

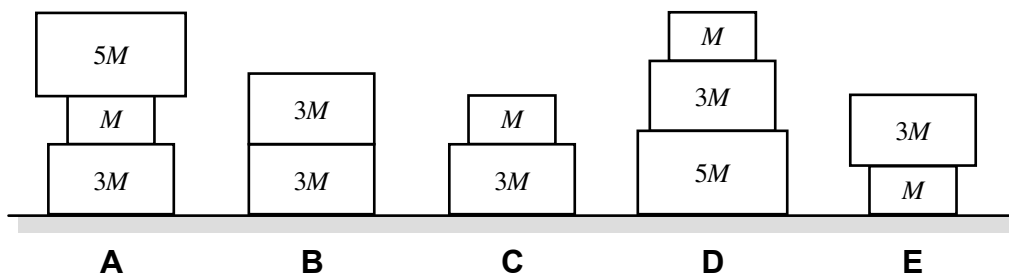
**Checklist:**

Make an appointment with Dr. Shen to set up WebAssign, Edpuzzle, get summer packet and textbook. Email Dr. Shen at [yshen@briarcliffschools.org](mailto:yshen@briarcliffschools.org) to set up an appointment **before June 25**.

1. Use the following link to register and get access to WebAssign:  
<https://www.getenrolled.com/?courseKey=briarcliff.ny99774328>
2. Textbook  
You can get a hard-copy textbook from Dr. Shen or download an eBook via email.
3. Watch the Edpuzzle videos *sequentially* **before 8/28/2026**  
The sequence of the videos is:
  - Textbook 1.1
  - Textbook 1.2
  - Textbook 1.3
  - Textbook 1.4
  - Textbook 1.5
  - AP Daily Video 1.1\_1 Vector and Scalar
  - AP Daily Video 1.1\_2 Vector Addition in One Dimension
  - Textbook 1.6
  - Textbook 1.7
  - Textbook 1.8
  - Optional example video: Example 1.46
4. 33 WebAssign problems - **Due on Monday 8/31/2026**
5. Summer packet - **Due on Friday 8/28/2026**  
BHS main office is open during working hours. You can drop or mail the packet to the main office.  
Dr. Shen does not take late work.

### Example on how to answer ranking problems:

Shown below are stacks of various blocks. All masses are given in the diagram in terms of  $M$ , the mass of the smallest block.



**Rank the total mass of each stack.**

|          |   |   |   |       |    |          |      |           |
|----------|---|---|---|-------|----|----------|------|-----------|
|          |   |   |   |       | OR |          |      |           |
| 1        | 2 | 3 | 4 | 5     |    | All      | All  | Cannot    |
| Greatest |   |   |   | Least |    | the same | zero | determine |

**Explain your reasoning.**

*Stacks A and D have a total mass of  $9M$ , C and E have a mass of  $4M$ , and B has a mass of  $6M$ .*

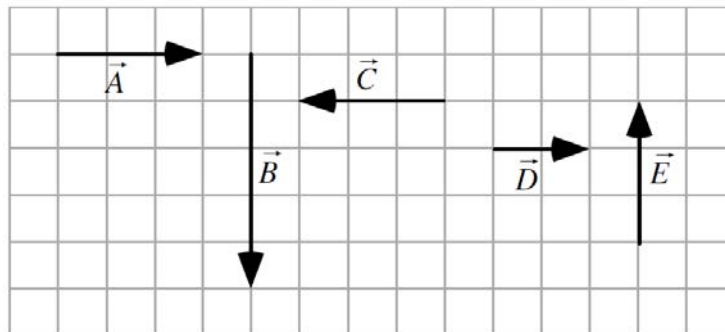
*Example answer format*

One way the ranking can be expressed is as “ $A = D > B > C = E$ ” based on the reasoning listed above.

## Vector Addition and Subtraction –Graphic Method

Revisit Section 1.6 if necessary

1. Five vectors are shown superimposed on the grid.

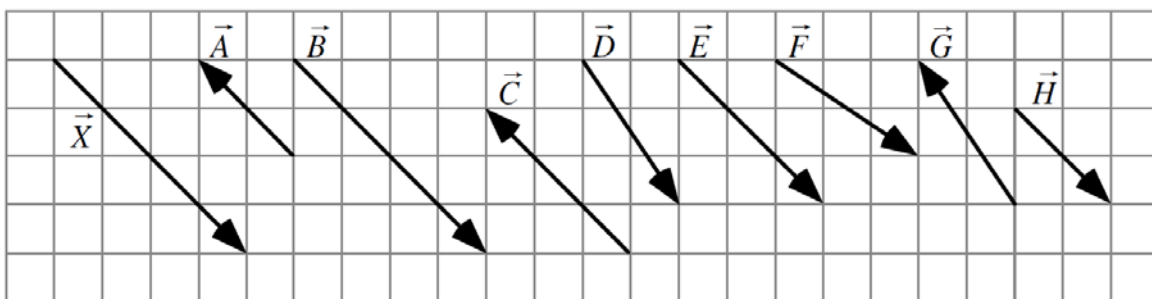


Rank the magnitudes (lengths) of the vectors.

|          |   |   |   |       |    |          |      |           |
|----------|---|---|---|-------|----|----------|------|-----------|
|          |   |   |   |       | OR |          |      |           |
| 1        | 2 | 3 | 4 | 5     |    | All      | All  | Cannot    |
| Greatest |   |   |   | Least |    | the same | zero | determine |

Explain your reasoning.

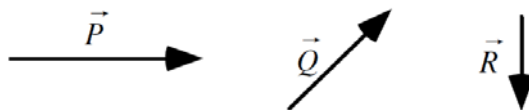
2. Nine vectors are shown superimposed on the grid.



(a) List all of the vectors that have the same direction as vector  $\vec{X}$ .

(b) List all of the vectors that have the same direction as vector  $-\vec{X}$ .

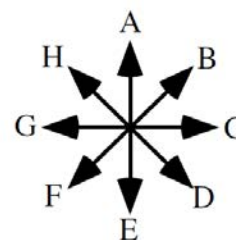
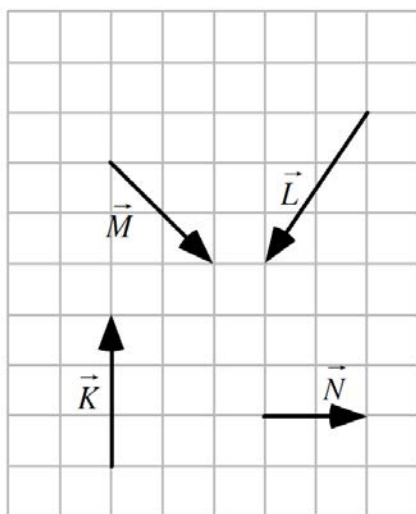
3. Three vectors, labeled  $\vec{P}$ ,  $\vec{Q}$ , and  $\vec{R}$  are shown below.



Write an expression using the vectors  $\vec{P}$ ,  $\vec{Q}$ , and  $\vec{R}$  for the resultant vectors shown.

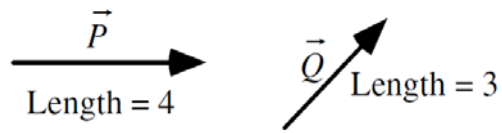
|                                                                       |                                               |                                               |
|-----------------------------------------------------------------------|-----------------------------------------------|-----------------------------------------------|
| <p><i>Example</i></p> <p><math>\vec{X} = \vec{P} + \vec{Q}</math></p> | <p><b>A</b></p> <p><math>\vec{A} =</math></p> | <p><b>B</b></p> <p><math>\vec{B} =</math></p> |
| <p><b>C</b></p> <p><math>\vec{C} =</math></p>                         | <p><b>D</b></p> <p><math>\vec{D} =</math></p> | <p><b>E</b></p> <p><math>\vec{E} =</math></p> |

4. Shown at left below are vectors labeled  $\vec{K}$ ,  $\vec{L}$ ,  $\vec{M}$ , and  $\vec{N}$ , with length in arbitrary units, superimposed on a grid.

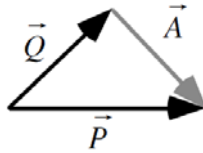


On the grid on the right, construct a graphical representation of  $\vec{J} = \vec{K} + \vec{L} + \vec{M} + \vec{N}$  with labels for each vector, and indicated the direction of  $\vec{J}$ : \_\_\_\_\_ (closest to one of the directions listed on the direction rosette above).

5. Two vectors, labeled  $\vec{P}$  and  $\vec{Q}$  are shown below. The length (magnitude) of each vector is given in arbitrary units.



A student constructs the figure shown below to figure out the sum of the vectors  $\vec{P}$  and  $\vec{Q}$ . The student contends that the lighter arrow  $\vec{A}$  represents the vector sum of the vectors  $\vec{P}$  and  $\vec{Q}$ .

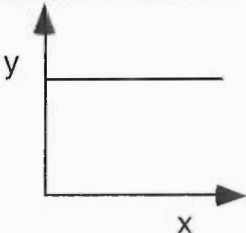
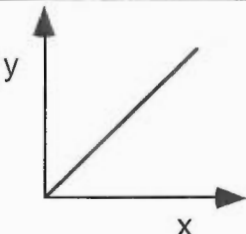
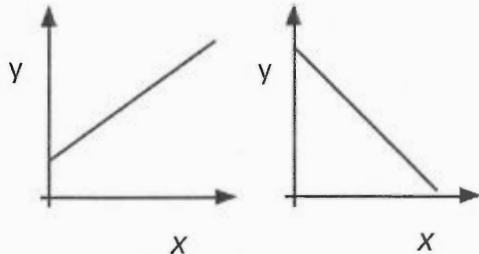
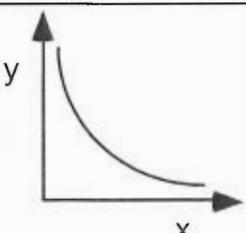
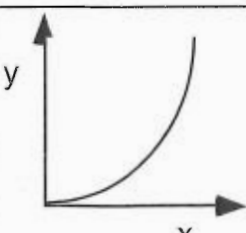


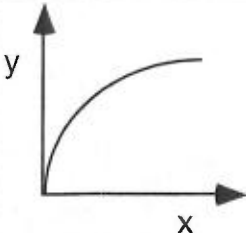
What, if anything, is wrong with the student's work? If something is wrong, identify it, and explain how to correct it. If his/her work is correct, explain why.

## Graphic and Algebraic Representations

When scientists set up experiments they often attempt to determine how a given variable affects another variable. A graph is one of the most effective representations of the relationship between two variables. The independent variable (one controlled by the experimenter) is usually placed on the  $x$ -axis. The dependent variable (one that responds to changes in the independent variable) is usually placed on the  $y$ -axis. It is important for you to be able interpret a graphical relationship and express it in a written statement and by means of an algebraic expression.

Read the summary of frequently used relationships below:

| Graphic representation                                                              | Written relationship                                                                                                                                        | Algebraic representation        |
|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|
|    | As $x$ increases, $y$ remains the same.<br>There is no relationship between the variables.                                                                  | $y = b$ , or<br>$y$ is constant |
|   | As $x$ increases, $y$ increases proportionally.<br>$y$ is directly proportional to $x$ .                                                                    | $y = mx$                        |
|  | $y$ is linearly related to $x$ .<br>left: As $x$ increases, $y$ increases at a constant rate.<br>right: As $x$ increases, $y$ decreases at a constant rate. | $y = mx + b$                    |
|  | As $x$ increases, $y$ decreases.<br>$y$ is inversely proportional to $x$ .                                                                                  | $y = m\left(\frac{1}{x}\right)$ |
|  | $y$ is proportional to the square of $x$ .                                                                                                                  | $y = mx^2$                      |

|                                                                                   |                                                 |                 |
|-----------------------------------------------------------------------------------|-------------------------------------------------|-----------------|
|  | $y$ is proportional to the square-root of $x$ . | $y = m\sqrt{x}$ |
|-----------------------------------------------------------------------------------|-------------------------------------------------|-----------------|

Practice:

6. Which of these equations are consistent with the statement “If  $x$  doubles, then  $y$  also doubles.” There might be multiple answers.

A.  $y = 2x$

Answer: \_\_\_\_\_

B.  $y = 3x$

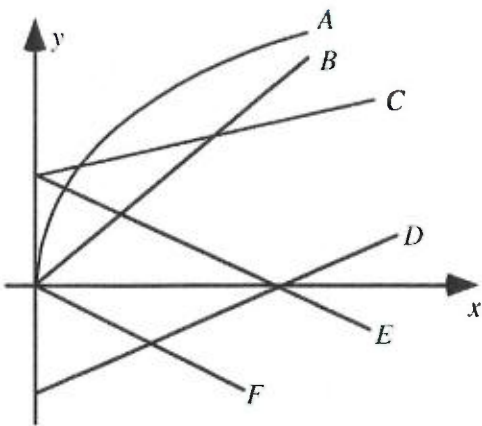
Explain your reasoning.

C.  $y = 2x + 7$

D.  $y = -4x$

E.  $y = x^2$

7. Six  $y$ - versus  $x$ - graphs are shown on a single set of axes. Which of these graphs are consistent with the statement “If  $x$  doubles, then  $y$  also doubles.” There might be multiple answers.



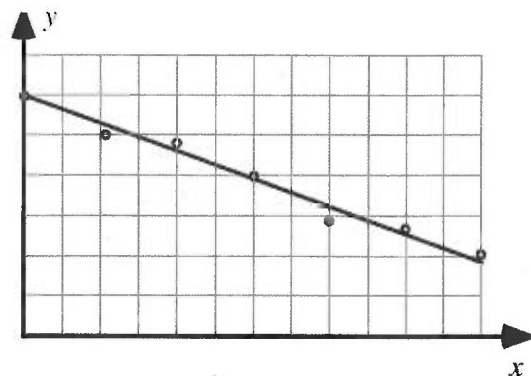
Answer: \_\_\_\_\_

Explain your reasoning.

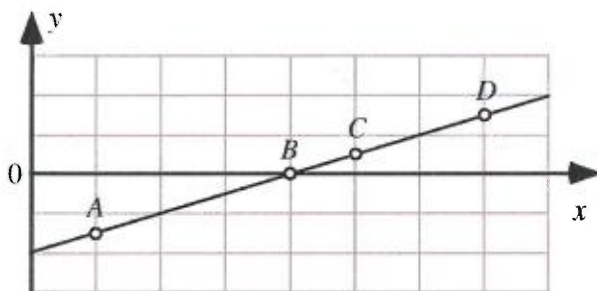
8. A student makes the following claim about some data that he and his lab partners have collected:

*"Our data show that the value of  $y$  decreases as  $x$  increases. We found that  $y$  is inversely proportional to  $x$ ."*

**What, if anything, is wrong with this statement? If something is wrong, identify and explain how to correct all errors. If this statement is correct, explain why.**



9. Four points are labeled on a line.

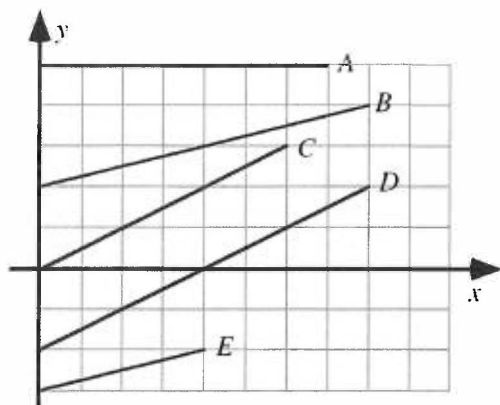


**Rank the magnitudes (sizes) of the slopes of the line at the labeled points.**

|          |   |   |       |    |          |      |           |
|----------|---|---|-------|----|----------|------|-----------|
|          |   |   |       | OR |          |      |           |
| 1        | 2 | 3 | 4     |    | All      | All  | Cannot    |
| Greatest |   |   | Least |    | the same | zero | determine |

**Explain your reasoning.**

10. Shown are several lines on a graph.



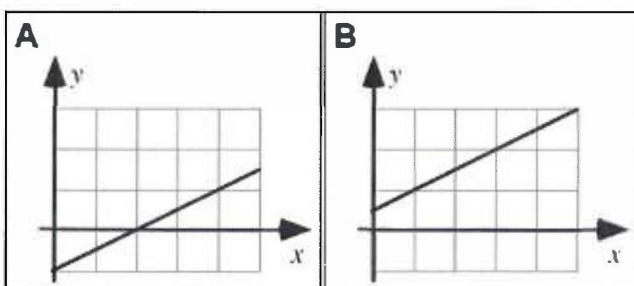
Rank the slopes of the lines in this graph.

|          |   |   |   |       |
|----------|---|---|---|-------|
|          |   |   |   |       |
| 1        | 2 | 3 | 4 | 5     |
| Greatest |   |   |   | Least |

OR

|                 |             |                     |
|-----------------|-------------|---------------------|
|                 |             |                     |
| All<br>the same | All<br>zero | Cannot<br>determine |

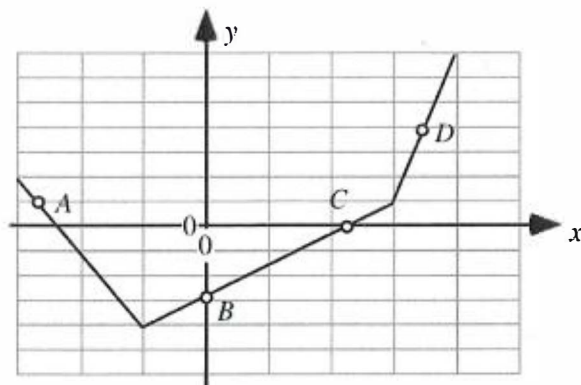
11. Shown are two graphs.



Is the slope of the graph (i) *greater in Case A*, (ii) *greater in Case B*, or (iii) *the same in both cases*? \_\_\_\_\_

Explain your reasoning.

Problems 12-13: Four points are labeled on a graph.



12. Rank the magnitudes (sizes) of the slopes of the graph at the labeled points.

|                      |                      |                      |                      |    |                      |                      |                      |
|----------------------|----------------------|----------------------|----------------------|----|----------------------|----------------------|----------------------|
| <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> | OR | <input type="text"/> | <input type="text"/> | <input type="text"/> |
| 1                    | 2                    | 3                    | 4                    |    | All                  | All                  | Cannot               |
| Greatest             |                      |                      | Least                |    | the same             | zero                 | determine            |

Explain your reasoning.

[Hint: If a point belongs to a straight line, the slope of the point is the slope of the line.]

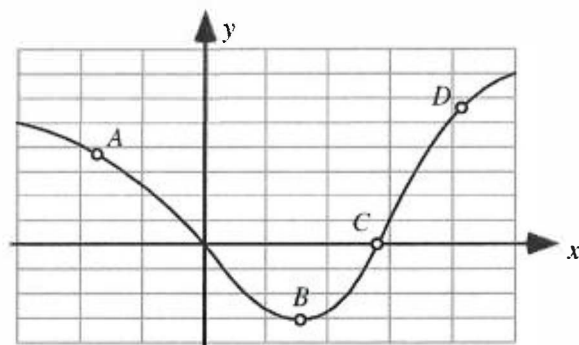
13. Rank the slopes of the graph at the labeled points.

|                      |                      |                      |                      |    |                      |                      |                      |
|----------------------|----------------------|----------------------|----------------------|----|----------------------|----------------------|----------------------|
| <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> | OR | <input type="text"/> | <input type="text"/> | <input type="text"/> |
| 1                    | 2                    | 3                    | 4                    |    | All                  | All                  | Cannot               |
| Greatest             |                      |                      | Least                |    | the same             | zero                 | determine            |

Explain your reasoning.

[Hint: Problems 12 and 13 are different. The magnitude of slope is a quantity without negative sign. Slope can be positive or negative.]

14. Four points are labeled on a graph.



Rank the slopes of the graph at the labeled points.

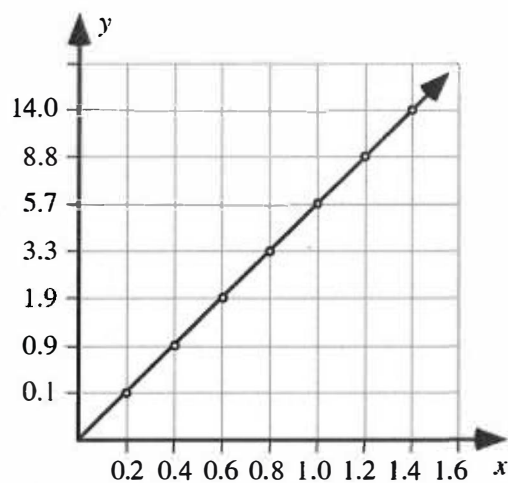
|          |   |   |       |    |          |      |           |
|----------|---|---|-------|----|----------|------|-----------|
|          |   |   |       | OR |          |      |           |
| 1        | 2 | 3 | 4     |    | All      | All  | Cannot    |
| Greatest |   |   | Least |    | the same | zero | determine |

Explain your reasoning.

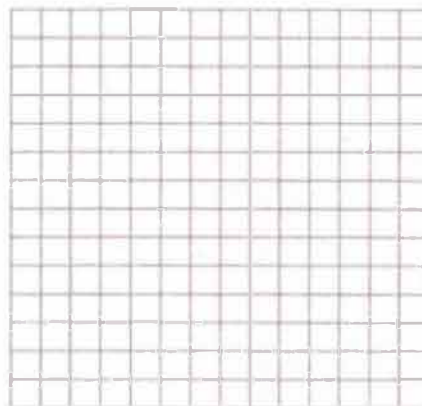
[Hint: If a point is on a curve, draw a tangent line at that point first. The slope of the point is the slope of the tangent line.]

15. A student uses data from a table to make a graph as shown.

| $x$ | $y$  |
|-----|------|
| 0.2 | 0.1  |
| 0.4 | 0.9  |
| 0.6 | 1.9  |
| 0.8 | 3.3  |
| 1.0 | 5.7  |
| 1.2 | 8.8  |
| 1.4 | 14.0 |



What, if anything, is wrong with this graph? If something is wrong, identify and explain how to correct all errors. If this statement is correct, explain why. Use the template below to draw a correct graph if needed.



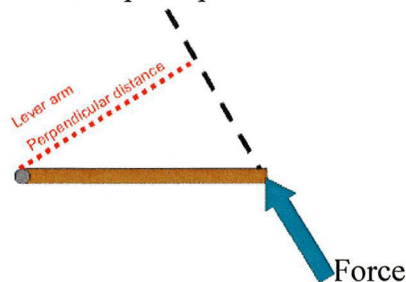
## Torque and Lever Arm

One of the challenging concepts in AP Physics-1 is torque. Torque is defined as the product of force and lever arm. Geometry skills are needed for this topic. Here is one way to find torque on an object.

Step 1: Find the rotational axis or pivot point.

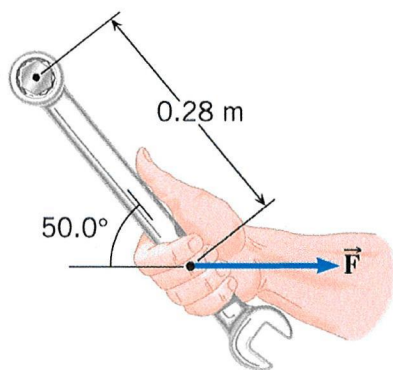
Step 2: Extend the given force line.

Step 3: Draw a perpendicular line from the pivot point to the force line. It is the shortest distance between pivot point to the force line, named as  $r_{\perp}$  or lever arm.

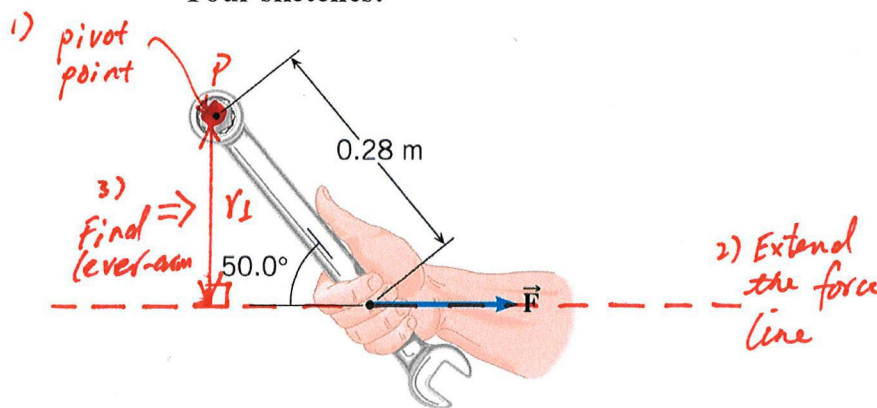


Example: You are installing a new spark plug in your car, and the manual specifies that it is to be tightened with a magnitude of force  $F = 200. \text{ N}$ . Using the data in the left drawing, determine the magnitude of torque you must exert on the wrench.

Diagram:



Your sketches:



Step 1: Identify the pivot point as the center of the spark plug. Label it as  $P$  as indicated above.

Step 2: Extended the force line as indicated on the right diagram above.

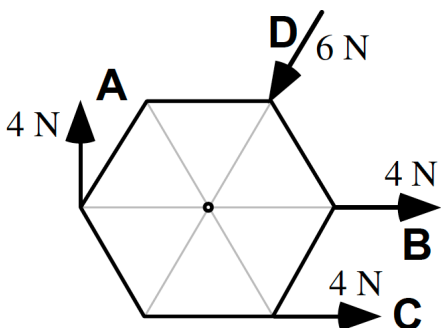
Step 3: Draw a perpendicular line from the pivot point to the force line, the distance is lever arm,  $r_{\perp}$ .

→ Find the value of lever arm:  $r_{\perp} = (0.28 \text{ m}) \cdot (\sin 50.0^\circ) = 0.21 \text{ m}$

→ Find the magnitude of torque: torque = force  $\cdot$  lever-arm =  $(200. \text{ N}) \cdot (0.21 \text{ m}) = \boxed{42 \text{ N}\cdot\text{m}}$

If you need more examples or more explanation, please read textbook p. 241-242. Now, it is your turn to show your work.

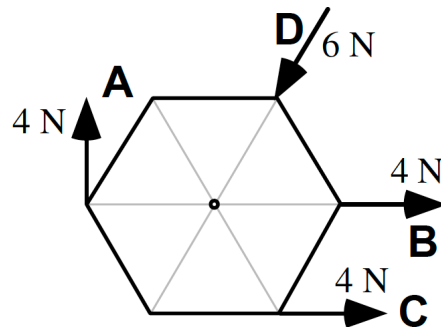
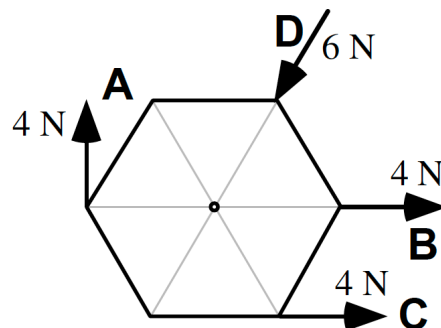
16. Four forces act on a plywood hexagon as shown in the diagram. The sides of the hexagon each have a length of 1 m. (Multiple diagrams are provided below for sketching and visual thinking.)



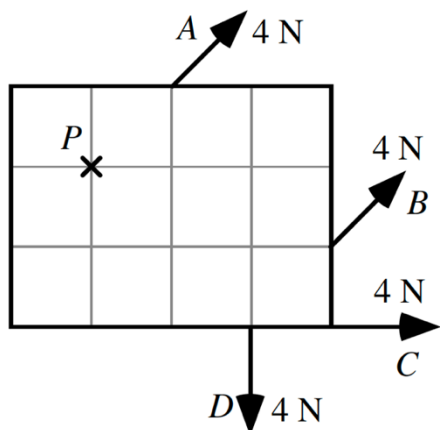
Rank the magnitude of the torque applied about the center of the hexagon by each force.

|          |   |   |       |    |          |      |           |
|----------|---|---|-------|----|----------|------|-----------|
|          |   |   |       | OR |          |      |           |
| 1        | 2 | 3 | 4     |    | All      | All  | Cannot    |
| Greatest |   |   | Least |    | the same | zero | determine |

Explain your reasoning below.



17. Four 4-Newton forces ( $A$ – $D$ ) act on a 3-m by 4-m piece of plywood as shown.



Rank the magnitudes of the torques due to the four forces about point  $P$ .  
(Multiple diagrams are provided below for sketching and visual thinking.)

|          |   |   |       |    |          |      |           |
|----------|---|---|-------|----|----------|------|-----------|
|          |   |   |       | OR |          |      |           |
| 1        | 2 | 3 | 4     |    | All      | All  | Cannot    |
| Greatest |   |   | Least |    | the same | zero | determine |

Explain your reasoning below.

