

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

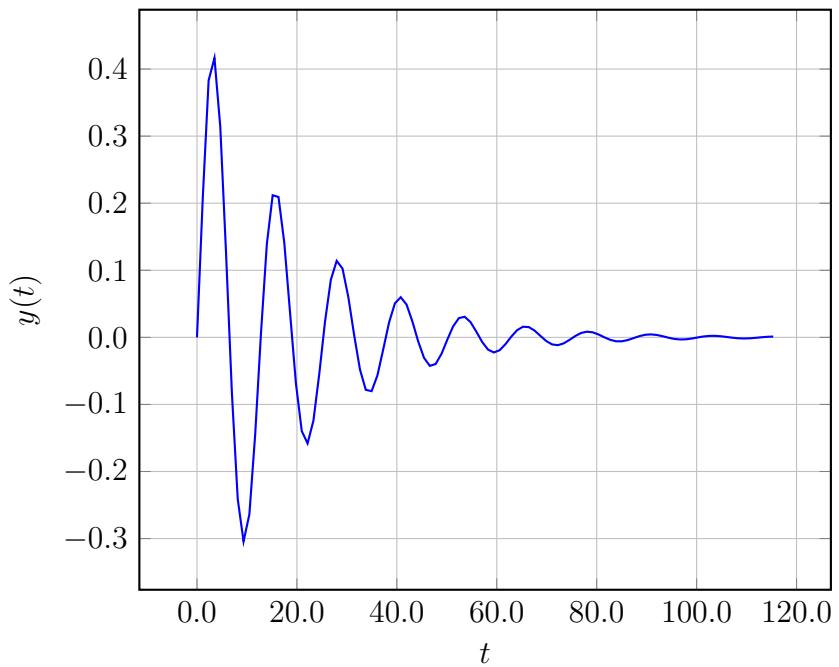
$$G(s) = \frac{1}{s^3 + 2.0s^2 + 3.00504s + 7.00504}$$

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

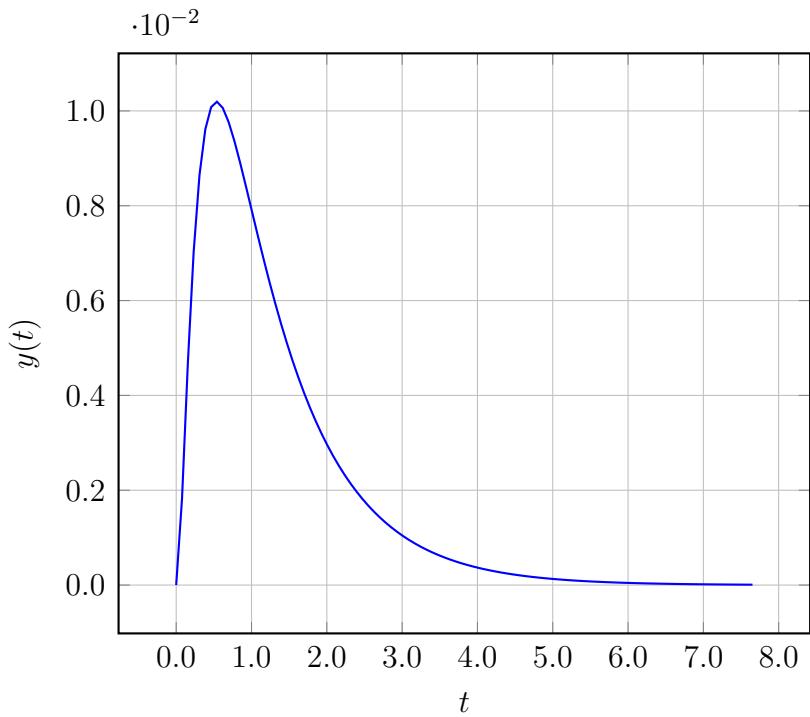
- A.  $F(s) = -9.97981 + \frac{1.01009}{s}$
- B.  $F(s) = -2.51009 + \frac{0.50504}{s}$
- C.  $F(s) = 0.53029 + \frac{1.01009}{s}$
- D.  $F(s) = -9.96971 + \frac{2.51009}{s}$
- E.  $F(s) = 0.52019 + \frac{2.51009}{s}$

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?

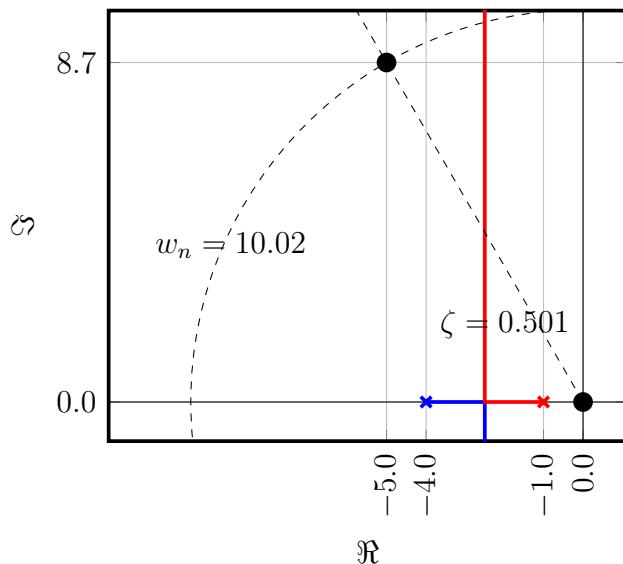
A.



B.

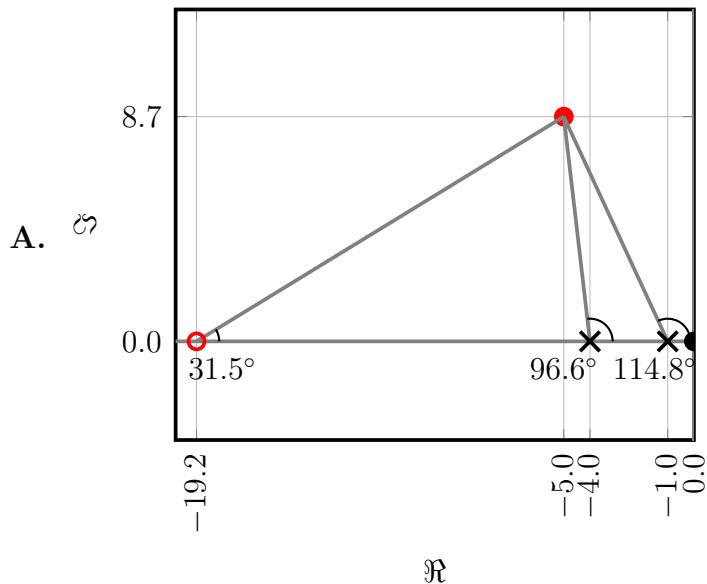


3. (30 points) A design point on the root-locus plot for a P-type controller is shown below.

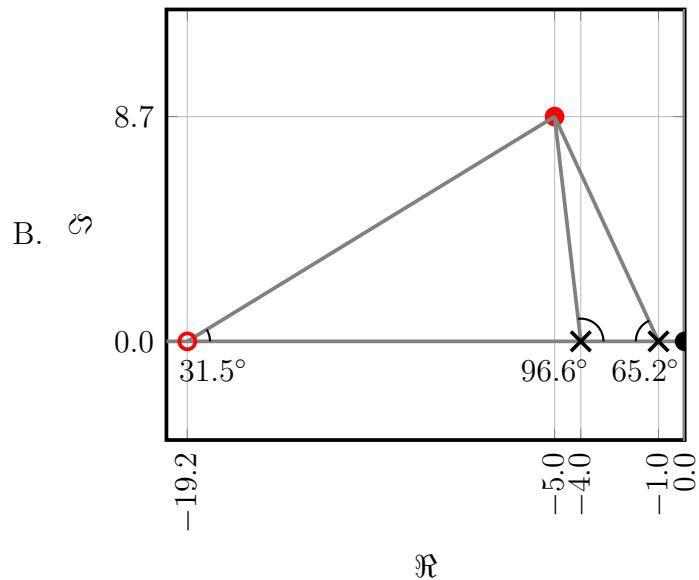


A zero is added so that the root-locus passes through this design point. Which of the following represents the correct angle condition for this design?

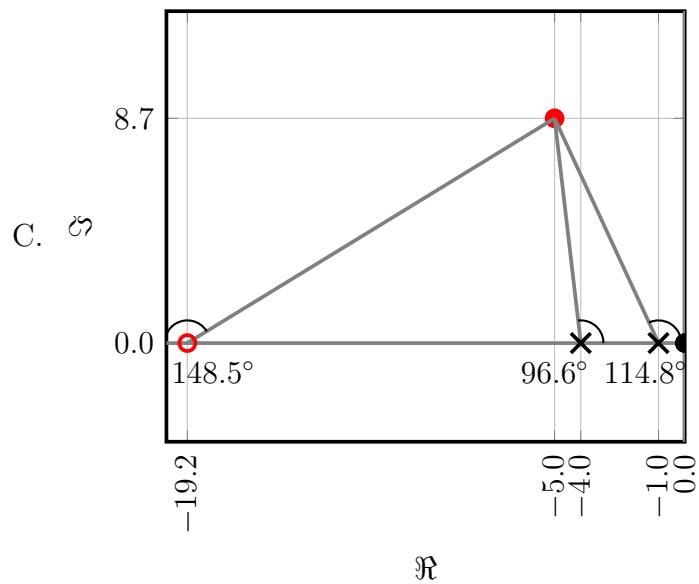
$$\sum \theta = 114.8^\circ + 96.6^\circ - 31.5^\circ = 180.0^\circ$$



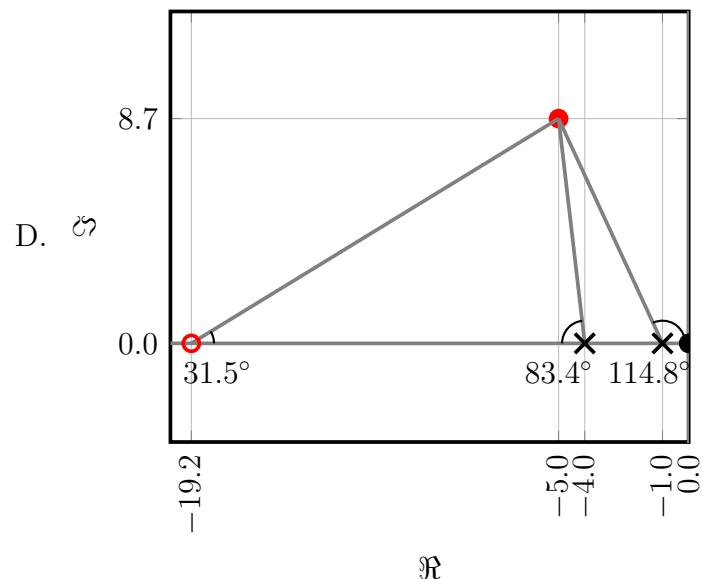
$$\sum \theta = 65.2^\circ + 96.6^\circ + 31.5^\circ = 193.3^\circ$$



$$\sum \theta = 114.8^\circ + 96.6^\circ + 148.5^\circ = 360.0^\circ$$



$$\sum \theta = 114.8^\circ + 83.4^\circ + 31.5^\circ = 229.6^\circ$$



Q	A
1	B
2	B
3	A