

1. (35 points) An open-loop transfer function is given by,

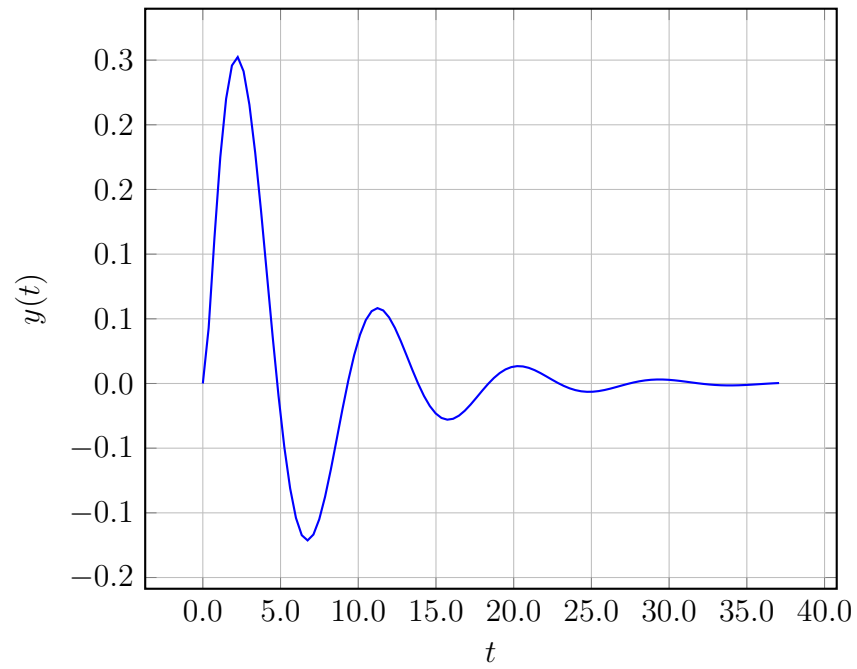
$$G(s) = \frac{1}{s^3 + 2.0s^2 + 3.21211s + 7.21211}$$

Which of the following PI controllers stabilizes the system in a unit-feedback closed-loop configuration?

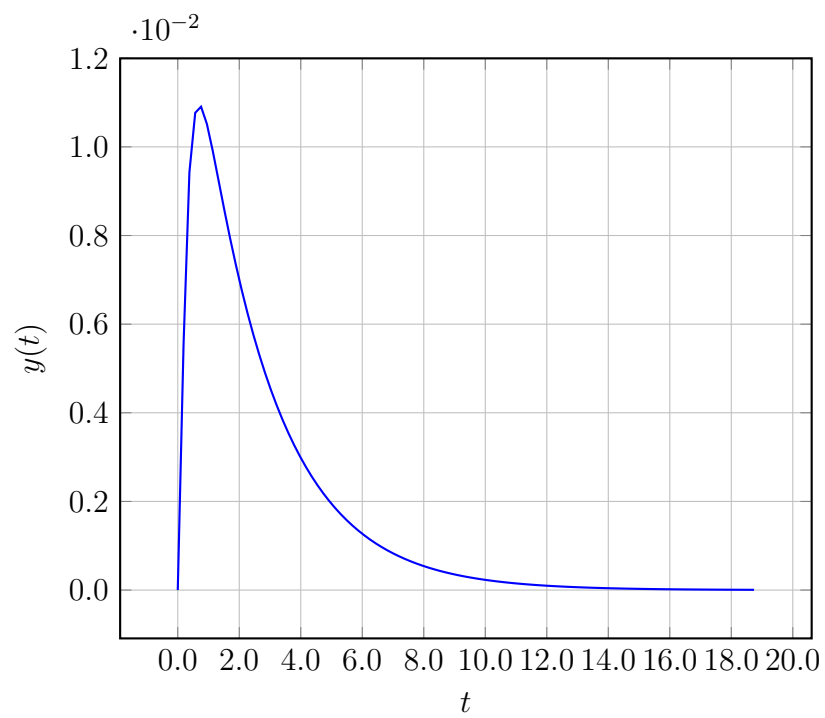
- A.  $F(s) = -8.72728 + \frac{2.92424}{s}$
- B.  $F(s) = -9.15152 + \frac{1.42424}{s}$
- C.  $F(s) = 1.77272 + \frac{1.42424}{s}$
- D.  $F(s) = -2.92424 + \frac{0.71211}{s}$
- E.  $F(s) = 1.34848 + \frac{2.92424}{s}$

2. (35 points) Which one of the following unit impulse responses corresponds to a system that does not overshoot when subjected to a unit step input?

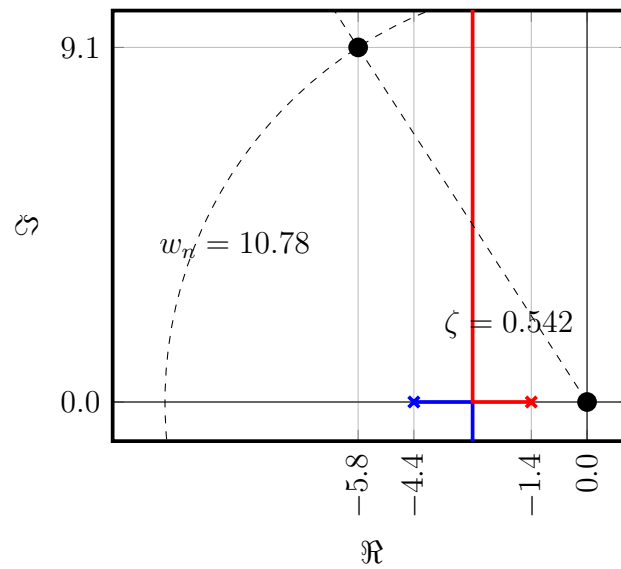
A.



B.

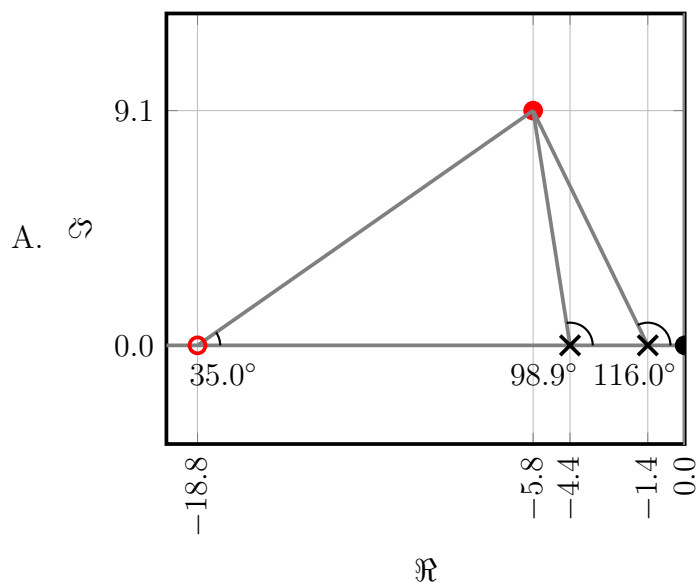


3. (30 points) A design point on the root-locus plot for a P-type controller is shown below.

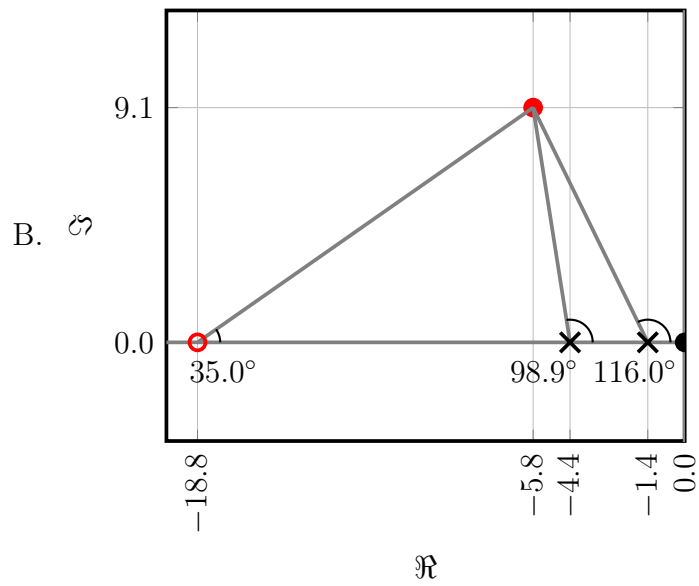


A zero is added so that the root-locus passes through this design point. Which of the following represents the correct angle condition for this design?

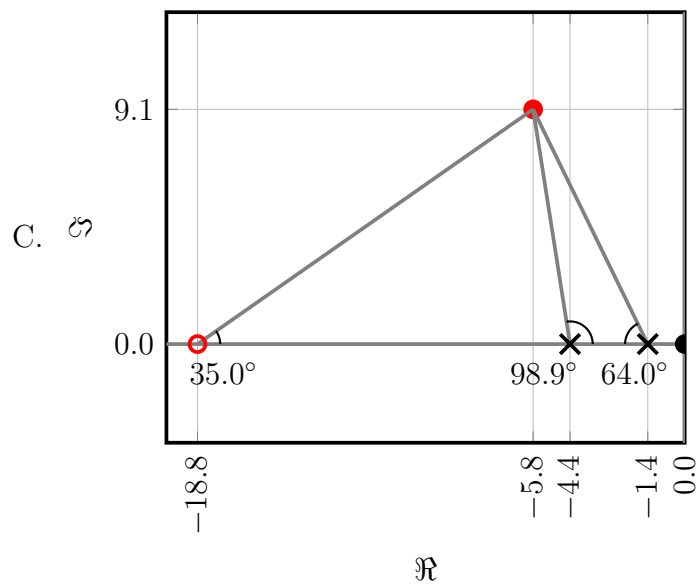
$$\sum \theta = 116.0^\circ + 98.9^\circ - 35.0^\circ =$$



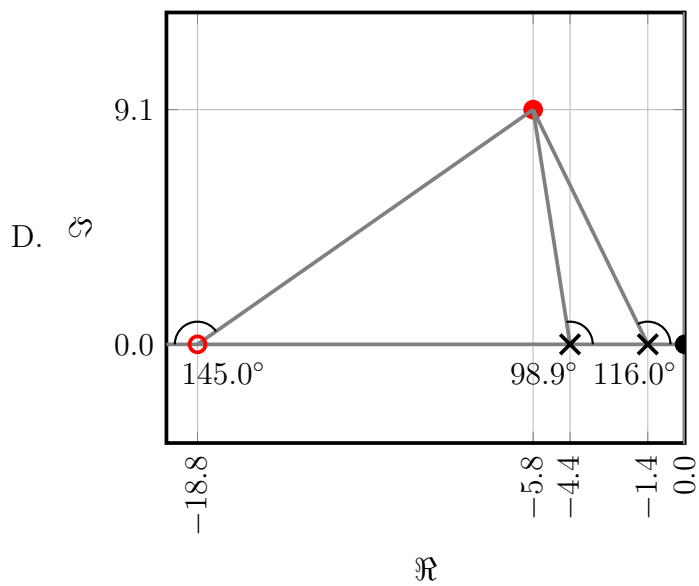
$$\sum \theta = 116.0^\circ + 98.9^\circ + 35.0^\circ =$$



$$\sum \theta = 64.0^\circ + 98.9^\circ + 35.0^\circ =$$



$$\sum \theta = 116.0^\circ + 98.9^\circ + 145.0^\circ =$$



$$\sum \theta = 116.0^\circ + 81.1^\circ + 35.0^\circ =$$

