1. Find $\dfrac{dy}{dx}$. 30%

1.1 $y = \dfrac{x^2 - 1}{x^2 + x - 2}$ 1.2 $y = (\dfrac{x}{5} + \dfrac{1}{5x})^5$ 1.3 $y = x^2\, e^{\frac{2}{x}}$

1.4 $y = \ln(2e^{-x}\sin x)$ 1.5 $y = \dfrac{1}{6}\left(1 + \cos^2(7x)\right)^3$ 1.6 $y^2\cos(\dfrac{1}{y}) = 2x + 2y$

2. Evaluate the integrals. 30%

2.1 $\displaystyle\int_9^4 \dfrac{1 - \sqrt{x}}{\sqrt{x}}\, dx$ 2.2 $\displaystyle\int_0^{\sqrt{\ln 2}} 2xe^{x^2}\, dx$ 2.3 $\displaystyle\int \dfrac{dx}{\sqrt{x}(x + 1)}$

2.4 $\displaystyle\int e^{-x}\cos x\, dx$ 2.5 $\displaystyle\int_0^2 \dfrac{dx}{\sqrt{|x - 1|}}$ 2.6 $\displaystyle\int_{\sqrt{3}}^2 x\sec^{-1} x\, dx$

3. For function $x^4 - 4x^3 + 10$, please (1) find the local extremes, (2) find the inflection points and (3) graph the function and include the coordinates of local extremes and inflection points in your sketch. 15%

4. Find the volume generated by revolving the region bounded by $y = \sqrt{x}$ and the lines $y = 1$ and $x = 4$ about the line $y = 1$. 5%

5. A ball is dropped from a height of 4 m. Each time it strikes the pavement after falling from a height of h m it rebounds to a height of 0.75h m. Find the total distance the ball travels up and down. 5%

6. Use the integral test to evaluate the convergence of the series $\displaystyle\sum_{n=3}^{\infty} \dfrac{(1/n)}{(\ln n)\sqrt{\ln^2 n - 1}}$. 5%

7. Find the Taylor series generated by $f(x) = \dfrac{1}{x}$ centered at 2. Where, in what interval of x, does the series converge? And what does the series converge to? 10%