Name: Key

Notes - 3.1. Kinematics in Two Dimensions: An Introduction

1. Give three examples of 2-dimensional motion.
   A. Arc of a basketball
   B. Orbit of a satellite
   C. Bicycle rounding a curve

2. Given a right triangle of sides a and b and a hypotenuse of c, write the equation to find the length of c. $c = \sqrt{a^2+b^2}$

3. What is used to represent the magnitude and direction of a vector? An arrow

4. The length of the vector is directly proportional to the magnitude of the vector.

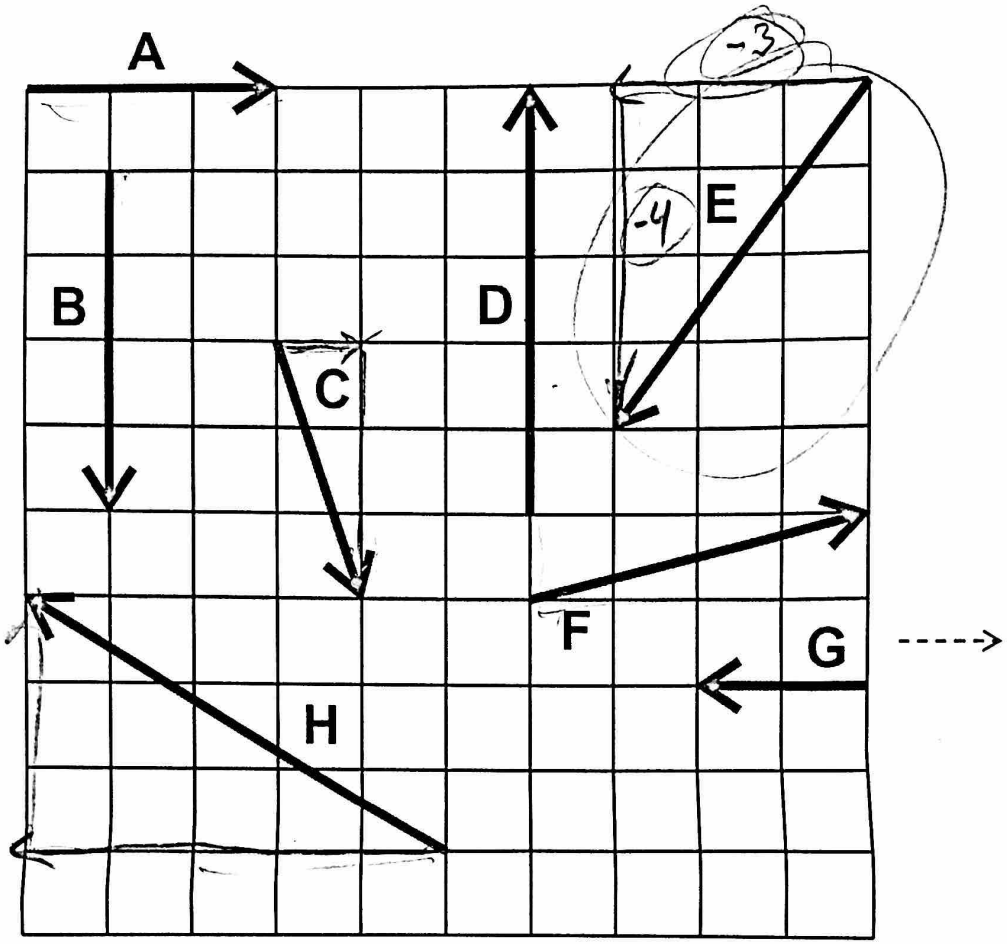
5. HUGE IDEA: The horizontal and vertical components of two-dimensional motion are independent of each other. Any motion in the horizontal direction does not affect motion in the vertical direction, and vice versa.

6. One baseball is dropped from rest. At the same instant, another is thrown horizontally from the same height and follows a curved path. Which baseball hits the ground first? They both hit the ground at the same time

7. For the thrown (blue) ball in Figure 3.6,
   A. Is there acceleration in the y-direction? Yes, $a = g$
   B. Is there acceleration in the x-direction? No

8. The key to analyzing such motion, called projectile motion, is to resolve (break) it into motions along perpendicular directions. Resolving two-dimensional motion into perpendicular components is possible because the components are independent.

Vector Addition Practice:



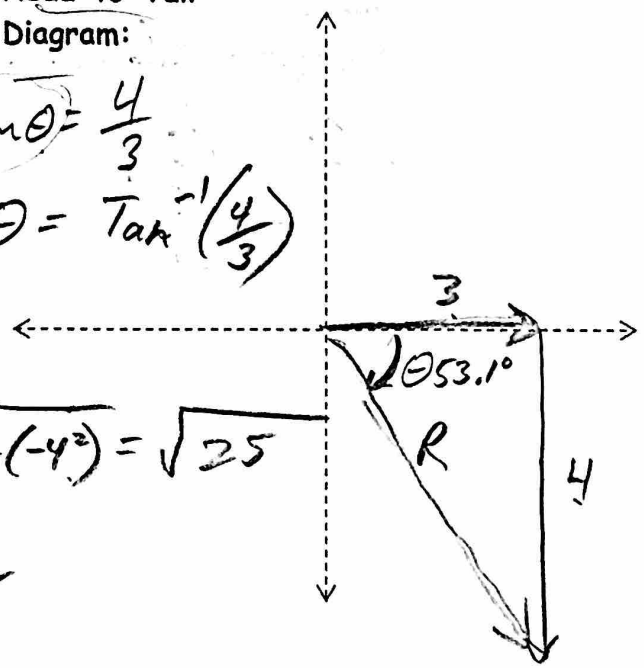
1. Find the resultant vector that is produced by adding vectors A and B.

Vector	X comp.	Y comp.
A	3	0
B	0	-4
Totals	3	-4
Magnitude of Resultant	5	
Direction of Resultant	53.1° below positive x	

Head-to-Tail Diagram:

$\tan\theta = \frac{4}{3}$

$\theta = \tan^{-1}\left(\frac{4}{3}\right)$



$\sqrt{3^2+(-4)^2} = \sqrt{25}$

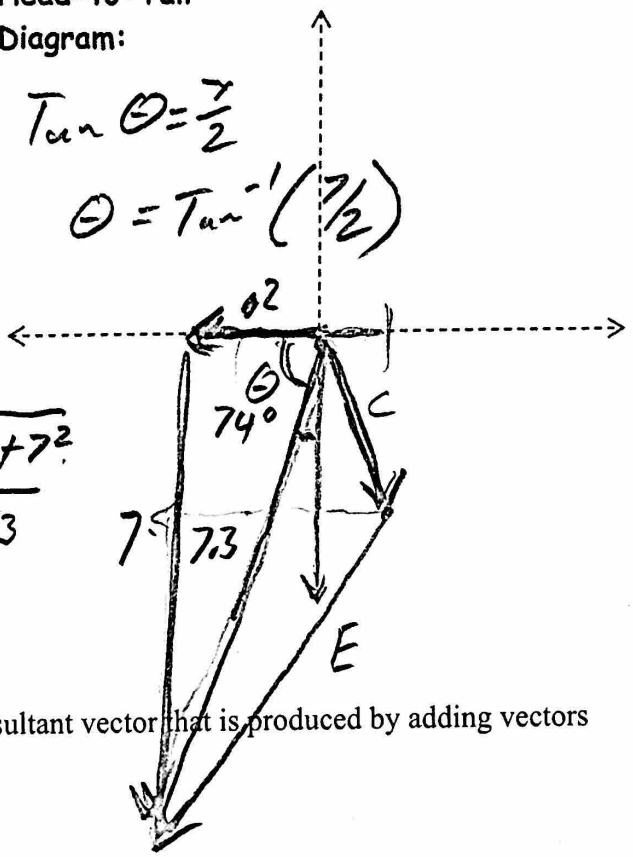
2. Add vectors E and C.

Vector	X comp.	Y comp.
E	-3	-4
C	+1	-3
Totals	-2	-7
Magnitude of Resultant	7.3	$\sqrt{2^2+7^2}$ $\sqrt{53}$
Direction of Resultant	74° below -x	

Head-to-Tail Diagram:

$\tan\theta = \frac{7}{2}$

$\theta = \tan^{-1}(7/2)$



3. What is are the magnitude and direction of the resultant vector that is produced by adding vectors D, C, and A?

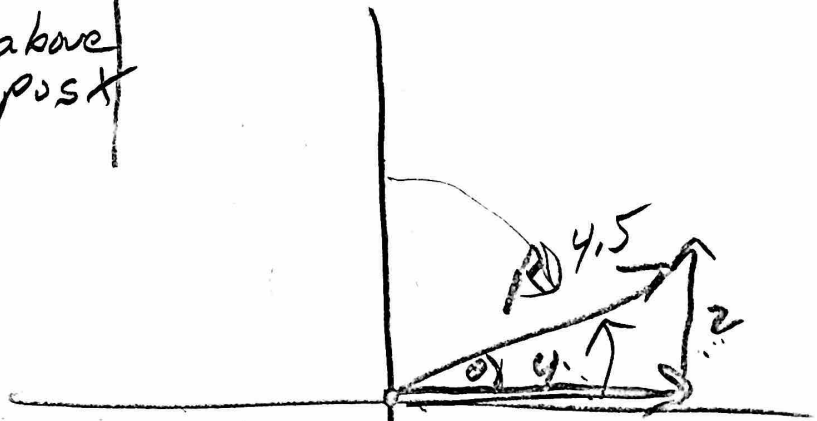
Find the resultant vectors from the additions of…

4. E + H
5. C + F
6. E + H + G

#3

	x	y
D	0	5
C	1	-3
A	3	0
Totals / Res. Components	4	2
Result (mag)	4.5	
Result Direction	26.5° above pos x	

$\sqrt{16+4} = \sqrt{20}$

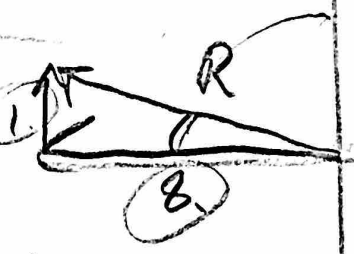


$\theta = \text{Tan}^{-1}\left(\frac{1}{2}\right) = 26.5°$

E+H
C+F
E+H6

#4

	X	Y
E	-3	-4
H	-5	+3
Res. Component	-8	-1
R Mag	8.1	
R Dir	7.1° above neg X	

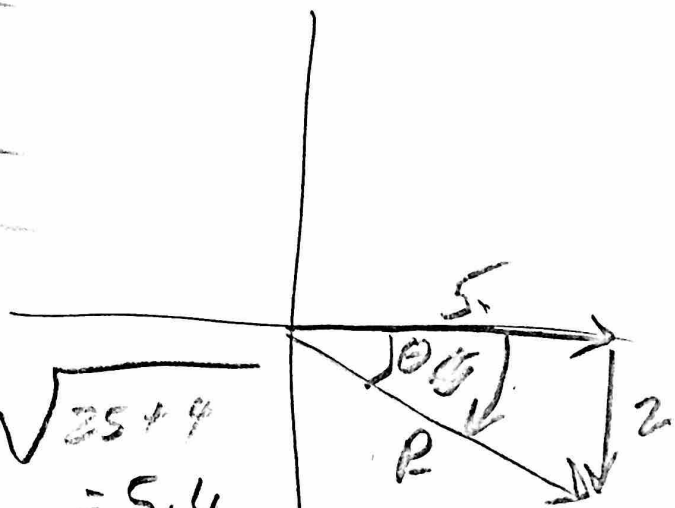


$\sqrt{1+64} = \sqrt{65}$

$\text{Tan}^{-1}\left(\frac{1}{8}\right) = 7.1^\circ$

#5

	X	Y
C	1	-3
F	4	1
R (comp)	5	-2
R Mag	5.4	
R Dir	21.8° below pos X	

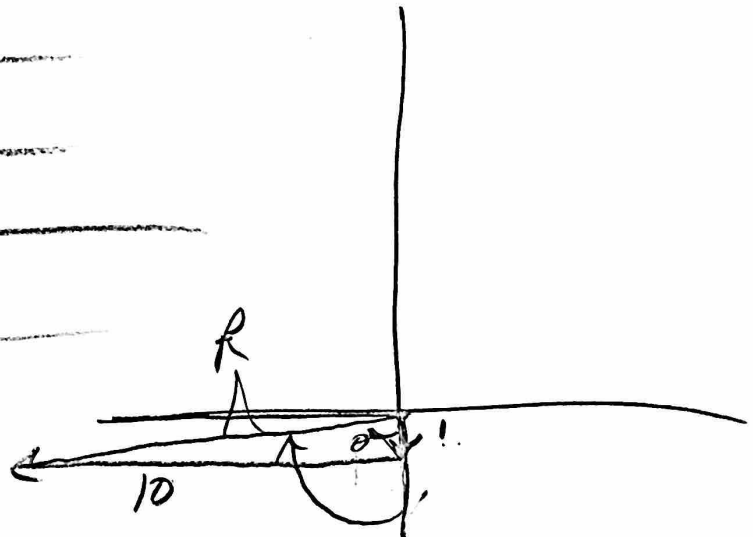


$\sqrt{25+4} = 5.4$

$\theta = \text{Tan}^{-1} = \frac{2}{5} = 21.8^\circ$

#6

	X	Y
E	-3	-4
H	-5	3
G	-2	0
R (comps)	-10	-1
R (mag)	10.05	
R Dir	84.2° left of neg Y	



$\sqrt{101} = 10.05$

$\theta = \tan^{-1}\left(\frac{10}{1}\right) = 84.2°$