

MA 351 Fall 2025 (Aaron N. K. Yip)

Homework 9

Due: Friday, Dec. 5, 12:00pm, in MATH 432 (slide under the door if closed)

Penney, Linear Algebra: Ideas and Applications (4th edition)

p.260 EXERCISES: 4.25, 4.26;

p.268 EXERCISES: 4.34, 4.36, 4.39, 4.41;

p.279 EXERCISES: 5.1, 5.2, 5.3, 5.5(a,c,e,g,h), 5.7

Additional Problem. Read the note *Week 14: Geometric Applications of Linear Transformations*.

1. Find the matrices corresponding to projection (P) and reflection (R) in $\mathbb{R}^2$ with respect to the straight line $y = mx$. Verify that $P^2 = P$ and $R^2 = I$.
2. Consider the matrix $R_\theta = \begin{pmatrix} \cos \theta & -\sin \theta \\ \sin \theta & \cos \theta \end{pmatrix}$ which rotates a vector in $\mathbb{R}^2$ counter-clockwise by angle θ . Explain in intuitive geometric terms *and* also by actually verifying algebraically the following statements:

$$R_\theta R_\phi = R_{\theta+\phi}, \text{ and } R_\theta^{-1} = R_{-\theta}.$$