2D Vector Practice Name:_____

Reflection and Self-Assessment

Completion: Circle the statement that best describes the completion of this practice.

- I completed every question on the practice.
- I did not complete some questions on the practice because:

_____

Answer Checking: Circle the statement that best describes how you checked your answers

- I checked all my answers against the key at the back and corrected any that were incorrect.
- I did not check all my answers and correct any mistakes because:

_____

Online Worked Solution: Circle the statement that best describes how you used the online worked solutions.

- I did not use the online worked solution at all.
- I used the online solution to understand some questions I got incorrect.
- I used the online solution to help me learn how to answer some questions.

Confidence: Circle the statement that best describes your confidence in answering questions of this type in the future.

- I am confident I can answer nearly any question of this type correctly without using notes or other assistance.
- I am confident I can answer **MOST** questions of this type correctly without using notes or other assistance.
- I am **NOT** confident I can answer most questions of this type correctly without using notes or other assistance.

Time: Circle the statement below that best describes the total amount of time you spent actively working on this practice:

Less than an hour	Between one and two hours	Between two and three hours	Between three and four hours	More than four hours

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Part 1: Drawing using scale and measurements.

1. Use a ruler and a protractor to draw the following vectors and MEASURE to determine the result of their addition (both magnitude and direction). Give all answers to 2 sig figs.

    a. 5.0 cm North + 3.0 cm East

    b. 7.0 cm, $45°$ North of East + 5.0 cm East

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2. Use a scale of 1 m/s = 1 cm to draw and MEASURE to solve each vector addition

    a. 5.0 m/s Horizontally + 8.0 m/s Down

    b. 7.0 m/s, 72° above the horizontal + 7.0 m/s horizontally.

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3. Use a scale of 1 N = 1 cm to draw and MEASURE to solve each vector addition

    a. 6.0 N East + 8.0 N North

    b. 5.0 N East + 5.0 N, 60.0° North of West + 8.0 N South

4. Solve each of the following subtractions by drawing scale diagrams:
    a. 500 yards West − 600 yards South

    b. 40 m/s, 15° North of West − 60 m/s 65° East of South

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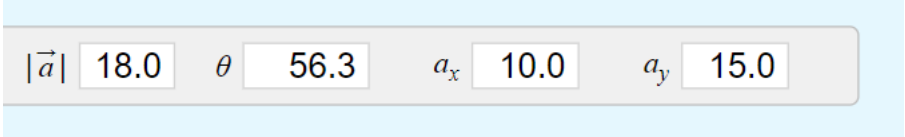
Part 2: Using PhET simulation

Use the link on the Google Classroom, or https://phet.colorado.edu/sims/html/vector-addition/latest/vector-addition_en.html. Then select "Explore 2D"

5.



What do each of the numbers shown here represent? Fill in with the terms:

Horizontal Component, Vertical Component, Angle, and **Magnitude**

$|\vec{a}|$ represents

θ represents the

a_x represents the

a_y represents the

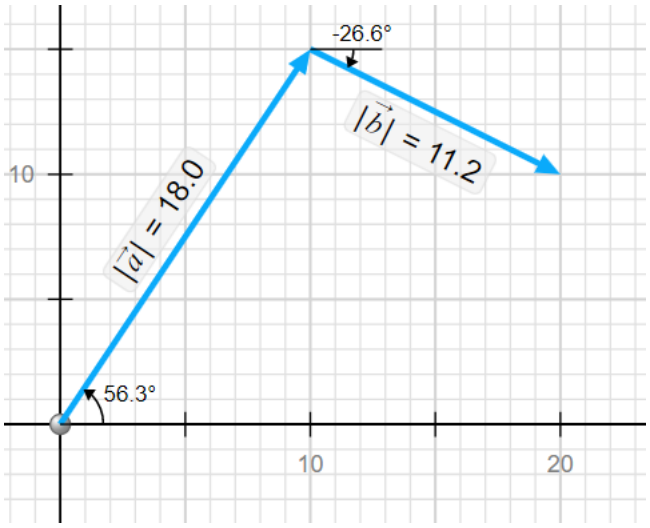
6. What could the following addition of vectors represent:

A: 18.0 m/s, at 56.3° above the horizontal + 11.2 m/s, at 26.6° below the horizontal

B: 18.0 N, at 56.3° North of East + 11.2 N 26.6° South of East

C: 18.0 kilometres, 56.3° up from straight across, plus 11.2 kilometres, 26.6° down from straight across.

D: All of the above



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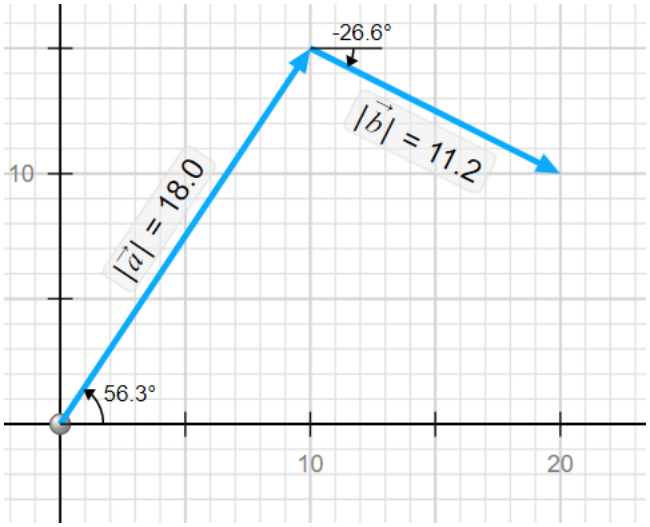
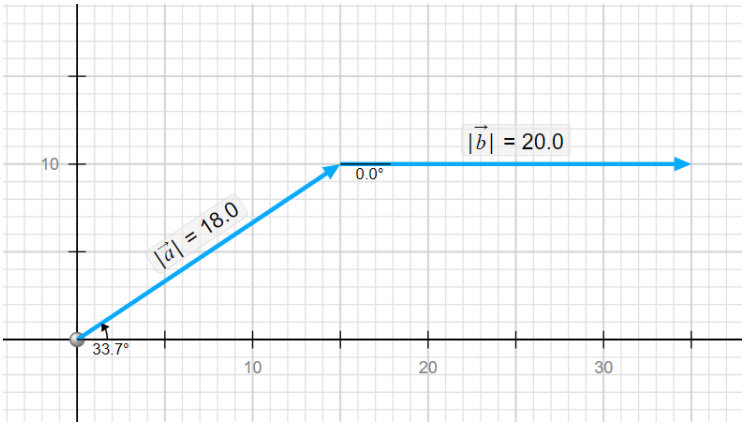
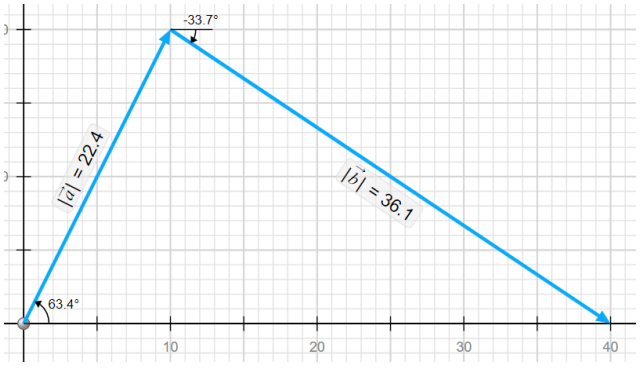
7. Draw the two vectors shown and turn on the "Sum", then drag the resultant vector so it connects the start of vector ***a*** to the end of vector ***b***. What is the magnitude and direction of the sum?



8. Use the simulation to determine the magnitude and direction of the sum of the vector addition shown:



9. Use the simulation to determine the magnitude and direction of the sum of the vector addition shown:



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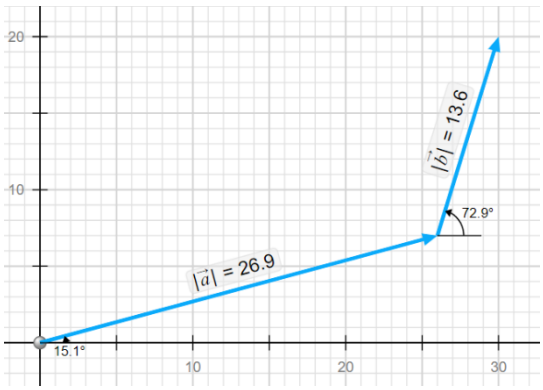
10.

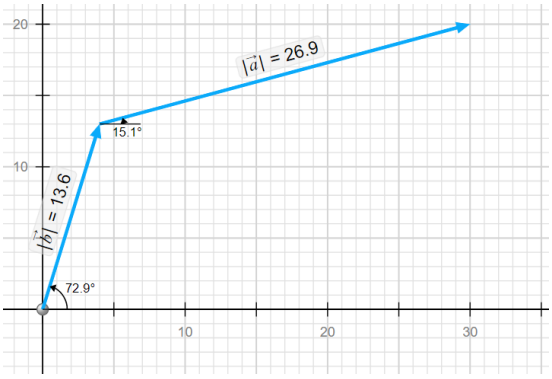
a. What addition is shown in the diagram?



b. What is the sum of that addition?

11.

a. What addition is shown in the diagram?



b. What is the sum of that addition?

c. Does the order of addition matter in vector addition?

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12. Use the simulation to determine the horizontal and vertical components of the vector shown:

13. Use the simulation to determine the result of adding 29.2 Newtons at 31° above the horizontal plus 11.2 Newtons at 63.4° above the horizontal. Your answer should have both angle and magnitude.

14. Use the simulation to determine the result of adding 18 m/s, 33.7° North of East + 11.2 m/s, 26.6° South of East + 19.0 m/s North.

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Part 3: Adding and subtracting vectors at right angles using trigonometry.

Draw a diagram, and using right angle trigonometry and the Pythagorean theorem to determine the solution to the following:

$\sin\theta = \frac{Opposite}{Hypotenuse}$ $\cos\theta = \frac{Adjacent}{Hypotenuse}$ $\tan\theta = \frac{Opposite}{Adjacent}$

15. 56 m/s^2 West + 72 m/s^2 North.

16. 18 newtons South $-$ 12 newtons West

17. 16 metres right + 29 metres up

18. 6.20 metres West + 19.2 metres South $-$ 12.4 metres East

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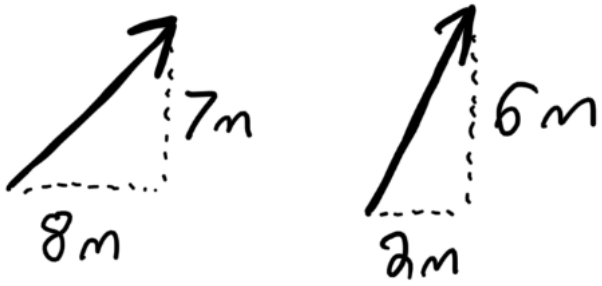
Part 4: Using components to add and subtract vectors

19. Use trigonometry to determine the components of the following vectors:
    a. 56.2 km, at 23.5° above the horizontal

    b. 0.0562 newtons, at 56.9° North of West

20. Two vectors and their components are shown.
    a. Determine the sum of the horizontal components.



    b. Determine the sum of the vertical components.

    c. Determine result of adding the two vectors, this should be a vector with magnitude and direction.

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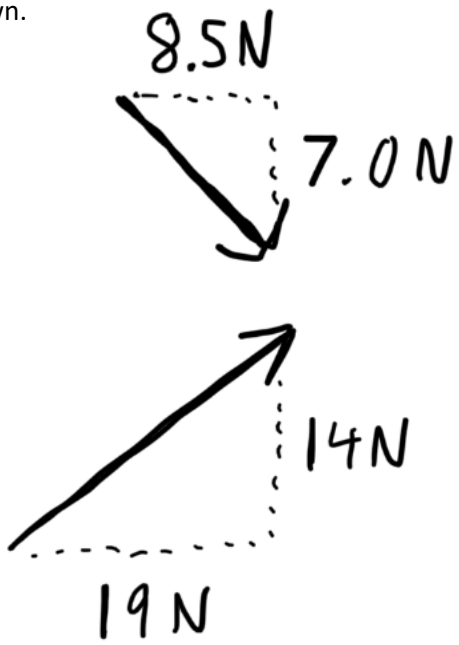
21. Determine the result of adding the two vectors shown.



22. Determine the components for each of the following vectors, and then use the components to determine the resultant vector.

Part 5: Solving Problems

23. A plane is flying due South. A 35.0 km/hr wind blows due West. The plane flies with a velocity of 425 km/hr. What is the actual speed and direction the plane is flying?

24. What is the acceleration of a car that turns from travelling 25.0 m/s North to travelling 20.0 m/s West in 3.00 seconds? $a = \frac{\Delta v}{t} = \frac{v_f - v_i}{t}$

25. A rocket is pointed at an angle of 56° above the horizontal and the engines output 2500 N of force, gravity pulls the rocket straight downwards with a force of 650 N. What is the net force acting on the rocket?

26. A pilot wishes to reach a city 400.0 km away in a direction of 15° S of W in two hours. If there is a wind of 70.0 km/h blowing at 10.0° W of S. What must be the heading and air speed of the plane?

27. Three forces act on a 5.0 kg block. There is a 25 N force at $16°$ North of East, a 49 N force at $34°$ South of East and a 56 N force acting at $11°$ North of West.
    a. What is the net force acting on the block?

    b. What is the acceleration of the block ($F_{net} = ma$)

    c. What will be the displacement of the block after travelling for 5.0 seconds?

    d. What will be the kinetic energy of the block after it has been travelling for 5.0 seconds?

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Answer Key				
Note on sig figs for the first section: When measuring we record measurements with one decimal of uncertainty. When I measured my ruler had lines every 0.1 cm, so my guess digit was in the second decimal place. Don't worry if you recorded a different # of sig figs for these, this is a place where our rules are a bit fuzzy, also don't worry if your values were a bit different, since we are drawing and measuring there are bound to be random errors.				
1a) 5.90 cm, 33° East of North	1b) 11.30 cm, 21° North of East	2a) 9.50 m/s, 58° below the horizontal	2b) 11.70 m/s, 37° above the horizontal	3a) 10.00 N, $53°$ North of East
3b) 4.70 N, 53° South of East	4a) 770 yards, 50° North of West	4b) 99 m/s, 22° North of West	5) Magnitude, angle, x-component, y-component	6) D
7) $\|s\| = 22.4$ $\theta = 26.6°$	8) $\|s\| = 36.4$ $\theta = 15.9°$	9) $\|s\| = 40.0$ $\theta = 0.0°$	10a) $26.9, 15.1°$ above the horizontal + 13.6, 72.9° above the horizontal	10b) $\|s\| = 36.1$ $\theta = 33.7°$
11a) 13.6, 72.9° above the horizontal + $26.9, 15.1°$ above the horizontal	11b) $\|s\| = 36.1$ $\theta = 33.7°$	11c) No order of addition doesn't matter	12)$a_x = 30.0$ $a_y = 15.0$	13) 39.1 N, 39.8° above the horizontal.
14) 34.7 m/s, 43.8° North of East	15) 91 m/s^2, 52° North of West	16) 22 N, 34° East of South	17) 33m, 61° up from right	18)27.0 m, 46.5° South of West
19a) Vertical component is 22.4 km Horizontal component is 51.5 km	19b) Vertical component is 0.0471 N Horizontal component is 0.0307 N	20a) 10 m	b) 13 m $\approx 10m$	c) 16 m, 52° North of East $\approx$ 20 m, 50° North of East
21) 28 N, $14°$ above the horizontal	22) 202 m, 13° above the horizontal $\approx 2.0 \times 10^2$ m, 13° above the horizontal	23) 430 km/hr, $4.7°$ West of South	24)10.7 m/s^2, 51° South of West	25) 2.0×10^3 N, 45° above the horizontal
26) 182 km/hr, $5.4°$ North of West	27a) 14 N, $45°$ South of East	27b) 2.8 m/s^2, 45° South of East	27c) 34 m, 45° South of East	27d) 480 J