

1. **(8 points)** Evaluate the following limits; if they cannot be evaluated, show why not.

(a) **(2 points)** $\lim_{x \rightarrow 3} \frac{x^2 - 2x + 1}{2^x - 1}$

(b) **(3 points)** $\lim_{x \rightarrow 0^-} x \cot x$

(c) **(3 points)** $\lim_{x \rightarrow 0} \frac{x^3 + x^2}{e^x - x - 1}$

2. **(8 points)** You have been asked to design a new size of paper. You're asked to make it no larger than 100 square inches, and told that printed material will have one-inch margins on top and bottom, and margins of 1.5 inches on the left and right. What dimensions should your paper have to maximize printable area?

3. **(8 points)** Find approximations to the following values using appropriate linearizations.
- (a) **(3 points)** Find a rational approximation to $\ln(e^3 + 0.1)$.

 - (b) **(3 points)** Approximate $\arctan(1.04)$ using rational numbers and π only.

 - (c) **(2 points)** Find a rational number approximately equal to $\sqrt{98}$.
4. **(8 points)** A bar of iron is taken from a 1400°F furnace into a 100°F metalworking studio. After 5 minutes it has cooled to 800°F .
- (a) **(4 points)** Produce a function $T(t)$ modeling the bar's temperature t minutes after removal from the furnace.

 - (b) **(2 points)** How quickly is the bar's temperature changing immediately upon removal from the furnace?

 - (c) **(2 points)** The metal can be worked as long as it is hotter than 1000°F . How soon after the bar is removed from the furnace does it become unworkable?

5. **(8 points)** A 13-foot-long ladder is leaning against a wall and the base of the ladder is sliding away from the wall at a rate of 2 feet per hour.

(a) **(5 points)** How quickly is the top of the ladder sliding down the wall when the base is 5 feet from the wall?

(b) **(3 points)** How quickly is the top of the ladder sliding down the wall when the base is 12 feet from the wall?

6. **(8 points)** Answer the following questions related to the shape of the graph of $f(x) = x^3 + 6x^2 - 15x + 7$.

(a) **(3 points)** Where is it increasing? Where is it decreasing?

(b) **(2 points)** What are its critical points, and is each a local maximum, a local minimum, or neither?

(c) **(3 points)** Where is it concave up? Where is it concave down? Does it have any points of inflection?