Name: _____

Task Master: _____ **Cynic:** _____ **Recorder:** _____

MTH 254 $\qquad$ **CURVILINEAR VOLUME** $\qquad$ Spring 2015

Working in small groups (3 or 4 people), solve as many of the problems below as possible. Try to resolve questions within the group before asking for help. Each group member should then write up the solutions in their own words; Show your work! Full credit will only be given if your answer is supported by calculations and/or explanations as appropriate.

On the following pages is a worksheet that you can use to construct the area and volume elements in both cylindrical and spherical coordinates.

SEE DIAGRAMS ON NEXT PAGES.

Cylindrical Coordinates:
You will now derive expressions for infintesimal distances in coordinate directions in cylindrical coordinates.

Geometrically determine the length ds of each of the three paths shown below. Notice that, along any of these three paths, only one coordinate r, ϕ, or z is changing at a time (i.e. along path 1, $dz \neq 0$, but $d\phi = 0$ and $dr = 0$).

Path 1: $ds =$

Path 2: $ds =$

Path 3: $ds =$

Spherical Coordinates:
You will now derive expressions for infintesimal distances in coordinate directions in spherical coordinates.
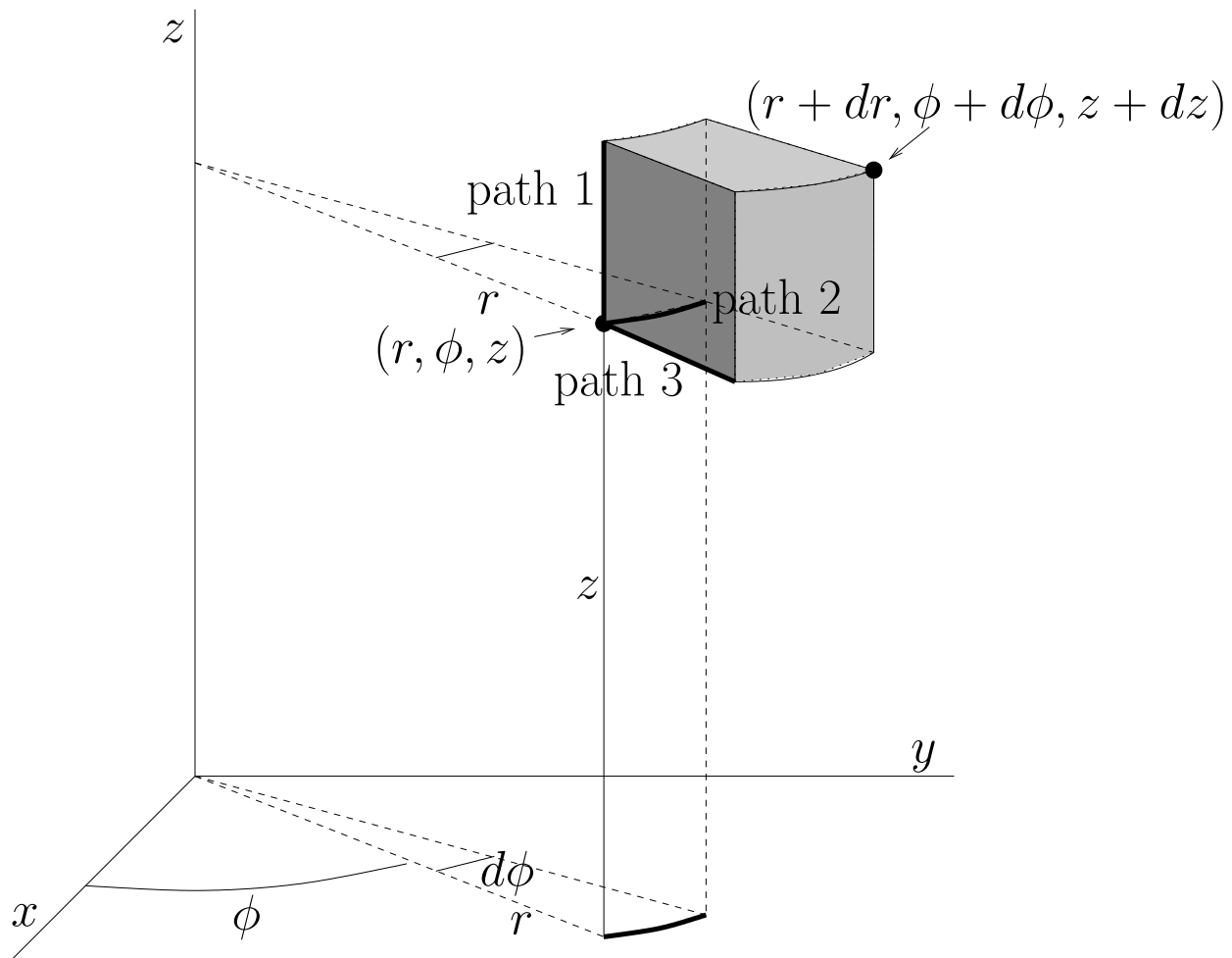
Geometrically determine the length ds of each of the three paths shown above. Notice that, along any of these three paths, only one coordinate r, θ, or ϕ is changing at a time (i.e. along path 1, $d\theta \neq 0$, but $dr = 0$ and $d\phi = 0$).

Path 1: $ds =$
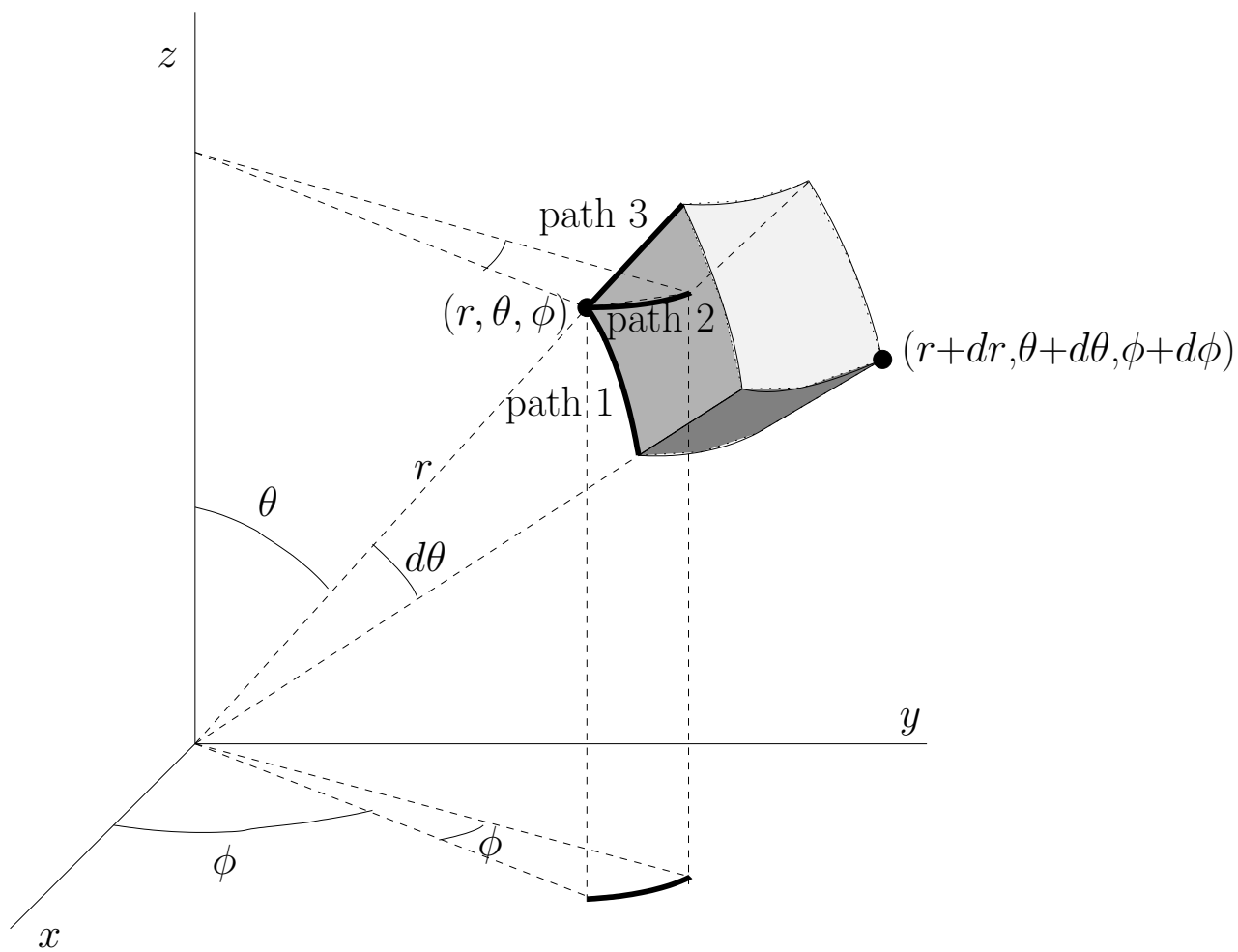
Path 2: $ds =$ $\qquad\qquad\qquad\qquad$ (Be careful, this is the tricky one.)

Path 3: $ds =$

Cylindrical Coordinates

Spherical Coordinates