Section 3.3 #4abd, 5ace, 7ac, 10, 11, 16, 17

**HINTS:**

If the answer is in the back of the book, it’s not enough to just verify that the given answer is correct—you should obtain it in the way you would if you didn’t know the answer in advance.

(5) There are two basic approaches here—pick the one that’s best for a given problem: (i) pick 3 points on the line or circle you’re mapping from, and 3 points on the line or circle you’re mapping to, and find a $T$ that sends the first 3 to the other 3; since any 3 points determine $T$, the $T$ you found must actually be correct for all points on the circle or line. (ii) Reason geometrically—for example, $S(z) = z + b$ translates any line or circle by $b$, and $R(z) = iz$ rotates any line through 0 by (what angle?)

(7)(c) Think about the two points where the images (which are $\mathbb{R}$ and a circle) intersect. These must be the images of what two points of $\mathbb{C} \cup \{\infty\}$? In general, this is similar to the example done in lecture, which was #7d, slightly modified.

(10)(a) Draw a picture to illustrate the text hint.

(16) You can do this by a “brute force” calculation, or you can try to be more clever. (Which do you think I recommend?) If you choose the “more clever” option, then similarly to p. 198–199, express $T$ as a composition $T = S^{-1} \circ R$, where $R$ maps $z_1, z_2, z_3$ to 0, 1, $\infty$ respectively, and $S$ maps $w_1, w_2, w_3$ to 0, 1, $\infty$. If you prove the desired cross-ratio equality for $S$ and $R$, explain how you then conclude it’s also true for $T$.

Note that in the formula for a cross ratio, if you get something like $\frac{\infty-a}{\infty-b}$ then you should interpret it as $\lim_{u \to \infty} \frac{u-a}{u-b}$ (which is what?)

(17) In the text hint, justifying the phrase “it is enough” requires some elaboration. Let $T$ map $z_1, z_2, z_3$ to 1, 0, $-1$, respectively. This means we know $C$ is a line or circle, and $T(C)$ contains the points 1, 0, $-1$, so what must $T(C)$ be? Also, calculate the cross ratio $(T(z), 1, 0, -1)$ so that you can use #16.