

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

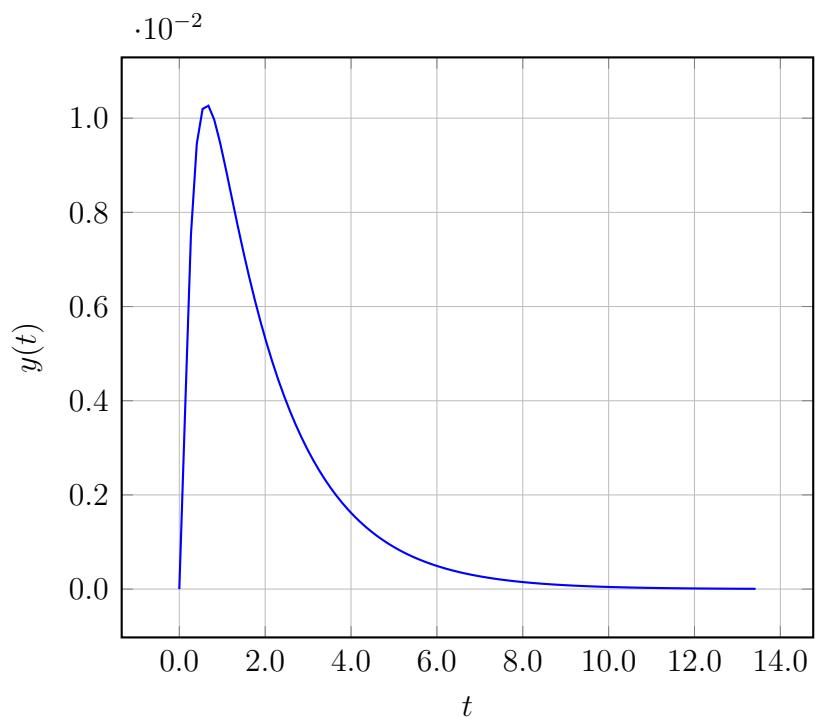
$$G(s) = \frac{1}{s^3 + 2.0s^2 + 3.1313s + 7.1313}$$

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

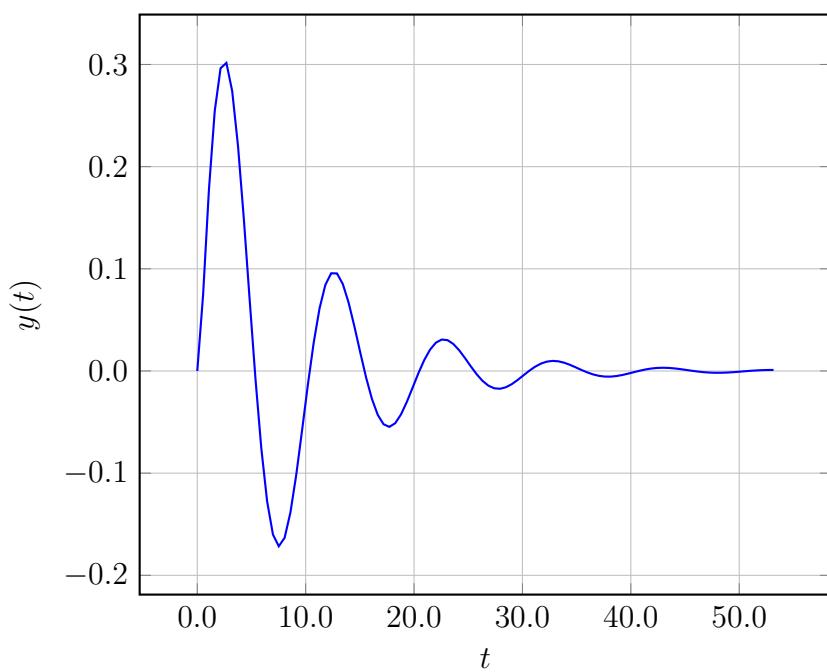
- A. $F(s) = -9.47476 + \frac{1.26262}{s}$
- B. $F(s) = 1.28787 + \frac{1.26262}{s}$
- C. $F(s) = -9.21213 + \frac{2.76262}{s}$
- D. $F(s) = 1.02524 + \frac{2.76262}{s}$
- E. $F(s) = -2.76262 + \frac{0.6313}{s}$

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?

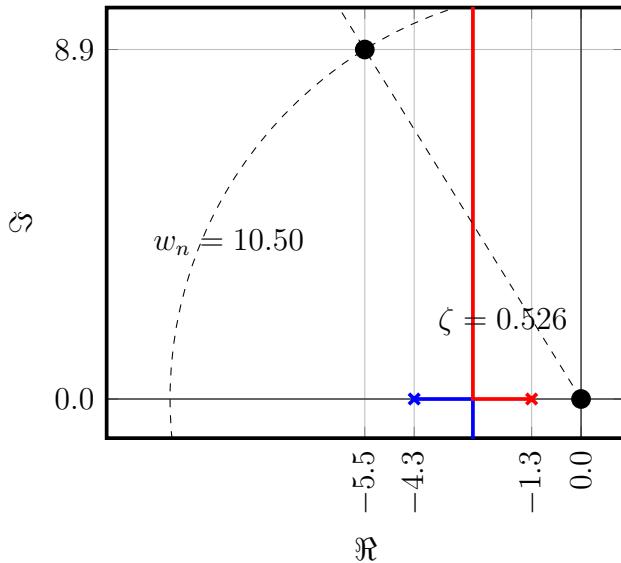
A.



B.

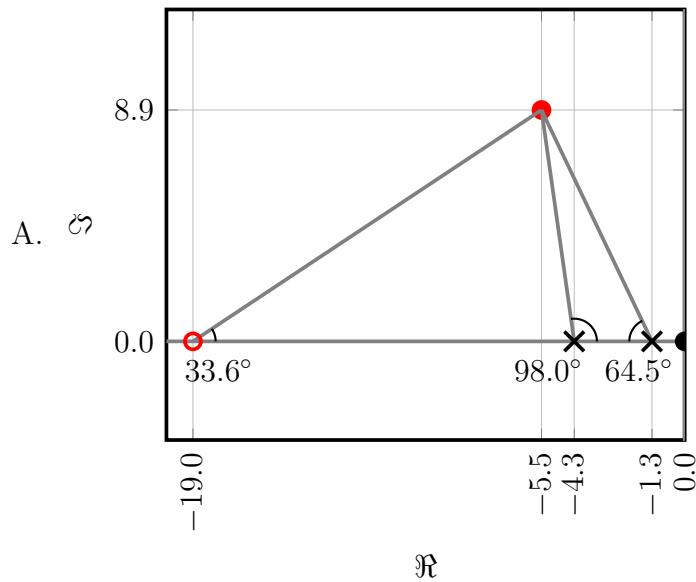


3. (30 points) A design point on the root-locus plot for a P-type controller is shown below.

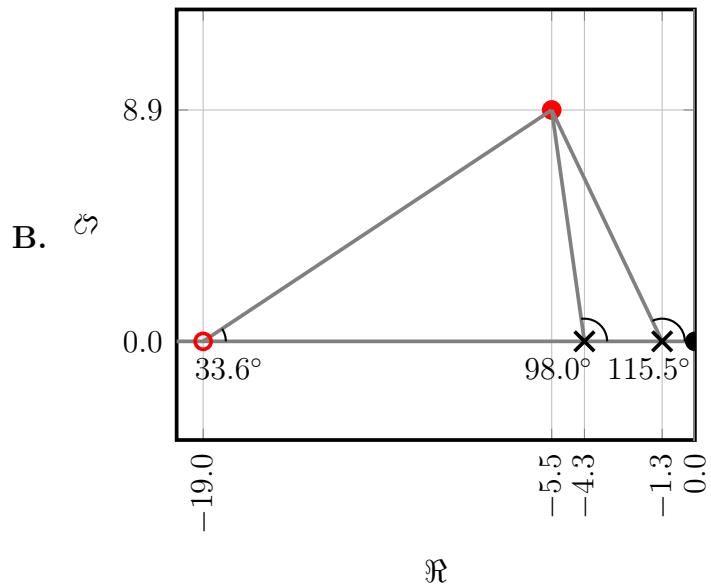


A zero is added so that the root-locus passes through this design point. Which of the following represents the correct angle condition for this design?

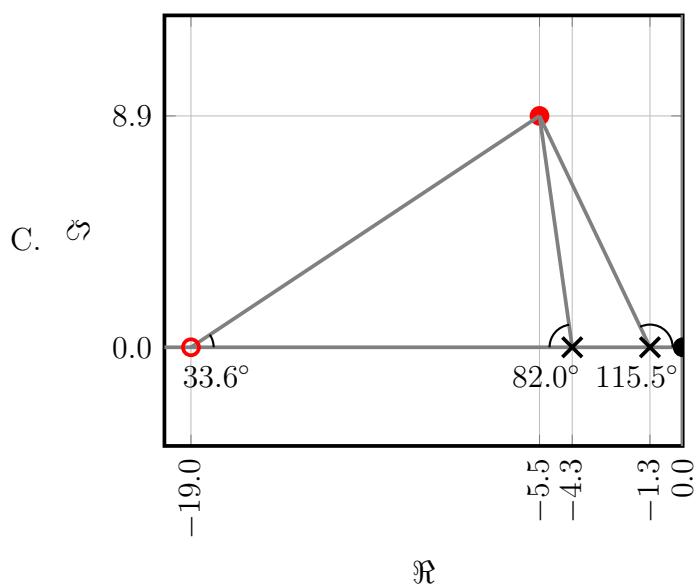
$$\sum \theta = 64.5^\circ + 98.0^\circ + 33.6^\circ = 196.1^\circ$$



$$\sum \theta = 115.5^\circ + 98.0^\circ - 33.6^\circ = 180.0^\circ$$



$$\sum \theta = 115.5^\circ + 82.0^\circ + 33.6^\circ = 231.0^\circ$$



$$\sum \theta = 115.5^\circ + 98.0^\circ + 146.4^\circ = 360.0^\circ$$

