Name_____

Date _____

Vector Problems Worksheet

(HS5.1.1.1, HS5.1.1.2, HS5.1.1.3, HS5.1.1.4.B)

Directions: Solve the following problems by:

1. *Sketching the vector addition for each situation, showing the Resultant magnitude and direction*
2. *Using the Pythagorean Theorum to find the resultant magnitude*
3. *Using simple trigonometry to find the direction and angle of the Resultant*

For this worksheet *Give all answers rounded to 3 decimal places*

1. A person walks 30 km west, then 20 km north, then 15 km east. What is her displacement? Ans: 25km N36.870°W

2. Two dogs are pulling on the same bone. One pulls to the west with 50 N of force. The other pulls to the south with 30 N of force. What is the resultant force on the bone? Ans: 58.310N of force S59.036°W

3. An escalator lifts a person vertically at 1 m/s while simultaneously moving the person 3 m/s horizontally. What is the person's resultant velocity? Ans: 3.162 m/s angle of elevation of 18.435°

4. A hiker walks away from base camp 30 km north, then 20 km east, then 50 km south, then 40 km west, then 45 km north, then 35 km east. Exhausted, he radios to base camp to come get him. Which way and how far do his rescuers have to go to get him? Ans: 29.155km N 30.964°E

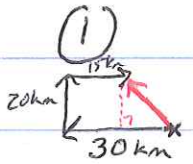
5. A motorboat heads east at 15 m/s directly across a 400 meter wide river with a current of 7 m/s south.
   a. Calculate the boat's velocity while traveling on the river. Ans: a) 16.553 m/s S64.983°E
   b. Calculate the time it takes for the boat to cross. b) 26.667sec
   c. How far downstream will the boat be when it reaches the opposite shore? c) 186.667m
   d. Calculate the angle upstream that the boat would have to head in order to end up directly east of where it started (no downstream drift). d) N62.182°E
   e. Calculate the boat's eastward velocity as it heads across at the angle you found in part "d" above. e) 13.266 m/s

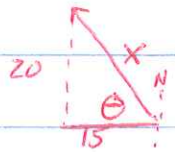
6. An airplane tries to fly due north at 100 m/s but a wind is blowing from the west at 30 m/s.
   a. What is the plane's resultant velocity? Ans: a) 104.403 m/s N 16.699°E
   b. What heading (angle and direction) should the plane take to go due north in spite of the wind? b) N17.458°W
   c. How fast will the plane be flying in the northward direction at the angle you found in part "b"? c) 95.394 m/s
   d. How long will it take the plane to get to a destination 30 km due north? d) 5.241 min

7. A plane is headed east with a speed of 150 m/s while an upper atmospheric jet stream wind blows from the west with a speed of 50 m/s.
   a. How much time will it take for this plane to reach a destination 200 km east? Ans: a) 16.667min
   b. How much time will it take for this plane to return the same 200 km west? b) 33.333min

8. A very lost goose flies 30 km north, then 50 km east, then 70 km south. Where is the goose now relative to its starting postion? Ans: 64.031km S 51.340°E

(1)





$15^2 + 20^2 = x^2$

$\therefore x = 25\text{ km}$

$\tan\theta = \frac{20}{15}$

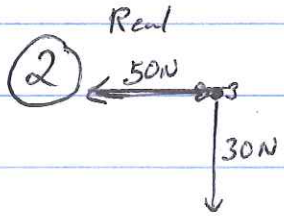
$\theta = \tan^{-1}\left(\frac{20}{15}\right)$

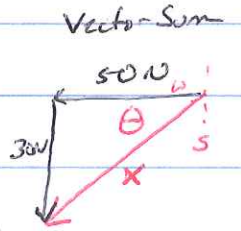
$\theta \approx 53.130°$

25 km at a bearing of N36.870°W

N 36.870° W

(2)





$50^2 + 30^2 = x^2$

$\therefore x \approx 58.310\text{N}$

$\tan\theta = \frac{30}{50}$

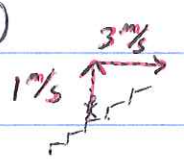
$\theta = \tan^{-1}\left(\frac{30}{50}\right)$

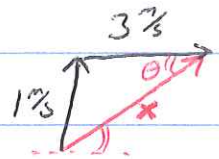
$\theta \approx 30.964°$

S 59.036° W

58.310 Newtons at a bearing of S 59.036° W

(3)





$1^2 + 3^2 = x^2$

$x \approx 3.162\text{ m/s}$

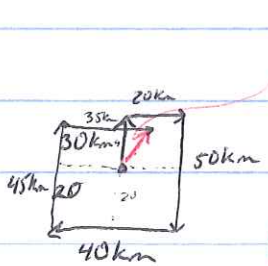
$\tan\theta = \frac{1}{3}$

$\theta = \tan^{-1}\left(\frac{1}{3}\right)$

$\theta \approx 18.435°$

3.162 m/s at angle of elevation of 18.435°

(4)



$15^2 + 25^2 = x^2$

$\therefore x \approx 29.155\text{km}$

$\tan\theta = \frac{25}{15}$

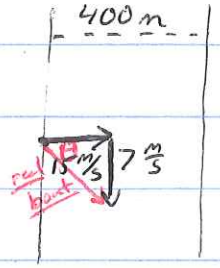
$\theta = \tan^{-1}\left(\frac{25}{15}\right)$

$\theta \approx 59.036°$

N 30.964° E

Go 29.155km on a bearing of N30.964°E from base camp

(5)



x = real boat's speed w/ current

$x^2 = 15^2 + 7^2$

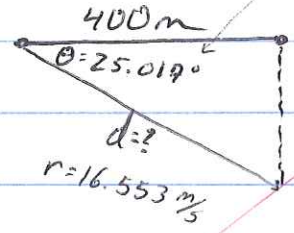
$\tan\theta = \frac{7}{15}$

(a) $x \approx 16.553 \text{ m/s}$

$\theta = \tan^{-1}\left(\frac{7}{15}\right)$

16.553 m/s at bearing of S64.983°E

$\theta \approx 25.017°$



$\cos 25.017...° = \frac{400 \text{ m}}{d \text{ m}}$

$d \approx 441.4118... \text{ m}$

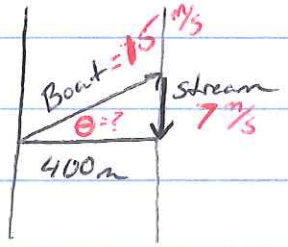
$d = rt$

$441.4118... = 16.553... t$

(b) 26.667 s ≈ t

$\tan 25.017...° = \frac{y \text{ m}}{400 \text{ m}}$

(c) $y \approx 186.667 \text{ m}$



$\sin\theta = \frac{7 \text{ m/s}}{15 \text{ m/s}}$

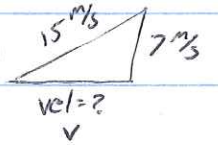
$\theta = \sin^{-1}\left(\frac{7}{15}\right)$

$\theta \approx 27.818°$

N 62.182° E

(d) Head on a bearing of N62.182°E

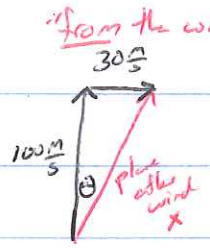
(e)



$v^2 + 7^2 = 15^2$

$v \approx 13.266 \text{ m/s}$

(6)



$100^2 + 30^2 = x^2$

$\therefore x = 104.403 \text{ m/s}$

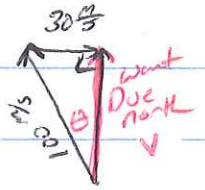
$\tan\theta = \frac{30}{100}$

$\theta = \tan^{-1}\left(\frac{30}{100}\right)$

$\theta \approx 16.699°$

(a) 104.403 m/s at a bearing of N 16.699° E

N 16.699° E



(b) $\sin\theta = \frac{30}{100}$

$\theta = \sin^{-1}\left(\frac{30}{100}\right)$

$\theta \approx 17.458°$

Head at a bearing of N 17.458° W

(c) $100^2 = v^2 + 30^2$

$v \approx 95.394 \text{ m/s}$

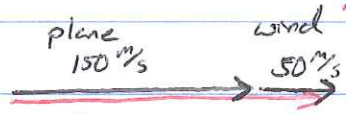
(d) $d = r \cdot t$ (units)

$30\text{km} = 95.393\ldots \frac{\text{m}}{\text{s}}\ t$

$30{,}000\text{m} = (95.393\ldots \frac{\text{m}}{\text{s}})t$

$t \approx 314.485 \text{ sec}$

or $\approx 5.241 \text{ min}$ ← whichever

(7) 

"from the west"

plane with wind 200 m/s east = r

(a) $d = r \cdot t$

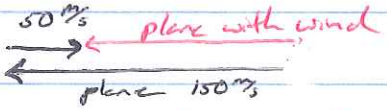
units

$200\text{km} = 200\ \frac{m}{s} \cdot t$

$200{,}000\text{m} = 200\ \frac{m}{s} \cdot t$

$t = 1000\text{ sec}$

or $\approx 16.667\text{ min}$

(b) 

plane with wind 100 m/s west

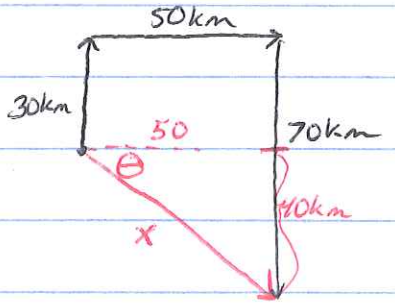
$d = rt$

$200\text{km} = 100\ \frac{m}{s}\ t$

$200000\text{ m} = 100\ \frac{m}{s}\ t$

$2000\text{sec} = t$

or 33.333 min

(8) 

$x^2 = 50^2 + 40^2$

$x \approx 64.031\text{km}$

$\tan\theta = \frac{40}{50}$

$\theta = \tan^{-1}\left(\frac{40}{50}\right)$

$\theta \approx 38.660°$

64.031km at a bearing of S 51.340° E