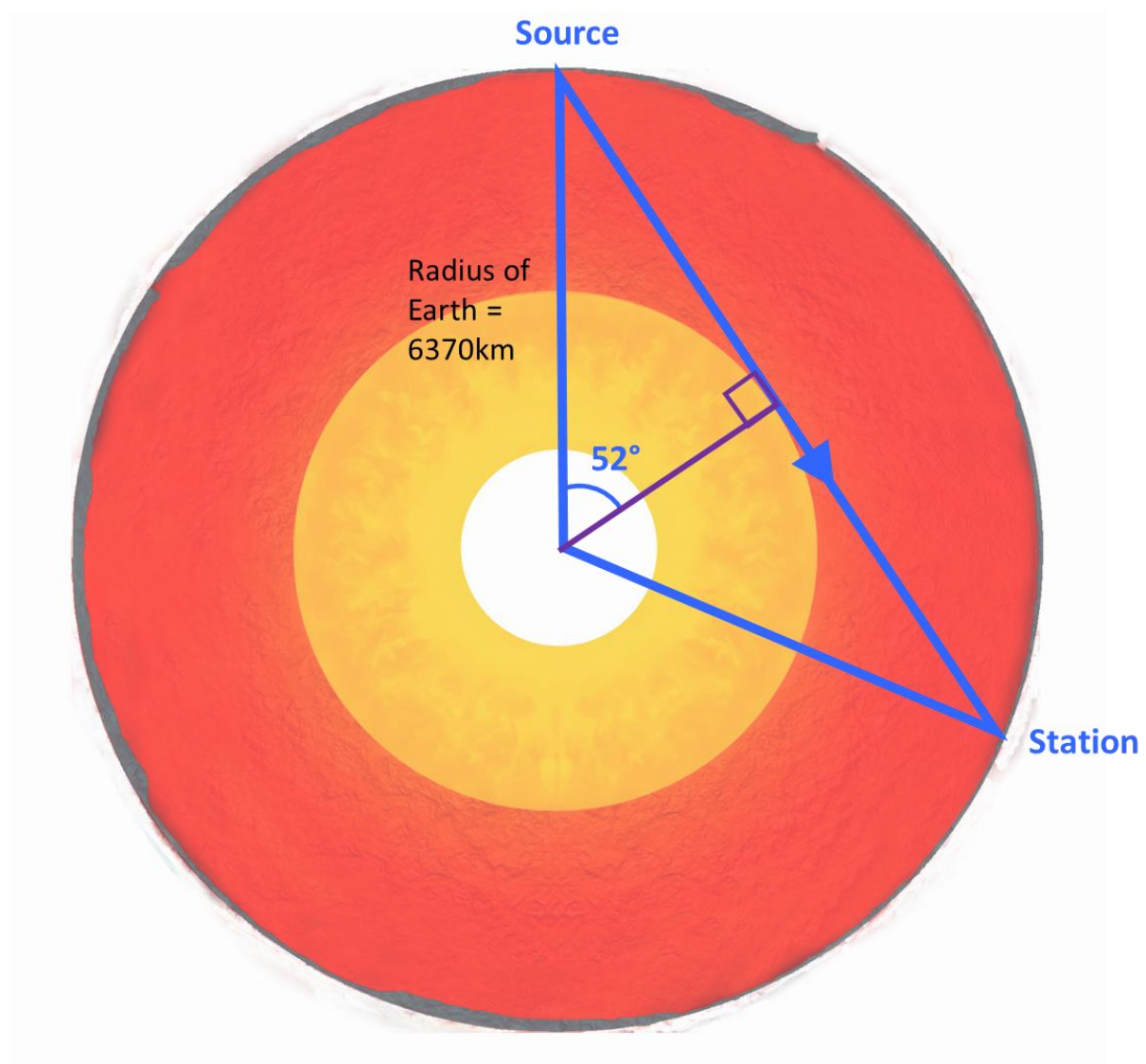


## Travelling through the Earth

### Q1a)

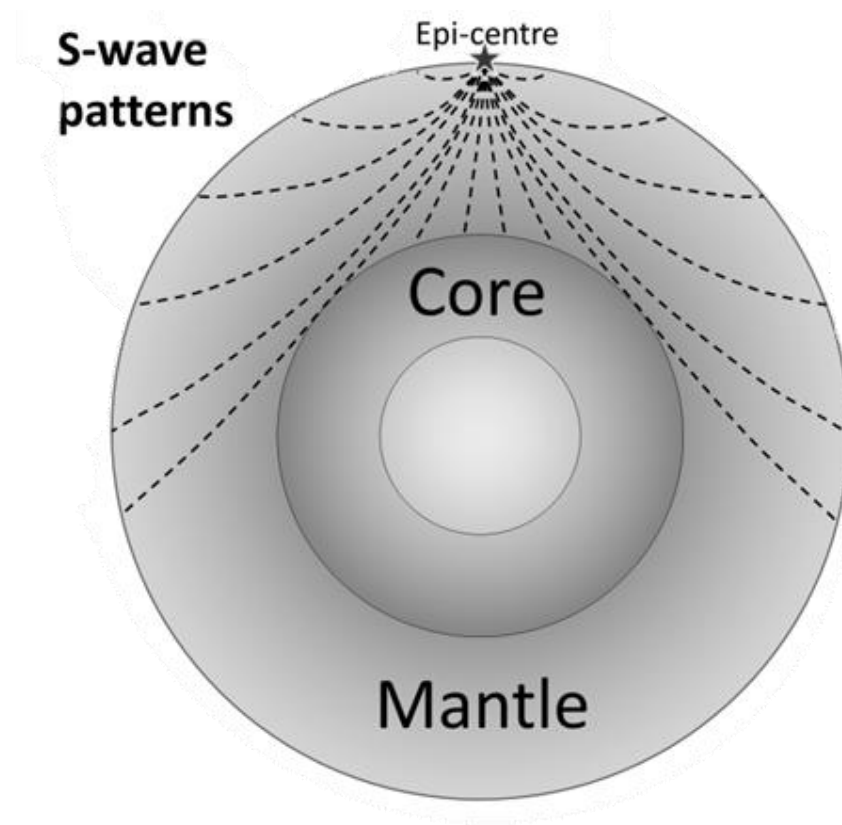
As we saw in the video about 'shadow zones', direct S wave arrivals disappear after about  $104^\circ$  (epicentral distance) from the source. This is because S waves cannot travel through the liquid outer core.

Assume that S waves travel in straight lines through the Earth. The diagram below shows the S wave that travels the closest to the outer core and emerges at the limit of the shadow zone – at  $104^\circ$ . Using this ray and the fact that the radius of the Earth is 6370km, calculate the total radius of the core. Give your answer in km to 3 significant figures.



### **Q1b)**

S waves do not travel in a straight line like this. Their paths are curved due to refraction as the wave speed changes with depth. This is shown below.



[Source: <https://opentextbc.ca/geology/chapter/9-1-understanding-earth-through-seismology/> ]

Was your value in Q1a an overestimate or underestimate of the size of the core? Why?

### **Q2)**

We will now work out the P wave speed in the inner core.

We will consider two different P wave paths. In both, the wave travels such that it hits boundaries parallel to the normal so that refraction does not occur.

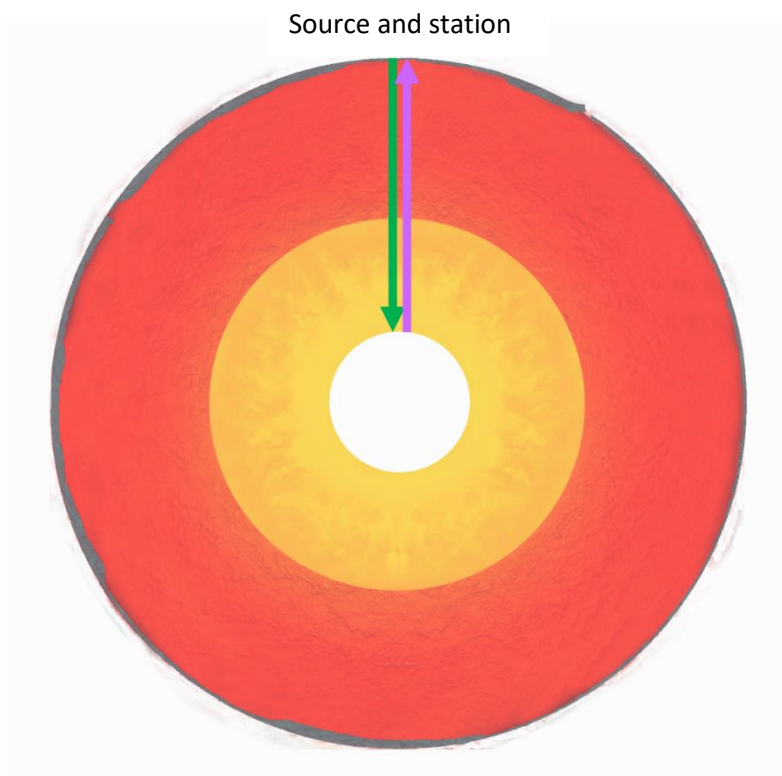


Diagram 1

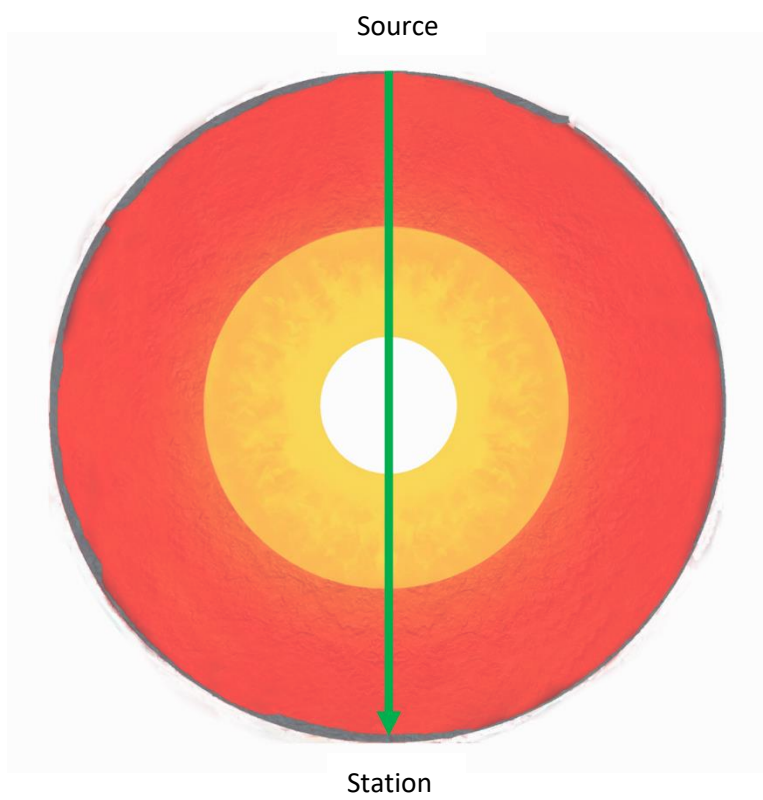


Diagram 2

As shown on diagram 1, a P wave travels through the layers of the Earth until it meets the inner core boundary and is reflected directly back the way it came. A seismologist detects the reflected wave at the surface 16 minutes and 24 seconds after the event which initially produced the wave.

Another seismologist has a station at the point exactly the other side of the Earth to the source. She detects the direct P wave arrival in diagram 2 at 20 minutes after the event which initially produced the wave.

The radius of the inner core is 1210km. Use the journeys of these two waves to calculate the P wave speed in the inner core. Give your answer in km/s to 3 significant figures.

### **Extension 1:**

Sketch the two wave journeys in Q2 as displacement-time graphs.

### **Extension 2:**

Using a compass, draw the Earth to scale. The thickness of oceanic crust is around 7km and the thickness of continental crust is around 35km.