Lecture3

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Content

- More problems in chapter2
- Chapter3:
  - Review of the main laws
  - How to get components for different vectors
  - How to get magnitude & angle for a vector
  - Some operations on vectors

Problem 30 page 70

30. A worker drops a wrench from the top of a tower 80.0 m tall. What is the velocity when the wrench strikes the ground?

- Drops ---> $V_i = 0$, $a = -g = -10\ m/s^2$.
- $\Delta x = -80m$ (going down)
- $V_f = ?$
- There is no mention to time at all ---> use law (3)
- ---> $V_f^2 = V_i^2 + 2\ a\ \Delta x$ ...(3)
- $V_f^2 = (0)^2 + 2\ (-10)\ (-80)$
- $V_f^2 = 1600$ ---> $V_f = 40\ m/s$
- Because it is going down ---> $V_f = -40\ m/s$

Problem 40 page 71

40. A small fish is dropped by a pelican that is rising steadily at 0.50 m/s.

a. After 2.5 s, what is the velocity of the fish?

b. How far below the pelican is the fish after 2.5 s?

- Rising steadily ---> Vi = +0.5 m/s, a = -g = -10 m/s^2.
- T = 2.5 s, Vf = ?
- Vf = Vi + a t …(1)
- ---> Vf = 0.5 + (-10) (2.5)
- Vf = -24.5 m/s

- Part (b) is not needed

Problem 46 page 72

46. A parachutist descending at a speed of 10.0 m/s loses a shoe at an altitude of 50.0 m.

a. When does the shoe reach the ground?

b. What is the velocity of the shoe just before it hits the ground?

- descending ---> $V_i = -10$ m/s, $a = -g = -10$ m/s^2.
- $\Delta x = -50$m (going down),
- t = ?, Vf = ?
- Use law (3) to find Vf first
- $V_f^2 = V_i^2 + 2\,a\,\Delta x$ ...(3)
- $V_f^2 = (-10)^2 + 2\,(-10)\,(-50)$
- $V_f^2 = 1100$
- Vf = 33.2 ---> Vf = -33.2 m/s (going down)
- $V_f = V_i + a\,t$ …(1)
- ---> -33.2 = -10 + (-10) (t)
- -23.2 = -10 t ---> t = 2.32 s

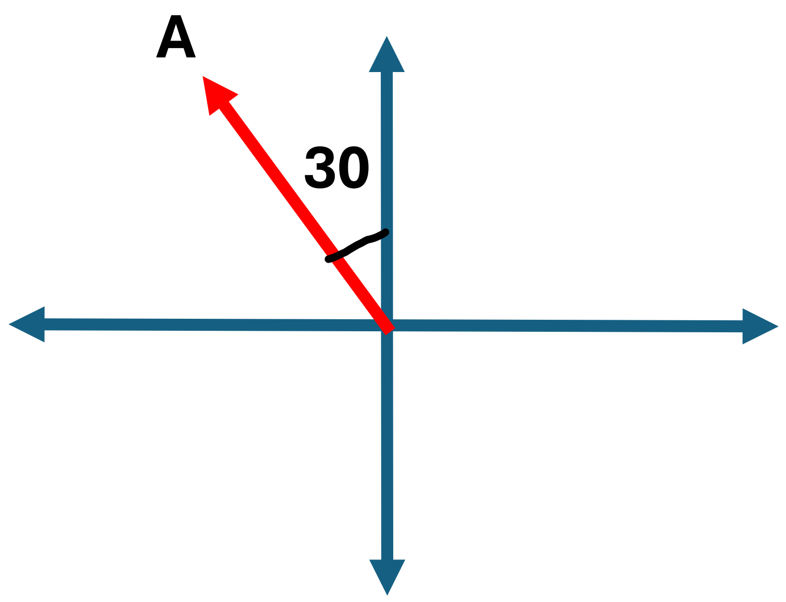
Chapter3

Vectors & scalars

- Scalars (كميات قياسية): quantities with magnitude only.
- (scalars has no direction)
- Examples: temperature, speed ...
- Vectors (كميات متجهة): quantities with magnitude and direction.
- Examples: velocity, force …
- Vectors have both magnitude (مقدار) and direction (اتجاه)
- Example: a plane is flying 600 m/s north

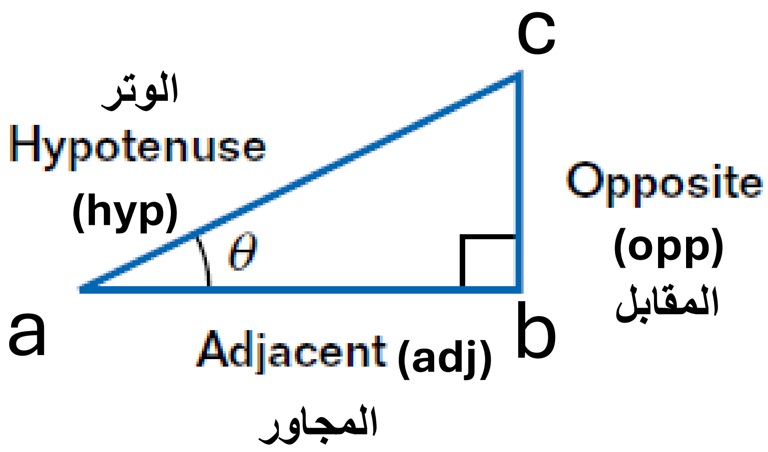
Vectors

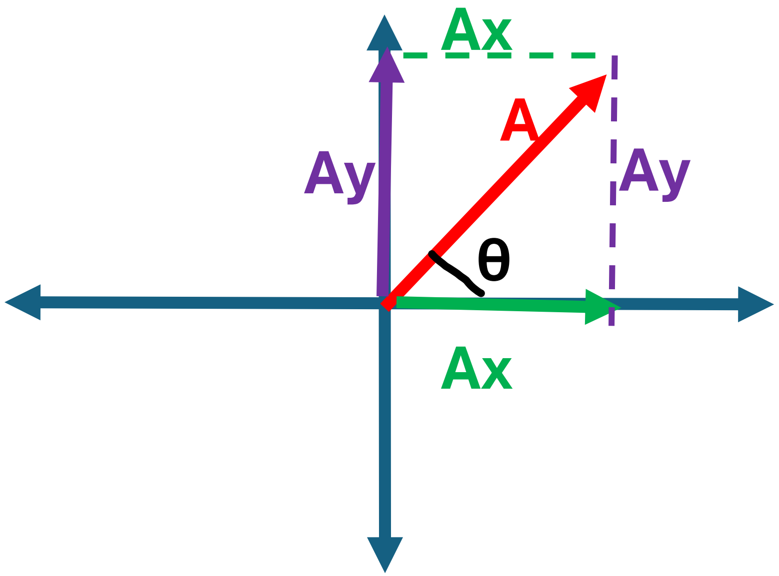
- Different ways to represent vectors:
  - Magnitude and direction (angle)
  - Vector components
- Example: vector A in the figure has magnitude 10 and direction 30° west of north
- Represent A as components (مركبات) in x axis and y axis



Vectors

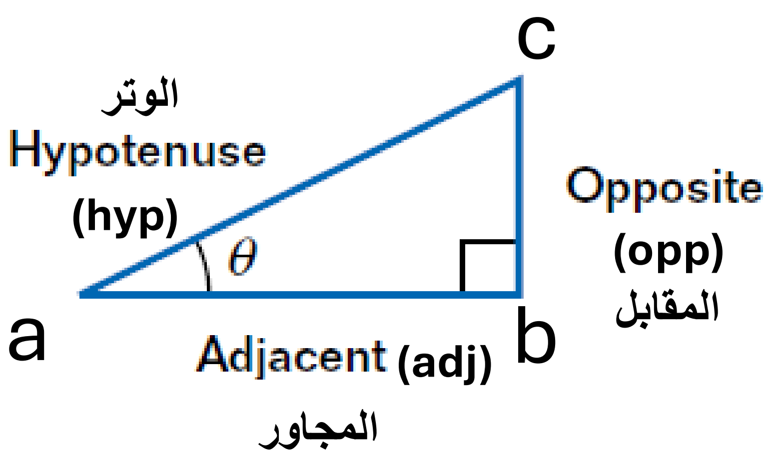
- Represent A as components (مركبات) in x axis and y axis
- According to trigonometry (علم المثلثات):
- cos θ = adj/hyp = المجاور/الوتر
- sin θ = opp/hyp = المقابل/الوتر
- tan θ = opp/adj = المقابل/المجاور
- According to Pythagorean thoerem:
- $(Hyp)^2 = (opp)^2 + (adj)^2$.
- الوتر) ^{2} = (المقابل) ^{2} + (المجاور) ^{2}) .
- The opp and adj represent the components

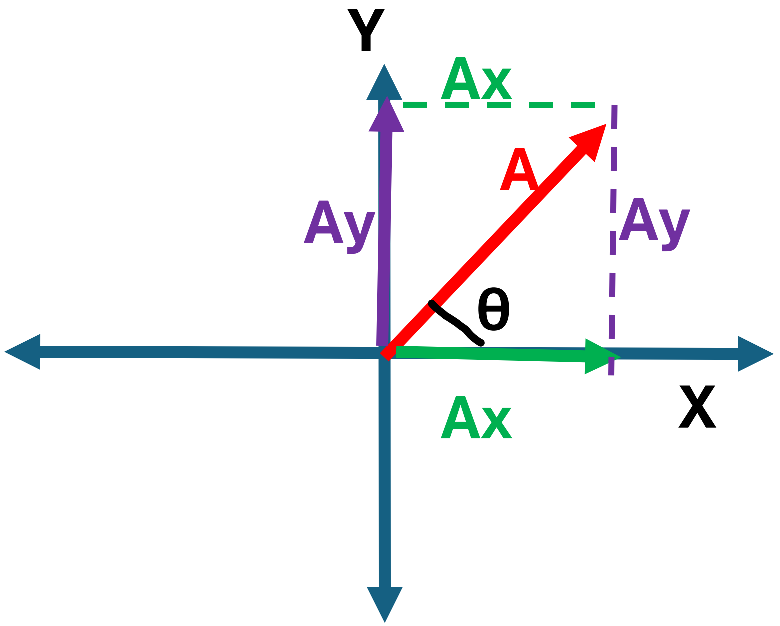




Vectors

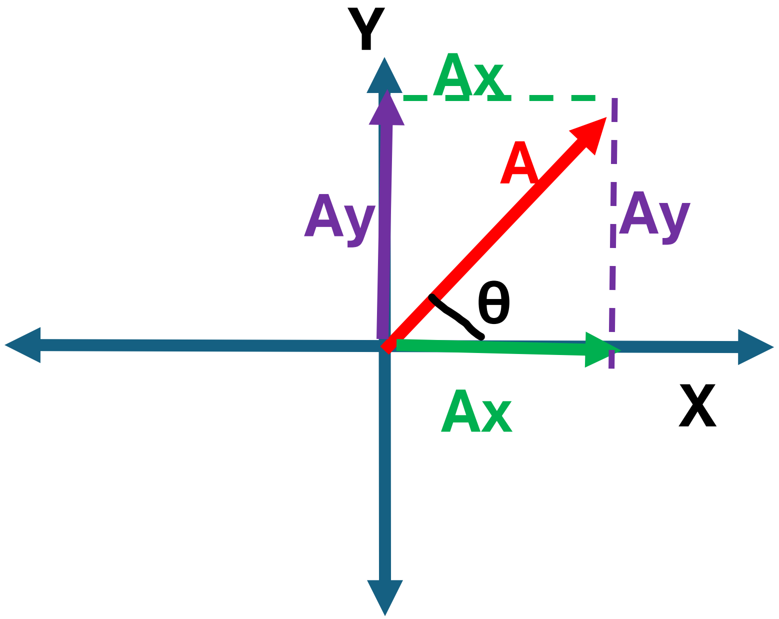
- Represent A as components (مركبات) in x axis and y axis (Ax and Ay)
- The opp and adj represent the components
- If you have (θ) you can find:
- sin θ , cos θ, tan θ using the calculator
- Using trigonometry, you can find Ax and Ay
- Need to be careful with directions





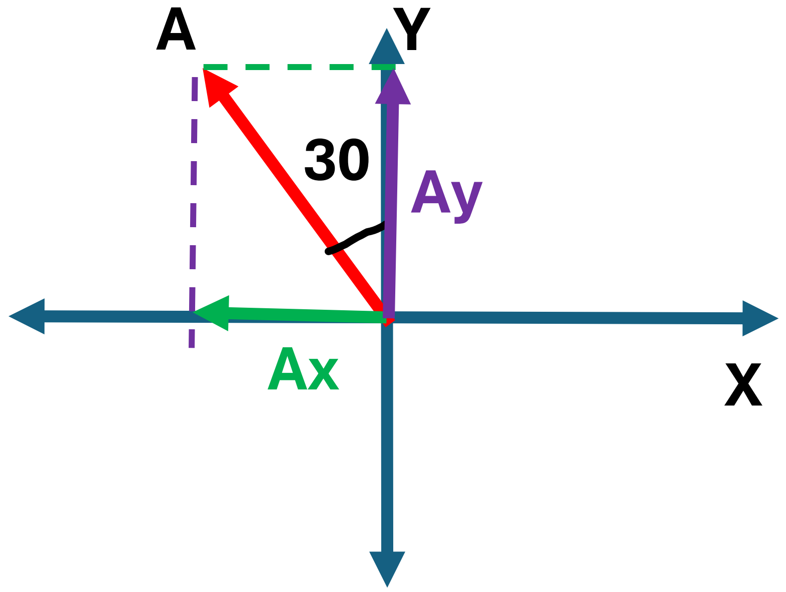
Vectors

- If |A| = 10 , θ = 30
- Ax = |A| cos θ
- Ax = |A| cos 30 = 10 x 0.866 = 8.66
- Ay = A sin θ
- Ay = |A| sin 30 = 10 (0.5) = 5



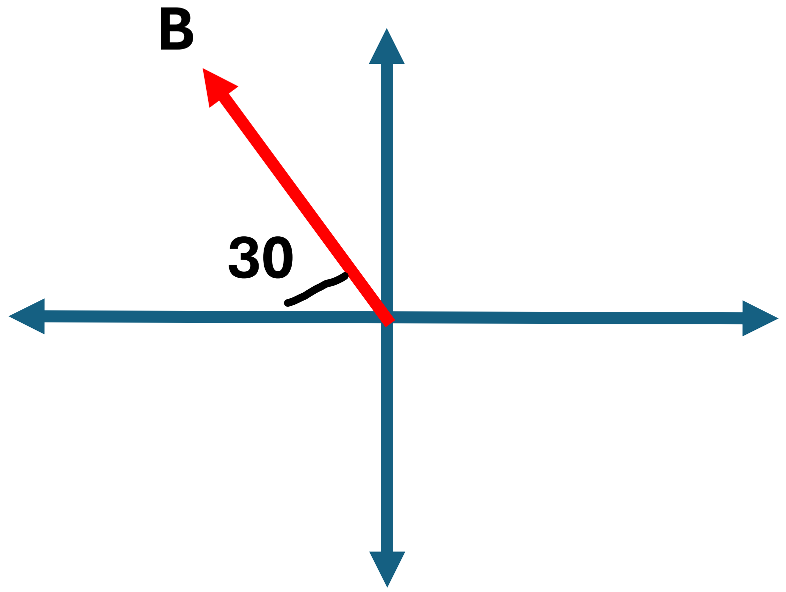
example

- If $|A| = 10$
- $Ax = -|A| \sin 30 = -10 \times 0.5 = -5$
- $Ay = |A| \cos 30 = 10\,(0.866) = 8.66$



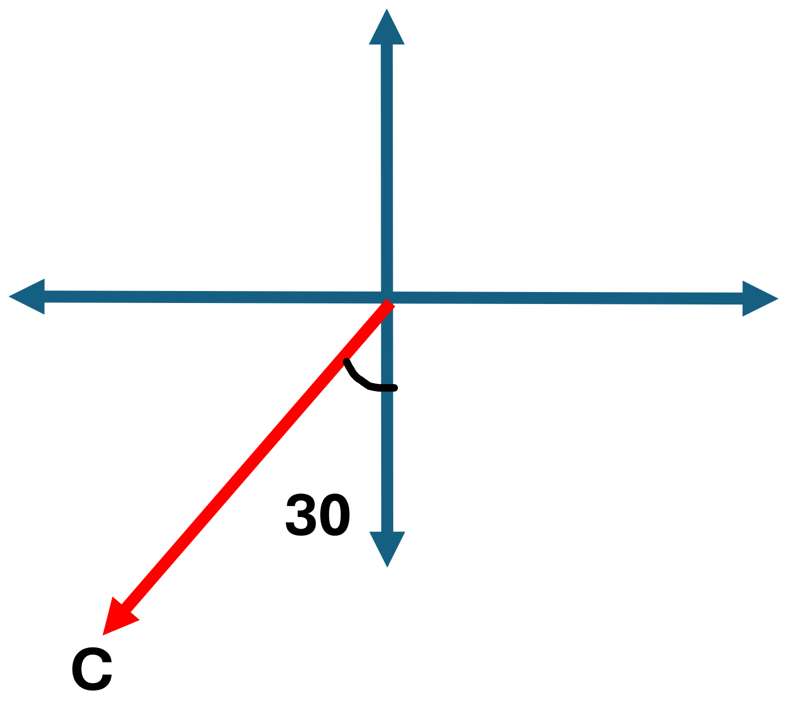
example

- If |B| = 10
- Bx = -|B| cos 30 = -8.66
- By = |B| sin 30 = 5



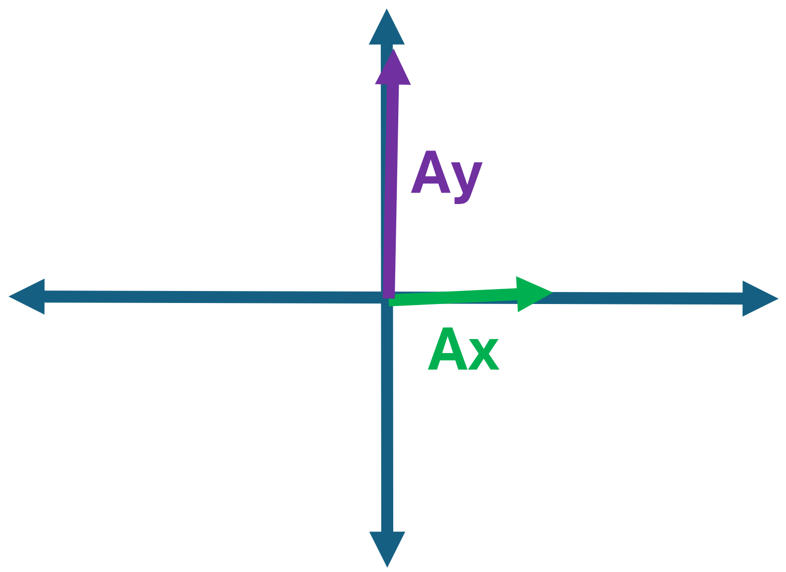
example

- If |C| = 10
- Cx = -|C| sin 30 = -5
- Cy = - |C| cos 30= -8.66



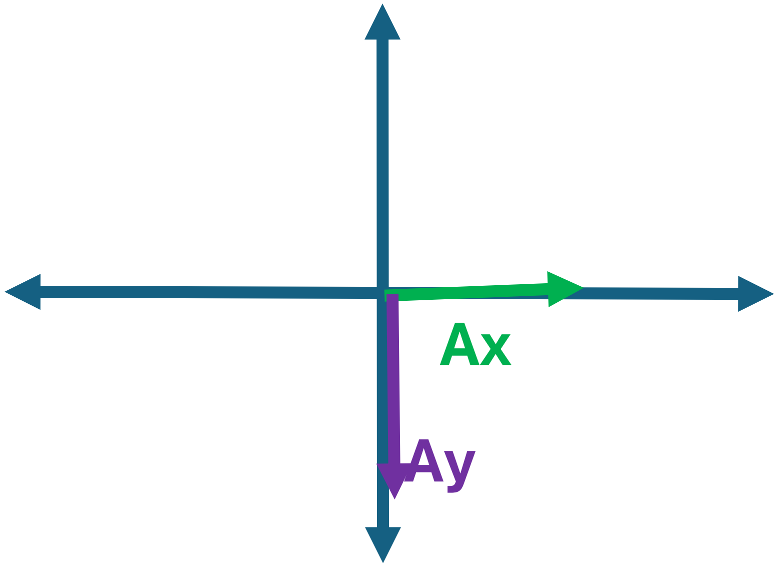
example

- If $A = 6i + 8j$
- $Ax = 6$
- $Ay = 8$
- $|A| = [Ax^2 + Ay^2]^{1/2}$
- $|A| = [6^2 + 8^2]^{½} = 10$
- Theta = $\tan^{-1} [y/x] = \tan^{-1} [8/6]$
- Theta = $\tan^{-1} [1.3333]$ ---> theta = 53
- Theta = 53



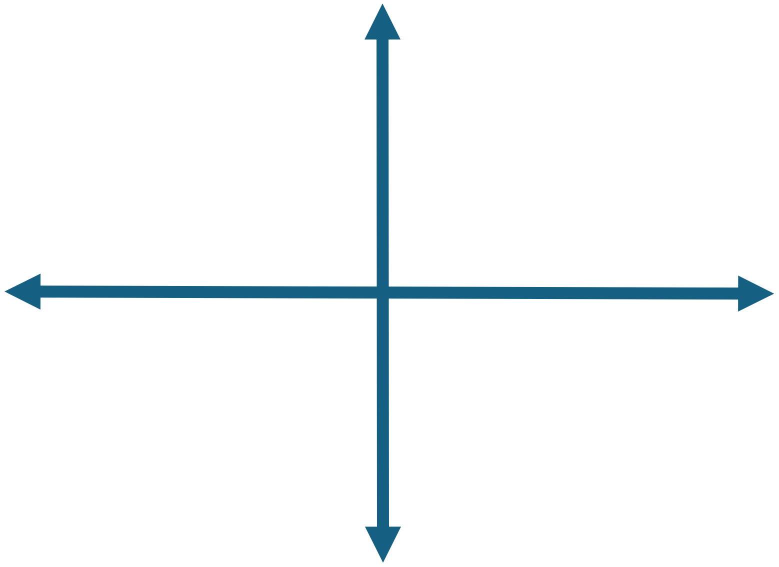
example

- If A = 6i - 8j
- Ax = 6
- Ay = -8
- $|A| = [Ax^2 + Ay^2]^{1/2}$
- $|A| = [6^2 + -8^2]^{½} = 10$
- Theta = $\tan^{-1}$ [y/x] = $\tan^{-1}$ [-8/6]
- Theta = $\tan^{-1}$[-1.333333]
- Theta = -53



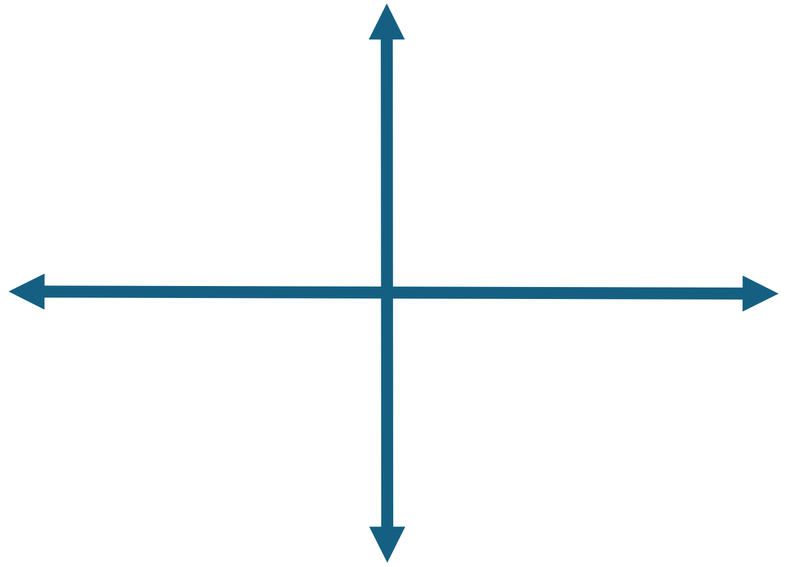
example

- If A = 6i – 8j, B = -2i + 3j
- What is C = A + B?
- Ax = 6, Ay = -8
- Bx = -2, By= 3
- C = A + B = [(6) + (-2)] i + [(-8) + (3)] j
- C = 4i + -5j



example

- If A = 6i – 8j, B = -2i + 3j
- What is D = A - B?
- $A_x = 6$, $A_y = -8$
- $B_x = -2$, $B_y = 3$
- D = A - B = [(6) - (-2)] i + [(-8) - (3)] j
- D = 8i + -11j



example

- If A = 6i – 8j, B = -2i + 3j
- What is E = 2A - 3B?
- 2A = 2 (6i – 8j) = 12i - 16j
- 3B = 3 (-2i +3j) = -6i + 9j
- E = 2A -3B = (12i – 16j) - (-6i + 9j)
- E = (12 - (-6))i + (-16 – 9)j
- E = 18i + -25j