Student: Arfaz Hossain **Date:** 02/28/22	**Instructor:** Muhammad Awais **Course:** Math 101 A04 Spring 2022	**Assignment:** Practice Questions for Sections 6.3 & 7.2 [Not for

Solve the differential equation.

$\frac{dy}{dx} = 3e^{x-y}$

Some differential equations can be solved by separating the variables. A differential equation of the form $y' = f(x,y)$ is separable if it can be expressed as a product of a function of x and a function of y.

Notice that e^{x-y} can also be written as $e^{x}e^{-y}$. Since e^{-y} is always greater than zero, we can solve the equation by separating the variables. Separate the variables by collecting all the y-terms with dy and all the x-terms with dx.

Rewrite the equation in its differential form.

$$\frac{dy}{dx} = 3e^{x-y}$$
$$e^{y}\,dy = 3e^{x}\,dx$$

Now integrate both sides of the equation. Begin by integrating the left side. Use the rule $\int e^{u}\,du = e^{u} + C$ to integrate.

$$\int e^{y}\,dy = \int 3e^{x}\,dx$$
$$e^{y} + C_1 = \int 3e^{x}\,dx$$

Integrate the right side. First move the constant to the outside of the integral. Use the rule $\int e^{u}\,du = e^{u} + C$ to integrate.

$$e^{y} + C_1 = 3\int e^{x}\,dx$$
$$e^{y} + C_1 = 3e^{x} + C_2$$

After completing the integrations, y is defined implicitly as a function of x. Combine the constants of integration as C.

$$e^{y} = 3e^{x} + C$$

Also, this equation can be solved for y as an explicit function of x.

$$y = \ln\left(3e^{x} + C\right)$$

Thus, solving the original differential equation, $\frac{dy}{dx} = 3e^{x-y}$, yields $e^{y} = 3e^{x} + C$ or $y = \ln\left(3e^{x} + C\right)$.