You have 70 minutes.

No notes, books, calculators, computers, etc. are allowed.

Show all of your work, in as organized a manner as possible. Incorrect answers with solid work often earn partial credit. Correct answers without explanatory work rarely earn full credit.

Perform as much algebraic simplification as you can. Do not bother to do non-trivial arithmetic. Mark your final answer clearly.

Good luck.

A. Rewrite the integral $\int_0^2 \int_0^{y^3} \int_0^{y^2} f(x, y, z)\, dz\, dx\, dy$ as an integral $dx\, dy\, dz$.

B. Let K denote the value of the integral $\int_{-\infty}^{\infty} e^{-x^2}\,dx$. Let $\mathbb{R}^3$ denote all of three-dimensional space. The triple integral $\iiint_{\mathbb{R}^3} e^{-(x^2+y^2+z^2)}\,dV$ is important in statistics. Working spherically, compute the triple integral in terms of K.

C. Compute the arc length of the curve parametrized by $\vec{r}(t) = \left\langle \frac{1}{2}t^2, \frac{\sqrt{2}}{3}t^3, \frac{1}{4}t^4 \right\rangle$ for $0 \leq t \leq 1$.

D. Compute the work performed by the force field $\vec{F} = \langle xe^z, xz, x + y\rangle$ on a particle moving along the curve parametrized by $\vec{r}(t) = \langle t, t^3, -t^2\rangle$ for $0 \leq t \leq 1$.

E. Let C be the piecewise-linear curve that goes from $\langle 0, 0\rangle$ to $\langle 1, 0\rangle$ to $\langle 1, 3\rangle$ to $\langle 0, 0\rangle$, oriented counterclockwise. Compute $\int_C \sqrt{1 + x^3}\, dx + 2xy\, dy$.