

1. (20%) Find the following limit. (If the limit does not exist or has an infinite limit, you should point it out)

(a) (5%) $\lim_{x \rightarrow 1} \frac{2x}{x-1} - \frac{2}{\ln \ln x}$

(b) (5%) $\lim_{x \rightarrow 0} \cos(x)^{\frac{1}{x^2}}$

(c) $\lim_{x \rightarrow 0} \frac{e^x + e^{-x}}{e^x - e^{-x}}$

(d) (5%) $\lim_{x \rightarrow 0} \frac{e^x}{x}$

2. (15%) Solve the following problems

(a) Evaluate $\int_{-2}^2 xe^{-x^4} dx$

(b) Find $\sum_{i=1}^n \frac{1}{n} \left[\frac{1}{1 + \frac{i^2}{n^2}} \right]$

(c) $\int_0^5 (5 - |x - 5|) dx$

3. (9%) Let $f(x) = \int_1^x \sqrt{1 + t^3} dt$

(a) (3%) Show that $f(x)$ has an inverse function

(b) (3%) What is the value of $f^{-1}(x)$ when $x = 0$

(c) (3%) What is the value of $(f^{-1})'(x)$ when $x = 0$

4. (10%) Compute the derivative.

(a) (5%) $f(x) = \frac{x\sqrt{x-1}}{2}$

(b) (5%) $f(x) = e^{\sin(x)} + \cos \cos(e^{2x}) - 2^{\sqrt{x}}$

5. (25%) Evaluate the following integral.

(a) (5%) $\int_0^1 \frac{dx}{2\sqrt{3-x}\sqrt{x+1}}$

(b) (5%) $\int \frac{\cos(1 - \ln \ln \theta) d\theta}{\theta}$

(c) (5%) $\int_0^1 3^{x^2+2x} (x+1) dx$

$$(d) (5\%) \int \frac{4\tan^{-1}\left(\frac{x}{2}\right)}{4+x^2} dx$$

$$(e) (5\%) \int_{\frac{\pi}{3}}^{\frac{\pi}{2}} \frac{\cos(x)}{\sin(x)\sqrt{\sin^2(x)-\frac{1}{4}}} dx$$

6. (7%) Find the area of the given region bounded by the graphs of $x = \cos \cos(y)$ and $x = \frac{1}{2}$ on the interval $\frac{\pi}{3} \leq y \leq \frac{7\pi}{3}$.
7. (7%) Find the volume of the solid formed by revolving the region bounded by the graphs of the equations $y = \frac{1}{x^2}$, $y = 0$, $x = 2$, $x = 5$ about the y-axis.
8. (7%) Find the area of the surface generated by revolving the curve $y = \frac{x^3}{18}$ on the interval $3 \leq x \leq 6$ about the x-axis.