Explicit & Implicit Differentiation

While working in a group make sure you:

- Expect to make mistakes but be sure to reflect/learn from them!
- Are civil and are aware of your impact on others.
- Assume and engage with the strongest argument while assuming best intent.

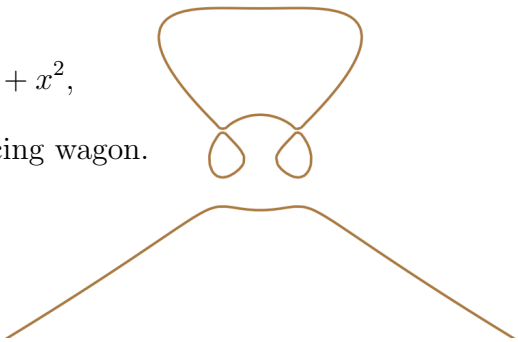
1. For each of the functions below find their respective derivatives.

   $y = \cos(x) + 3^{4x^2 - x}$ $\qquad$ $y = \sqrt{9 - (x-1)^2}$

2. The graph of the equation

   $$2y^3 + y^2 - y^5 = x^4 - 2x^3 + x^2,$$

   as seen to the right, without axes, looks like a bouncing wagon. Find $\frac{dy}{dx}$.



3. Assume that y is a function of x. Find $\frac{dy}{dx}$ if $y\tan(x) = x^2 + y^2$

BASIC DIFFERENTIATION RULES FOR ELEMENTARY FUNCTIONS

1. $\frac{d}{dx}[cu] = cu'$
2. $\frac{d}{dx}[u \pm v] = u' \pm v'$
3. $\frac{d}{dx}[uv] = uv' + vu'$
4. $\frac{d}{dx}\left[\frac{u}{v}\right] = \frac{vu' - uv'}{v^2}$
5. $\frac{d}{dx}[c] = 0$
6. $\frac{d}{dx}[u^n] = nu^{n-1}u'$
7. $\frac{d}{dx}[x] = 1$
8. $\frac{d}{dx}[|u|] = \frac{u}{|u|}(u'), \quad u \neq 0$
9. $\frac{d}{dx}[\ln u] = \frac{u'}{u}$
10. $\frac{d}{dx}[e^u] = e^u u'$
11. $\frac{d}{dx}[\log_a u] = \frac{u'}{(\ln a)u}$
12. $\frac{d}{dx}[a^u] = (\ln a)a^u u'$
13. $\frac{d}{dx}[\sin u] = (\cos u)u'$
14. $\frac{d}{dx}[\cos u] = -(\sin u)u'$
15. $\frac{d}{dx}[\tan u] = (\sec^2 u)u'$
16. $\frac{d}{dx}[\cot u] = -(\csc^2 u)u'$
17. $\frac{d}{dx}[\sec u] = (\sec u \tan u)u'$
18. $\frac{d}{dx}[\csc u] = -(\csc u \cot u)u'$
19. $\frac{d}{dx}[\arcsin u] = \frac{u'}{\sqrt{1-u^2}}$
20. $\frac{d}{dx}[\arccos u] = \frac{-u'}{\sqrt{1-u^2}}$
21. $\frac{d}{dx}[\arctan u] = \frac{u'}{1+u^2}$
22. $\frac{d}{dx}[\operatorname{arccot} u] = \frac{-u'}{1+u^2}$
23. $\frac{d}{dx}[\operatorname{arcsec} u] = \frac{u'}{|u|\sqrt{u^2-1}}$
24. $\frac{d}{dx}[\operatorname{arccsc} u] = \frac{-u'}{|u|\sqrt{u^2-1}}$

Differentiation Practice

4. Given the information about f and g in the table to the right, and that:
$S(x) = \ln(f(x)) + \ln(g(x)) \qquad T(x) = \ln(f(x)g(x),$
find $S'(1)$ and $T'(1)$

x	f(x)	f'(x)	g(x)	g'(x)
1	5	2	-3	-2

Let b be a positive real number. Recall the properties of logarithms:

$\log_b(xy) = \log_b x + \log_b y \qquad \log_b\left(\frac{x}{y}\right) = \log_b x - \log_b y \qquad \log_b(x^y) = y \log_b x$

Note: you need to *know* these for quizzes & exams as they will not be provided!!!

5. Given the information about f and g in the table to the right, and that:
$y = [f(x)]^{g(x)},$
find $\frac{dy}{dx}|_1$.

x	f(x)	f'(x)	g(x)	g'(x)
1	5	2	-3	-2