

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

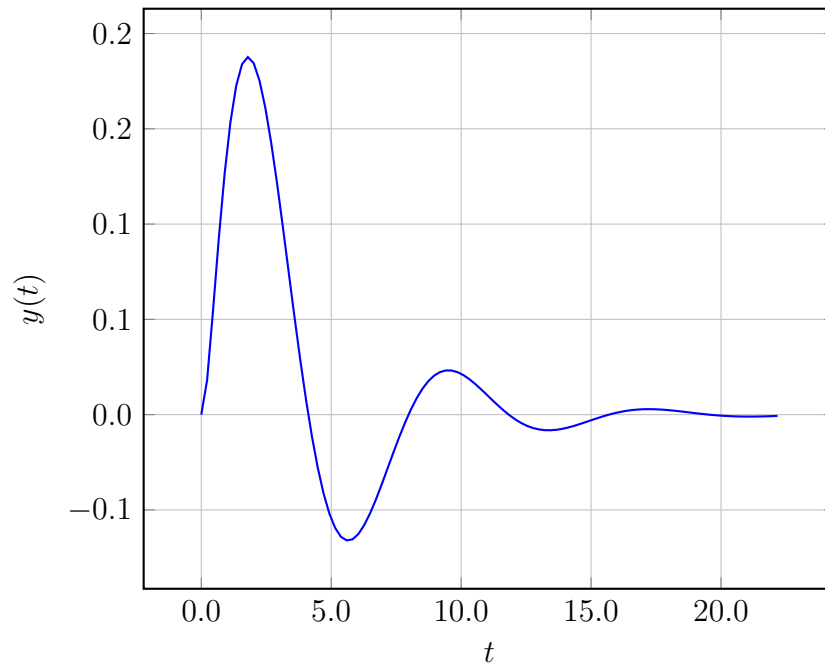
$$G(s) = \frac{1}{s^3 + 2.0s^2 + 3.35858s + 7.35858}$$

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

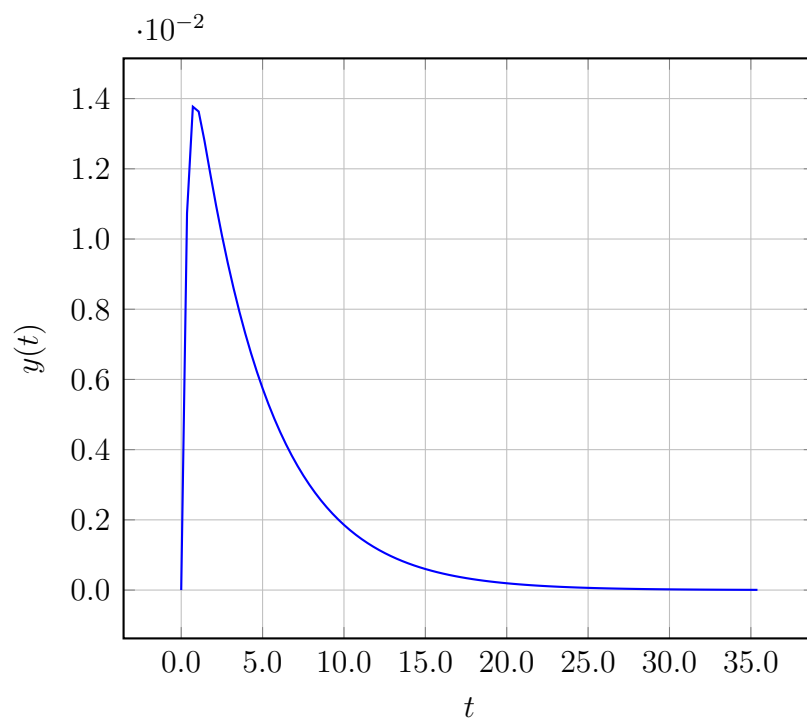
- A.  $F(s) = -8.56566 + \frac{1.71716}{s}$
- B.  $F(s) = -3.21716 + \frac{0.85858}{s}$**
- C.  $F(s) = 2.6515 + \frac{1.71716}{s}$
- D.  $F(s) = -7.8485 + \frac{3.21716}{s}$
- E.  $F(s) = 1.93434 + \frac{3.21716}{s}$

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?

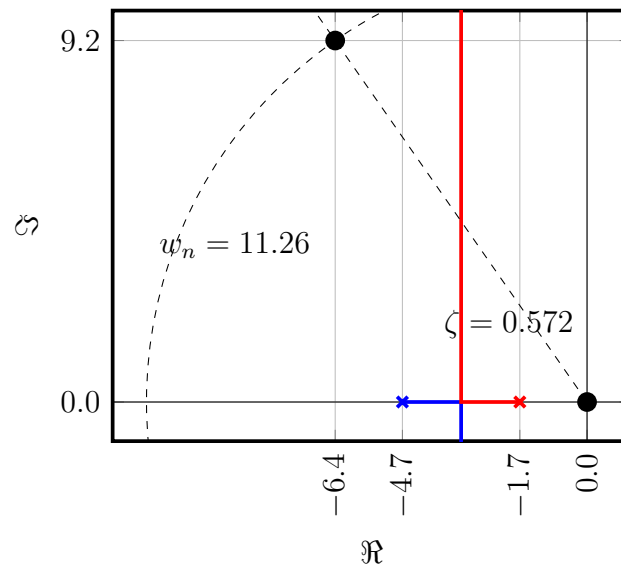
A.



B.

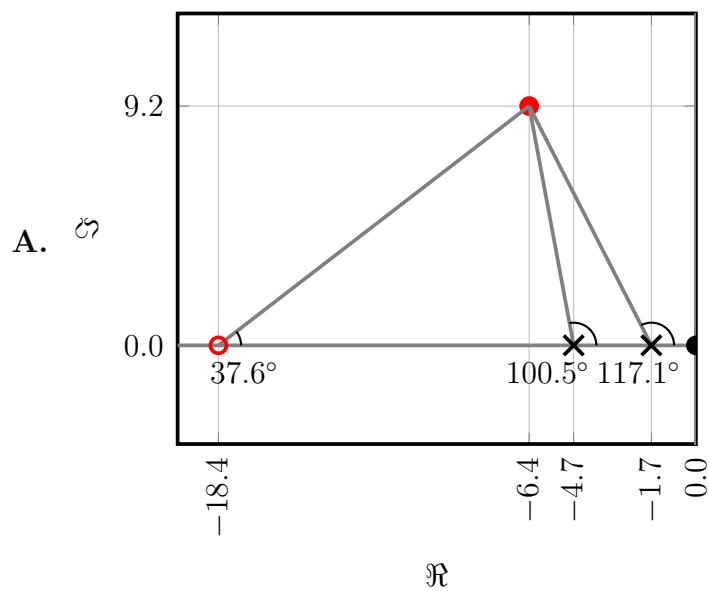


3. (30 points) A design point on the root-locus plot for a P-type controller is shown below.

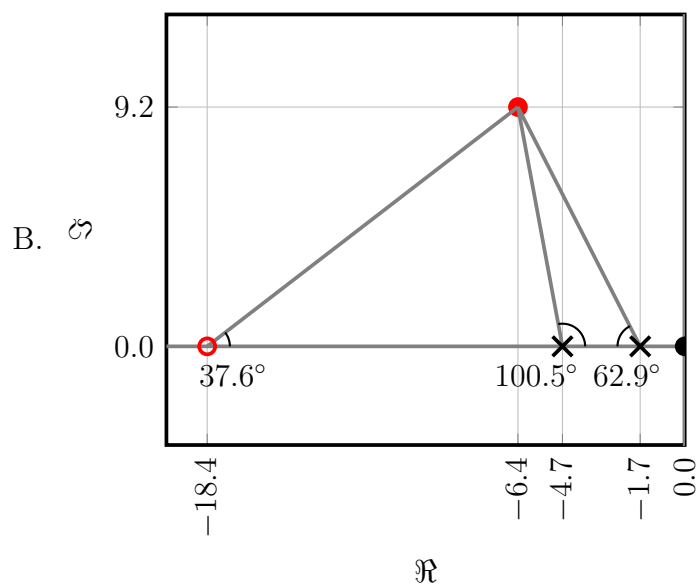


A zero is added so that the root-locus passes through this design point. Which of the following represents the correct angle condition for this design?

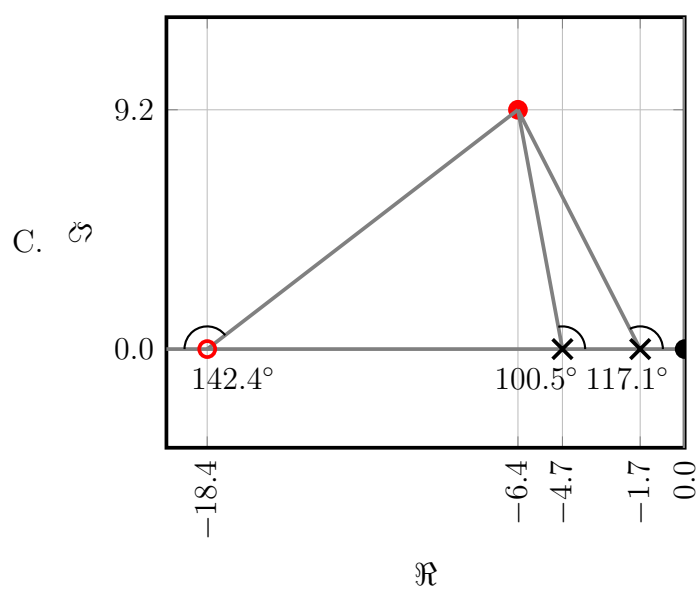
$$\sum \theta = 117.1^\circ + 100.5^\circ - 37.6^\circ = 180.0^\circ$$



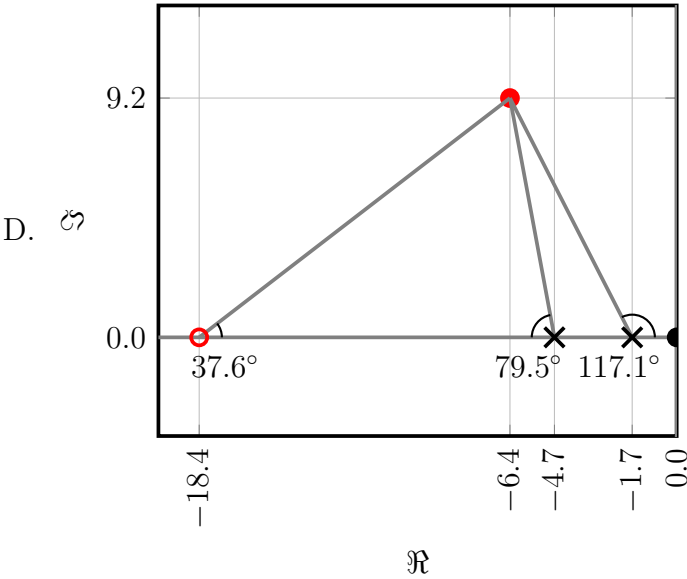
$$\sum \theta = 62.9^\circ + 100.5^\circ + 37.6^\circ = 201.1^\circ$$



$$\sum \theta = 117.1^\circ + 100.5^\circ + 142.4^\circ = 360.0^\circ$$



$$\sum \theta = 117.1^{\circ} + 79.5^{\circ} + 37.6^{\circ} = 234.1^{\circ}$$



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