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## 1 Some Concepts from Calculus and ODEs

### 1.1

Prove that a closed set contains all of its boundary points while an open set contains none of its boundary points.

*Proof.* Let  $A \subset \mathbb{R}^n$  be a closed set. This implies that  $A$  contains all of its limit points. Now suppose the point  $x \in \mathbb{R}^n$  is a boundary point of the set  $A$ . This implies that every ball with center at  $x$  contains points of  $A$  and points of  $A^c$ . It then follows, from the definition of a limit point, that  $x$  is itself a limit point of  $A$ . Then since we know  $A$  contains all of its limit points then it follows that  $x \in A$ , as desired.

Now let  $A \subset \mathbb{R}^n$  be an open set. This implies that every point of  $A$  is an interior point, further implying that  $A$  contains none of its limit points. Since we just showed that boundary points are also limit points, it must be that  $A$  contains none of its boundary points, as desired.  $\square$