

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

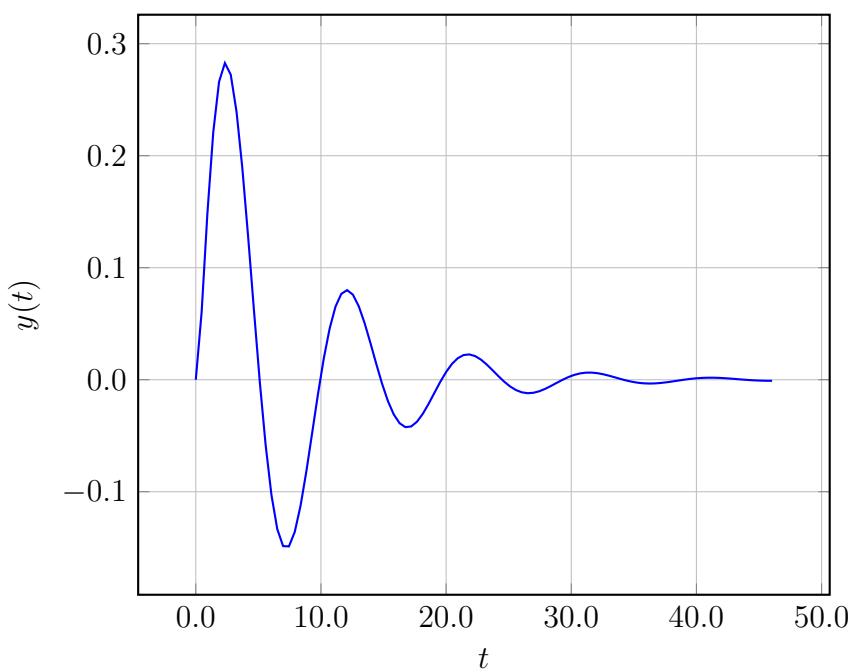
$$G(s) = \frac{1}{s^3 + 2.0s^2 + 3.1616s + 7.1616}$$

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

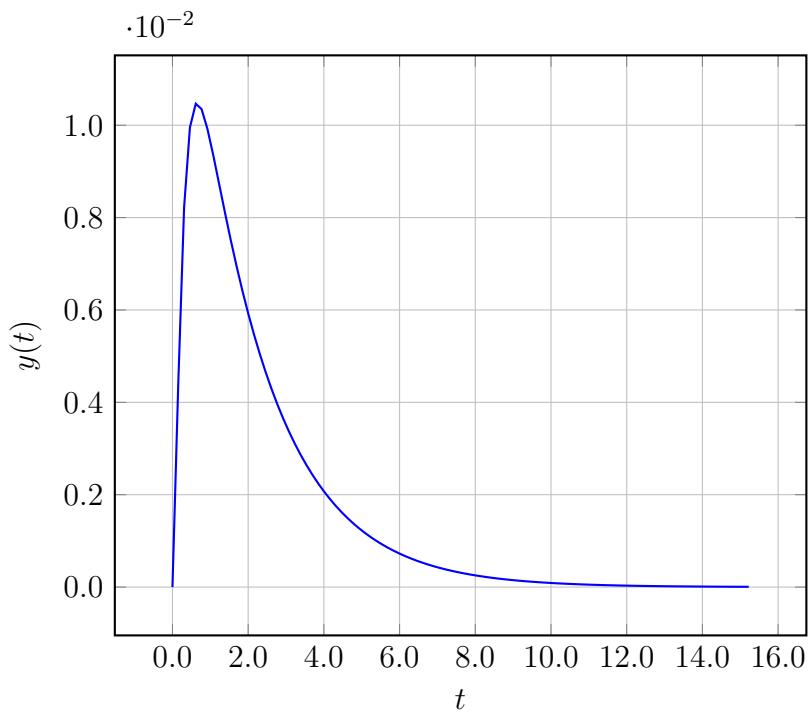
- A. $F(s) = -9.0303 + \frac{2.82323}{s}$
- B. $F(s) = -9.35355 + \frac{1.32323}{s}$
- C. $F(s) = 1.4697 + \frac{1.32323}{s}$
- D. $F(s) = 1.14645 + \frac{2.82323}{s}$
- E. $F(s) = -2.82323 + \frac{0.6616}{s}$

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?

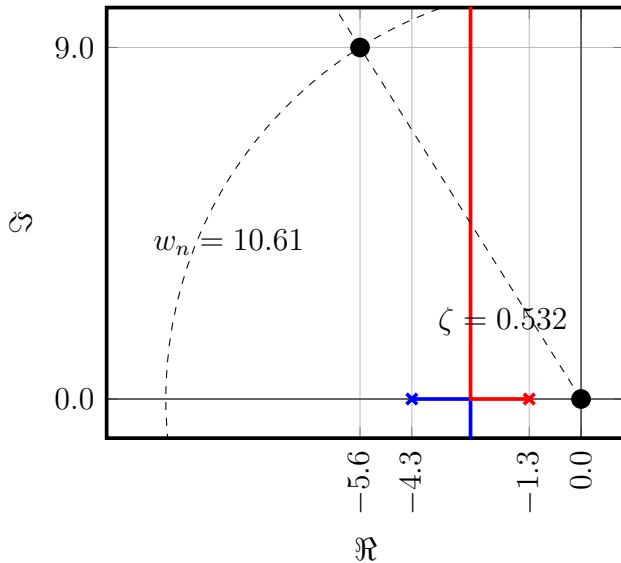
A.



B.

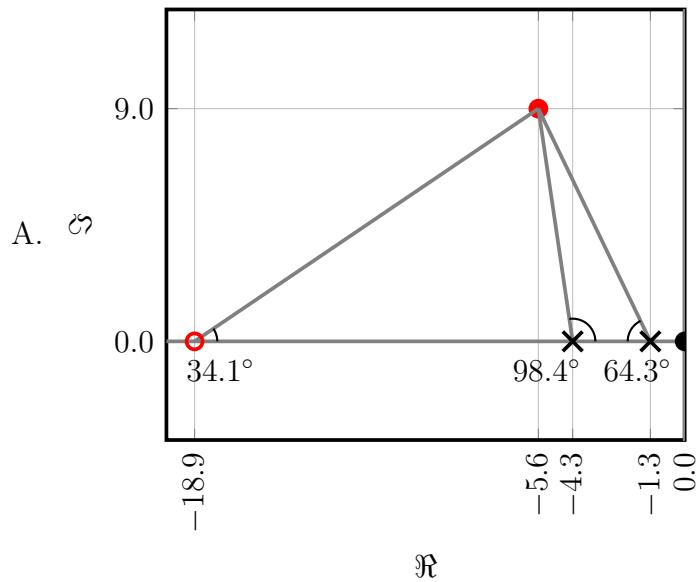


3. (30 points) A design point on the root-locus plot for a P-type controller is shown below.

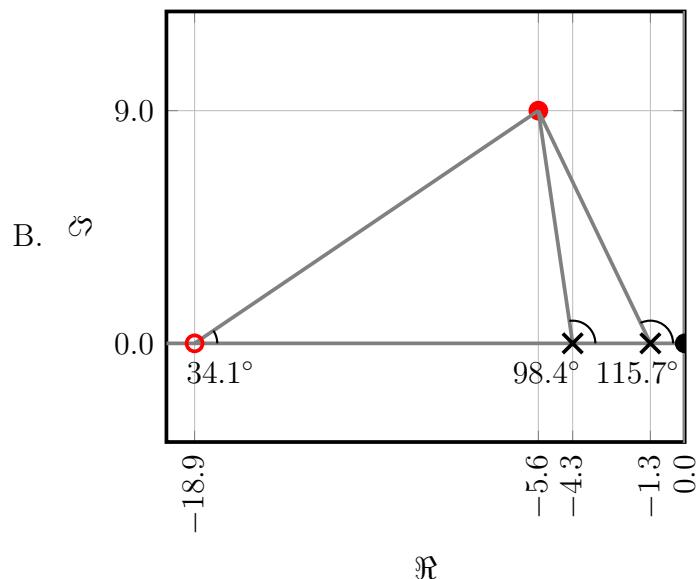


A zero is added so that the root-locus passes through this design point. Which of the following represents the correct angle condition for this design?

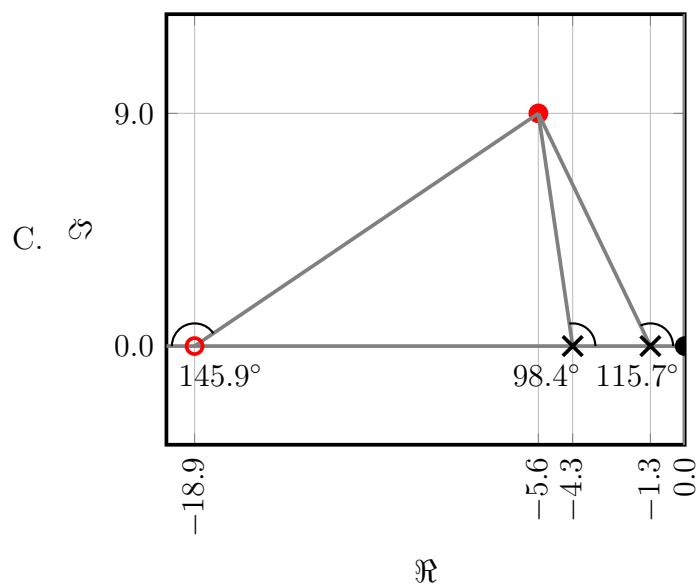
$$\sum \theta = 64.3^\circ + 98.4^\circ + 34.1^\circ =$$



$$\sum \theta = 115.7^\circ + 98.4^\circ - 34.1^\circ =$$



$$\sum \theta = 115.7^\circ + 98.4^\circ + 145.9^\circ =$$



$$\sum \theta = 115.7^\circ + 81.6^\circ + 34.1^\circ =$$

