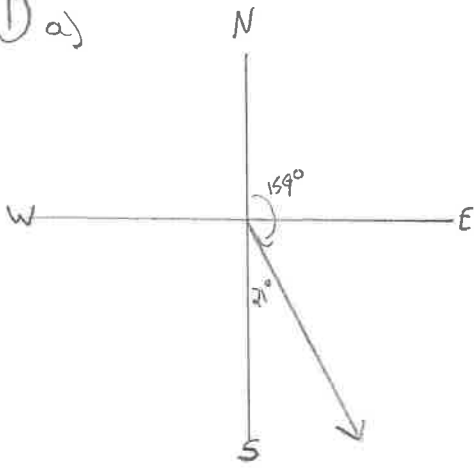


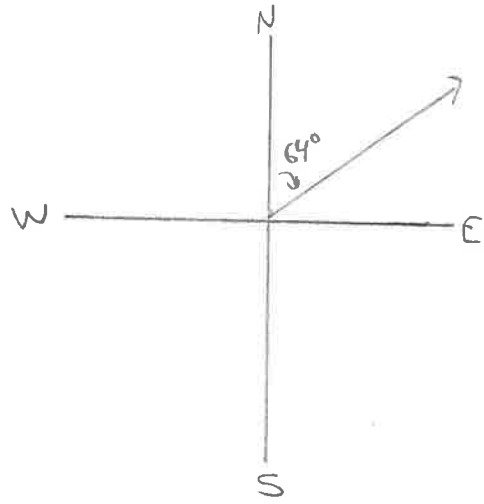
# UNIT 4 PRE-TEST - GEOMETRIC VECTORS

① a)



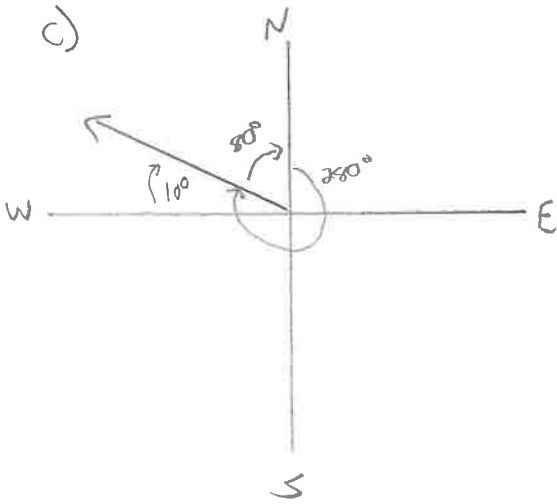
S 21° E

b)



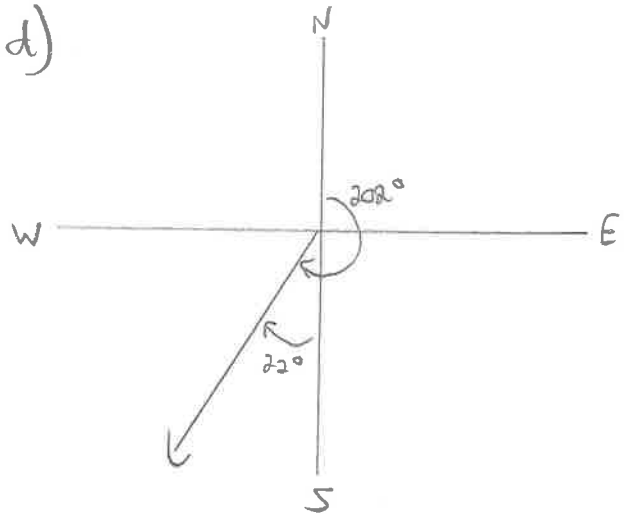
N 64° E

c)



N 80° W

d)

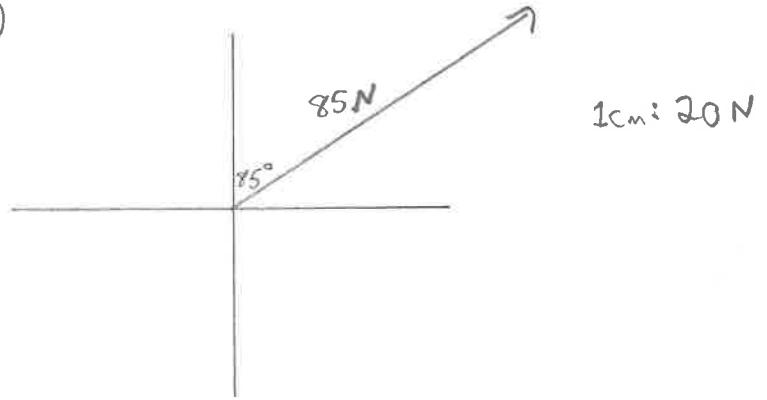


S 22° W

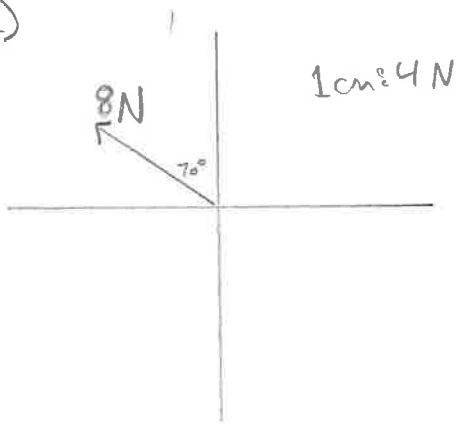
2) a)



b)



c)



3)

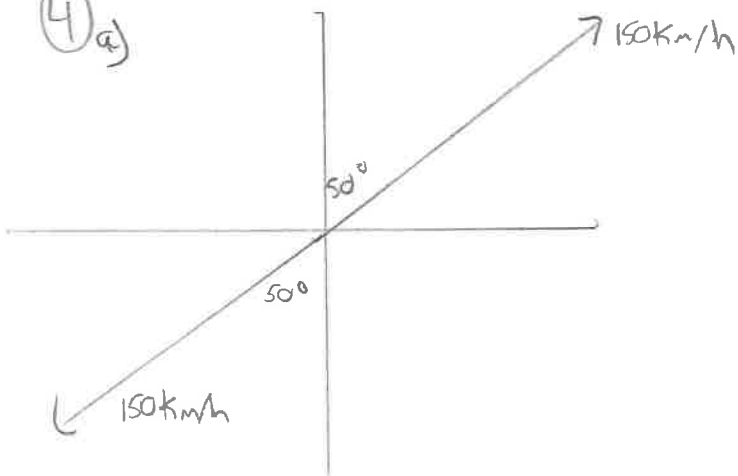
$$\vec{AB} = \vec{FC} = \vec{ED}, \quad \vec{BA} = \vec{CF} = \vec{DE}$$

$$\vec{AF} = \vec{BC}, \quad \vec{FA} = \vec{CB}$$

$$\vec{FE} = \vec{CD}, \quad \vec{EF} = \vec{DC}$$

$$\vec{AE} = \vec{BD}, \quad \vec{EA} = \vec{DB}$$

4) a)



150km/h N50°E

b)  $\vec{BA}$  or  $-\vec{AB}$

c)  $-\vec{v}$

d) 200 N downward.

5) a)  $\vec{AF}$    b)  $\vec{AC}$    c)  $\vec{DE}$    d)  $\vec{BD}$    e)  $\vec{ED}$    f)  $\vec{BE}$

6) a)  $\vec{HB}$    b)  $\vec{FH}$    c)  $\vec{0}$    d)  $\vec{GA} - \vec{EH} + \vec{DG}$

$$= \vec{GA} + -\vec{EH} + \vec{DG}$$

$$= \vec{GA} + \vec{HE} + \vec{DG}$$

$$= \vec{GA} + \vec{AD} + \vec{DG}$$

$$= \vec{0}$$

7) a)  $\vec{EA}$    b)  $-\vec{EB} + \vec{EF} - \vec{AF}$

$$= \vec{BE} + \vec{EF} + \vec{FA}$$

$$= \vec{BA}$$

c)  $\vec{AE} + \vec{ED} - \vec{CD}$

$$= \vec{AE} + \vec{ED} + \vec{DC}$$

$$= \vec{AC}$$

8) a)  $\vec{AF} = \frac{1}{2}\vec{AC}$    b)  $\vec{AE} = \vec{AB} + \frac{1}{2}\vec{BC}$    c)  $\vec{AB} = 2\vec{AF} + (-2\vec{EC})$

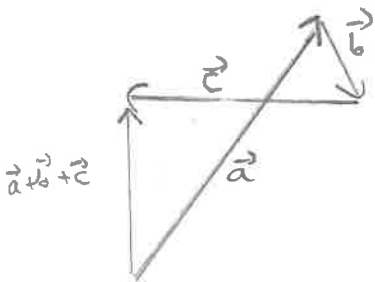
$$= 2\vec{AF} - 2\vec{EC}$$

9) a)  $\xrightarrow{10\text{ cm}}$

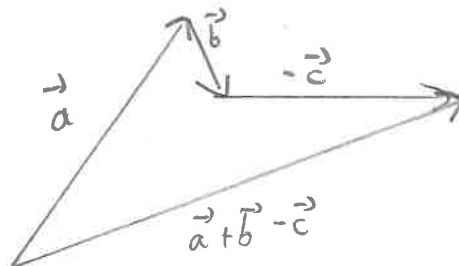
b)  $\xrightarrow{15\text{ N}}$   
 $\xleftarrow{6\text{ N}}$  +

=  $\xrightarrow{9\text{ N}}$

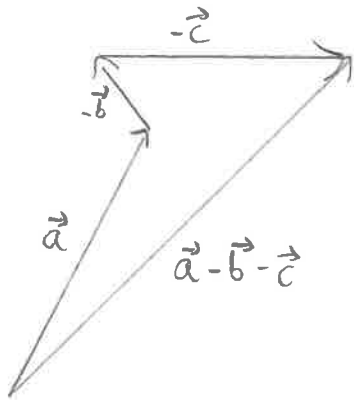
10) a)



b)



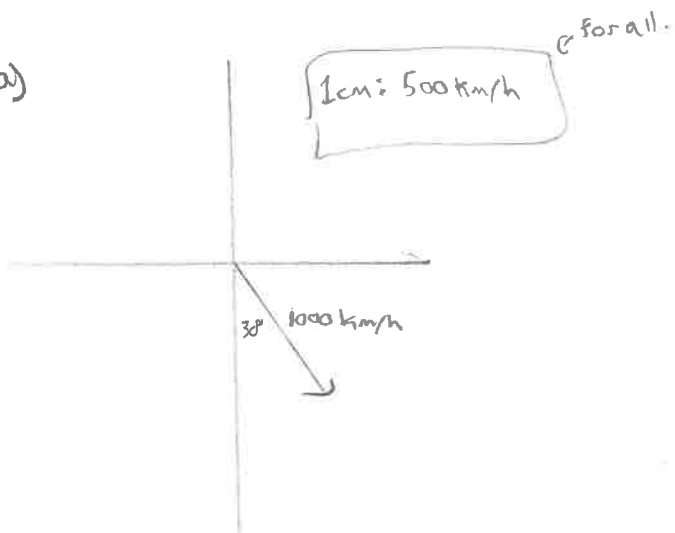
c)



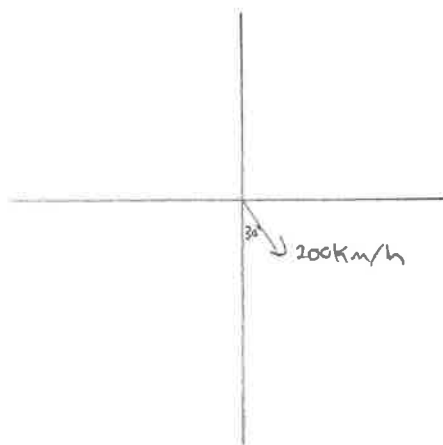
⑪ a)  $\vec{AB}$    b)  $\vec{AC}$    d)  $\vec{BC}$

d)  $\vec{AD}$    e)  $\vec{AD}$

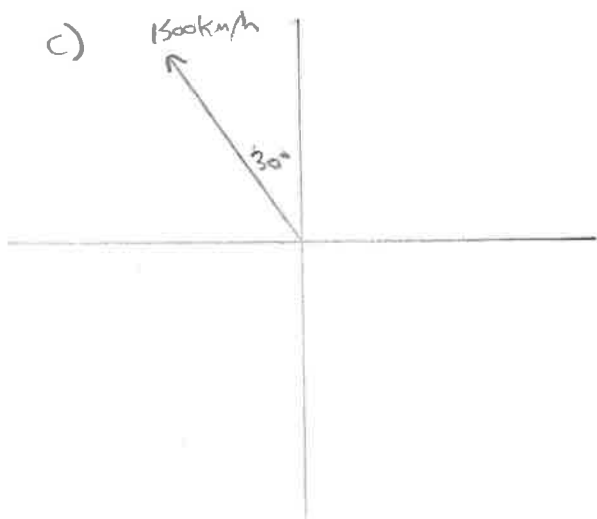
⑫ a)



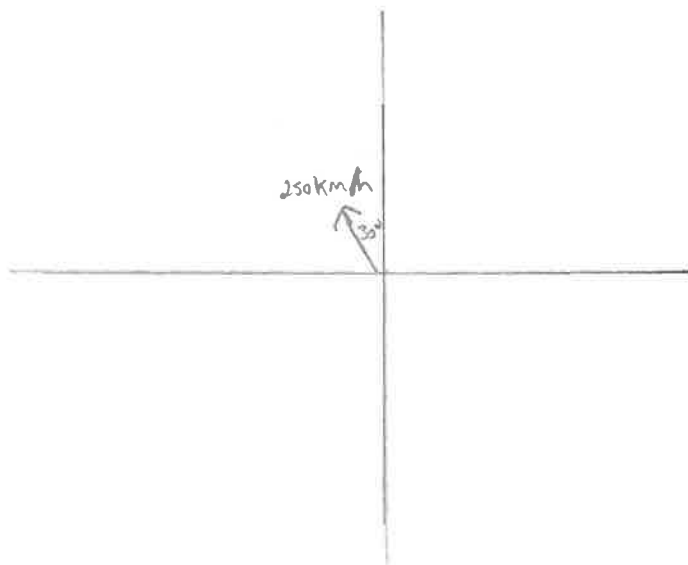
b)



c)



d)

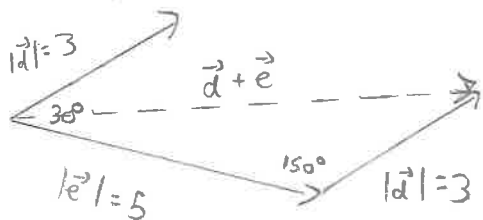


13) a)  $-2\vec{u}$    b)  $\vec{v} + \vec{u}$    c)  $2\vec{u} - \vec{v}$    d)  $-2\vec{u} + \vec{v}$

e)  $\vec{EB} = \vec{ED} + \vec{DE} + \vec{CB}$   $\rightarrow$   $\vec{CB} = -2\vec{u} + \vec{v} + \vec{u}$   
 $= \vec{u} + \vec{v} + \vec{v} - \vec{u}$   
 $= 2\vec{v}$

f)  $-2\vec{v}$

14) a)



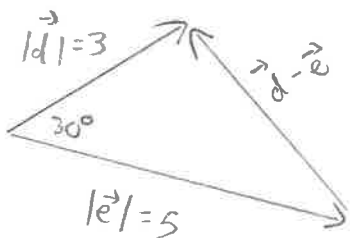
$$|\vec{d} + \vec{e}|^2 = 3^2 + 5^2 - 2(3)(5)\cos(150^\circ)$$

$$|\vec{d} + \vec{e}|^2 = 34 - 30\left(-\frac{\sqrt{3}}{2}\right)$$

$$|\vec{d} + \vec{e}| = \sqrt{34 + 15\sqrt{3}}$$

$$|\vec{d} + \vec{e}| \approx 7.7$$

b)



$$|\vec{d} - \vec{e}|^2 = 3^2 + 5^2 - 2(3)(5)\cos(30^\circ)$$

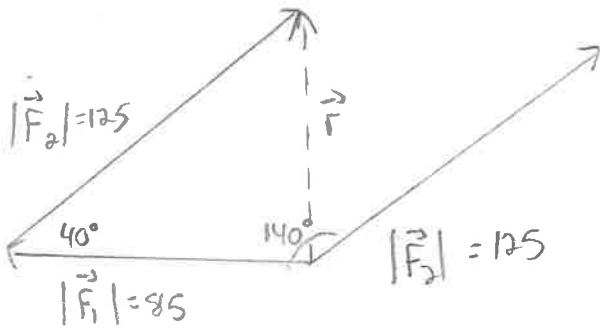
$$|\vec{d} - \vec{e}|^2 = 34 - 30\left(\frac{\sqrt{3}}{2}\right)$$

$$|\vec{d} - \vec{e}| = \sqrt{34 - 15\sqrt{3}}$$

c)  $\frac{1}{\sqrt{34 + 15\sqrt{3}}} (\vec{d} + \vec{e})$

15

a)



$$|\vec{R}|^2 = 85^2 + 125^2 - 2(85)(125)\cos(40^\circ)$$

$$|\vec{R}| \approx 81.1 \text{ N}$$

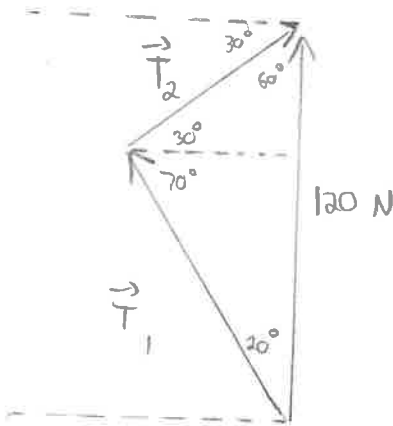
b)

$$\cos \theta = \frac{125^2 - 85^2 - 81.1^2}{-2(85)(81.1)}$$

$$\theta \approx 97.6^\circ$$

$\vec{R}$  makes an angle of  $97.6^\circ$  with  $\vec{F}_1$ .

16

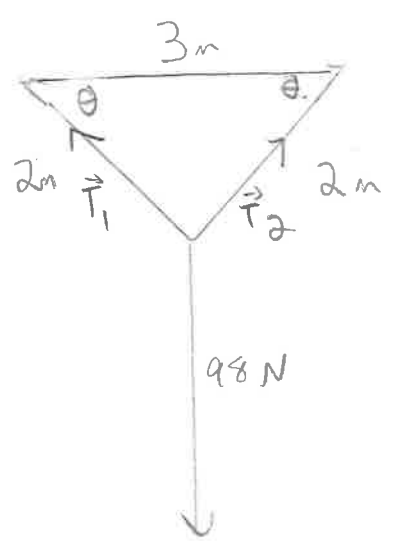


$$\frac{|\vec{T}_1|}{\sin 60} = \frac{|\vec{T}_2|}{\sin 20} = \frac{120}{\sin 100}$$

$$|\vec{T}_1| = \frac{120 \sin 60}{\sin 100} \approx 105.5 \text{ N}$$

$$|\vec{T}_2| = \frac{120 \sin 20}{\sin 100} \approx 41.7 \text{ N}$$

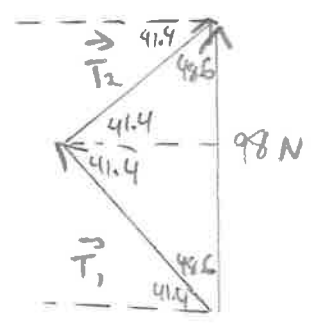
17



$$\cos \theta = \frac{2^2 - 3^2 - 2^2}{-2(3)(2)}$$

$$\theta \approx 41.4^\circ$$

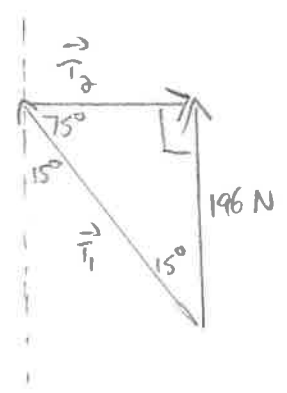
Vector Diagram:



$$\frac{|\vec{T}_1|}{\sin 48.6} = \frac{|\vec{T}_2|}{\sin 48.6} = \frac{98}{\sin 82.8}$$

$$|\vec{T}_1| = |\vec{T}_2| = \frac{98 \sin 48.6}{\sin 82.8} \approx 74.1 \text{ N}$$

18



$$\cos(15^\circ) = \frac{196}{|\vec{T}_1|}$$

$$|\vec{T}_1| = \frac{196}{\cos(15^\circ)}$$

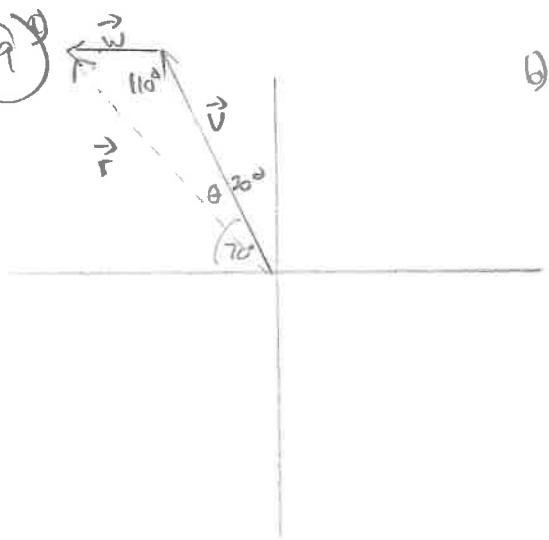
$$|\vec{T}_1| \approx 202.9 \text{ N}$$

$$\tan(15^\circ) = \frac{|\vec{T}_2|}{196}$$

$$|\vec{T}_2| = 196 \tan(15^\circ)$$

$$|\vec{T}_2| \approx 52.5 \text{ N}$$

19



b)

$$|\vec{r}|^2 = 560^2 + 140^2 - 2(560)(140)\cos(110)$$

$$|\vec{r}| \approx 622 \text{ km/h}$$

$$\cos \theta = \frac{140^2 - 560^2 - 622^2}{-2(560)(622)}$$

$$\theta \approx 12.2$$

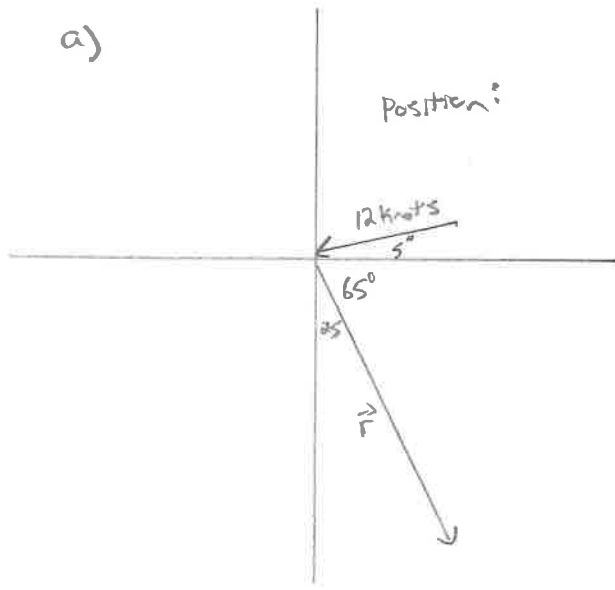
The ground velocity is 622 km/h N 32.2° W

(true bearing of 327.8°)

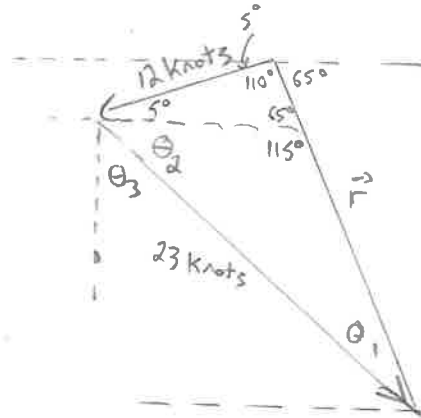


20

a)



Vector:



b)

$$\frac{12}{\sin \theta_1} = \frac{23}{\sin 110}$$

$$\theta_1 \approx 29.4^\circ$$

$$\theta_2 \approx 35.6$$

$$\theta_3 \approx 90 - 35.6 \approx 54.4^\circ$$

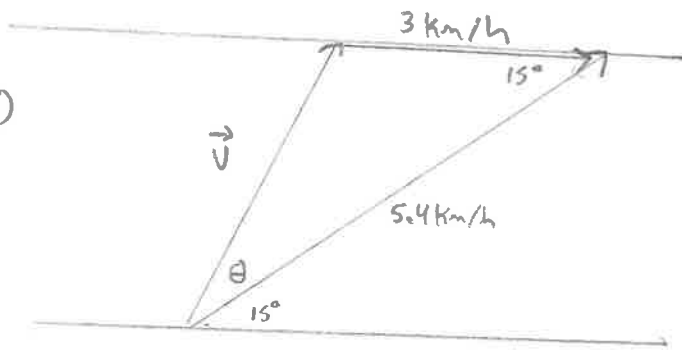
$554.4^\circ E$

c)  $|\vec{r}|^2 = 23^2 + 12^2 - 2(23)(12) \cos(40.6^\circ)$

$$|\vec{r}| \approx 15.9 \text{ knots}$$

21

a)



$$b) |\vec{V}|^2 = 5.4^2 + 3^2 - 2(5.4)(3)\cos(15^\circ)$$

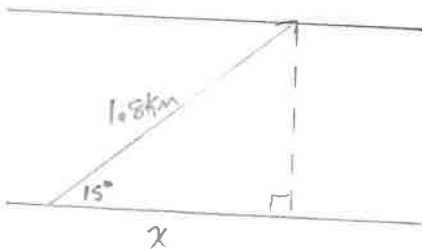
$$|\vec{V}| \approx 2.6 \text{ km/h}$$

$$\cos\theta = \frac{3^2 - 5.4^2 - 2.6^2}{-2(5.4)(2.6)}$$

$$\theta \approx 16.5^\circ$$

Velocity of 2.6 km/h at an angle of  $31.5^\circ$  with the shore.

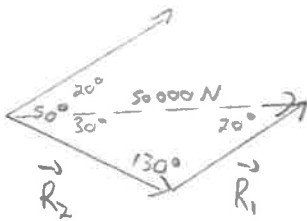
c)



$$\cos(15^\circ) = \frac{x}{1.8}$$

$$x \approx 1.74 \text{ km}$$

22

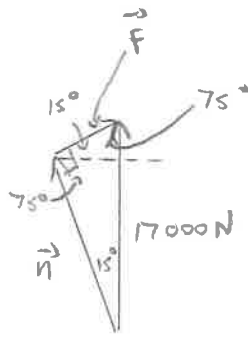
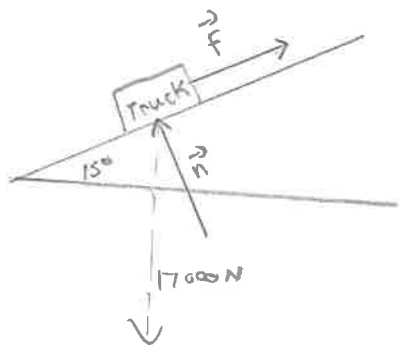


$$\frac{|\vec{R}_2|}{\sin 20^\circ} = \frac{|\vec{R}_1|}{\sin 30^\circ} = \frac{50000}{\sin 130^\circ}$$

$$|\vec{R}_1| = \frac{50000 \sin 30^\circ}{\sin 130^\circ} \approx 32635.2 \text{ N}$$

$$|\vec{R}_2| = \frac{50000 \sin 20^\circ}{\sin 130^\circ} \approx 22323.8 \text{ N}$$

23



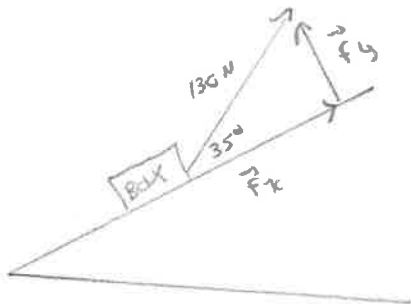
$$\cos(15^\circ) = \frac{|\vec{n}|}{17000}$$

$$\sin(15^\circ) = \frac{|\vec{F}|}{17000}$$

$$|\vec{n}| \approx 16400.7 \text{ N}$$

$$|\vec{F}| \approx 4399.9 \text{ N}$$

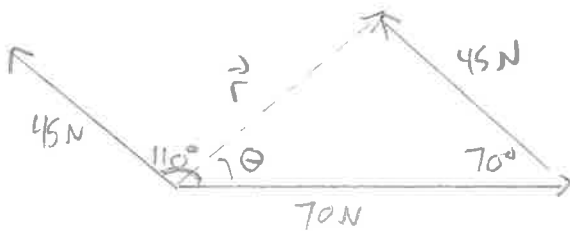
24



a)  $|\vec{F}_x| = 130 \cos(35) \approx 106.5 \text{ N}$

b)  $|\vec{F}_y| = 130 \sin(35) \approx 74.6 \text{ N}$

25



$$|\vec{F}|^2 = 70^2 + 45^2 - 2(70)(45)\cos(70^\circ)$$

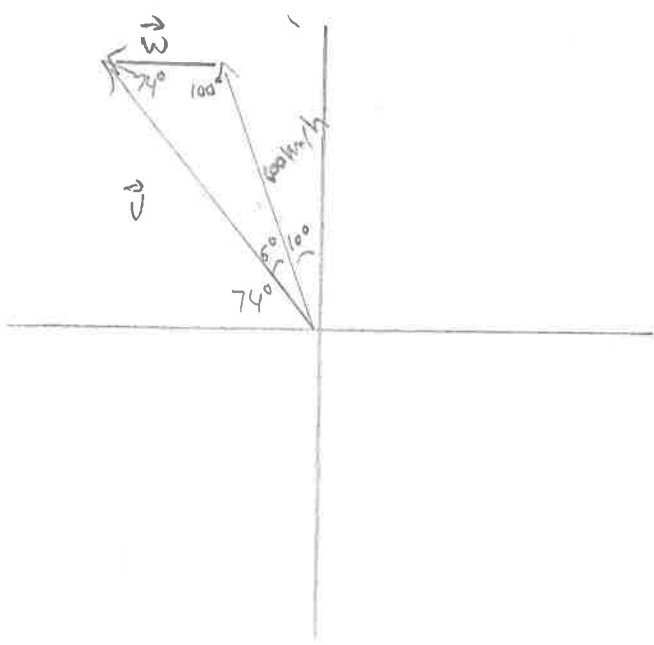
$$|\vec{F}| \approx 69.1 \text{ N}$$

$$\cos \theta = \frac{45^2 - 69.1^2 - 70^2}{-2(69.1)(70)}$$

$$\theta \approx 37.7^\circ$$

69.1 N at an angle of  $37.7^\circ$  with the 70 N force.

26

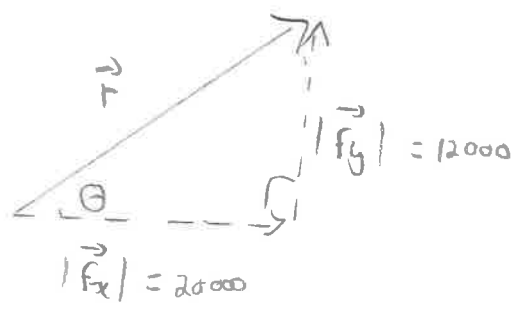


$$\frac{|\vec{v}|}{\sin 100} = \frac{|\vec{w}|}{\sin 6} = \frac{600}{\sin 74}$$

$$|\vec{v}| = 614.7 \text{ km/h (ground speed)}$$

$$|\vec{w}| = 65.2 \text{ km/h (wind speed)}$$

27



$$|\vec{F}|^2 = 12000^2 + 20000^2$$

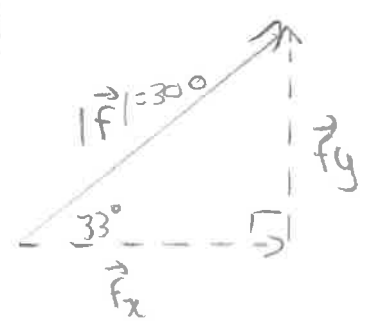
$$|\vec{F}| \approx 23323.8 \text{ N}$$

$$\tan \theta = \frac{12000}{20000}$$

$$\theta \approx 31^\circ$$

A force of  $23323.8 \text{ N}$  at an angle of  $31^\circ$  with the horizontal.

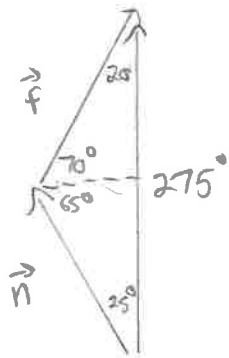
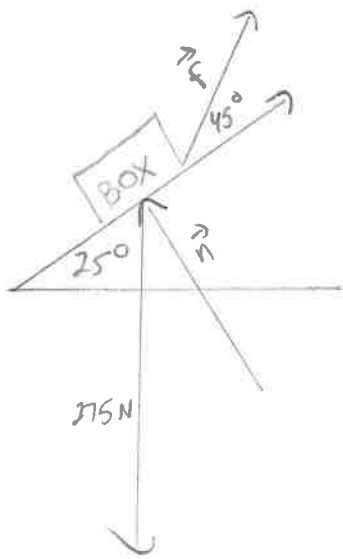
28



$$|\vec{F}_x| = 300 \cos(33^\circ) \approx 251.6 \text{ N}$$

$$|\vec{F}_y| = 300 \sin(33^\circ) \approx 163.4 \text{ N}$$

29



$$\frac{|F|}{\sin 25} = \frac{275}{\sin 35}$$

$$|F| \approx 164.36 \text{ N}$$