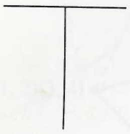
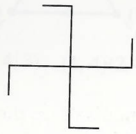
3.

	τ	ρ	μ	γ
τ	τ	ρ	$\mu\gamma$	$\mu\gamma$
ρ	ρ	$\rho\tau$	$\mu\gamma$	$\mu\gamma$
μ	$\mu\gamma$	$\mu\gamma$	$\tau\rho$	$\tau\rho$
γ	$\mu\gamma$	$\mu\gamma$	$\tau\rho$	$\tau\rho$

5.  **7.** 

9. *Translation:* order ∞
Rotation: order any $n \geq 2$ or ∞
Reflection: order 2
Glide reflection: order ∞

11. Rotations **13.** Only the identity and reflections.

17. Yes. The product of two translations is a translation and the inverse of a translation is a translation.

19. Yes. There is only one reflection μ across one particular line L, and μ^2 is the identity, so we have a group isomorphic to $\mathbb{Z}_2$.

21. Only reflections and rotations (and the identity) because translations and glide reflections do not have finite order in the group of all plane isometries.

25. **a.** No **b.** No **c.** Yes **d.** No **e.** D_∞

27. **a.** Yes **b.** No **c.** No **d.** No **e.** D_∞

29. **a.** No **b.** No **c.** No **d.** Yes **e.** $\mathbb{Z}$

31. **a.** Yes. 90°, 180° **b.** Yes **c.** No

33. **a.** No **b.** No **c.** No

35. **a.** Yes. 180° **b.** Yes **c.** No

37. **a.** Yes. 120° **b.** Yes **c.** No

39. **a.** Yes. 90°, 180° **b.** Yes **c.** No **d.** $(-1, 1)$ and $(1, 1)$

41. **a.** Yes. 120° **b.** Yes **c.** No **d.** $(0, 1)$ and $(1, \sqrt{3})$

SECTION 13

1. Yes **3.** Yes **5.** No

7. Yes **9.** Yes

11. Yes **13.** Yes **15.** No

17. $\text{Ker}(\phi) = 7\mathbb{Z}$; $\phi(25) = 2$

19. $\text{Ker}(\phi) = 6\mathbb{Z}$; $\phi(20) = (1, 2, 7)(4, 5, 6)$

21. $\text{Ker}(\phi) = \{0, 4, 8, 12, 16, 20\}$; $\phi(14) = (1, 6)(4, 7)$

23. $\text{Ker}(\phi) = \{(0, 0)\}$; $\phi(4, 6) = (2, 18)$

25. 2 **27.** 2 **29.** For all $g \in G$

33. No nontrivial homomorphism. By Theorem 13.12, the image of ϕ would have to be a subgroup of $\mathbb{Z}_5$, and hence all of $\mathbb{Z}_5$ for a nontrivial ϕ. But the number of cosets of a subgroup of a finite group is a divisor of the order of the group, and 5 does not divide 12.