

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

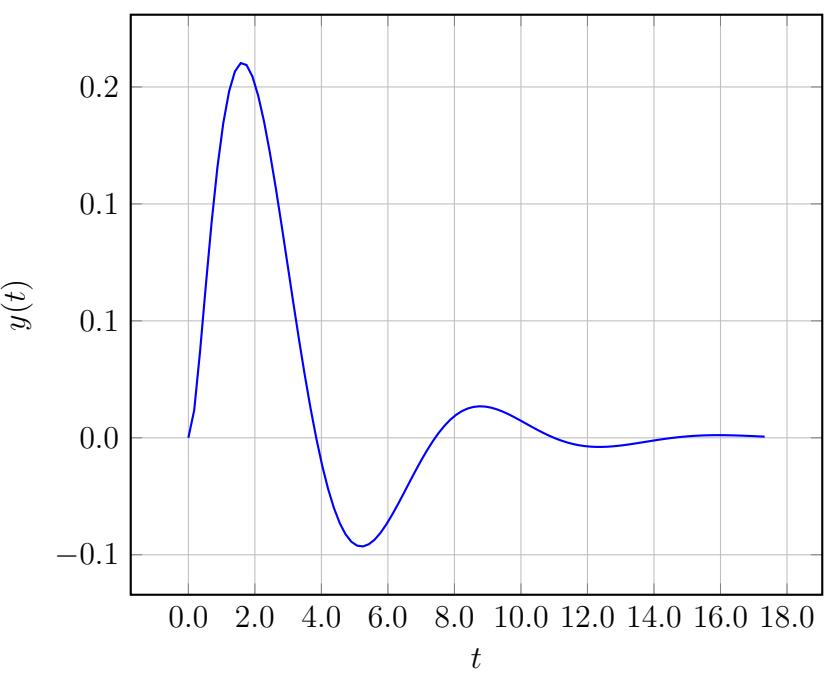
$$G(s) = \frac{1}{s^3 + 2.0s^2 + 3.44444s + 7.44444}$$

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

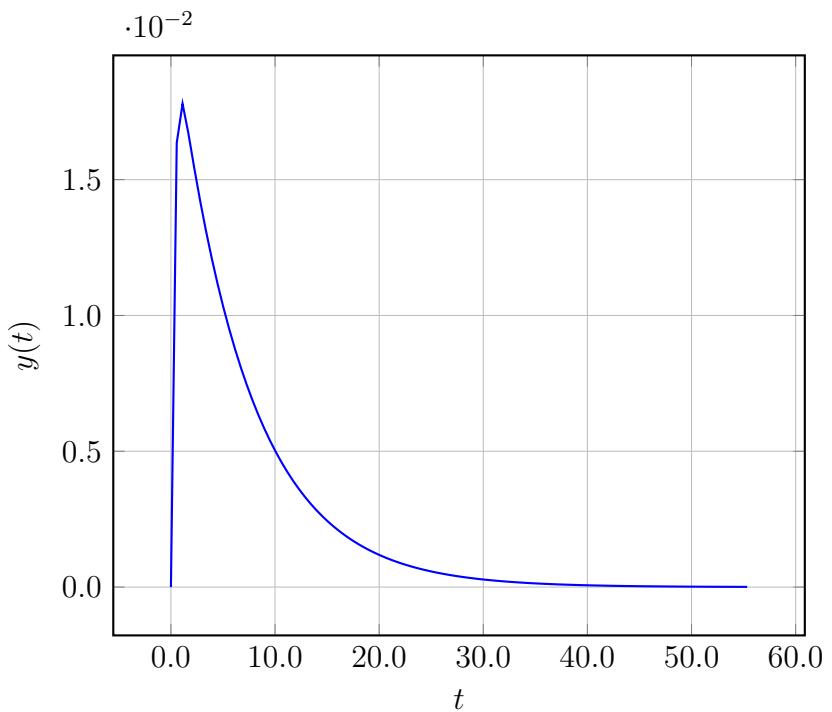
- A.  $F(s) = 2.27777 + \frac{3.38889}{s}$
- B.  $F(s) = 3.16666 + \frac{1.88889}{s}$
- C.  $F(s) = -7.33334 + \frac{3.38889}{s}$
- D.  $F(s) = -8.22223 + \frac{1.88889}{s}$
- E.  $F(s) = -3.38889 + \frac{0.94444}{s}$

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?

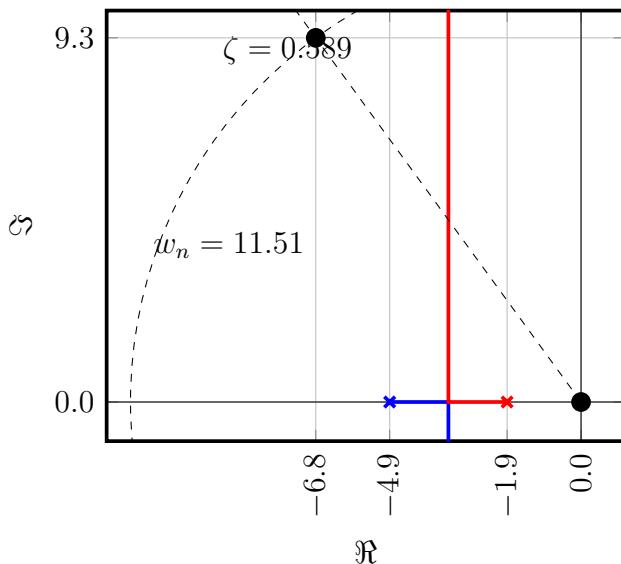
A.



B.

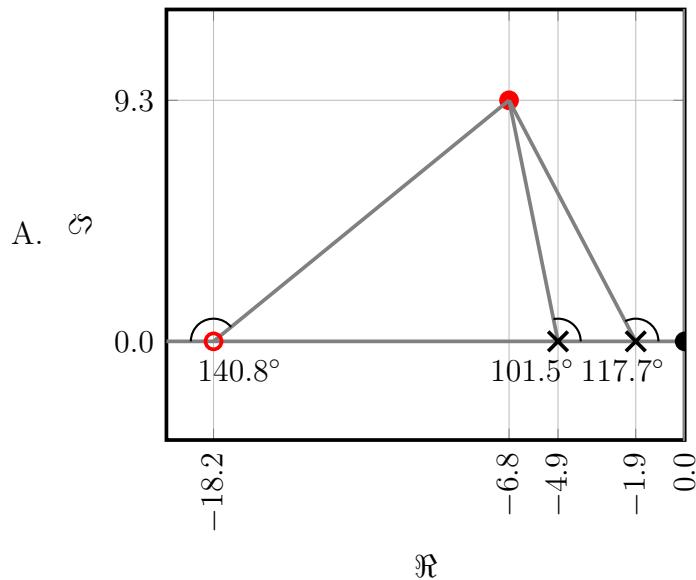


3. (30 points) A design point on the root-locus plot for a P-type controller is shown below.

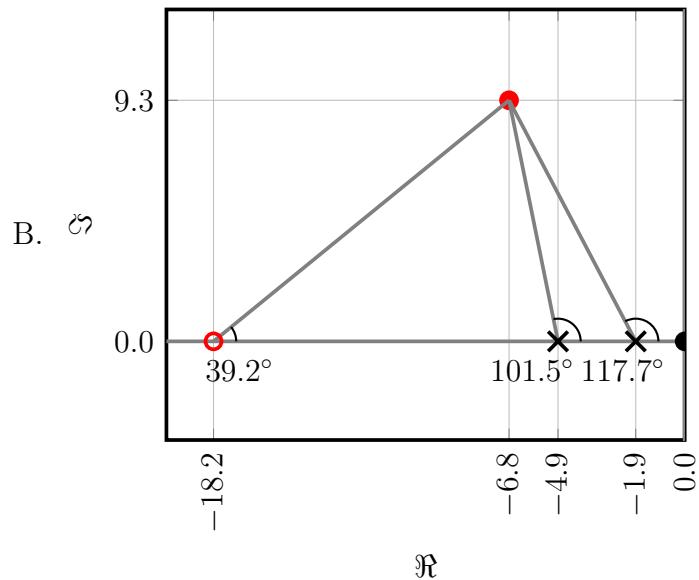


A zero is added so that the root-locus passes through this design point. Which of the following represents the correct angle condition for this design?

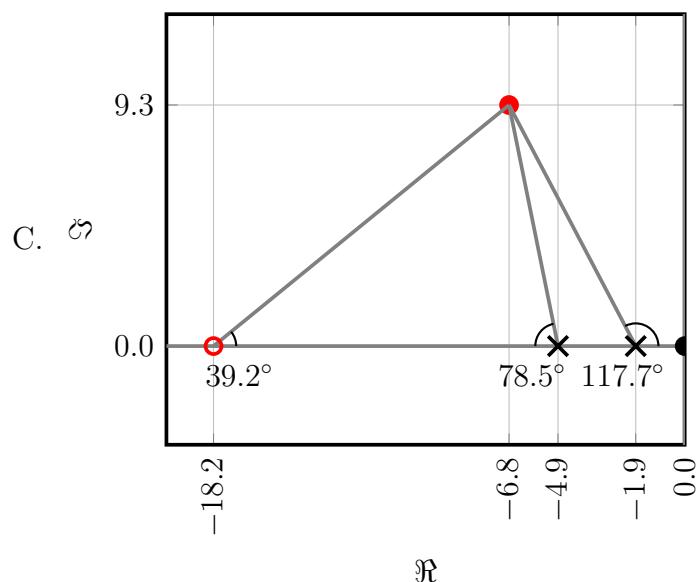
$$\sum \theta = 117.7^\circ + 101.5^\circ + 140.8^\circ =$$



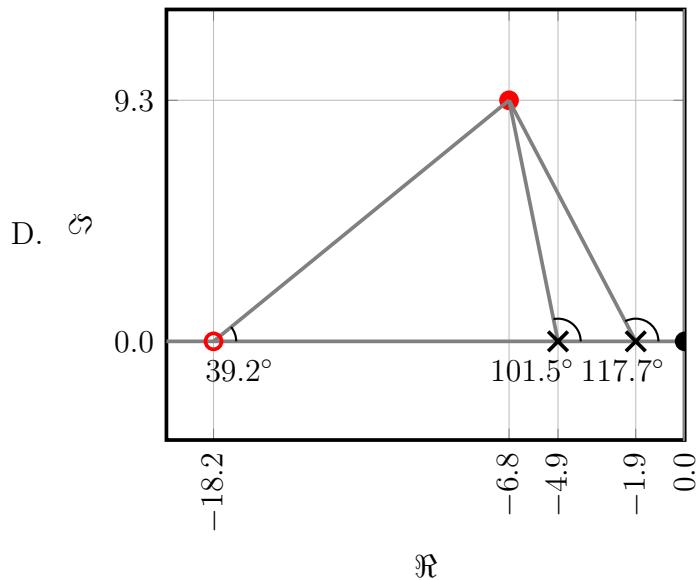
$$\sum \theta = 117.7^\circ + 101.5^\circ + 39.2^\circ =$$



$$\sum \theta = 117.7^\circ + 78.5^\circ + 39.2^\circ =$$



$$\sum \theta = 117.7^\circ + 101.5^\circ - 39.2^\circ =$$



$$\sum \theta = 62.3^\circ + 101.5^\circ + 39.2^\circ =$$

