Week 3 Group Problem: Thin-film interference

After a rain, you often see patches of color on the road. These are regions where oil has dripped from a car onto the wet road. Below is a side view of such an oil slick. White light, made up of wavelengths in the range 400-700nm, are incident normally on the oil slick.

a) On the diagram above, draw two different paths that the incident light can travel to reach your eye, leading to interference.

b) Write down an expression for contributions to the phase difference between your two paths (in terms of the local oil thickness \( t \) and the wavelength in air \( \lambda \)) due to

1) Path length difference:

2) Phase change on reflection:
Below is a top view of the oil slick, with the approximate bands of color that appear. There is actually a continuous band of colors, but these are indicative of the sequence. You always look directly down at the slick.

Orange-Brown: 650nm
Blue-Green: 450nm

C) Explain why the outer band appears dark.
d) Explain why the colors appear in the order they do, starting from Blue-Green band near the outside of the slick.

e) Calculate the thickness $t_{center}$ of the oil at the center of the oil slick.