1. A 15-foot ladder leans against a wall (assume the ground is flat, and the wall is perpendicular to the ground). Suppose the base of the ladder is sliding away from the wall at a rate of 0.5 ft/s. Determine how fast the top of the ladder is sliding down the wall when the base of the ladder is 9 feet from the wall. (70 points)

   a. Draw a diagram representing the situation, label all important features, and determine the relationship between those features (25 points).

   ![Diagram of ladder against a wall](image)

   \[ x = \frac{1}{2}, \quad x^2 + y^2 = 15^2 \]

   \[ x_\ast = 9 \]

   \[ x': (t \mapsto x_0) \]

   b. Determine how high up the wall the top of the ladder rests when the base is 9 feet from the wall (15 points).

   \[ y_\ast := y_\ast, \quad x_\ast^2 + y_\ast^2 = 15^2 \]

   \[ 9^2 + ?^2 = 15^2 \]

   \[ ? = \sqrt{15^2 - 9^2} = \sqrt{3^2 (5^2 - 3^2)} = \sqrt{3^2 \cdot 4^2} = 3 \cdot 4 = 12 \text{ ft/sec} \]

   c. Determine how fast the top of the ladder is sliding down the wall when the base of the ladder is 9 feet from the wall (30 points).

   \[ \dot{x}_\ast := -\frac{9}{2}, \quad x_\ast = 9, \quad y_\ast = 12, \quad x_\ast' = \frac{1}{2} \]

   \[ \frac{dx}{dt} \left[ x^2 + y^2 = 15^2 \right] \]

   \[ \left[ 2x \dot{x} + 2y \dot{y} = 0 \right] \]

   \[ (9)(\frac{1}{2}) + (12)(-\dot{y}) = 0 \]

   \[ \dot{y} = -\frac{9/2}{12} = \frac{9}{24} = \frac{3}{8} \text{ ft/sec} \]

   Turn over the page.
2. Which of the following represents all antiderivatives in $x$ of $\left(e^x - \sin(x) + 2\right)$? (15 points)

   a. $e^x - \cos(x) + 2x$
   b. $e^x - \cos(x) + 2x + c$
   c. $e^x + \cos(x) + 2x$
   d. $e^x + \cos(x) + 2x + c$
   e. None of the above

3. Which of the following represents an antiderivative in $x$ of $\left(\frac{1}{1+x^2} + \frac{1}{\sqrt{1-x^2}}\right)$? (15 points)

   a. $\arctan(x) + \arccos(x) + 12\pi$
   b. $\arccot(x) + \arcsin(x) - \frac{\pi}{3}$
   c. $\arctan(x) + \arcsin(x) + \sqrt{\pi}$
   d. $\arccot(x) + \arccos(x) - \pi$
   e. None of the above