Property: _____

b) $\vec{u} \bullet \vec{v} = a \bullet c + b \bullet d$

Property: _____

c) $\vec{u} - \vec{v} = (a - c) + (b - d)$

Property: _____

Question 3

By using either the parallelogram or triangle method, determine the direction, the angle and the magnitude of the following operations:
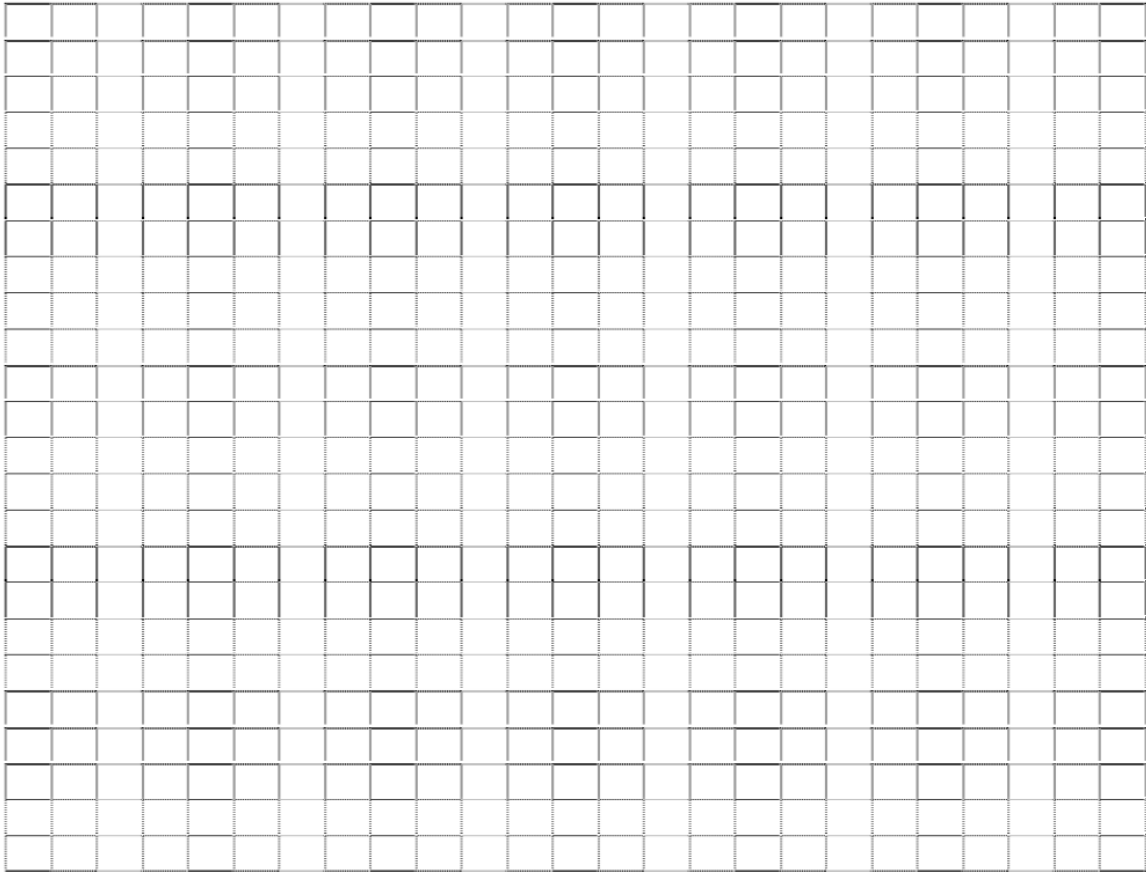
$$\left\| \vec{u} \right\| = 5 \qquad 30°E \text{ of } N$$

$$\left\| \vec{w} \right\| = 2 \qquad West$$

$$\left\| \vec{t} \right\| = 4 \qquad 60°W \text{ of } S$$
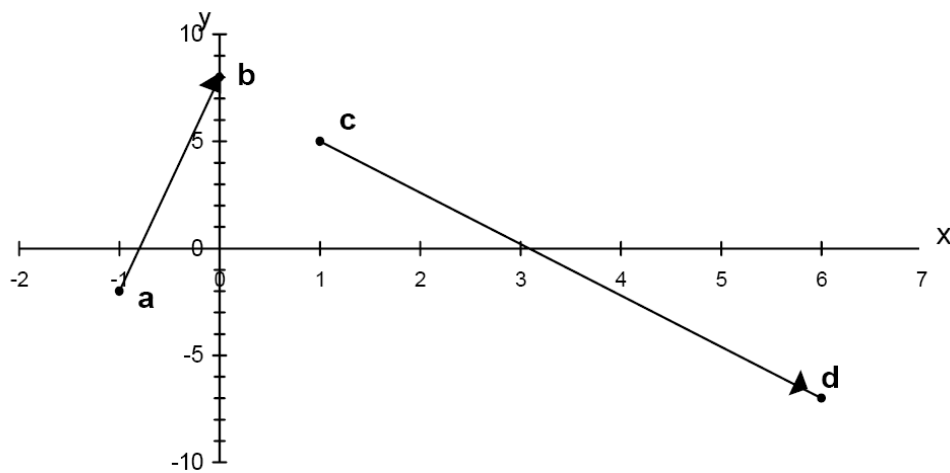
a) $\vec{w} + \vec{u}$ b) $\vec{t} - \vec{w}$

Question 4

Calculate the components of the resultant vector $\vec{r} = \vec{ab} + \vec{cd}$ algebraically.

Question 5

Calculate the magnitude of the resultant vector $\vec{r} = \vec{u} + \vec{v}$ given:

$\left\| \vec{u} \right\| = 6$ 20°E of N

$\left\| \vec{v} \right\| = 8$ 65°W of S

Question 6

Given:

$$\left\|\vec{u}\right\| = 3 \qquad 28°W \text{ of } N$$

$$\left\|\vec{v}\right\| = 6 \qquad \text{at } 156°$$

Find the angle between the resultant vector $\vec{r} = \vec{u} + \vec{v}$ and vector $\vec{u}$.
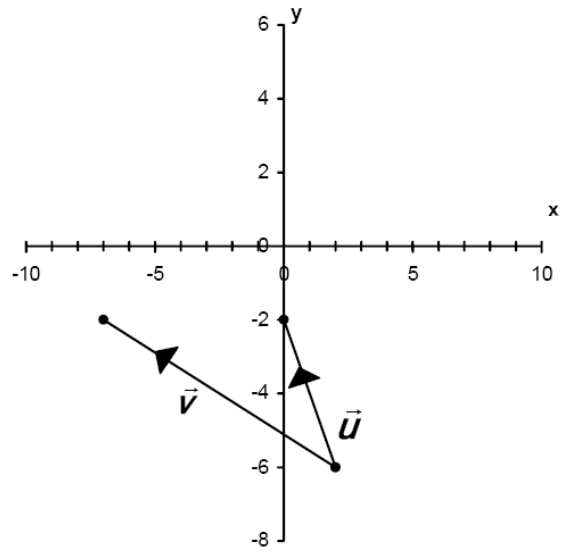
Question 7

Find the angle between vectors $\vec{u}$ and $\vec{w}$ resulting from the following linear combinations of vectors $\vec{r} = (2.5, -1)$ and $\vec{v} = (0, -5)$.

$$\vec{u} = 3\vec{v} - \frac{1}{5}\vec{r} \qquad\qquad \text{and} \qquad\qquad \vec{w} = \frac{1}{10}\vec{v} + 4\vec{r}$$

Question 8

Find the coefficients of linear combination that allow us to express vector $\vec{w} = (-4,5)$ in terms of the basis vectors $\vec{r} = (6,-15)$ and $\vec{s} = (1,2)$.
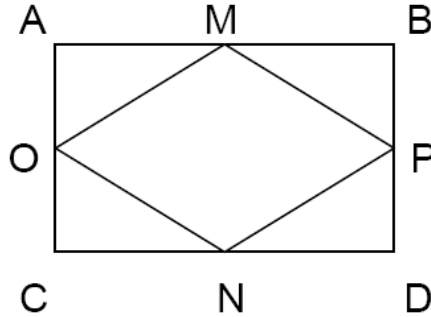
Question 9

Find the scalar product of the two following vectors.

$\left\| \vec{u} \right\| = 6$, E 20°S

$\left\| \vec{v} \right\| = 2$, E 70°N

Question 10

Complete the following proof. Show that if we join the middle point of the adjacent sides of a rectangle, we obtain a Rhombus. Write the affirmations and justifications in the space provided.

Hypothesis   Justification

AB = CD   _____

AC = ____   _____

CN = ND

___ = ___   _____

___ = ___

___ = ___

To show that OM = _____ = MP = _____

Proof

1. AB = _____

2. CD = _____

3. AM + MB = CN + ND because _____

4. $\dfrac{2AM}{2} = \dfrac{2CN}{2}$ because _____

5. AO + ____ = CO + _____

6. OM = ON because _____

Question 11

Given triangle ABC, point M is the mid-point of side BC and $\overrightarrow{AM}, \overrightarrow{AB}, \overrightarrow{AC}$ are vectors.
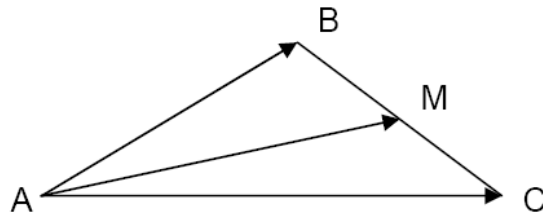
Using Chasles' principle, prove that:

$$\overrightarrow{AM} = \frac{1}{2}\overrightarrow{AB} + \frac{1}{2}\overrightarrow{AC}$$

Question 12

Given the following cube, whose sides measure 1 unit in length:
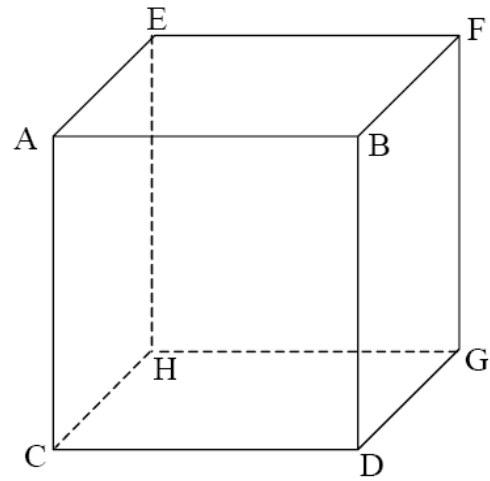
Determine the false statements below, and correct them.

a) $\vec{AB} + \vec{CH} = \vec{AF}$

b) $\vec{AB} + \vec{EF} = 2\vec{AB}$

c) $\vec{DB} - \vec{FH} = \vec{0}$

d) $\vec{AB} + 2\vec{CE} + \vec{HG} = \vec{CF}$

e) $\vec{DB} - \vec{FG} + \vec{CD} - \vec{FE} = 2\vec{CB}$

f) $\vec{FA} + \vec{FH} + \vec{FD} = 2\vec{FC}$

Question 13

A) A fly, influenced by extreme sports, moves at a speed of 2.5 km/h. It flies by a spider web 24 cm long. The wind is blowing perpendicularly to its trajectory at a speed of 3.5 km/h, bringing the fly dangerously close to the spider web.

Calculate the distance between the fly's trajectory and the spider web.

Wind

24 cm

S
P
I
D
E
R

W
E
B

d
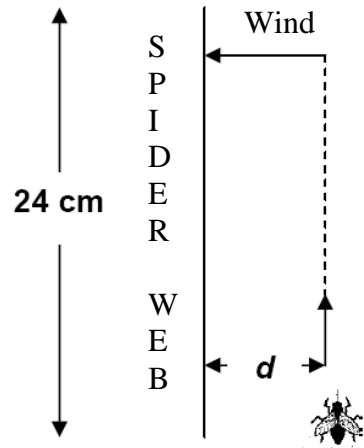
B) A package of mass 50N is suspended using two ropes that can support a maximum force of 35N each. (Force is a vector quantity that takes into account the mass of an object on Earth and it is measured in Newtons (N))
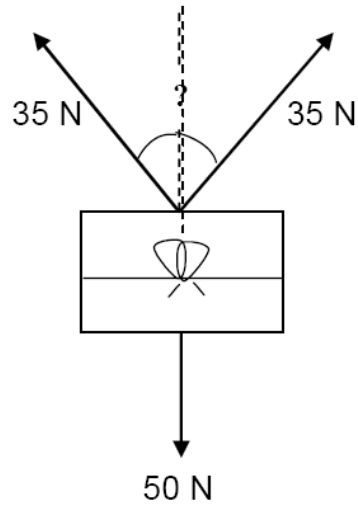
What is the maximum angle between the two ropes to avoid them breaking? (Make a sketch representing the forces)