

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

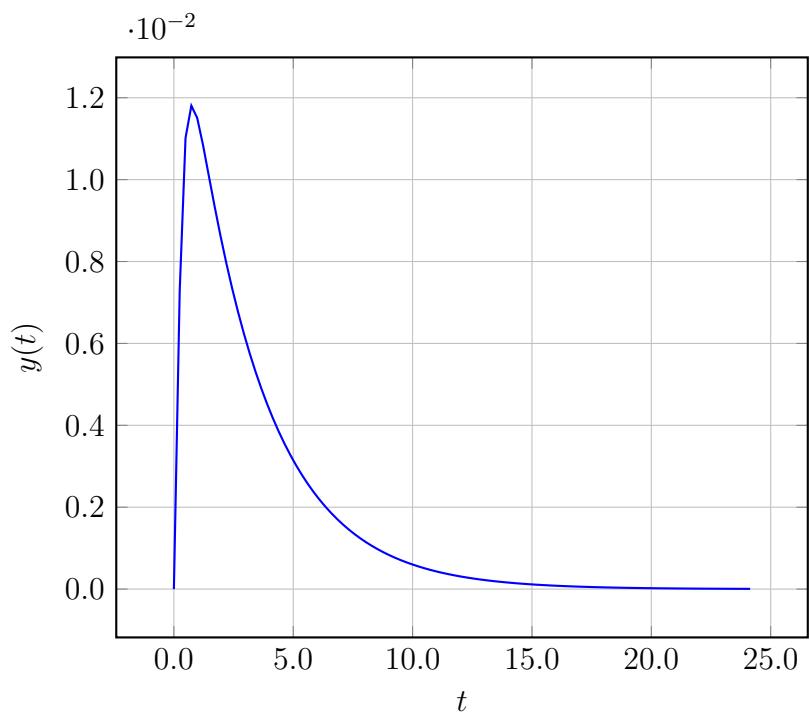
$$G(s) = \frac{1}{s^3 + 2.0s^2 + 3.27272s + 7.27272}$$

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

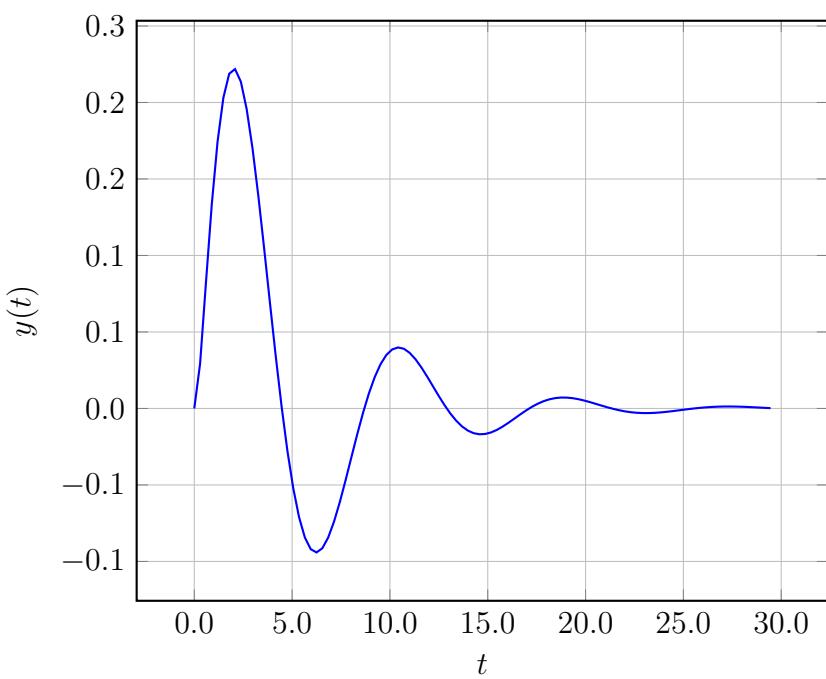
- A. $F(s) = -3.04544 + \frac{0.77272}{s}$
- B. $F(s) = 2.13635 + \frac{1.54544}{s}$
- C. $F(s) = -8.36365 + \frac{3.04544}{s}$
- D. $F(s) = -8.9091 + \frac{1.54544}{s}$
- E. $F(s) = 1.5909 + \frac{3.04544}{s}$

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?

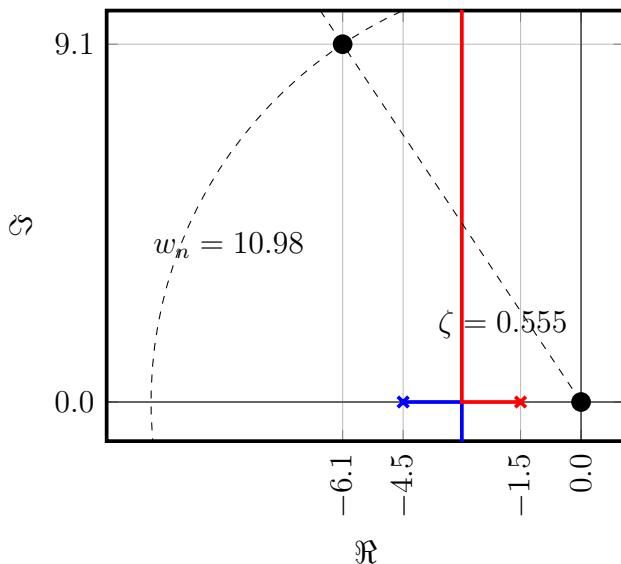
A.



B.

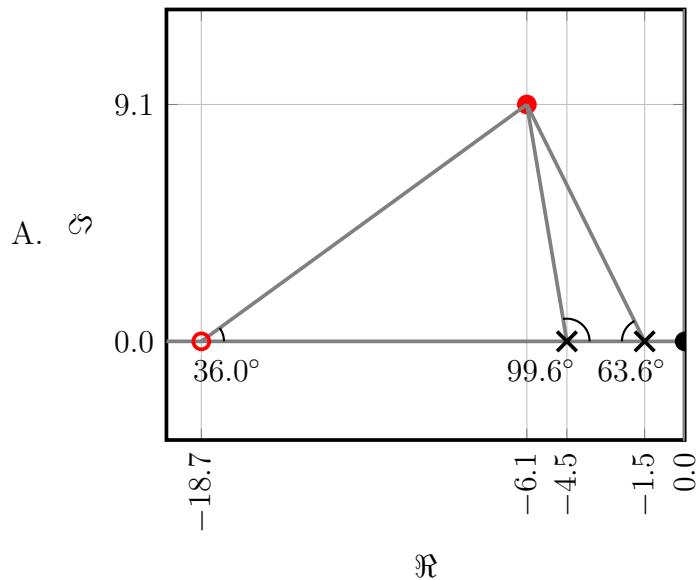


3. (30 points) A design point on the root-locus plot for a P-type controller is shown below.

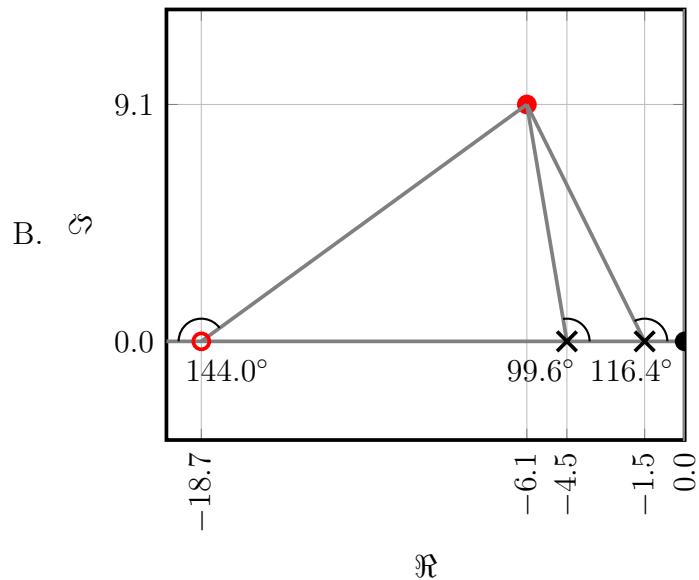


A zero is added so that the root-locus passes through this design point. Which of the following represents the correct angle condition for this design?

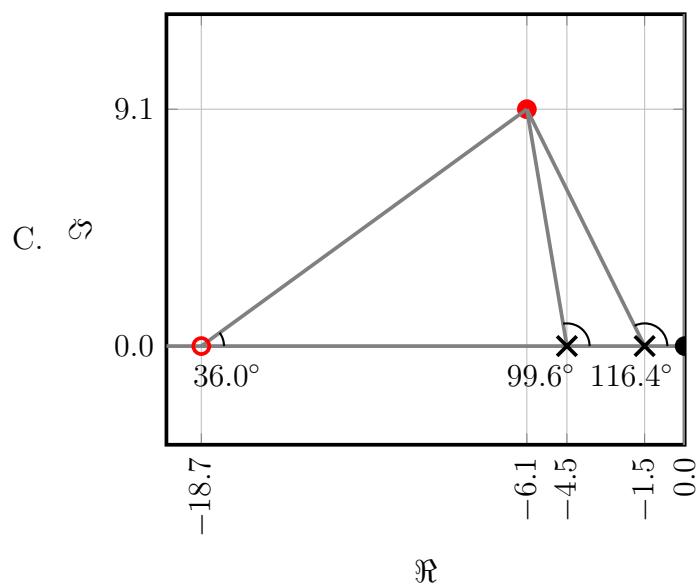
$$\sum \theta = 63.6^\circ + 99.6^\circ + 36.0^\circ =$$



$$\sum \theta = 116.4^\circ + 99.6^\circ + 144.0^\circ =$$



$$\sum \theta = 116.4^\circ + 99.6^\circ - 36.0^\circ =$$



$$\sum \theta = 116.4^\circ + 80.4^\circ + 36.0^\circ =$$

