ACES
MAA4102, MAA5104

Class-B

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Hello. Please write **DNE** in a blank if the described object does not exist or if the indicated operation cannot be performed.

B1: Show no work.

z) $\lim_{GPA \to 0}$ [*Engineering student*] equals (Circle one):

Business major — *"For Here Or To Go?"* — *Dental-floss designer*

(The Business school has a *different* version of this joke...)

a) In $\mathbb{R}^3$, the point $P := (3, 1, -2)$ has orthogonal projection Proj(P)=(___ , ___ , ___) on the line passing through $(20, 40, 20)$ and the origin.

b) Open $\mathbb{R}$-intervals $J_n :=$ (___ , ___) intersect to a "half-open" nv-interval $\bigcap_{n=1}^{\infty} J_n =$ (___ , ___].

c') Let $S := \{q \in \mathbb{Q}_+ \mid 4 < q^2 \leqslant 7\}$. Then:

$\mathrm{Cl}_{\mathbb{R}}(S)$= ___ . $\mathrm{Itr}_{\mathbb{R}}(S)$= ___ .

$\mathrm{Cl}_{\mathbb{Q}}(S)$= ___ . $\mathrm{Itr}_{\mathbb{Q}}(S)$= ___ .

d) Let $S := \{q \in \mathbb{Q}_+ \mid 4 < q^2 \leqslant 7\}$. Then:

$\mathrm{Bdry}_{\mathbb{R}}(S)$= ___ . $\mathrm{Bdry}_{\mathbb{Q}}(S)$= ___ .

e) On $\mathbb{Z}$, say $k \,\$\, n$ IFF $k - n$ is a multiple of 6. Then \$ is: (Circle) **Trans.**: *T F*. **Symm.**: *T F*. **Refl.**: *T F*.

B2: Show no work. i) Give an example of a set,

$\{$ ___ $\in \mathbb{R} \mid$ ___ $\}$,

which has $5 \in \mathbb{R}$ as its **only** $\mathbb{R}$-cluster point.

ii) Suppose that $U, V_1, V_2, \ldots$ are $\mathbb{R}$-open-sets, and $E, K_1, K_2, \ldots$ are $\mathbb{R}$-closed-sets. (Circle) those of the following sets which are guaranteed to be $\mathbb{R}$-*closed*.

$E \setminus U$. $K_1 \setminus E$. $\bigcap_{n=1}^{\infty} K_n$.

$\mathbb{R} \setminus [\bigcup_{n=1}^{\infty} V_n]$. $[U \cap V_1]^c$.

Essay questions: For each question, carefully write a triple–spaced essay solving the problem.
Each essay starts a new page.

B3: In MS (Ω, d), sequence $\vec{b} \subset \Omega$ converges to both q and r in Ω. Prove that $q = r$, by showing that $\mathsf{d}(q, r) = 0$. [*Hint:* Use the Triangle Inequality.]

B4: Use $\langle \cdot, \cdot \rangle$ for an inner-product on real vector-space $\mathbf{V}$. Carefully state the Cauchy-Schwarz Inequality Theorem, making precise the IFF-condition for equality. If you use a term such as "orthogonal" or "linearly independent" or "parallel", then *define* it precisely in terms of the inner-product and/or the vectorspace operations.

End of Class-B

B1:	___ ___	95pts
B2:	___ ___	25pts
B3:	___ ___	50pts
B4:	___ ___	25pts
No name, or no honor code:	___	−5pts
Unstapled, or no ordinal :	___	−5pts
Total:	___ ___ ___	195pts

Please PRINT your name and ordinal. Ta:

Ord: ___

HONOR CODE: *"I have neither requested nor received help on this exam other than from my professor."*

Signature: ___