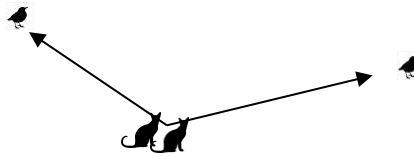


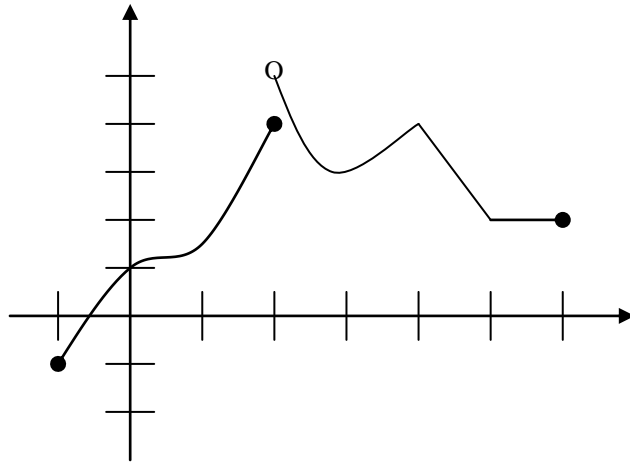
Show all of your work, give exact values only, and completely simplify all answers. Provide a clear and organized presentation. You may choose to use technology, but if you do so, you may only use a scientific calculator.

1. (15 pts) My two cats, Pythagoras and Jolie, are standing together (you may consider them at the same point), when they spot two birds in the yard. Being very intelligent cats, and knowing my birthday is near, they decide to each go for a separate bird, so I can be presented with two presents this year. At the same instant, both cats lunge for the birds. Being on a strict diet of field mice, Pythagoras is a bit more fit than Jolie, and runs at a rate of 3 m/s, while Jolie runs at a rate of 2 m/s. If the angle between them is 150° , how fast is the distance between Pythagoras and Jolie changing after 2 seconds?



2. (10 pts) Use either a linear approximation or differentials to approximate $\cos(32^\circ)$.

3. (10 pts) Determine all absolute and local extrema for f (each tick on each axis represents one unit):



4. (10 pts) In the theory of electrical circuits, *Ohm's Law* describes the relationship between the voltage V across a resistor, the electrical current I passing through the resistor, and a quantity R known as the resistance. The law can be written as follows:

$$V = IR$$

Usually voltage is measured in volts, current is measured in amperes (amps), and the resistance is measured in ohms, where 1 ohm = 1 volt/amp. In a circuit with variable resistance, the quantities V , I , and R might all depend on time.

i) Take the derivative of *Ohm's law* to find an equation relating $\frac{dV}{dt}$, $\frac{dI}{dt}$, and $\frac{dR}{dt}$.

ii) Suppose that the current is increasing at a rate of 0.3 amps/sec, while the resistance is holding steady at 4 ohms. How quickly is the voltage across the resistor increasing?

Now suppose that the voltage across the resistor is held constant at 20 volts, while the resistance is steadily increased at a rate of 0.4 ohms/sec.

iii) What is the Current through the resistor when the resistance reaches 10 ohms?

iv) At what rate is the current changing at that time? Is it increasing or decreasing?

5. (10 pts) Prove that $\frac{d}{dx} \sinh^{-1} x = \frac{1}{\sqrt{1+x^2}}$

6. (10 pts) Find $f'(x)$ if $f(x) = x^{\ln^2(\sin^{-1}x)}$

7. (15 pts) Find y' if $y = \frac{1}{2} \operatorname{sech}^{\frac{3}{2}}(x^3 + 3 \tanh^{-1} x)$

8. (10 pts) Find all absolute extrema for $f(x) = x + 3\sin x$.

9. (10 points) Verify the identity $(\cosh x + \sinh x)^n = \cosh(nx) + \sinh(nx)$