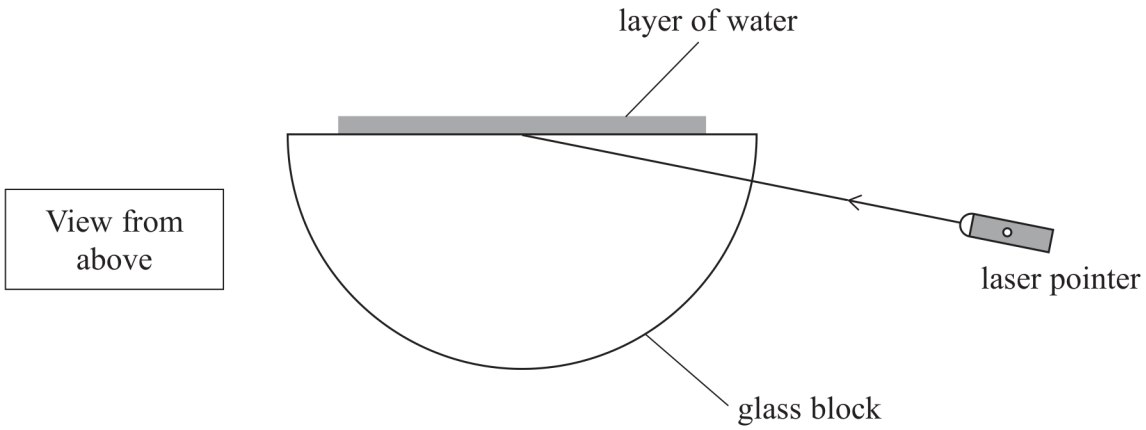
18 A ray of light from a laser pointer is directed into a semi-circular glass block, as shown. There is a layer of water along the vertical flat side of the glass block.



(a) Explain why the ray of light does not change direction when entering the glass block.

Your answer should refer to wavefronts.

(4)

(b) Show that the critical angle between glass and water is about 60°.

refractive index of glass = 1.51
refractive index of water = 1.33

(3)

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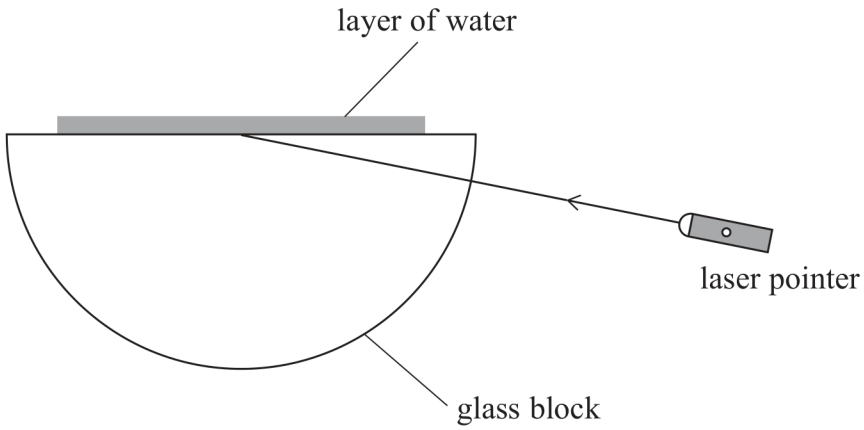
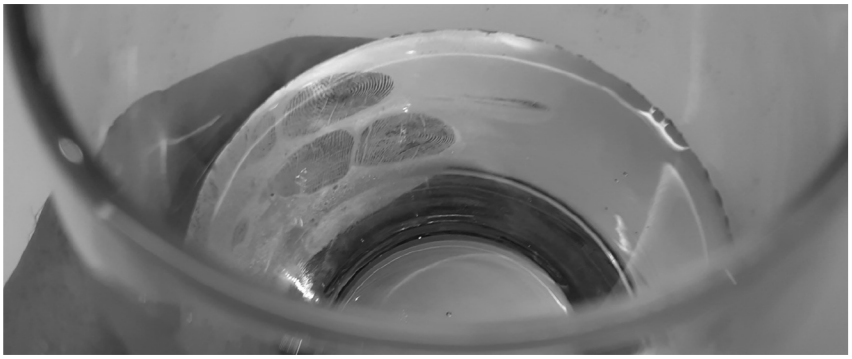
(c) Complete the diagram to show the path of the ray of light after meeting the boundary between the glass and water.

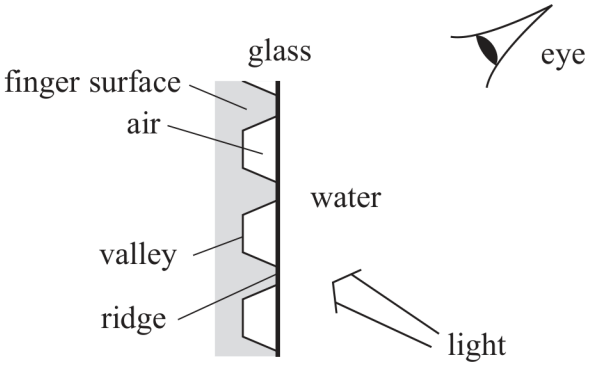
(3)



(d) The photograph shows a hand holding a glass beaker containing water.



Fingerprints are a series of ridges and valleys on the surface of fingers. The valleys trap air when the finger presses against the glass as shown in the diagram below.



Light in the water is incident upon the boundary between the glass and the air.

The critical angle between glass and air is about 40°. Skin has a similar value of refractive index to glass.

Explain why the fingerprints are seen as light and dark regions.

(4)

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(Total for Question 18 = 14 marks)