Q- A layer of unknown liquid is held on a flint glass slab with an index of refraction 1.65. A ray of light is falling on the glass liquid interface from below and the critical angle is 53^0.

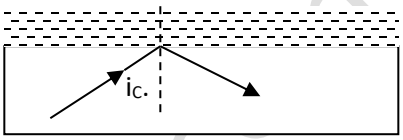
(a) What is the refractive index of the unknown liquid?

The critical angle of incidence is given by

Sin i_C = refractive index of rarer medium/ refractive index of dancer medium

Or Sin $53^0 = \mu_l/1.65$

Or $\mu_l = 1.65 * \text{Sin } 53^0 = 1.65*0.8 = 1.32$



(b) If the liquid is removed, what is the angle of incidence for total internal reflection?

Sin i_C = refractive index of rarer medium/ refractive index of dancer medium

Or Sin $i_C = 1.00/1.65 = 0.606$

Or $i_C = 37.3^0$

37.3°

(c) For the angle of incidence found in part (b), what is the angle of refraction of the ray into the liquid film?

Using Snell's law, we get the angle of refraction r as

$$\frac{\mu_l}{\mu_g} = \frac{1.32}{1.65} = \frac{\sin 37.3^0}{\sin r}$$

Or $$\sin r = \frac{1.65 * sin 37.3^0}{1.32}$$

Or sin r = 0.7575

Or $r = 49.2^0$

(d) Does a ray emerge from the liquid film into the air above?

The critical angle for liquid air interface is given by

sin θ = 1/1.32

gives $\theta = 49.2^0$

hence the second incidence is again critical. But as initially the ray suffers total internal reflection, here too it will suffer total internal reflection, hence, the answer is no.