

Exercise 1: What is the initial object in  $\text{Grp}$ ? In  $\text{Rng}$ ?

Exercise 2: Coproducts & products are dual concepts. Thinking about  $\text{Set}$ , can you see a sense in which addition and multiplication of members are dual?

Exercise 3: What are coproducts of vector spaces, abelian groups or top. space?

we will look at coproducts in this setting when we study modules.

Exercise 4: Suppose that  $\mathcal{C}$  admits a terminal object  $1$ .

a) Show that there are isomorphisms  $A \times 1 \cong A \cong 1 \times A$ .

b) Define the product  $A \times B \times C$  of three objects using a universal property & show it is unique up to iso.

c) Show that  $(A \times B) \times C \cong A \times (B \times C)$ .

by showing both have the univ. property defining  $A \times B \times C$ .

d) Given maps  $f: A \rightarrow B$  &  $g: C \rightarrow D$  use the univ. prop. of the product to construct a map  $f \times g: A \times C \rightarrow B \times D$ .