

Please write down all your work.

1. Let  $f(x) = \frac{x(x+1)(x+2)\cdots(x+n)}{\cos x}$ , find  $f'(0)$ . 10%

2. Let  $g(x) = \int_{\sqrt{x}}^{x^2} \frac{t^2}{t^4+1} dt$ , find  $g'(1)$ . 10%

3. Find  $\lim_{n \rightarrow \infty} \sum_{k=1}^n \frac{k}{n^2 + 3nk}$ . 10%

4. For  $a < b$ , show that  $e^a(b-a) < e^b - e^a < e^b(b-a)$ . 10%

5. The region bounded by the graphs of  $y = 1/(x-1)(4-x)$ ,  $y = 0$ ,  $x = 2$  and  $x = 3$  is resolved about the y-axis. Find the volume of the resulting solid. 10%

6. Evaluate the iterated integral  $\int_0^9 \int_{\sqrt{y}}^3 \sin x^3 dx dy$ . 10%

7. Determine the convergence or divergence of the series. 10%

(a)  $\sum_{n=1}^{\infty} \frac{(2n)^n}{n^{2n}}$                       (b)  $\sum_{n=1}^{\infty} \frac{\cos(n\pi/6)}{n^2}$

8. Find the integral  $\int_0^{\frac{\pi}{4}} (1 + \sec x)^2 dx$ . 10%

9. Find the derivative  $dy/dx$ . 20%

(a)  $y = \ln |1 - e^{2x}|^3$

(b)  $y = [(1 + \frac{1}{x})^{-1} + 1]^{-1}$

(c)  $x = \sin xy$

(d)  $y = \cos e^{5x} + e^{\cos 5x}$