**P836:**

1. **Solution: Since the distance of the point P to the origin is**

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**then we want to find the maximum and minimum of |*PO*| subject to**

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**Since |*PO*| has a minimum and maximum whenever the function**

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**has a minimum and maximum, then we can find the points where  attains its maximum and minimum value subject to the constraint .**

**Let , then solve the system**

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**then we can find**

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**Since , then the closest points on the curve to the origin are  and**

**, the farthest points on the curve to the origin are **

**and .**

1. Solution: Let *r* and *h* be the radius and height of the cylindrical portion of the tank, then *r* and *h* satisfy



The surface area of the tank is



To want smallest amount of material possible in building the tank means to find the absolute minimum of  subject to the constraint .

Let , then solve the system

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We can find



Since there is only one suspicious point, and we know the smallest amount material can be used to make the tank, therefore, when the radius and height of the cylindrical portion of the tank are , we can make the tank using the least materials.