

Answer the problems on separate paper. You do not need to rewrite the problem statements on your answer sheets. Do your own work. Show all relevant steps which lead to your solutions. Retain this question sheet for your records.

1. Evaluate the following integrals:

a) $\int 2 e^x \sin(e^x) dx$

b) $\int \frac{dx}{1 + e^{-x}}$

2. Find the derivative (with respect to the dependent variable) of the following functions:

a) $y = t^2 e^{2t} - 2t e^{2t}$

b) $y = (2x + 1)^{\cos x - 1}$

3. Find each of the following limits, if the limits exist. If, in calculating the limit, you apply l'Hôpital's Rule, identify the form of the indeterminacy.

a) $\lim_{x \rightarrow 0} \frac{\sin 5x}{\sin 3x}$

b) $\lim_{x \rightarrow \frac{\pi}{2}} \left(\frac{\pi}{2} - x \right) \tan x$

c) $\lim_{x \rightarrow 0^+} \left(\frac{1}{x} - \frac{1}{x\sqrt{1+x}} \right)$

4. a) Consider $f(x) = 2x^{3/2} + 7x$ and $g(x) = \sqrt{x^3 + x + 4}$. Does f grow faster than g , at the same rate as g or slower than g ?

b) Consider $f(x) = (x + 1) \ln x$ and $g(x) = x + 1 + \ln x$. Determine whether $f = O(g)$.

5. The temperature of an ingot of silver is 60°C above room temperature right now. Twenty minutes ago it was 70°C above room temperature. How far above room temperature will the silver be 15 minutes from now?

Bonus (5 points): The half-life of radium is approximately 1600 years. How long will it take for a sample of 150 mg of radium to decay to 30 mg?