

1. **(6 points)** Compute the following infinite limits, or, if the limit is uncomputable, briefly describe (in symbols or words) the relevant long-term behavior of the function.

(a) **(2 points)**  $\lim_{x \rightarrow -\infty} \frac{4x^3 + 6x^2 - 2}{2x^3 - 4x + 5}$

(b) **(2 points)**  $\lim_{t \rightarrow +\infty} \frac{(t-2)(t+5)}{t^2(2t-6)}$

(c) **(2 points)**  $\lim_{r \rightarrow -\infty} \frac{2-r^3}{r^2+2r+1}$

2. **(4 points)** Using the difference quotient, find the derivative of the function  $f(x) = 4x^2 - 5x$ .

3. **(4 points)** If  $g(t) = 6t^3 - \frac{1}{\sqrt{t}} + 6e^t$ , compute  $g''(t)$ .

4. **(6 points)** Perform the following computations; you do not need to algebraically simplify fully differentiated expressions.

(a) **(3 points)** Determine  $\frac{d}{ds} \frac{s^3 - 3s}{5s^2 - e^s}$

(b) **(3 points)** If  $y = (t^e + e^t) \left( 3\sqrt{t} - \frac{1}{t^3} \right)$ , find  $\frac{dy}{dt}$ .

5. **(2 point bonus)** If  $f(x) = x^2 e^x$ , find (with justification) a general formula for  $f^{(n)}(x)$  on the back of this page.