Math 140 **Tutorial 9**
March 10 - 13

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1. Find the derivative of the following functions:

   (a) $x^4 + 3x^3 + 3x + 1$

   (b) $(x+1)^4$

   (c) $3e^x - \dfrac{2}{x} + \dfrac{3}{x^2}$

   (d) $\sin xe^x$

   (e) $\dfrac{e^x}{x^3}$

   (f) $\dfrac{\sin xe^x}{x^3}$

   (g) $(2x^2 + 3x + 1)^6$

   (h) x^2e^{2x}

   (i) 3^x

   (j) $e^{\cos x} + \cos\left(e^x\right)$

   (k) $\sec\left(1 + x^2\right)$

   (l) $(x^2 + 1)^{\sin x}$

2. Find the equations of the tangent lines through the given points:

   (a) $x^2 + 4xy + y^2 = 13, \quad (2, 1)$

   (b) $y = (2 + x)e^{-x}, \quad (0, 2)$

3. For which non-zero point P on the curve given by

   $$\mathcal{C} : y = (x+1)^3 - 1$$

   does the tangent line to $\mathcal{C}$ at P go through the origin?

4. Consider the curve given by

   $$\mathcal{C} : y^2 = x^3 + 17.$$

   The point $P = (-2, 3)$ is on this curve, and the tangent line going through P intersects the curve $\mathcal{C}$ at another point. Find the coordinates of this second point of intersection.

5. Find the points on the ellipse $x^2 + 2y^2 = 1$ such that the tangent line has slope 1.

6. The volume of a cube is increasing at a rate of $10\text{cm}^3/\text{min}$. How fast is the surface area increasing when the length of an edge is 30 cm?

7. *Recall that the temperature of an object changes at a rate proportional to the temperature difference of the object and its surrounding.* A cup of hot chocolate has temperature 80°C in a room kept at 20°C. After half an hour the hot chocolate cools to 60°C.

   (a) What is the temperature of the chocolate after another half hour?

   (b) When will the chocolate have cooled to 40°C?