1. Solve the following DE: $d_{1} = e^{2-3x+y}$

a)
$$\frac{dy}{dx} = \frac{e^{2-3x+y}}{e^{2x-3y+1}}; y(0) = 2$$

b)
$$\frac{dy}{dx} = xy^3 e^{2x^2 + 1}$$

c)
$$(x^2+1)\frac{dy}{dx} + xy = kx; y(0) = 2k$$
 where k is a constant

d)
$$\frac{dy}{dx} = 1 - \frac{\sin(x+y)}{\sin y \cos x}; \ y\left(\frac{\pi}{4}\right) = \frac{\pi}{4}$$

2. The number of bacteria in a culture grows at a rate that is proportional to the number present. After 10 hours, there were 5000 bacteria present, and after 12 hours, there were 6000 bacteria present. Determine the initial size of the culture and the double time of the population.

3. A container initially contains 200 gals of water in which there is 4 lbs of salt dissolved. A solution contain ¹/₂ lb of salt per gal is pumped into the container at the rate of 5gal/min, and the well-stirred mixture runs out at the same rate of 5gal/min. Determine the concentration of salt in the tank after 1 hour.

4. Set up an IVP to find the monthly payment of a mortgage loan of \$650,000 at interest rate of 5.5% per year compounded continuous for 30 years, and then determine the total interest of the loan after 30 yrs.

5. Of the 1500 passengers, crew and staff that board a cruise ship, 5 have the flu. After one day of sailing, the number of infected people has risen to 10. Assuming that the rate at which the flu virus spreads is proportional to the product of the number of infected individuals and the number not yet infected, determine how many people will have the flue at the end of 14 – day cruise.

6. Solve the following linear DE: (2n)

a)
$$\frac{dy}{dx} + \frac{6}{2x-1}y = \frac{\cos(3x)}{(2x-1)^3}; y(0) = 2$$

b)
$$\frac{dy}{dx} = \sin(x) [y \sec(x) - 2]$$

c)
$$\sin(x)\frac{dy}{dx} - \cos(x)y = \sin(2x); y\left(\frac{\pi}{2}\right) = 2$$

d)
$$\frac{dy}{dx} + y = f(x); \ y(0) = 3 \ where \ f(x) = \begin{cases} 1; \ if \ x \le 1 \\ 0; \ if \ x > 1 \end{cases}$$

7. A 600 – gal tank initially contain 400 gals of water with 10 lbs of salt. A solution contain ½ lb of salt per gallon flows into the tank at a rate of 5 gal/min and the well-stirred mixture flows out at a slower rate of 3 gal/min. Determine the concentration of salt in the tank when it's full.