King Saud University,
College of Sciences
Mathematical Department.

Mid-Term Exam/S2/2026
Full Mark:25. Time 1H30mn

Question 1. [4,4] **a)** Determine and sketch the largest loçal region of the $xy-$plane for which the initial value problem

$$\begin{cases} y' = \sqrt{y+1}\ln[(y+1)x] + \frac{1}{x-3} \\ y(1) = 1, \end{cases}$$

has a unique solution.

b) Solve the initial value problem

$$\begin{cases} (1 - y\sin 2x)dx = (1+\sin^2 x)dy \\ y(0) = 1 \end{cases}$$

Question 2. [4, 4]. **a)** Obtain the general solution of the differential equation

$$xy' + y = y^2x^2\ln x,\ x > 0.$$

b) Solve the differential equation

$$(x+y)dx + (y-x)dy = 0.$$

Question 3. [4, 5]. **a)** Solve the initial value problem

$$\begin{cases} -xy^2dx + (x^2y^2 + x^2y)dy = 0,\ x > 0,\ y > 0 \\ y(2) = 2. \end{cases}$$

b) A body is discovered in a hotel room at 8 : 00 PM. The room temperature is constant at 20^0C. The police investigator measures the body temperature and finds it to be 30^0C. One hour later, at 9 : 00 PM, the body temperature is measured again and is found to be 28^0C. Assuming the victim's body temperature at the time of death was the normal human body temperature of 37^0C, and that cooling follows Newton's Law of Cooling, determine the time of death.

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