

**Fall 2021, Math 620: Week 4 Preliminary Problems**  
**Due: Thursday, September 16th, 2021**  
**Isomorphism Theorems**

**Preliminary problems.** These problems should be completed before discussion on Thursday.

(P1) Let  $G = \mathbb{Z}_3 \times \mathbb{Z}_3$ , and consider the map  $\varphi : \mathbb{Z} \rightarrow G$  with  $1 \mapsto ([1]_3, [1]_3)$ . What is  $\ker \varphi$ ?

(P2) Let  $G = \mathbb{Z}_3 \times \mathbb{Z}_4$ , and consider the map  $\varphi : \mathbb{Z} \rightarrow G$  with  $1 \mapsto ([1]_3, [1]_4)$ . What is  $\ker \varphi$ ?

(P3) State the first isomorphism theorem in its entirety.