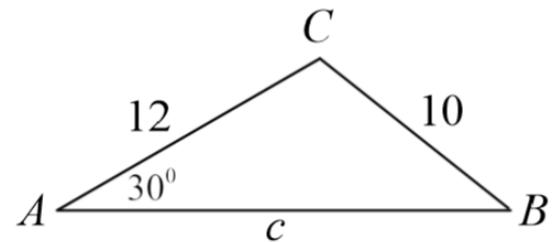


10-point deduction for each of the following: Faint writing, Lack of margin, Problems out of order, Illegible work.
Work on the back of any page will receive zero points. Other than that, we're golden. :o)

1. We convert $(x, y) = (4, -2)$ to polar coordinates, (r, θ) .
 - a. (15 pts) Assume $r > 0$ and $\theta \in [0, 360^\circ)$. Find the *exact* polar coordinates of the point. This may require leaving your answer with an 'arctan' in it. Use degrees for angle measures.
2. (15 pts) Convert $(r, \theta) = \left(8, \frac{11\pi}{6}\right)$ to rectangular coordinates. Give an exact answer and a decimal answer, accurate to 4 decimal places.
3. (15 pts) Sketch the graph of $r = 7\cos\theta$.

4. Consider the triangle in the figure on the right. Assume lengths are in miles.



- a. (15 pts) Find Angle B . Round final answer to 4 decimal places.
- b. (15 pts) Find side c . Round final answer to 4 decimal places.

Bonus 1. (5 pts) Find angle C . Round final answer to 4 decimal places.

5. Let $f(x) = 3x^3 - 10x^2 + 31x + 26$.
 - a. (10 pts) Use synthetic division to show that $x = 2 + 3i$ is a solution of the equation $f(x) = 0$.
 - b. (10 pts) Find the linear factorization of f that is promised to us in the Fundamental Theorem of Algebra.

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 $\cos(u) = -\frac{3}{7}$ and $\sin(u) < 0$.

MOAR Bonus Answer up to 3 of the following, for up to 30 bonus points.

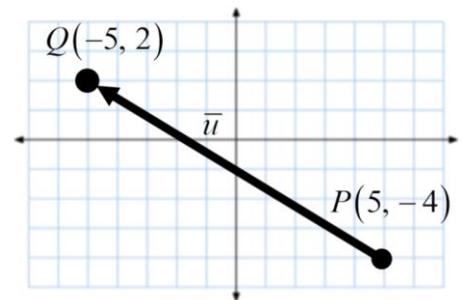
- Bonus 2.** (10 pts) Find all solutions of the equation $2\sin^2(2x) - 1 = 0$ in the interval $[0, 2\pi)$.

Bonus 3. Let $z = 16 \left(\cos\left(\frac{7\pi}{6}\right) + i \sin\left(\frac{7\pi}{6}\right) \right)$.

- (10 pts) Express z in standard form.
- (10 pts) Find the principal 3rd root of z , i.e., find $\sqrt[3]{z}$. Leave z in trigonometric form for this.
- (10 pts) Now, find the other *two* 3rd roots of z , in trigonometric form.
- (10 pts) Finally, let $w = 2 \left(\cos\left(\frac{\pi}{6}\right) + i \sin\left(\frac{\pi}{6}\right) \right)$, and find the trigonometric form of the product $z \cdot w$.

Bonus 4. (10 pts) Draw the sketch and use it to find an algebraic expression that is equivalent to $\cos(\arctan(3x))$.

Bonus 5. (10 pts) Find the direction angle of \bar{u} , where \bar{u} is the vector corresponding to the directed line segment \overrightarrow{PQ} in the figure on the right. Use degrees, rounded to 4 places.



Bonus 6. (10 pts) Build a *cosine* function that achieves its maximum height of $y = 50$ meters at time $x = 3$ seconds and its minimum height of $y = -30$ meters at $x = 27$ seconds.

Bonus 7. (10 pts) Write $z = 6 - 6\sqrt{3}i$ in trigonometric form, rounded to 4 decimal places. Use an angle $\theta \in [0, 2\pi)$.