## **Queens College Department of Mathematics**

## **Final Examination**

 $2\frac{1}{2}$  Hours

## **Mathematics 142 FALL 2024** <u>Instructions</u>: Answer all questions and show all your work.

- Find  $\frac{dy}{dx}$ : (algebraic simplification not necessary) 1.
  - $v = e^{x^3 + \tan x}$ (a)

(b) 
$$y = \int_{-2}^{x^3} \frac{t^2 - 1}{t^2 + 2} dt$$

(c) 
$$y = \frac{(x^2 + x)^3 \cdot \sin^{-1} x}{\sin^4 x \cdot e^{\cos x}}$$

(d) 
$$y = \ln(\tan(x))$$

(e) 
$$y = \frac{1}{\ln x}$$

2. Evaluate:

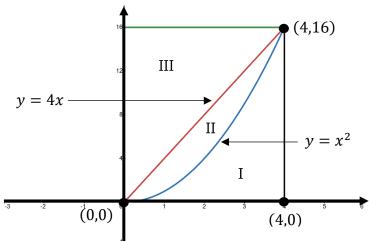
(a) 
$$\int \frac{\sec x \tan x}{e^{\sec x}} dx$$

(b) 
$$\int \pi^x dx$$

(c) 
$$\int_{1}^{e} \frac{1}{[1 + (\ln x)^{2}] \cdot x} dx$$
 (Find exact value, calculator solution not acceptable)

(d) 
$$\int \frac{e^{2x}}{\sqrt{1-e^{4x}}} dx$$

- 3. Penicillin-V is eliminated from the body at a rate proportional to the amount present.
  - How much will remain in the body  $2\frac{1}{2}$  hours after a patient takes a 500 mg dose? (The half-life of Penicillin-V is 3.7 hours)
  - (b) When will the patient have 0.01 mg Penicillin left in the body?
- 4. (a)
- Find the function g such that g(f(x)) = x if  $f(x) = \frac{x+1}{x-1}$ . Find the value of  $\sin\left(\tan^{-1}\frac{a}{b}\right)$ . (Answer will be in terms of a and b.) (b)
- The slope of a curve is given by  $y^2(1-x)$ . The curve passes through the point (0,1). Find an 5. equation of the curve.
- Find the exact area between the curves y = x 3 and  $x = y^2 + 1$  (calculator solution not 6. acceptable).
- 7. For each of the following, set up the integral(s) which will give the volume generated when the region is rotated. Do not evaluate the integrals.
  - (a) Region I is revolved around the x-axis.
  - Region II is revolved around the *y*-axis. (b)
  - Region III is revolved around the line (c) y = 20.



This material is the property of Queens College and may not be reproduced in whole or in part, for sale or free distribution, without the written consent of Queens College, Flushing, NY 11367.