Answer on Question # 59265 – Physics – Mechanics | Relativity

If an object is in air from point A of earth at height of 15000 ft at 90 degree, after 12 hour when it comes back to earth what will be its location? Is its location same? Why?

Solution:
The location of the object will be different due to the Earth's rotation about its axis. If an object is thrown up at 90 degree, it will fall down on the same trajectory due to the gravity, but the surface of Earth will shift.

During 12 hours, the Earth will make half of a turn, which is half of the length of the appropriate circle of latitude:

$$l = \frac{L_c}{2} = \frac{L_e}{2} \times \cos\lambda = \frac{40075.7}{2} \times \cos\lambda = 20037.85 \times \cos\lambda \left[km \right],$$

where L_e is the length of equator,
λ is the degree of latitude.

For example, if the object was in air above the equator, it will come back to earth in the point $l = 20037.85 \times \cos 0^o = 20037.85 \left[km \right]$ from its previous location on earth. If the object was on a pole, it will come down at the same point: $l = 20037.85 \times \cos(\pm 90^o) = 0 \left[km \right]$.

Answer: the object will come down at $l = 20037.85 \times \cos\lambda \left[km \right]$ from the initial position on the surface of Earth, where λ is the degree of latitude.