HONOR STATEMENT
I affirm that my work upholds the highest standards of honesty and academic integrity at the University of Washington, and that I have neither given nor received any unauthorized assistance on this exam.

Name (**printed letters please**)

Signature

Student ID #

1.	2.	3.	4.	5.	6.	7.	8.	$\sum$
10	10	10	10	10	10	10	10	80

- You have 80 minutes for 8 problems. Check your copy of the exam for completeness.

- You are allowed to use a hand written sheet of paper (8x11 in), back and front.

- Calculators may only have basic functions, but no graphing or differentiation functions.

- Justify all your answers and show your work for credit.

- **All answers must be exact, no rounding.**

Do not open the test until everyone has a copy and the start of the test is announced.

GOOD LUCK!

Problem 1. Find the derivative of

$$f(x) = \ln(\arctan(x^4)).$$

Problem 2. Find the derivative of
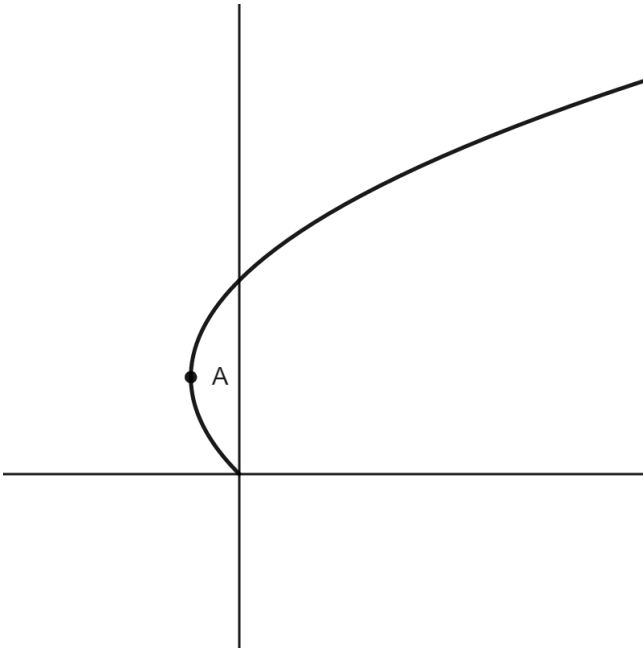
$$f(x) = \frac{\arcsin(2x) + 5x}{\cos(x^2)}.$$

Problem 3. Find the derivative of

$$f(x) = x^3 + 3^x + x^{\sqrt{x}}.$$

A curve in the xy-plane is defined by the parametric equations

$$x(t) = t^4 - t^2, \quad y(t) = t^2.$$

Find the coordinates of the leftmost point A of the curve. Exact values.

Problem 5. A curve is given through the parametric equations

$$x(t) = 3t^2 - 4, \quad y(t) = 4t^3 - 4,$$

where $t > 0$. Find the equation of the tangent line to the curve that passes through the point $(0, -4)$. Exact values.

Problem 6. Given the implicitly defined curve

$$8y^3 + y^2 \sin(\pi(x-1)) = x^2,$$

find the tangent line equation at the point (x, y) on the curve where $x = 1$. Exact answers.

At $x = 1$: $\sin(\pi(x-1)) = \sin(0) = 0$, so $8y^3 = 1$, giving $y = \tfrac{1}{2}$.

Differentiating implicitly:
$$24y^2 y' + 2y y' \sin(\pi(x-1)) + y^2 \cos(\pi(x-1))\cdot \pi = 2x.$$

At $(1, \tfrac12)$, $\sin(0)=0$, $\cos(0)=1$:
$$24\cdot\tfrac14\, y' + \tfrac14\pi = 2 \implies 6y' = 2 - \tfrac{\pi}{4} \implies y' = \frac{8-\pi}{24}.$$

Tangent line:
$$y = \frac12 + \frac{8-\pi}{24}(x-1).$$

Problem 7. A conical paper cup is 5 cm in diameter (not the radius!) at the top and 10cm deep. Water is pouring into the cup at the rate of $2cm^3$ per second. How fast is the depth of the water in the cup rising when it is $3cm$ deep. The volume of a conical cup is $V = \frac{1}{3}\pi r^2 h$, where r is the radius of the cone.

Problem 8. Two ladybugs are sitting in adjacent corners of the ceiling of a room, 20 feet apart. They start walking along the edges of the ceiling, in directions as indicated below. If ladybug A walks at a pace of 4 feet per minute and ladybug B at a pace of 2 feet per minute, what is the rate of change of the straight line distance between them after 3 minutes?
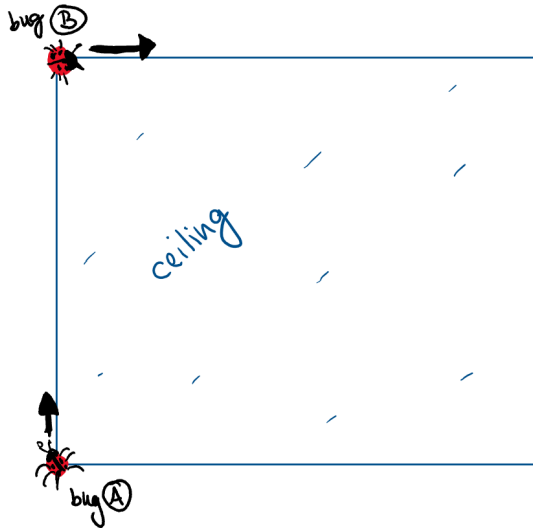
For full credit, make your own sketch, label it with all variables you use, and write out the rates that you know and that you want. Keep your answers exact.