

Name: _____

Section: _____

Clear your desk of everything except pens, pencils and erasers. **Show all your work.**

If you have a question raise your hand and I will come to you.

1. Solve equation $\frac{dy}{dx} = xe^{-y}$ (total 3 points).

Answer: $y = \ln(\frac{1}{2}x^2 + C)$ (2 points for $e^y = \frac{1}{2}x^2 + C$; and 1 point for the correct final step.)

2. Evaluate $\int_e^{e^2} \frac{dx}{x(\log_{10} x)^2}$ (total 4 points).

Answer: $\frac{1}{2}(\ln 10)^2$

(2 points for $(\ln 10)^2 \int_1^2 (\ln x)^{-2} d \ln x$; 2 points for the correct final result)

3. The physical law for the radioactive decay of C^{14} mass (y) over time (t) is given by

$$\frac{dy}{dt} = -ky,$$

where $k > 0$ is a constant. The initial C^{14} mass is y_0 and half-life of C^{14} mass is 5700 years. What is the the age of a sample in which 40% of the original C^{14} mass has decayed (total 3 point)?

Answer: $t = -\frac{5700}{\ln 2} \ln 0.6$

(1 point for $y = y_0 e^{-kt}$; 2 points for the correct final result)