

- Print Name, ID number and Section on your blue book.
- BOOKS and CALCULATORS are NOT allowed.
One sheet of NOTES is allowed.
- **You must show your work to receive credit.**

1. (8 points) Which of the following integrals diverge? Remember to give a reason for your answer in each case!

(a) $\int_0^1 e^{\sin x} dx$ (b) $\int_0^1 \frac{dx}{\sqrt{x}}$

2. (12 points) Consider the curve given by $y(x) = \ln x$ for $1 \leq x \leq e$.

- (a) Write down an integral for its length.
(b) The curve is rotated about the y -axis. Write down an integral for the surface area.

Do NOT evaluate the integrals.

3. (16 points) Solve the differential equations:

- (a) $\frac{dy}{dx} = e^{x+y}$, $y(0) = 0$.
(b) $y'(t) - t(y(t))^2 = t$ (general solution).

4. (8 points) Write down an integral in polar coordinates for the area of the region that lies inside the curve $r = 2 \cos \theta$ and outside the curve $r = \sqrt{2}$.

5. (6 points) Consider the differential equation $y'(t) = 1 - y^2$. Find the limiting behavior of $y(t)$ (that is, what is $\lim_{t \rightarrow +\infty} y(t)$) if the initial condition is

- (a) $y(0) = 0$ (b) $y(0) = 2$.

You do not need to solve the equation — a clear explanation in a few words will suffice.

END OF EXAM