1. Get a copy of *Mathematical Physics* by Robert Geroch, U.Chicago Press, 1985, and read chapter 1.

2. What's the definition of a function? When are two functions equal? Two sets? What's an "equivalence relation?" What are "equivalence classes?"

3. How many functions are there between $\{1, 2, 3\}$ and $\{a, b\}$? How many between $\{1\}$ and $\{a, b\}$? Between $\{\}$ and $\{a, b\}$? Is there a function from $\{\}$ to $\{\}$? What's the general formula?

4. Consider an equivalence relation $E$ on set $X$. Let $f$ be the function mapping $[x]$ to $x$. What's wrong with this?

5. Define a category. What's an "object"? What's a morphism? Is a morphism always a function? Is an object always a set?

6. (Geroch's Exercise 1): Prove that every isomorphism is both a monomorphism and an epimorphism.

7. (Geroch's Exercise 5): Prove the the inverse of an isomorphism is unique.

8. (Geroch's Exercise 2): Let $A \xrightarrow{\phi} B \xrightarrow{\psi} C$. Prove that if $\psi \circ \phi$ is a monomorphism, so is $\phi$ and if $\psi \circ \phi$ is an epimorphism, so is $\psi$. Find examples in the category of sets showing that the converses of these two statements are false.

9. (Geroch's Exercise 7): In the category of sets, the two projections in the definition of a direct product are epimorphisms and the two insertions in the direct sum are monomorphisms [Geroch's statement of Exercise 7 has epi and mono incorrectly switched.]. Is this true in every category?

10. (Geroch's Exercise 11): Fix two categories. Introduce a new category that can be though of as the "product" of these. (Hint: choose, for objects, pairs consisting of one object from each of the given categories).

11. (Geroch's Exercise 4): Let the objects be sets with exactly 17 elements, the morphisms mappings of such sets, and composition composition. Verify that this is a category. Prove that in this category, no two objects have either a direct product or a direct sum.