

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

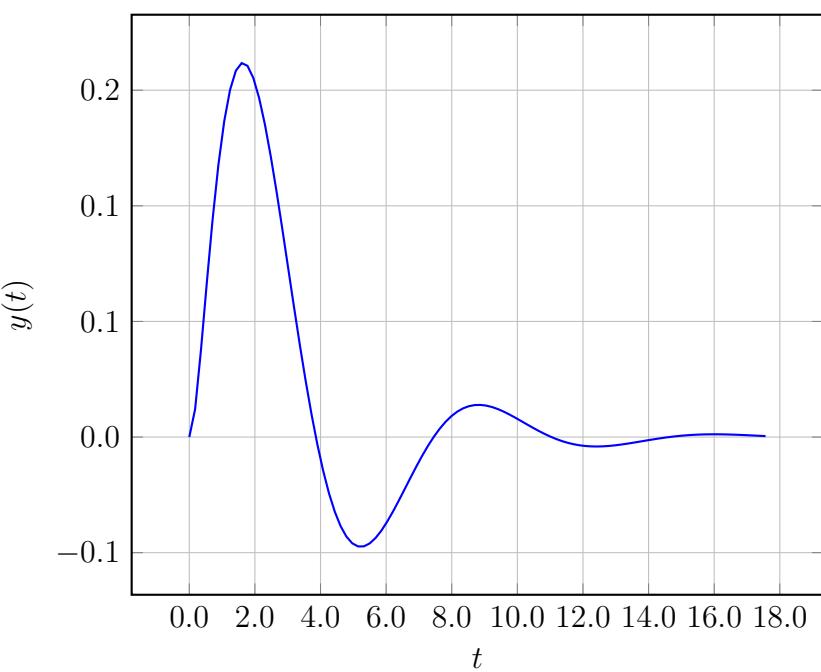
$$G(s) = \frac{1}{s^3 + 2.0s^2 + 3.43939s + 7.43939}$$

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

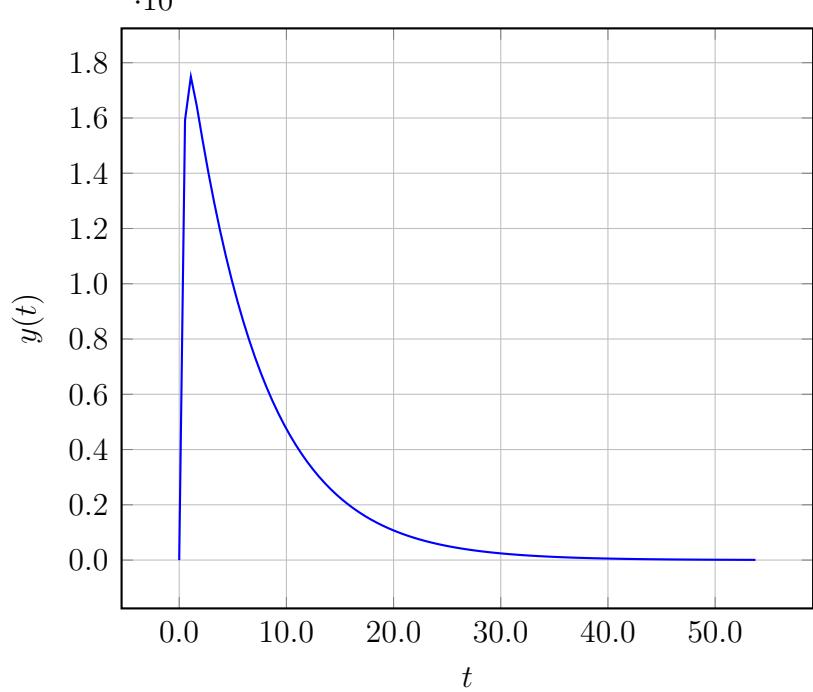
- A. $F(s) = -7.36365 + \frac{3.37878}{s}$
- B. $F(s) = -3.37878 + \frac{0.93939}{s}$
- C. $F(s) = -8.24243 + \frac{1.87878}{s}$
- D. $F(s) = 3.13635 + \frac{1.87878}{s}$
- E. $F(s) = 2.25757 + \frac{3.37878}{s}$

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?

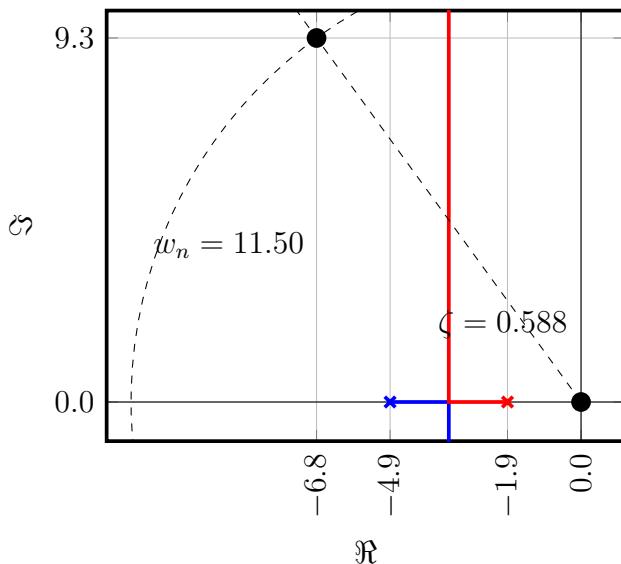
A.



B.

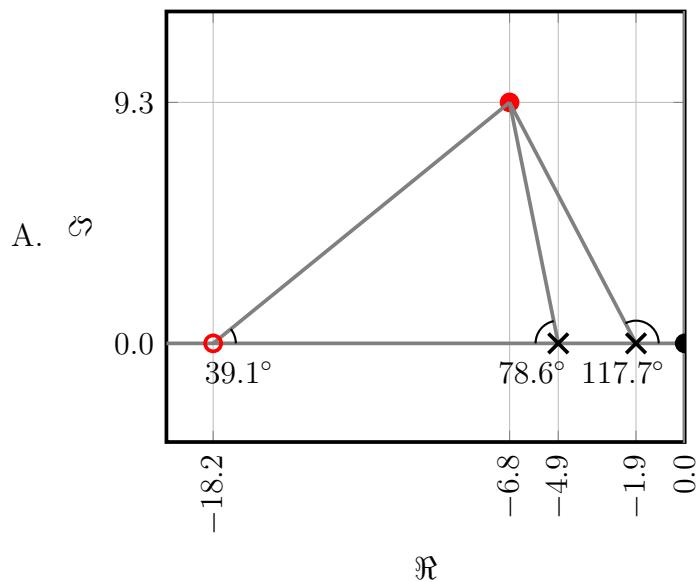


3. (30 points) A design point on the root-locus plot for a P-type controller is shown below.

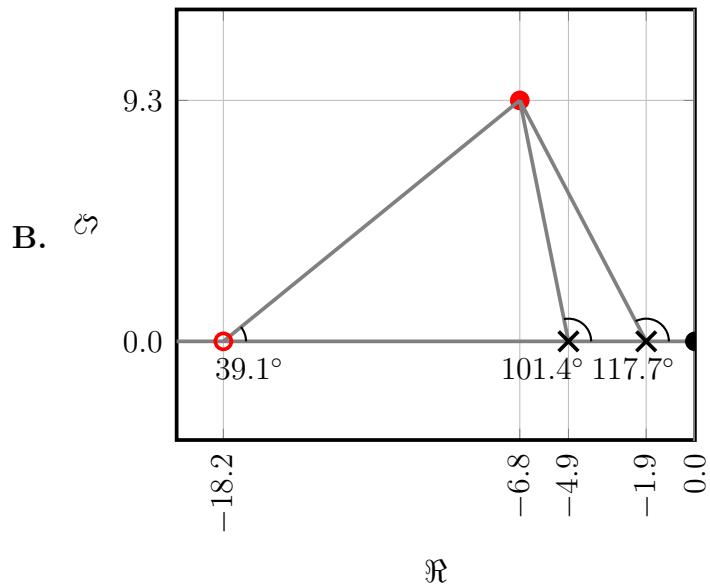


A zero is added so that the root-locus passes through this design point. Which of the following represents the correct angle condition for this design?

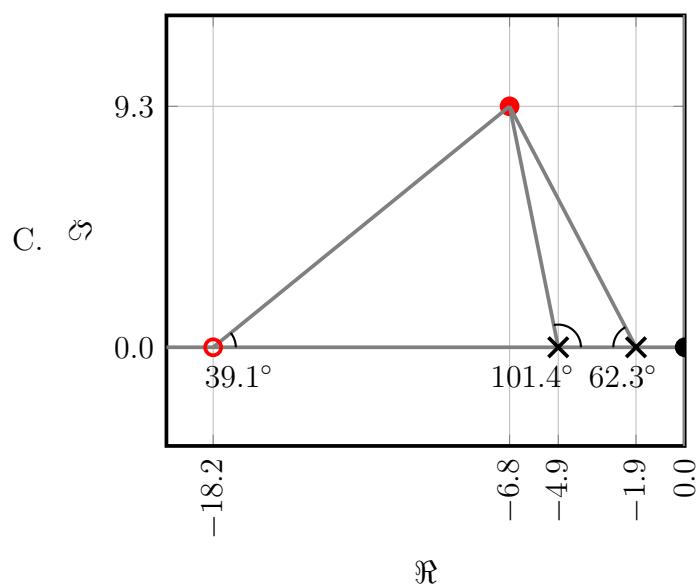
$$\sum \theta = 117.7^\circ + 78.6^\circ + 39.1^\circ = 235.4^\circ$$



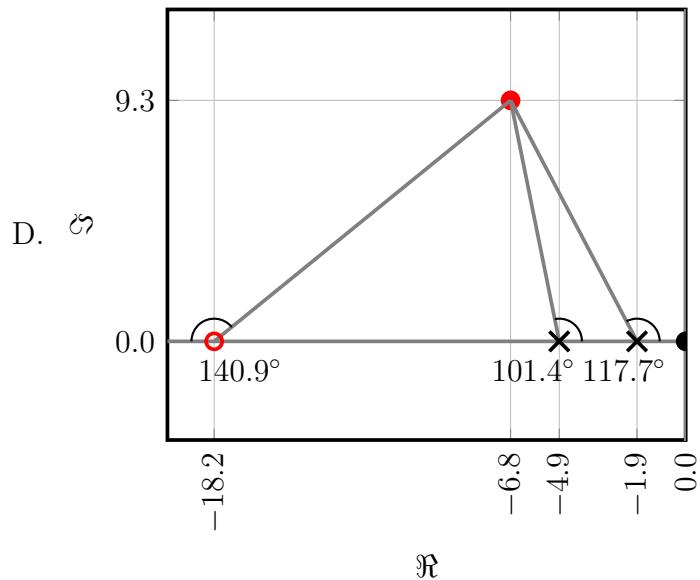
$$\sum \theta = 117.7^\circ + 101.4^\circ - 39.1^\circ = 180.0^\circ$$



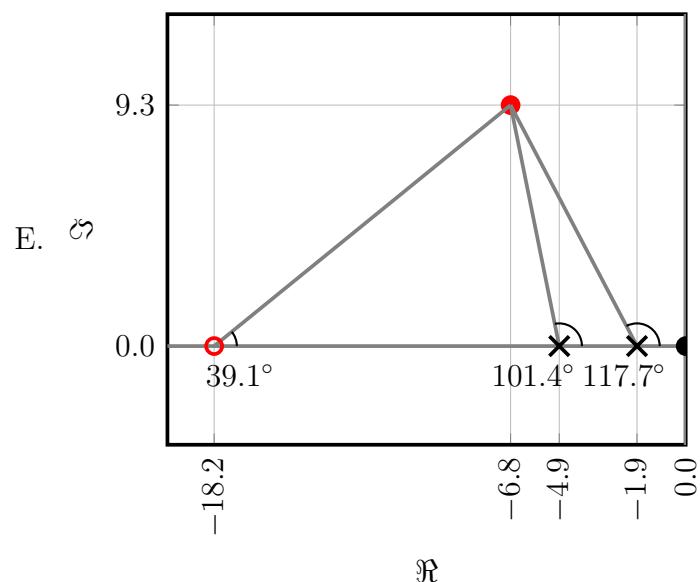
$$\sum \theta = 62.3^\circ + 101.4^\circ + 39.1^\circ = 202.8^\circ$$



$$\sum \theta = 117.7^\circ + 101.4^\circ + 140.9^\circ = 360.0^\circ$$



$$\sum \theta = 117.7^\circ + 101.4^\circ + 39.1^\circ = 258.2^\circ$$



| Q | A |
|---|---|
| 1 | B |
| 2 | B |
| 3 | B |