This particular homework assignment is not typical of the assignments in this course, because it is intended to test your background from physics and math rather than to practice new skills.

1. The circle to the left represents a cross section of infinitely long filamentary conductor carrying a current of 1 A out of the page. Sketch the magnetic field lines in the vicinity of the conductor.

2. Consider the resistor shown to the right.
   a. What is the value of voltage $V_x$?

   $\text{5 A} \quad 2 \Omega$

   b. What is the value of the power dissipated in the resistor?

3. If each battery in the network to the right has a voltage of 1.5 V, what is the value of $V_x$?

4. What is the value of $V_x$ for the network shown to the right?

5. Consider the capacitor shown to the right.
   a. How much charge is stored in the capacitor?

   b. How much energy is stored in the capacitor?
For Problems 6 through 8, consider two lines
\[2x - 3y = 6\] and \[y = -3x + 2\].

6. Sketch both lines on the set of axes to the right.

7. Determine the coordinates of the point of intersection for the two lines.

8. Express the first line in slope-intercept form \(y = mx + b\).

For Problems 9 and 10, consider the graph shown to the right.

9. Write an expression for Line Segment 1.

10. Write an expression for Line Segment 2.

11. Write an expression for the curve shown to the right.
For Problems 12 through 15 consider the matrix \( \mathbf{A} = \begin{bmatrix} 5 & -2 \\ -1 & 4 \end{bmatrix} \)

12. What is the value of the product \( \mathbf{Ax} \) when \( \mathbf{x}^T = [2 \ 1] \)?

13. What is the value of the inverse of \( \mathbf{A} \)?

14. What is the value of the solution \( \mathbf{x} \) to the equation \( \mathbf{Ax} = \mathbf{b} \) when \( \mathbf{b}^T = [12 \ -6] \)?

15. What are the eigenvalues of \( \mathbf{A} \)?
16. Simplify the following expression by performing the indicated derivative. Assume that \( \omega \) and \( \phi \) are parameters (constants).

\[
x(t) = \frac{d}{dt} \sin(\omega t + \phi)
\]

17. Simplify the following expression by performing the indicated integration. Assume that \( t \) is the independent variable and that \( t_0, \lambda, \) and \( F \) are parameters (constants). Your answer should be such that \( t \) and \( t_0 \) appear only together as the difference \( t - t_0 \).

\[
x(t) = \int_{t_0}^{t} e^{\lambda(t - \xi)} F \, d\xi
\]
For Problems 18 and 19, consider the function $f(x)$ shown on the graph to the right.

18. Sketch the derivative $\frac{d}{dx} f(x)$.

19. Sketch the integral $F(x) = \int_{0}^{x} f(\xi) d\xi$.

20. Find the maximum value of the function $f(x) = \frac{x}{(x+1)^2}$ over the semi-infinite interval $x \in [0, \infty)$.
21. Consider the following differential equation:

\[
\frac{dx(t)}{dt} + ax(t) = F
\]

Later in the course you will learn how to find the solution \(x(t)\) to such a problem, but for now we will give you the solution:

\[
x(t) = \frac{F}{a} + Ae^{-at}
\]

where \(A\) is an arbitrary (for now) constant

Show that the given solution satisfies the differential equation by differentiating it and then substituting \(dx/dt\) and \(x\) into the differential equation.
22. What are the roots of the polynomial \( p(s) = s^2 + 2s - 8 \)?

23. What are the roots of the polynomial \( p(s) = s^2 + 2s + 5 \)?

24. The expression \( f(t) = K \cos(\omega t + \phi) \) can also be written \( f(t) = A \cos(\omega t) + B \sin(\omega t) \). Determine the appropriate expressions for \( A \) and \( B \) in terms of \( K \) and \( \phi \).

For Problems 25 and 26, consider the right triangle shown to the right.

25. What is the length of the hypotenuse?

26. What is the value of the angle \( \phi \)?
For problems 27 through 37 consider the two complex numbers $c_1 = 3 - j4$ and $c_2 = 1 + j2$.

27. What is the complex conjugate of $c_1$?

28. Rewrite $c_1$ in polar form.

29. What is the value of the sum $c_1 + c_2$?

30. What is the value of the product $c_1 c_2$?

31. What is the value of the ratio $c_1 / c_2$?
For Problems 32 through 34, construct the desired vector using only a straight edge and compass.

32. Construct the sum $\vec{v}_1 + \vec{v}_2$.

33. Construct the difference $\vec{v}_2 - \vec{v}_1$.

34. Construct the projection of $\vec{v}_1$ onto $\vec{v}_2$.

35. Construct the rotation of $\vec{v}_1$ by $45^\circ$. 