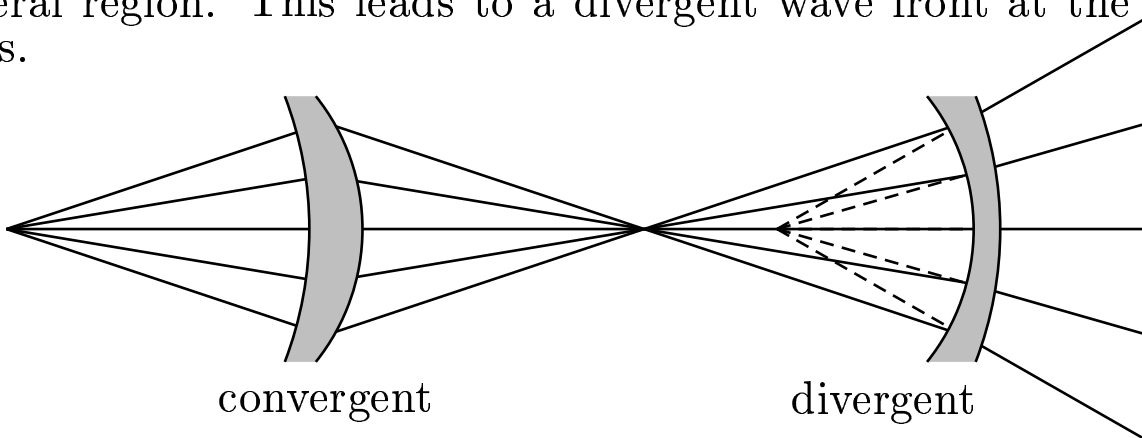


Which three of the glass lenses above, when placed in air, will cause parallel rays of light to converge?

- | | |
|----------------|----------------|
| A) A, B, and C | D) A, C, and E |
| B) B, C, and E | E) B, D, and E |
| C) A, B, and E | F) D, E, and F |

Digression based on Huygens's principle.

Consider the passage of a wave front of a plane wave through a lens. If the center part of the lens is thicker, the center of the exit vertical plane has a larger phase change compared to that in the region surrounding the center. So the surrounding region needs to travel farther to acquire the same phase change. Analogously, if the lens at the center is thinner, at the exit side the center part needs to travel farther to acquire the same phase as that in the peripheral region. This leads to a divergent wave front at the exit side of the lens.



Diverging Lens: The glass is thinner on the axis than at the edge. *B* and *D* satisfy these conditions for a diverging lens ($f < 0$).

Converging Lens: The glass is thicker on the axis than at the edge. *A*, *C*, and *E* satisfy these conditions for a converging lens ($f > 0$).

Answer **D**.