

18.014–ESG Exam 1

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1. Compute the following integrals:

(a) $\int_2^5 (5x^4 + 3x^2)$

(b) $\int_0^\pi (2 \sin x - \cos x)$

2. Compute the following derivatives:

(a) $D\left(\frac{x^2}{\sqrt{\sin x}}\right)$

(b) $D \left(\int_0^x \sqrt{1+t^3} \right)$

3. What theorem is needed to prove that if $Df = 0$, then f must be a constant?
4. Let $f, g : A \rightarrow \mathbb{R}$ be two differentiable functions. Show that if $Df = Dg$, then $f - g$ is a constant.
5. (a) State the Extreme-Value Theorem. Be sure to state the assumptions about the function and its domain carefully.
- (b) Give an example of a function that does not have a maximum. Be sure to specify the domain of your function explicitly.
6. Match the following statements to their sources.
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| “Mathematicians are machines for turning coffee into theorems.” | L. E. J. Brouwer |
| “By ‘life,’ I mean ‘math.’” | Pál Erdős |
| “The Brouwer Fixed-Point Theorem is false.” | Pramod N. Achar |