1. (35 points) An open-loop transfer function is given by,
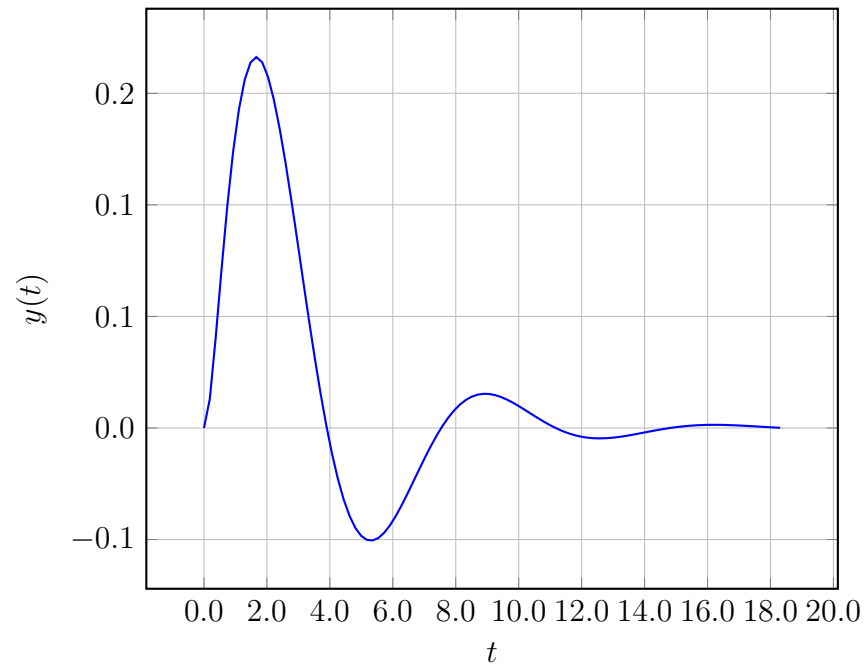
$$G(s) = \frac{1}{s^3 + 2.0s^2 + 3.42424s + 7.42424}$$

Which of the following PI controllers stabilizes the system in a unit-feedback closed-loop configuration?
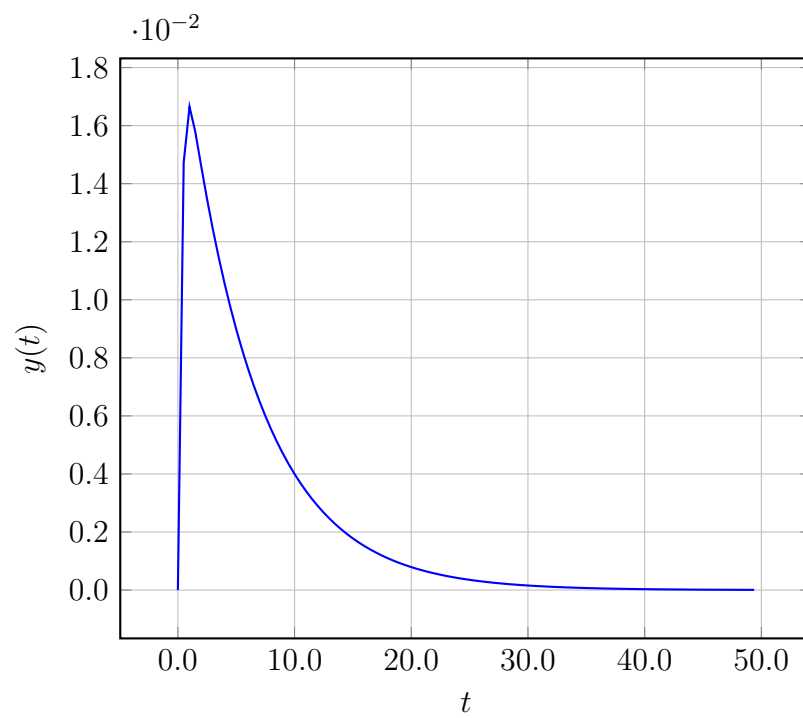
    A. $F(s) = -3.34848 + \frac{0.92424}{s}$

    B. $F(s) = -7.45456 + \frac{3.34848}{s}$

    C. $F(s) = -8.30304 + \frac{1.84848}{s}$

    D. $F(s) = 3.04544 + \frac{1.84848}{s}$

    E. $F(s) = 2.19696 + \frac{3.34848}{s}$

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?
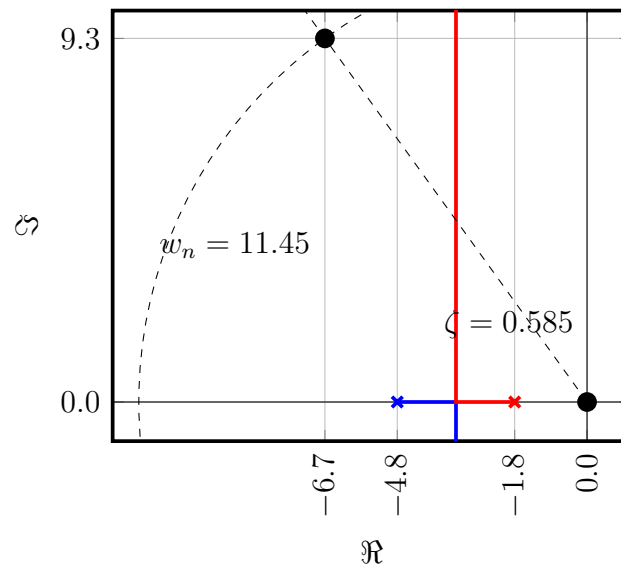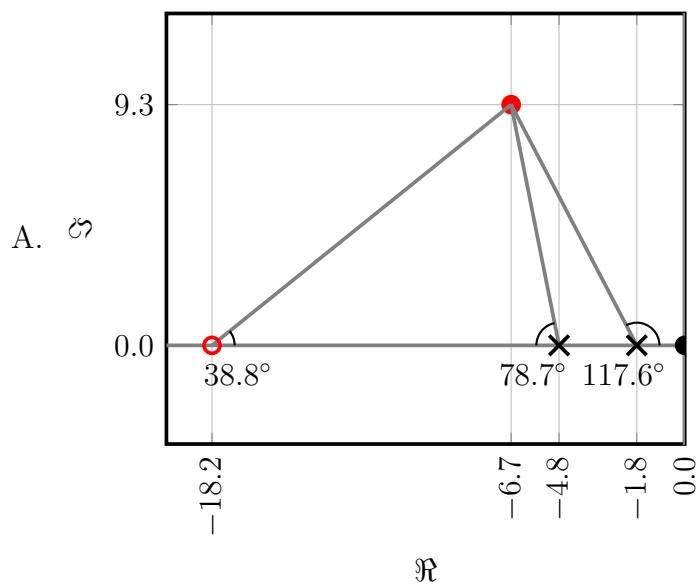
A.



B.

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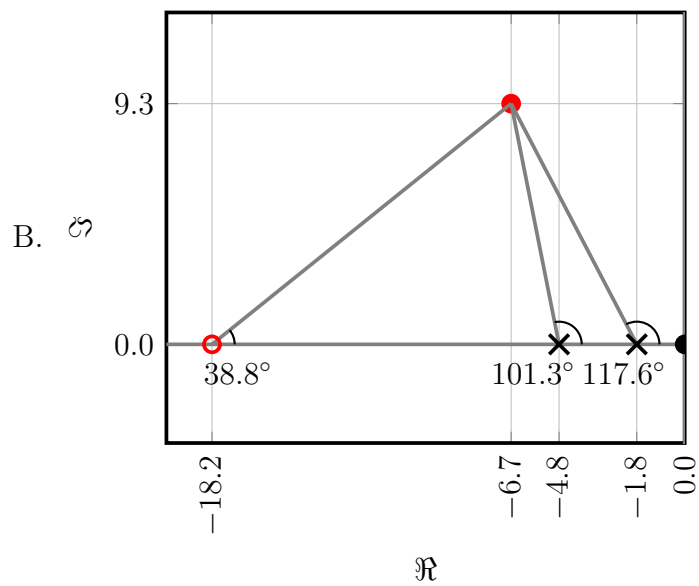


$w_n = 11.45$

$\zeta = 0.585$

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?
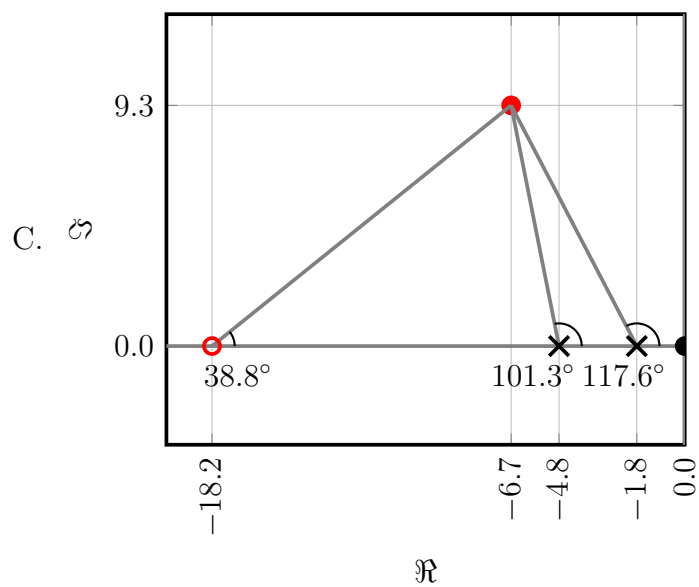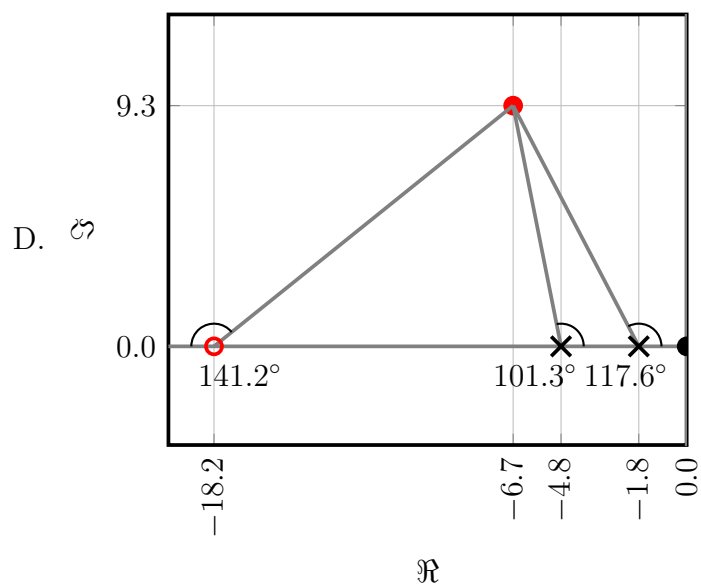
$$\sum \theta = 117.6° + 78.7° + 38.8° =$$

A.



38.8°    78.7°  117.6°

B.
$$\sum \theta = 117.6° + 101.3° - 38.8° =$$



C.
$$\sum \theta = 117.6° + 101.3° + 38.8° =$$

D. $\sum \theta = 117.6° + 101.3° + 141.2° =$



E. $\sum \theta = 62.4° + 101.3° + 38.8° =$