1. (9 points) Solve the following differential equation

\[
\frac{t^2 A' - 100A'}{A} = 1.
\]

2. (2 points) Separation of variables can be used to solve \( y'' = y' + y \).

○ True ○ False

3. (2 points) \( y(t) = \cos(t) + 5 \) is a solution to the differential equation \( y'(t) \cos(t) + y'(t)y(t) = -5 \sin(t) \). (Hint: the derivative of \( \cos(t) \) is \( -\sin(t) \)).

○ True ○ False

4. (2 points) A student is asked to write a differential equation to model the amount of water in a puddle in the following scenario: “A puddle of water initially contains 50 mL of water. Water evaporates from the puddle at a rate proportional to the amount of water in the puddle. There is also a light rain which adds water to the puddle at a rate of 5 mL per minute.” The student writes

\[
\frac{dW}{dt} = 5t - kW(t); \ W(0) = 50
\]

where \( W(t) \) is the amount of water in the puddle (in mL) after \( t \) minutes and \( k \) is a constant. The student’s reasoning is as follows: the derivative of \( W \) is how much water is entering the puddle minus how much water is leaving the puddle. After \( t \) minutes, \( 5t \) mL of water have entered the puddle and water is leaving the puddle through evaporation at a rate that is some constant multiple of the amount of water in the puddle. Also, at time 0 there are 50 mL of water in the puddle. The student’s answer is:

○ Correct with valid reasoning.
○ Correct with invalid reasoning.
○ Incorrect.