NAME: KEY

Vector Word Problems 2

1. The pilot of a plane points his airplane due South and flies with an airspeed of 120 m/s. Simultaneously, there is a steady wind blowing due West with a constant speed of 40 m/s.
   a. Make a sketch that shows how to find the resultant velocity of the plane. Roughly in what direction is the resultant velocity?

So roughly SW

You don't need to do this, but for those who know trig better

$\tan\theta = \frac{40}{120} \rightarrow \theta = \tan^{-1}(.333)$

$\theta = 18.4°$ W of S

[or 71.6° S of W]

   b. What is the resultant speed of the airplane?

$V^2 = (120)^2 + (40)^2$

$V^2 = 16{,}000$

$V = 126.5$ m/s

   c. After one hour, how far away is the plane from its starting point?

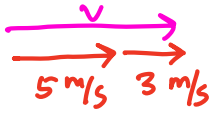
1 hour = 3600 s

$d = vt$

$d = (126.5)(3600)$

$d = 455{,}000$ m

2. A swimmer is able to swim with a speed of 5 m/s in a pool (this is her "water speed".) This same swimmer goes swimming in a river which has a current flowing to the East with a constant speed of 3 m/s. Assume her water speed is always 5 m/s.
   a. What would be her resultant velocity if she tries to swim due East with the current? Include a vector sketch.

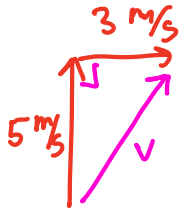


So $V = 5 + 3 =$ 8 m/s E

   b. What would be her resultant velocity if she were to try to swim due West against the current? Include a vector sketch.

$V = 5 - 3 =$ 2 m/s W

   c. What would be her resultant velocity if she points herself due North straight across the river? Include a vector sketch.



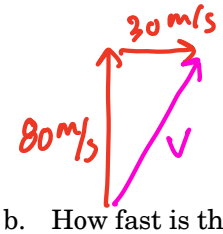
So $V^2 = (5)^2 + (3)^2$

$V^2 = 34$

$V = 5.83$ m/s

Vector Word Problems 2

3. A plane is flying due North at 80 m/s. There is a cross wind of 30 m/s that is blowing due East.
   a. Draw a vector diagram showing how these velocities add. Roughly in what direction is the resultant velocity?



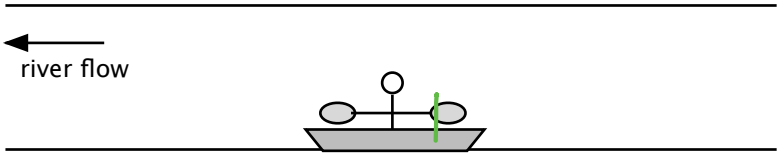
roughly NE

   b. How fast is the plane flying with respect to the ground?

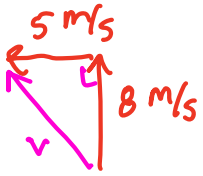
$v^2 = (80)^2 + (30)^2$

$v^2 = 7300$

$v = 85.4$ m/s



4. A 50 meter wide river is flowing at 5 m/s to the left, as shown in the diagram above. A person in a kayak always rows with a water speed of 8 m/s.
   a. If the kayaker points straight across, what is the final speed of the kayaker? Include a vector sketch.



$v^2 = (8)^2 + (5)^2$

$v^2 = 89$

$v = 9.43$ m/s

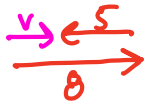
   b. What would be the maximum possible speed of the kayaker and in what direction should they point?

If the kayak with the current, so WEST

$v = 5 + 8 = 13$ m/s

   c. What would be the slowest possible speed of the kayaker and in what direction should they point?

If they kayak against the current, so EAST



$v = 8 - 5 = 3$ m/s

   d. How long would it take the kayaker to cross from part a? (Hint: what is the component of the velocity straight across the river?)

$v_y = \frac{y}{t}$ $\quad 8 = \frac{50}{t}$ $\quad 8t = 50$ $\quad t = 6.25$ s

   e. From part d, how far downstream does the kayaker travel?

$x = v_x t$

$x = (5)(6.25)$

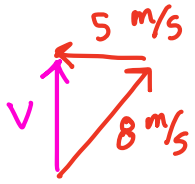
$x = 31.25$ m

Make sure the directions match in the equations!

* v & d
* v_x & x
* v_y & y

Vector Word Problems 2

f. In about what direction should they point so that their resultant velocity is straight across the river? You don't need to give the exact angle, but include a vector sketch.

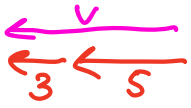


~ NE

5. A 50 meter wide river is flowing at 5 m/s to the left, as shown in the previous diagram. Another person in a kayak always rows with a water speed of 3 m/s.

a. What would be the maximum possible speed of this kayaker and in what direction should they point?

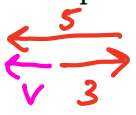
with the current
so point WEST



$v = 3+5 =$ **8 m/s W**

b. What would be the slowest possible speed of this kayaker and in what direction should they point?

Against the current
So point EAST



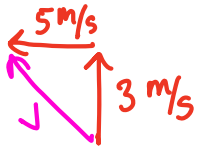
$v = 3-5 = -2$ m/s

2 m/s W

Notice they still end up going west!

Trying to go East, but current too strong!

c. If the kayaker tries heads straight across the river (due North), how long would it take the kayaker to cross?



$V_y = 3$ m/s

$V_x = (-)\,5$ m/s

$y = 50$ m

$V_y = \frac{y}{t}$

$3 = \frac{50}{t}$

$3t = 50$

$t = 16.7$ s

d. From part c, how far downstream do they drift?

$x = v_x t$

$x = (-5)(16.7)$

$x = -83.5$ m

(they went WEST)

e. From part c, how far away from their starting point is the kayaker?

Note: 2 ways to do this:

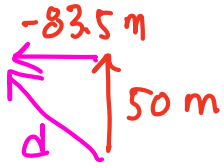
① $v^2 = (3)^2 + (5)^2$

$v = 5.83$ m/s

$d = vt$

$= (5.83)(16.7)$

$d = 97.4$ m

② 

$d^2 = (-83.5)^2 + (50)^2$

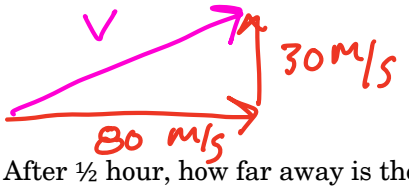
$d^2 = 9472$

$d = 97.3$ m

← rounding off differences →

Vector Word Problems 2

6. A plane heads due East with a constant velocity of 80 m/s. At the same time, there is a cross wind with a constant velocity of 30 m/s due North.
   a. Make a vector sketch that shows how to find the resultant velocity of the plane.



   b. After ½ hour, how far away is the plane? (Warning: this is two steps!)

$V^2 = (80)^2 + (30)^2$

$V^2 = 7300$

$V = 85.4$ m/s

$t = 0.5h = 1800s$

$d = vt$

$d = (85.4)(1800)$

$\boxed{d = 154{,}000 \text{ m}}$

OR

$x = v_x t$

$x = (80)(1800)$

$x = 144{,}000$ m

$y = v_y t = (30)(1800)$

$y = 54{,}000$ m

$d^2 = x^2 + y^2$

$d^2 = (144{,}000)^2 + (54{,}000)^2$

$\boxed{d = 154{,}000 \text{ m}}$

7. A duck is trying to cross a ~~river that is 30 meters wide~~. The river flows South, with a current of 4 m/s. The duck starts off on the West side, as shown. The duck has a water speed of 2 m/s. If the duck points itself due East, straight across the river, it gets to the other side in 15 seconds, but has drifted downstream.
   a. How wide is the river?

$v_y = -4$ m/s

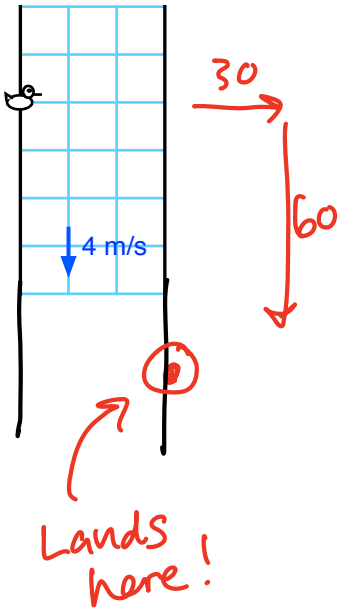
$v_x = 2$ m/s

$t = 15$ s

$x = v_x t$

$x = (2)(15)$

$\boxed{x = 30 \text{ m}}$



   b. How far downstream did the duck travel? Mark it on the picture.

$y = v_y t$

$y = (-4)(15)$

$\boxed{y = -60 \text{ m}}$

(just means South.) can ignore if you like.

Lands here!

Answers:

1. a) ~SW (71.6° S of W) b) 126.5 m/s c) 455,000 m (=455 km)

2. a) 8 m/s E b) 2 m/s W c) 5.83 m/s

3. a) ~NE (69.4° N of E) b) 85.4 m/s

4. a) 9.43 m/s b) 13 m/s W c) 3 m/s E d) 6.25 s e) f) ~NE (51.3° N of E)

5. a) 8 m/s W b) 2 m/s W - but they point E c) 16.7 s d) e)

6. a) b)

7. a) b)