I think you know the drill on margins and legibility. I can't give points for what I can't read. Take a minute, at the end, to make sure your work is organized and submitted in proper order.

1. Consider the triangle in the figure. Assume lengths are in centimeters.
   a. (5 pts) Use the Law of Cosines to find the length of side a, to 4 decimal places.

   b. (5 pts) Use the Law of Sines to find angle B to 4 decimal places.
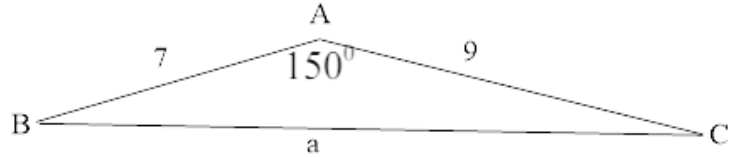
2. Consider the directed line segment $\overrightarrow{PQ}$ in the figure on the right. I want you to provide some basic facts about the vector $\bar{u}$:

   a. (5 pts) Express the vector $\bar{u} = \overrightarrow{PQ}$ in component form.

   b. (5 pts) Compute the magnitude of $\bar{u}$. Leave your answer in simplified radical form.

   c. (5 pts) Find the direction angle of $\bar{u}$. Use degrees, rounded to 4 places.
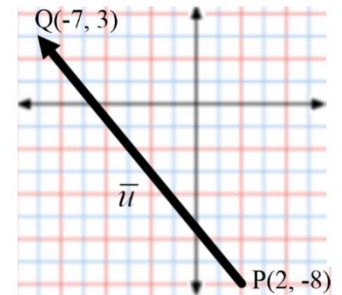
3. Let $\bar{u} = \langle 3, -2 \rangle$.
   a. (5 pts) Express $\bar{u}$ as a linear combination of the canonical (standard) unit vectors $\bar{i}$ and $\bar{j}$.
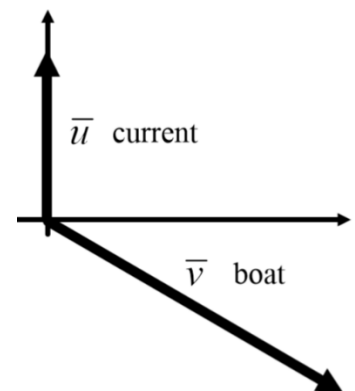
   b. (5 pts) What's another word for the sum of 2 vectors?

4. The current in a river is flowing at 5 miles per hour, due North. $\left(\|\bar{u}\| = 5 \text{ mph} \right)$
   . A man in a boat points his boat 30^0 upstream to attempt a crossing. His boat moves at 10 miles per hour $\left(\|\bar{v}\| = 10 \text{ mph} \right)$.

   a. (5 pts) Express $\bar{u}$ and $\bar{v}$ in component form.

   b. (10 pts) What's the resulting direction and speed of his boat?

5. Let $f(x) = 2x^3 - 9x^2 + 14x - 5$.
   a. (5 pts) Use synthetic division to find $f(2)$.

   b. (5 pts) Use synthetic division to show that $x = 2 + i$ is a solution of the equation $f(x) = 0$.

   c. (5 pts) Find the linear factorization of f that is promised to us in the Fundamental Theorem of Algebra.

6. Let $z = -4 - 4\sqrt{3}i$
   a. (5 pts) Find $z + \bar{z}$ and $z\bar{z}$, where $\bar{z}$ is the complex conjugate of z.

   b. (5 pts) Express z in trigonometric form.

7. Let $z = 27\left(\cos\left(\dfrac{3\pi}{4}\right) + i\sin\left(\dfrac{3\pi}{4}\right)\right)$.

   a. (5 pts) Express z in standard form.

   b. (5 pts) Find the principal 3rd root of z, i.e., find $\sqrt[3]{z}$. Leave z in trigonometric form for this.

   c. (5 pts) Now, find *all* the 3rd roots of z, in trigonometric form.

   d. (5 pts) Find the trigonometric form of z^2.

   e. (5 pts) Finally, let $w = 3\left(\cos\left(\dfrac{\pi}{6}\right) + i\sin\left(\dfrac{\pi}{6}\right)\right)$, and find the trigonometric form of the product $z \cdot w$.

Answer as many as you have time for! Woo-Hoo!

B1 A potato cannon with a muzzle velocity of 70 meters per second is fired, with an angle of 22.5^0 from the horizontal.

   a. (5 pts) Find the horizontal and vertical components of the potato, as it leaves the cannon, accurate to 4 decimal places.

   b. (5 pts) Use a half-angle formula to find the *exact* value for the answer to the previous.

B2 (5 pts) Find $\sin\left(\dfrac{u}{2}\right), \cos\left(\dfrac{u}{2}\right)$ and $\tan\left(\dfrac{u}{2}\right)$, given that $\cos(u) = \dfrac{2}{5}$ and $\sin(u) < 0$.

B3 (5 pts) Build a sine function that achieves its maximum height of $y = 100$ meters at time $x = 9$ seconds and its minimum height of $y = -120$ meters at $x = 17$ seconds.

B4 (5 pts) Find all solutions of the equation $4\cos^2(2x) - 3 = 0$ in the interval $[0, 2\pi)$.

B5 (5 pts) Sketch the graph of $-3\sin\left(\dfrac{3\pi}{5}x - 3\pi\right) + 11$.

B6 The triangle described has 2 possible solutions:
   Angle $A = 45^0$, side $b = 8\sqrt{2}$ and side $a = 10$.

   a. (5 pts) Prove there are 2 possible triangles from this ambiguous information.

   b. (5 pts) Find both triangles.