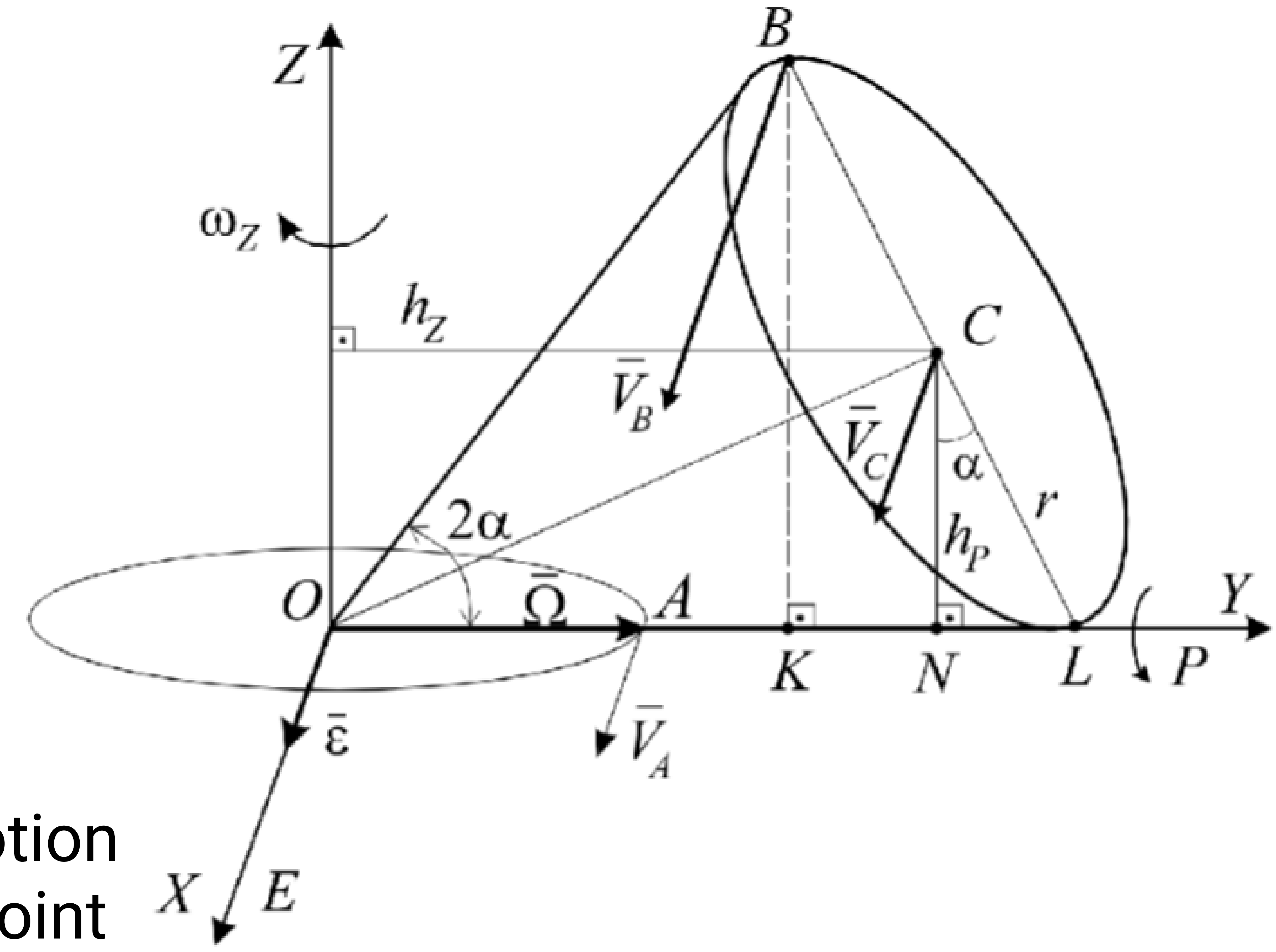
The cone (angle — 2α, $\alpha = 30°$, $r = 20$ — base) is rolling on a ground without friction. $\vec{V}_C = const = 60$.
It is needed to find Ω, ε, $\vec{V}_B$, $\vec{a}_B$.



Lab 4, Task 3

High Level Algorithm
1) Imagine how it works. In spherical motion a body can rotate around all axes. One point should not move.
2) Find the axes of rotations
3) Most of the time we know some angular velocities and velocities on a body. We need to find all angular velocities firstly
4) Find other stuff

HINTS:
1) You need to think about angular velocities as vectors, not as scalars (like we did on a plane)
2) You are working in 3D. Use vectors and projections on bases

SOLUTION:
1) Our cone rotates around Z axis -> IC axis is OP
2) We need to find angular velocity of a cone around OP (around Z we almost have)
OP is IC and we know some velocities on a body -> use the same way as on plane

$$\bar{V}_c = 0 + \Omega h_p, \quad h_p = r\cos\alpha \Rightarrow \underline{\underline{\Omega}} = \frac{V_c}{r\cos 45°} = 3.46$$

In the same manner -> V_B

$$\underline{V_B} = \Omega\, 2h_p = 120$$

Now, we have to use hint "1" for finding ε (it is needed for $\bar{a}_B$)

$$\varepsilon = \omega \times v \ ; \quad \varepsilon = \omega \times \Omega = \omega\,\Omega \cos 90°$$

In our case it is the same. Why? Our cone makes a circle, where Ω change the direction each time, not the amplitude. ε should be perpendicular to the plane between angular velocity and radius of rotation

$$\underline{\underline{\varepsilon}} = \omega_z \Omega = 6.92 \ ; \quad \omega_z = \frac{V_c}{h_z} = 2$$

$$\bar{a}_B = \bar{a}_B^\tau + \bar{a}_B^n \ ; \quad a_B^\tau = \varepsilon BO \ ; \quad a_B^n = \Omega^2 2h_p$$

$$\underline{\underline{a_B}} = \sqrt{(a_B^\tau)^2 + (a_B^n)^2 + 2a_B^\tau a_B^n \cos(90+\alpha)} = 366$$