1.3 VECTORS AND SCALARS *HW/Study Packet*

SL/HL	
Required: READ Hamper, pp 10-14	Supplemental: READ Cutnell and Johnson, pp 9-17 Giancoli, pp 45-53 DO Tsokos pp 28-30 #2,3,5,6,12,13,14,16

REMEMBER TO….

- ✓ *Work through all of the 'example problems' in the texts as you are reading them*
- ✓ *Refer to the **IB Physics Guide** for details on what you need to know about this topic*
- ✓ *Refer to the **Study Guides** for suggested exercises to do each night*
- ✓ *First try to do these problems using only what is provided to you from the **IB Data Booklet***
- ✓ *Refer to the solutions/key ONLY after you have attempted the problems to the best of your ability*

UNIT OUTLINE

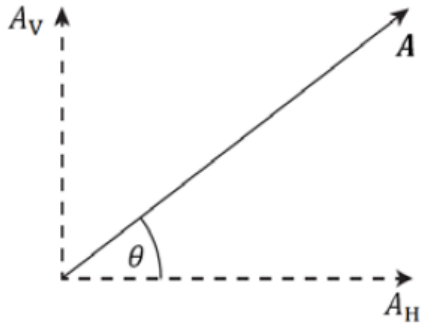
I. DISTINGUISHING VECTORS AND SCALARS
- A. HOW TO TELL WHICH IS WHICH
- B. REPRESENTING VECTORS

II. VECTOR MATHEMATICS
- A. IN ONE DIMENSION
- B. IN TWO DIMENSIONS

III. VECTOR COMPONENTS AND TRIGONOMETRY
- A. BASIC RIGHT-ANGLE TRIGONOMETRY
- B. UNIT VECTORS
- C. THE DOT PRODUCT AND CROSS PRODUCT

IV. RESOLVING VECTORS AND FINDING RESULTANT VECTORS ANALYTICALLY

FROM THE IB DATA BOOKLET



$$A_H = A\cos\theta$$

$$A_V = A\sin\theta$$

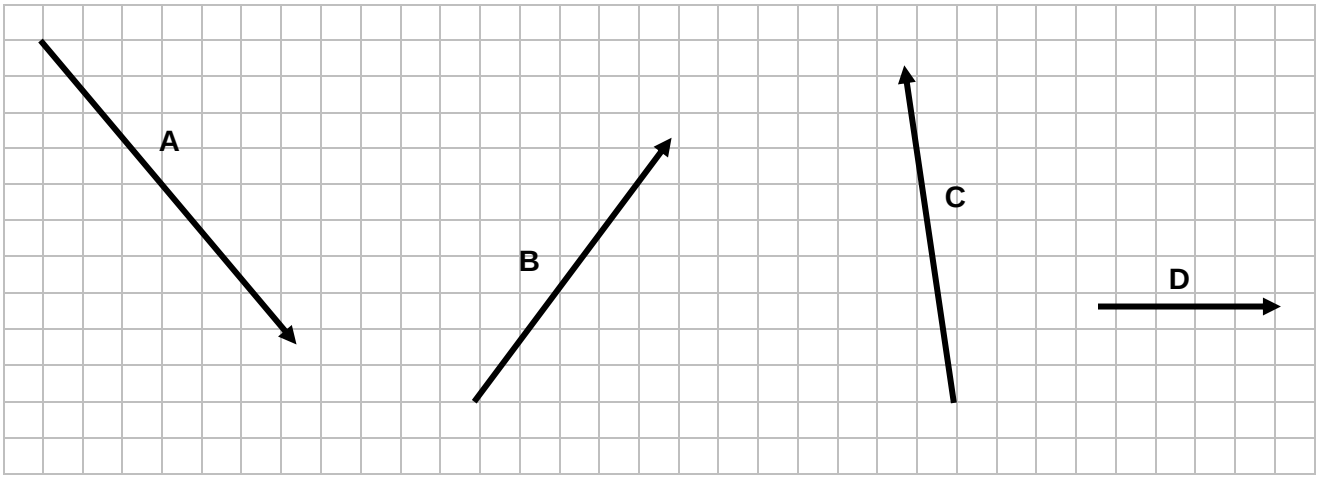
WHAT YOU SHOULD BE ABLE TO DO AT THE END OF THIS TOPIC

- □ Describe the difference between, and identify, vectors and scalars
- □ Add and subtract vectors both graphically and analytically
- □ Multiply and divide vectors by scalars
- □ Find the components of a vectors along the horizontal and vertical axes
- □ Find components of vectors parallel and perpendicular to an inclined plane
- □ Construct a vectors from its given components
- □ Solve problems involving two or more vectors at any angles

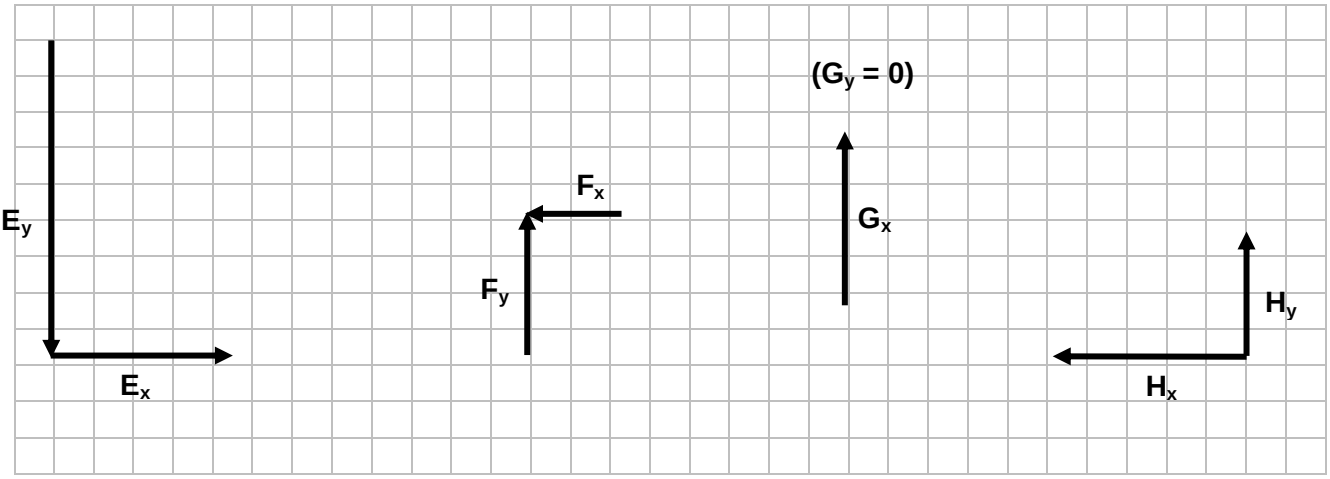
HOMEWORK PROBLEMS:

*For all problems, use a sheet of graph paper, ruler, and a protractor if necessary. Draw a **tidy vector diagram** for every problem as appropriate. **Put effort into making a neat diagram**.*

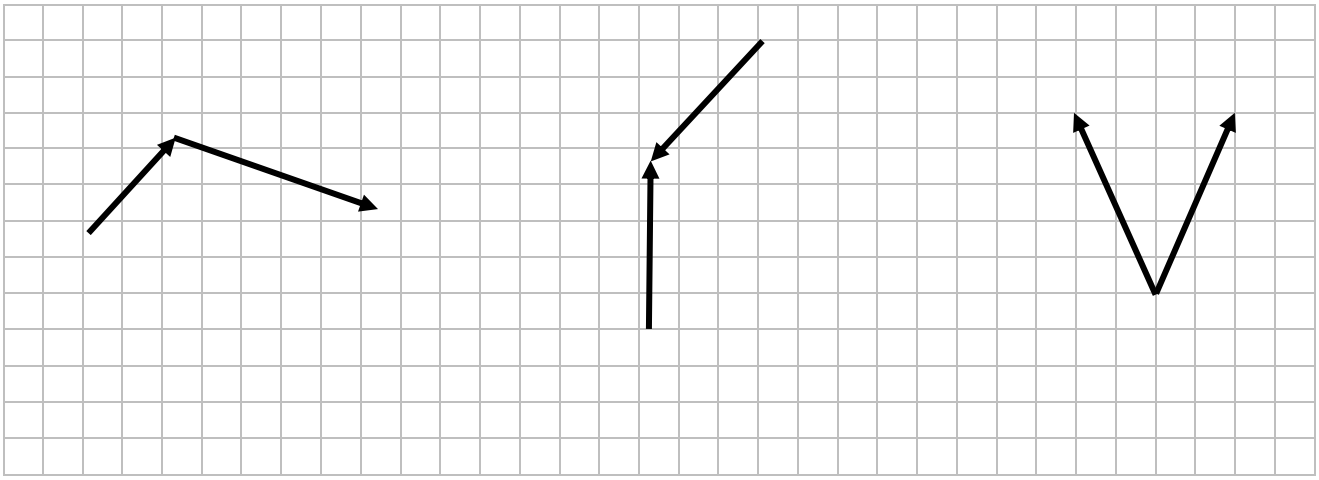
1. For each vector, draw and label its x and y components: *



2. For each set of component vectors, draw and label the resultant vector. *



3. For each pair of vectors, draw and label the resultant vector **R**. *



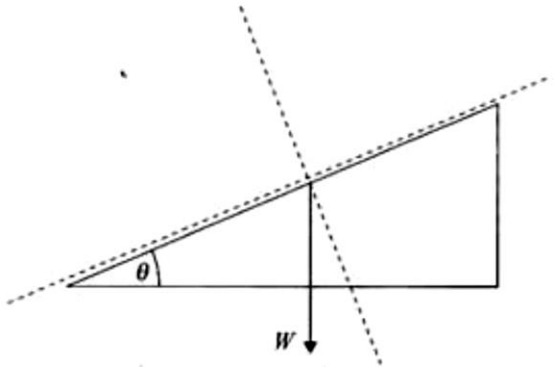
4. The components of a vector are given as $\mathbf{s}_x$ = 17.0 m and $\mathbf{s}_y$ = 8.0 m. Determine the resultant vector **s** graphically and analytically. **[s = 19 m at 25°]***

5. The components of a vector are given as $\mathbf{v}_x$ = - 5.0 ms^{-1} and $\mathbf{v}_y$ = 20.0 ms^{-1}. Determine the resultant vector **v** graphically and analytically. **[v = 21 ms^{-1} at 76° above the –x axis]**

6. **B** is a vector 15.8 units in magnitude at 34.7° above the –x axis.
a) Sketch this vector, choosing an appropriate scale.
b) Find $\mathbf{B}_x$ and $\mathbf{B}_y$ by measuring with a ruler.
c) Find $\mathbf{B}_x$ and $\mathbf{B}_y$ analytically. **[B_x = 13.1 units, B_y = 9 units]**
d) Use $\mathbf{B}_x$ and $\mathbf{B}_y$ from parts b) and c) to obtain (again) the magnitude and direction of **B**. Are they the same? Why or why not? **[same from c, not the same from b]**

7. An eagle leaves his nest and flies 22.0 km north. He then flies in a direction 60.0° south of east for 47.0 km. What is the eagle's displacement from his nest?
[30.0 km 38.5° below the +x axis (321.5°)]*

8. Draw and compute the components of the vector **w** as shown, along the axes indicated, if **w** = 12.5 N and θ = 23.0°. **[w_x = -4.88 N, w_y = -11.5 N]***



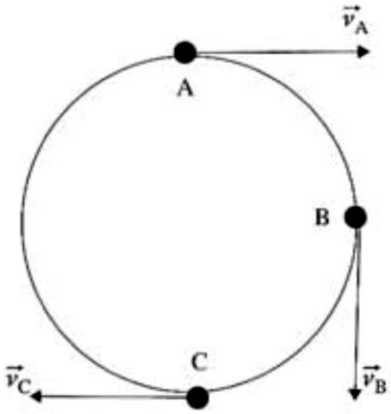
9. An airplane is traveling at **v** = 735 km/h in a direction 42.5° west of north.
a) Find the components of **v** in the northerly and westerly directions.
[v_y = 542 km/h (north), v_x = 497 km/h (west)]
b) How far north and how far west has the plane traveled in 3.00 h? **[1630 km N, 1490 km W]**

10. Vector **D** is 7.0 cm long at 180° and vector **E** is 8.5 cm long at 45°.
a) Find the x and y components of **D** and **E**. **[D_x = -7.0 cm, D_y = 0 cm; E_x = 6.0 cm, E_y = 6.0 cm]**
b) Determine **D** + **E** (magnitude and direction). **[6.1 cm 81° above the –x axis]**

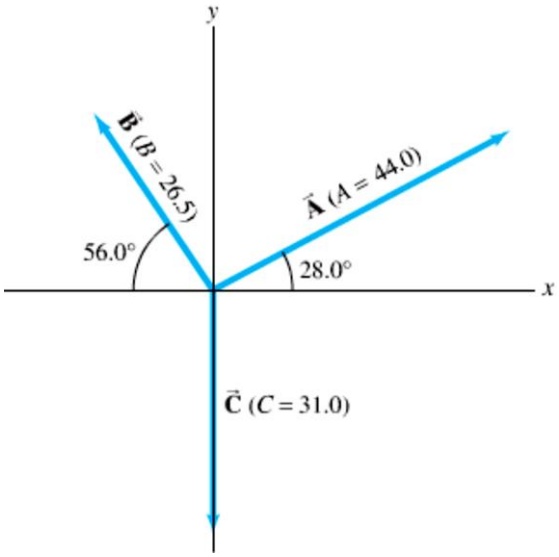
11. An airplane trip involves three legs, with two stopovers. The first leg is due east (90.0°) for 620 km; the second leg is southeast (315.0°) for 440 km and the third leg is 53.0° south of west, for 550 km. What is the plane's total displacement? **[962 km 51.3° below the +x axis (309°)]**

12. A mass on a string moves in a circle of radius 3.0 m with a constant speed of v = 6.0 ms^{-1}. However, **v** changes constantly (why?) and is at all times tangent to the circular path as shown. The mass goes from A to B to C. Find:

a) $\Delta\mathbf{v}$ ($\mathbf{v}_B - \mathbf{v}_A$) between A and B **[8.5 ms^{-1} 45° below the –x axis]**
b) $\Delta\mathbf{v}$ ($\mathbf{v}_C - \mathbf{v}_B$) between B and C **[8.5 ms^{-1} 45° above the –x axis]**

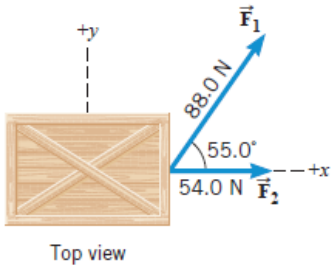


13. Three vectors are shown with magnitudes in arbitrary units. Determine the following:

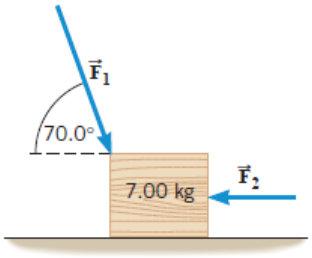


a) The resultant vector R (**R** = **A** + **B** + **C**) **[R = 26.4 units at 24.8°]**
b) **A – C** **[64.2 units at 52.8°]**
c) **A – B** **[53.6 units 2.0° below the +x axis]**
d) **B – A** **[53.6 units 2.0° above the –x axis]**
e) **A – B + C** **[62.9 units at 329°]**
f) **A + B – C** **[76.9 units at 71.8°]**
g) **C – A – B** **[76.9 units at 252°]**
h) **B – 2A** **[94.2 units at 191°]**
i) **2A – 3B + 2C** **[150. units at 324°]**

14. The drawing shows the top view of two forces pulling on a box in different directions. Determine the resultant force (draw it and calculate it) and call it **F**. **[127 N at 34.6°]**



15. The drawing shows the side view of two forces pushing on a box on the floor. F_1 = 5.00 N and F_2 = 3.00 N. Determine the resultant force and call it **F**. In what direction does the box move?
[F = 4.87 N at 74.7° below the –x axis; to the left]



16. The drawing shows the side view of a force pulling on a box. Describe what happens to the vertical ($\mathbf{F}_y$) and horizontal ($\mathbf{F}_x$) components of **F** as varies from 0° to 90°. **[$\mathbf{F}_y$ increases and $\mathbf{F}_x$ decreases]**