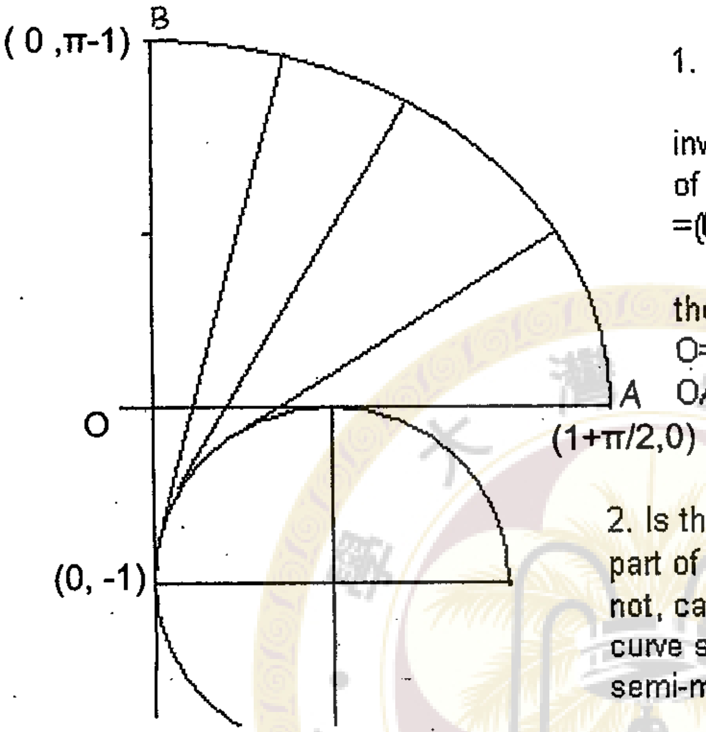
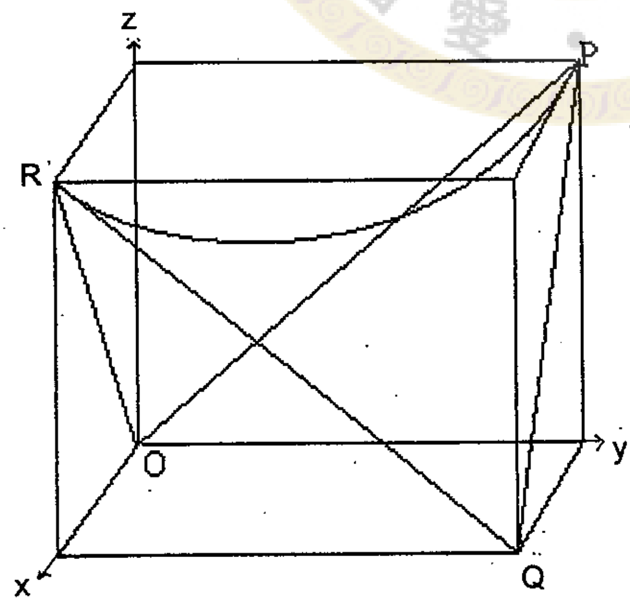


1. The circle $(x-1)^2+(y+1)^2 = 1$ has an involute $\overset{\frown}{BA}$ in the left picture. A string of length π has its one end fixed at (x,y) =(0, -1), while the other end traces out the arc $\overset{\frown}{BA}$, B=(0,π-1), A=(1+π/2,0), O=(0,0). Find the area of the sector OAB in the first quadrant. (25/100)

2. Is the involute arc $\overset{\frown}{BA}$ in problem 1 the part of an ellipse in the first quadrant? If not, can you replace the circle by another curve so that its involute is an ellipse with semi-major a=1+ π/2, semi-minor b=π- 1? (25/100)

3. Can you find a surface in R^3, (u,v)->(x,y,z) so that its first fundamental form $dx^2 + dy^2 + dz^2 = du^2 + 2\,du\,dv + 3\,dv^2$ and its second fundamental form $\Pi= du^2 + 3\,du\,dv + dv^2$? If yes, x=x(u,v)=?, y=y(u,v)=? z=z(u,v)=? (25/100)



4. O=(0,0,0), P=(0,1,1), R =(1,0,1), Q =(1,1,0). Let S be the Schwarz minimal surface which is the solution to the Plateau problem with boundary curve $\overline{OP} \cup \overline{PQ} \cup \overline{QR} \cup \overline{RO}$. Let $\vec{N}$ = (l,m,n) n>0 be the upward unit normal of S, $\vec{k}$=(0,0,1). Find the flux integral $\iint \vec{N}\cdot\vec{k}\,dS$ = ? (25/100)