

Ph.D. Qualifying Examination
Engineering Mathematics
Fall 2019

Logistics Notes:

- Time allowed: 2.5 hours
- Closed book and closed notes; one sheet (8.5×11 in, 2-sided) of formulas is allowed
- 4 problems
- Calculators are allowed
- Laptops, cell phones, and similar electronic devices with Internet access are not allowed

Show your work, including intermediate steps. State your assumptions clearly. Use as many sheets of paper as necessary to present each solution.

Problem 1 (25 points). Find

$$\lim_{x \rightarrow 7} \frac{\sqrt{x+2} \sqrt[3]{x+20}}{\sqrt[4]{x+9} - 2}$$

Problem 2

a) Solve $\frac{dy}{dx} = -2xy$ where $y(0) = 1$ (12.5 points)

b) Solve $\frac{d^2y}{dx^2} - 4\frac{dy}{dx} + 3y = 10e^{-2x}$ where $y(0) = 1, y'(0) = -3$ (12.5 points)

Problem 3.

a) Compute

$$\frac{d}{dx}(\arctan(\sqrt{\cos 2x}) - \sqrt{\cos 2x}) \quad (12.5 \text{ points})$$

b) Compute

$$\int \frac{dx}{\sqrt{x+1} + \sqrt{x-1}} \quad (12.5 \text{ points})$$

Problem 4 (25 points)

Find the area fully enclosed by the parametric curve

$$x = 2t - t^2$$

$$y = 2t^2 - t^3$$