[mex153] Flat Earth versus round Earth

Consider the gravitational potential $\phi(z)$ along the axis of a flat Earth in the shape of a thin homogeneous disk of radius R as derived in [mex152]. Consider also the the gravitational potential $\phi(z) = -Gm/(R+z)$ outside a round Earth in the shape of a homogeneous sphere of mass m and radius R. If an Earthling, who does not know whether the Earth is flat or round and knows nothing about its size in either shape, is able to measure the variation of the gravitational field $g(z)$ near the Earth's surface, which power of z in an expansion of $g(z)$ will enable her to distinguish the flat shape from the round shape? Does the conclusion change if the point considered for the disk is not on the axis?

Solution: