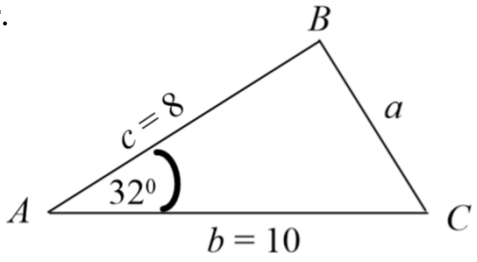
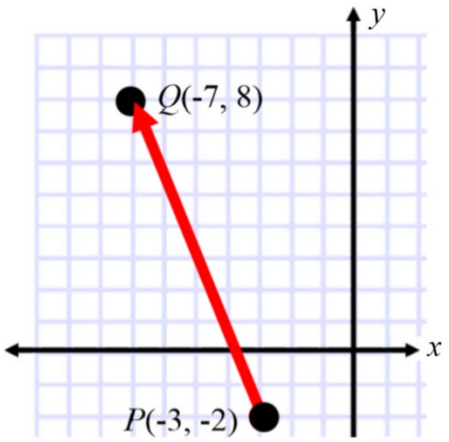
MAT 122 Test 3 – Fall, 2018 Name_____
100 Points NO GRAPHING CALCULATORS!!!

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. (10 pts) Use the Law of Cosines to find the length of side a, to 4 decimal places.
   b. (10 pts) Use the Law of Sines to find angle C to 4 decimal places.

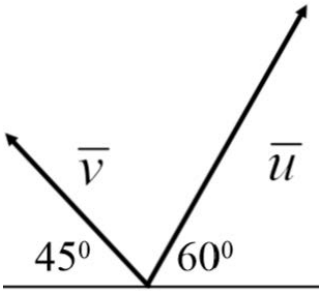


2. Consider the directed line segment $\overrightarrow{PQ}$ in the figure on the right. I want you to provide some basic facts about the vector $\bar{u}$:
   a. (5 pts) Express the vector $\bar{u} = \overrightarrow{PQ}$ in component form.
   b. (5 pts) Compute the magnitude of $\bar{u}$. Leave your answer in simplified radical form.
   c. (10 pts) Find the direction angle of $\bar{u}$. Use degrees, rounded to 4 places.

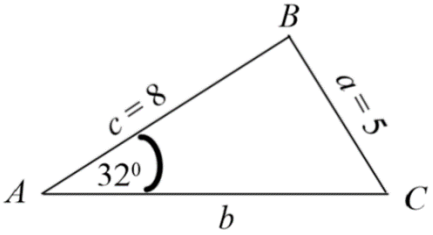


3. Let $\bar{u} = \langle 7, -6 \rangle$.
   a. (5 pts) Express $\bar{u}$ as a linear combination of the canonical (standard) unit vectors $\bar{i}$ and $\bar{j}$.
   b. (5 pts) What's another word for the sum of 2 vectors?

4. Dad's out walking his dog and his toddler. The dog pulls with 80 pounds of force in the direction of the vector $\bar{u}$. The toddler pulls with 20 pounds of pressure in the direction of the vector $\bar{v}$.
   a. (10 pts) Express $\bar{u}$ and $\bar{v}$ in component form, in two ways: Give an exact answer, and an answer rounded to 3 decimal places.
   b. (10 pts) What's the net force, as a vector, on poor Dad? Give an exact answer, and an answer rounded to 3 decimal places.



5. Consider the triangle in the figure on the right.
   a. (10 pts) Prove there are 2 triangles that are possible from this ambiguous information.
   b. (10 pts) Find the two possible values for Angle C. Round to 4 decimal places.



6. (10 pts) Find $\sin\left(\frac{u}{2}\right), \cos\left(\frac{u}{2}\right)$ and $\tan\left(\frac{u}{2}\right)$, given that $\sin(u) = -\frac{5}{13}$ and $\cos(u) < 0$. Give exact answer in simplified radical form.

BONUS SECTION: Answer up to 4 questions for up to 20 bonus points.

B1 (5 pts) Build a cosine function that achieves its maximum height of y = 200 meters at time x = 7 seconds and its minimum height of $y = -130$ meters at x = 19 seconds.

B2 (5 pts) Find all solutions of the equation $\tan^2(3x) - 3 = 0$ in the interval $[0, 2\pi)$.

B3 (5 pts) Sketch the graph of $-20\sin\left(\frac{7\pi}{22}x - \frac{14\pi}{11}\right) + 53$.

B4 Let $f(x) = 2x^3 - 15x^2 + 44x - 39$

a. (5 pts) Use synthetic division to find $f(2)$.

b. (5 pts) Use synthetic division to show that $x = 3 - 2i$ 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.

B5 Let $z = -1 + \sqrt{3}i$

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.

B6 Let $z = 8\left(\cos\left(\frac{7\pi}{4}\right) + i\sin\left(\frac{7\pi}{4}\right)\right)$.

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

b. (5 pts) Find the principal 4th root of z, i.e., find $\sqrt[4]{z}$. Leave z in trigonometric form for this.

c. (5 pts) Now, find the *other* 4th roots of z, in trigonometric form.

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

B7 (5 pts) Finally, let $w = 3\left(\cos\left(\frac{\pi}{4}\right) + i\sin\left(\frac{\pi}{4}\right)\right)$, and find the trigonometric form of the product $z \cdot w$.