

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

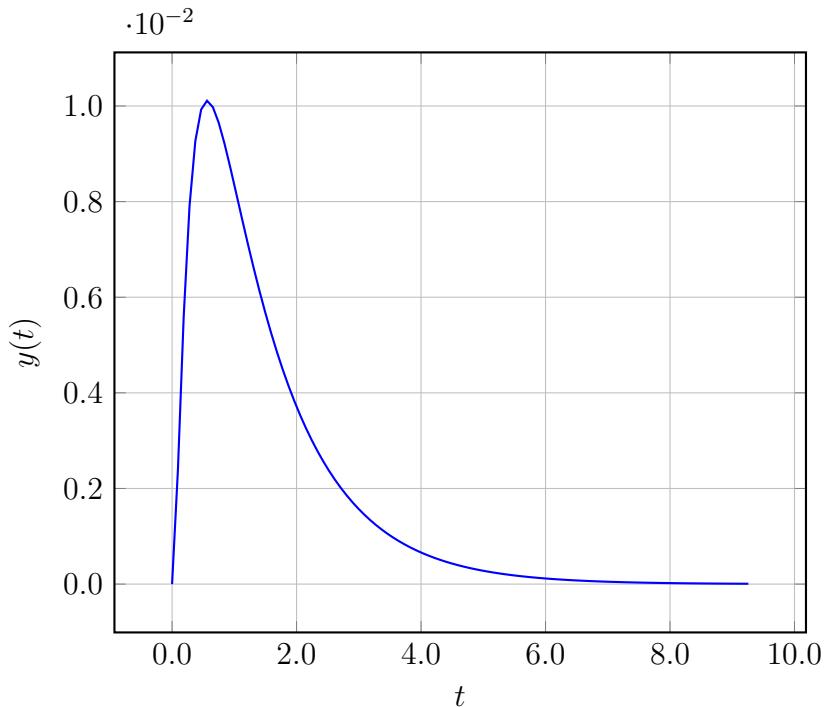
$$G(s) = \frac{1}{s^3 + 2.0s^2 + 3.04544s + 7.04544}$$

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

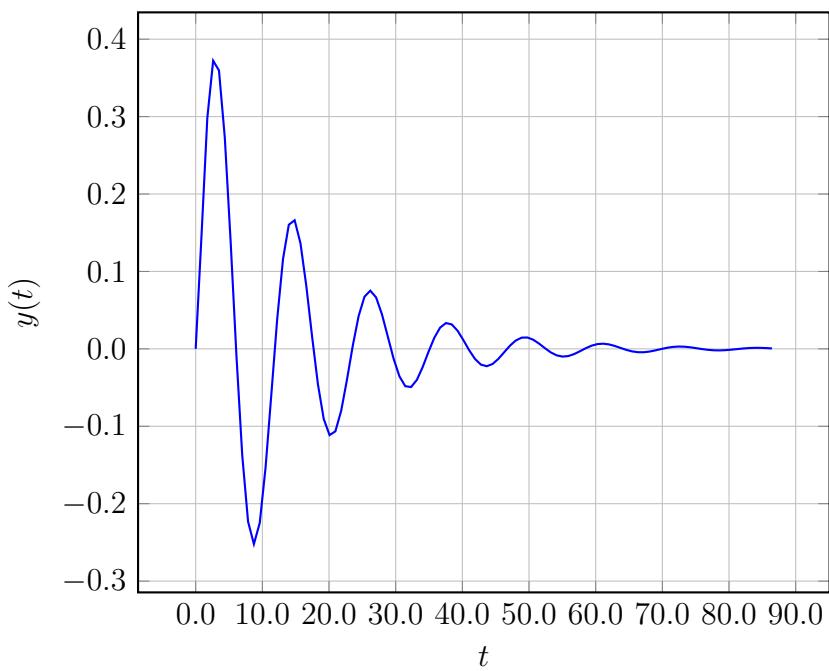
- A. $F(s) = -2.5909 + \frac{0.54544}{s}$
- B. $F(s) = -9.72728 + \frac{2.5909}{s}$
- C. $F(s) = 0.77272 + \frac{1.0909}{s}$
- D. $F(s) = -9.81819 + \frac{1.0909}{s}$
- E. $F(s) = 0.68181 + \frac{2.5909}{s}$

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?

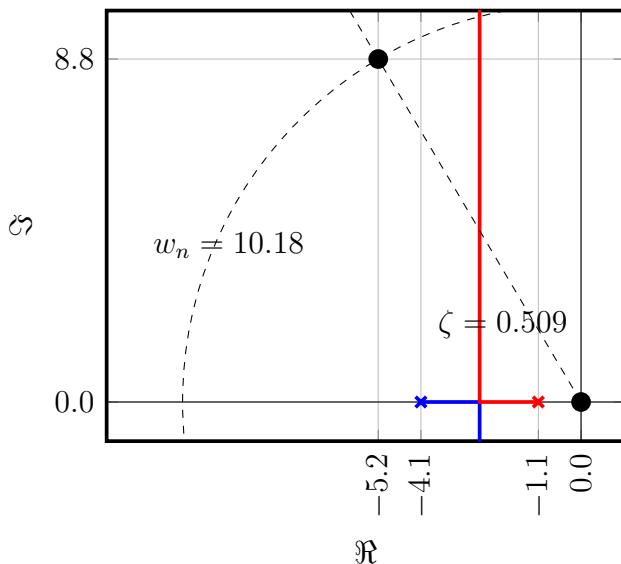
A.



B.

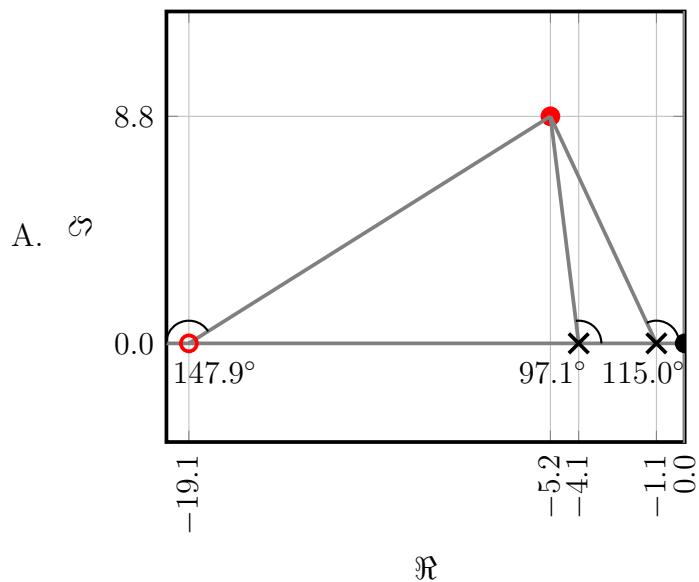


3. (30 points) A design point on the root-locus plot for a P-type controller is shown below.

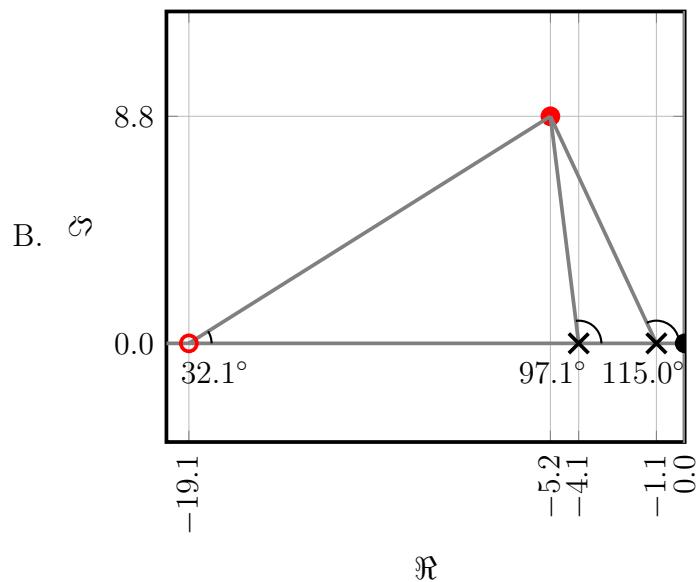


A zero is added so that the root-locus passes through this design point. Which of the following represents the correct angle condition for this design?

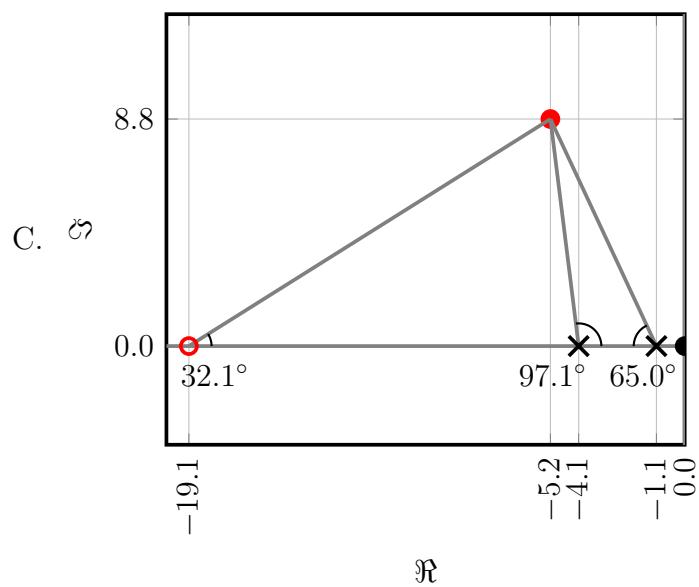
$$\sum \theta = 115.0^\circ + 97.1^\circ + 147.9^\circ =$$



$$\sum \theta = 115.0^\circ + 97.1^\circ - 32.1^\circ =$$



$$\sum \theta = 65.0^\circ + 97.1^\circ + 32.1^\circ =$$



$$\sum \theta = 115.0^\circ + 82.9^\circ + 32.1^\circ =$$

