

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

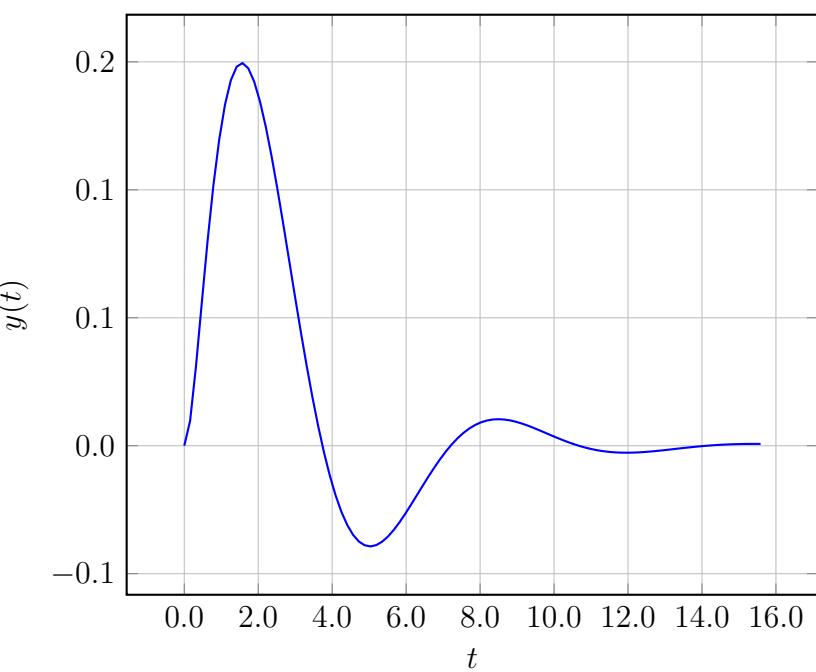
$$G(s) = \frac{1}{s^3 + 2.0s^2 + 3.48485s + 7.48485}$$

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

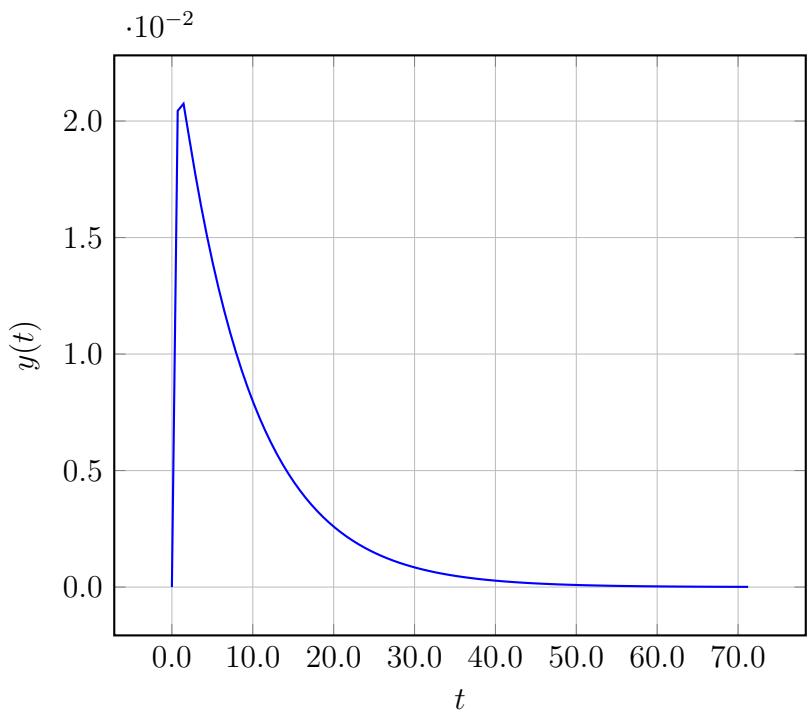
- A.  $F(s) = -8.06061 + \frac{1.9697}{s}$
- B.  $F(s) = 3.40909 + \frac{1.9697}{s}$
- C.  $F(s) = -7.09091 + \frac{3.4697}{s}$
- D.  $F(s) = 2.43939 + \frac{3.4697}{s}$
- E.  $F(s) = -3.4697 + \frac{0.98485}{s}$

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?

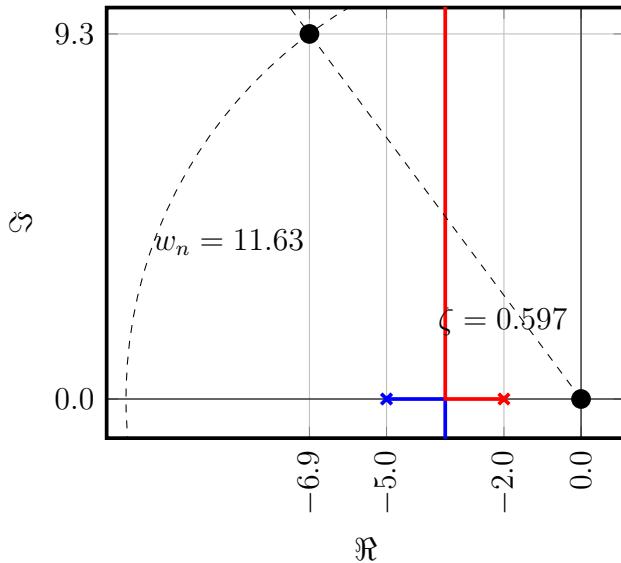
A.



B.

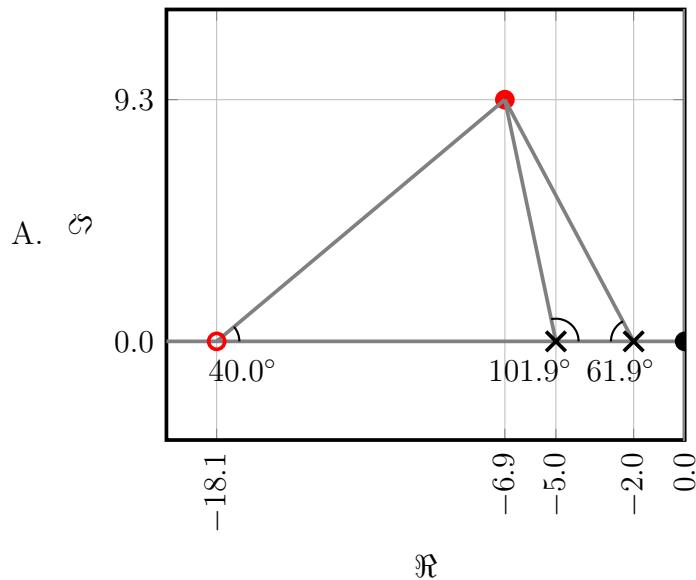


3. (30 points) A design point on the root-locus plot for a P-type controller is shown below.

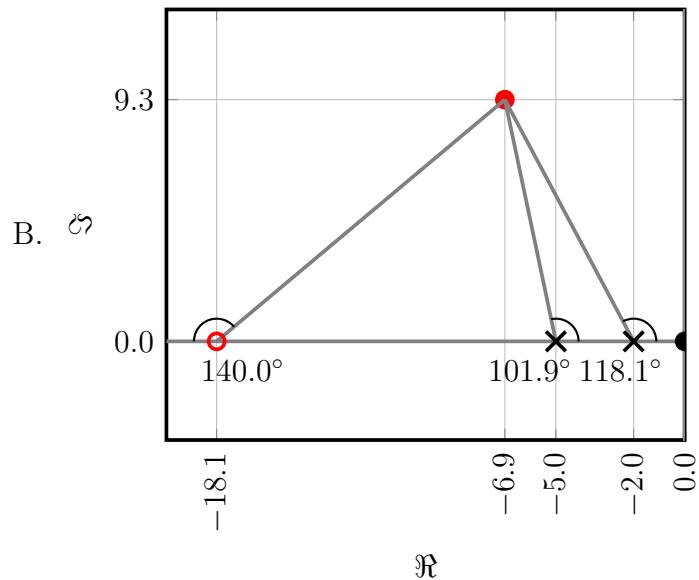


A zero is added so that the root-locus passes through this design point. Which of the following represents the correct angle condition for this design?

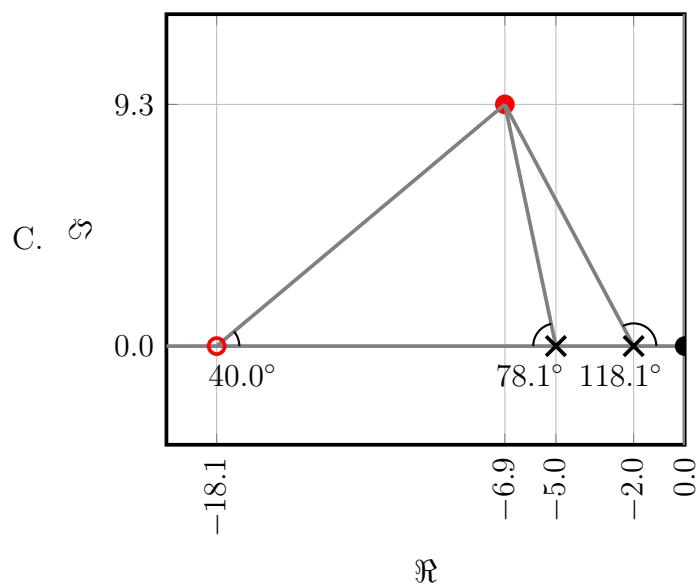
$$\sum \theta = 61.9^\circ + 101.9^\circ + 40.0^\circ =$$



$$\sum \theta = 118.1^\circ + 101.9^\circ + 140.0^\circ =$$



$$\sum \theta = 118.1^\circ + 78.1^\circ + 40.0^\circ =$$



$$\sum \theta = 118.1^\circ + 101.9^\circ - 40.0^\circ =$$

