

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

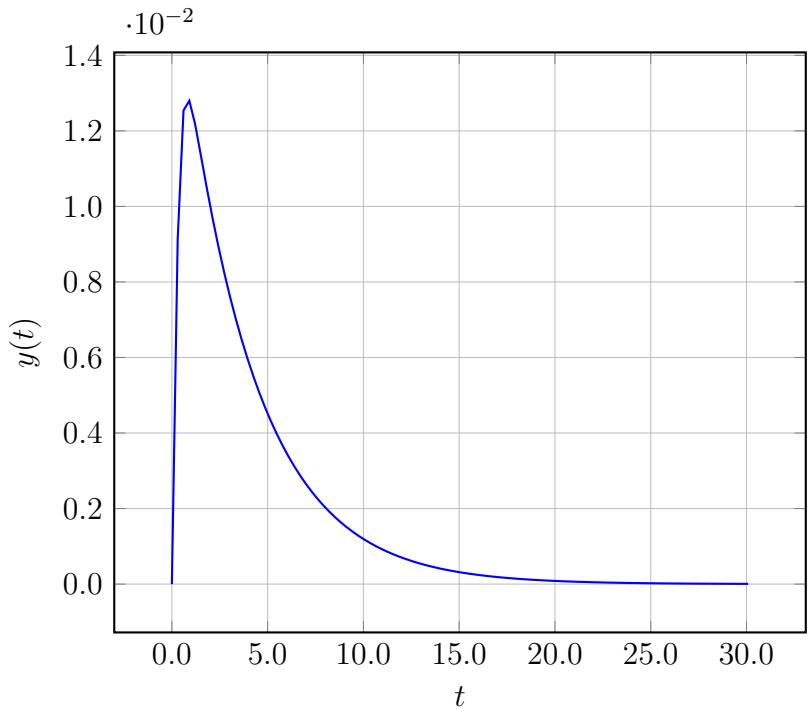
$$G(s) = \frac{1}{s^3 + 2.0s^2 + 3.32323s + 7.32323}$$

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

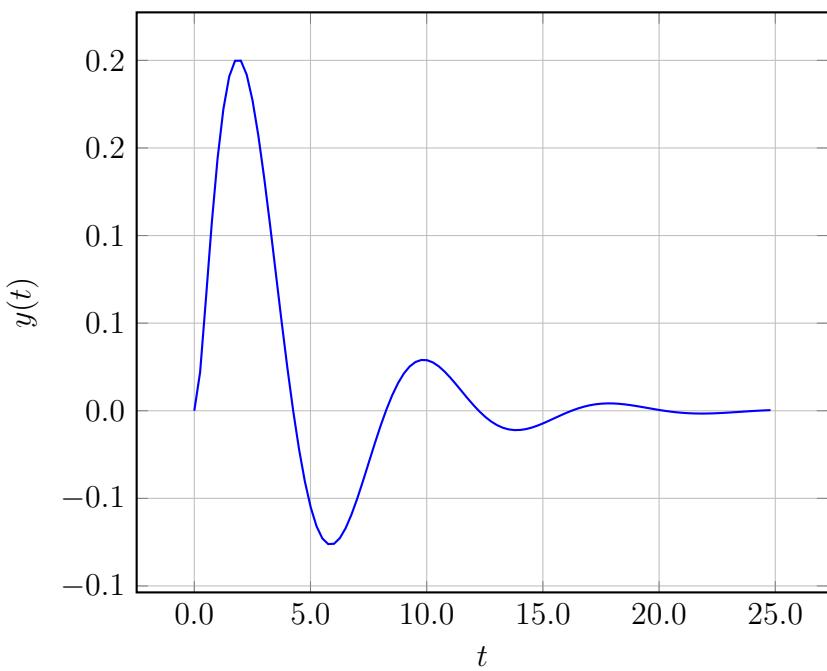
- A. $F(s) = -3.14645 + \frac{0.82323}{s}$
- B. $F(s) = -8.70708 + \frac{1.64645}{s}$
- C. $F(s) = -8.06061 + \frac{3.14645}{s}$
- D. $F(s) = 2.43939 + \frac{1.64645}{s}$
- E. $F(s) = 1.79292 + \frac{3.14645}{s}$

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?

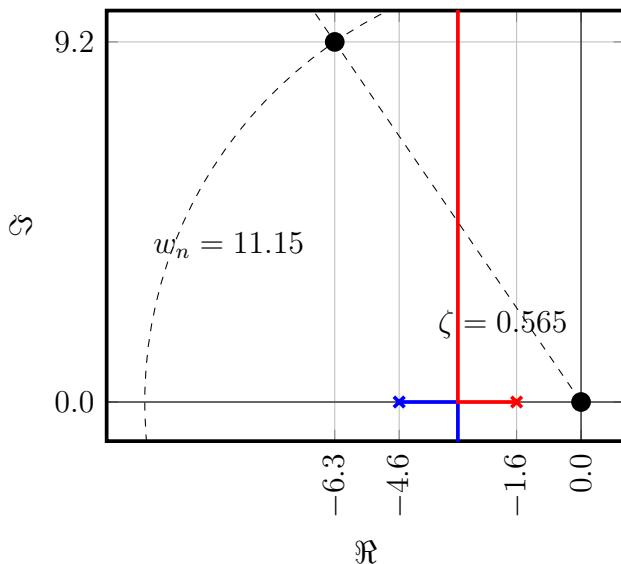
A.



B.

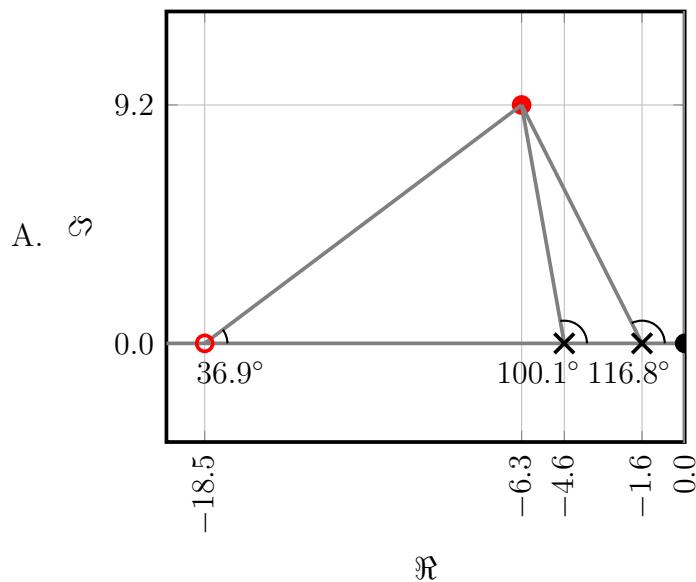


3. (30 points) A design point on the root-locus plot for a P-type controller is shown below.

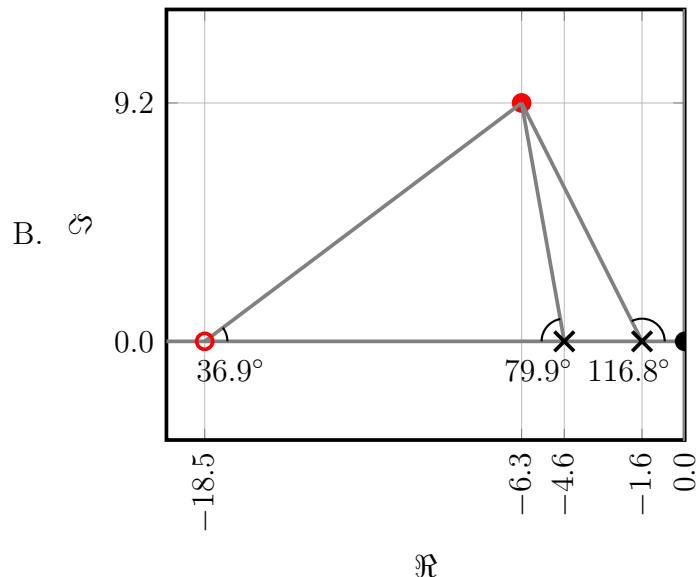


A zero is added so that the root-locus passes through this design point. Which of the following represents the correct angle condition for this design?

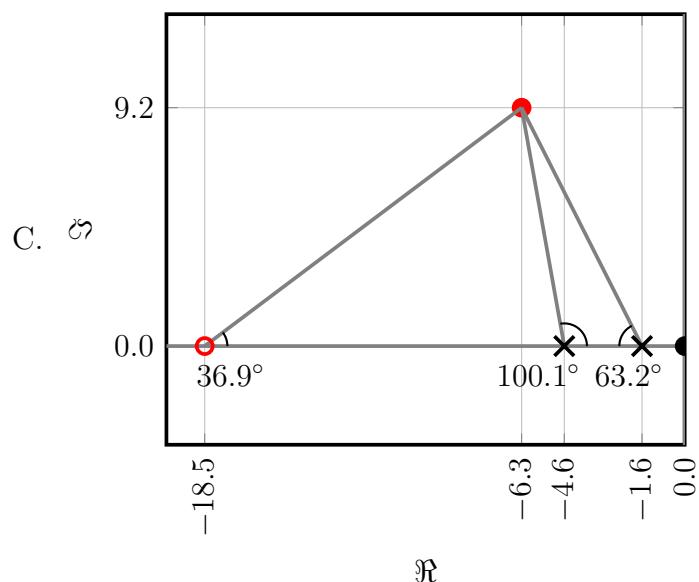
$$\sum \theta = 116.8^\circ + 100.1^\circ - 36.9^\circ =$$



$$\sum \theta = 116.8^\circ + 79.9^\circ + 36.9^\circ =$$



$$\sum \theta = 63.2^\circ + 100.1^\circ + 36.9^\circ =$$



$$\sum \theta = 116.8^\circ + 100.1^\circ + 143.1^\circ =$$

