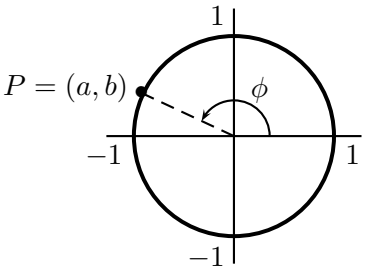
8. [10 points]

The point P (with coordinates (a, b)) is on the unit circle at angle ϕ, as shown in the diagram to the right. Use this information to **find the values below in terms of a and/or b.**
NOTE: Your answers should NOT include function names like "sin", "cos", or "tan".
You do not need to show your work for this problem.



a. [2 points] Find $\sin(\phi)$.

Solution: $\sin(\phi)$ is the y–coordinate of the point P, so $\sin(\phi) = b$.

Answer: $\sin(\phi) =$ b

b. [2 points] Find $\tan(-\phi)$.

Solution: The tangent function is an odd function, so

$$\tan(-\phi) = -\tan(\phi) = -\frac{\sin(\phi)}{\cos(\phi)} = -\frac{b}{a}.$$

Answer: $\tan(-\phi) =$ $-\frac{b}{a}$

c. [2 points] Find $\cos(\phi + \pi)$.

Solution: $\cos(\phi + \pi)$ is the x–coordinate of the point halfway around the circle from P, so $\cos(\phi + \pi) = --a$. (Alternatively, note that the graph of $\cos(\phi + \pi)$ is the graph of $\cos(\phi + \pi)$ shifted left π units. This is the same as the graph of $-\cos(\phi)$, so $\cos(\phi + \pi) = -\cos(\phi) = -a$.)

Answer: $\cos(\phi + \pi) =$ $-a$

d. [2 points] Find $\sin(\phi - \frac{\pi}{2})$.

Solution: The graph of $\sin(\phi - \frac{\pi}{2})$ results from shifting the graph of $\sin(\phi)$ to the right $\pi/2$ units. This is the same as the graph of $-\cos(\phi)$, so $\sin(\phi - \frac{\pi}{2}) = -\cos(\phi) = -a$. (Alternatively, note that the point at angle $\phi - \pi/2$ has y–coordinate equal to the opposite of the x–coordinate of the point P.)

Answer: $\sin(\phi - \frac{\pi}{2}) =$ $-a$

e. [2 points] Find the coordinates of the point at angle ϕ on the circle of radius 7 centered at the point $(-3, 2)$.

Solution: The point at angle ϕ on the circle of radius 7 centered at the origin is $(7a, 7b)$, so the point at angle ϕ on the circle of radius 7 centered at the point $(-3, 2)$ is $(7a - 3, 7b + 2)$.

Answer: $(7a - 3, 7b + 2)$