

Show all work. Arithmetic expressions do not need to be simplified in your final answer.

1. **(10 points)** Evaluate the following limits:

(a) $\lim_{\theta \rightarrow 0} \theta \cot(2\theta)$.

(b) $\lim_{t \rightarrow 4} \frac{\sqrt{t}+2}{t^2+16}$

(c) $\lim_{x \rightarrow 0} \frac{\cos x - 1}{x^2}$

(d)

2. **(10 points)** Answer the following questions which would be preparatory to sketching the graph of the function $y = (x + 3)e^x$.

(a) **(2 points)** What is its long-term behavior in each direction? You may describe it in words or symbolically.

(b) **(4 points)** On which intervals is it increasing, and on which intervals is it decreasing? Label which is which.

(c) **(4 points)** On which intervals is it concave up, and on which intervals is it concave down? Label which is which.

3. **(2 point bonus)** Calculate $\lim_{x \rightarrow \infty} \left(1 + \frac{a}{x}\right)^{bx}$ as an expression in a and b .