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

$$G(s) = \frac{1}{s^3 + 2.0s^2 + 3.40909s + 7.40909}$$

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

    A. $F(s) = -8.36365 + \frac{1.81818}{s}$

    B. $F(s) = -3.31818 + \frac{0.90909}{s}$

    C. $F(s) = 2.95454 + \frac{1.81818}{s}$

    D. $F(s) = 2.13635 + \frac{3.31818}{s}$

    E. $F(s) = -7.54546 + \frac{3.31818}{s}$

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?
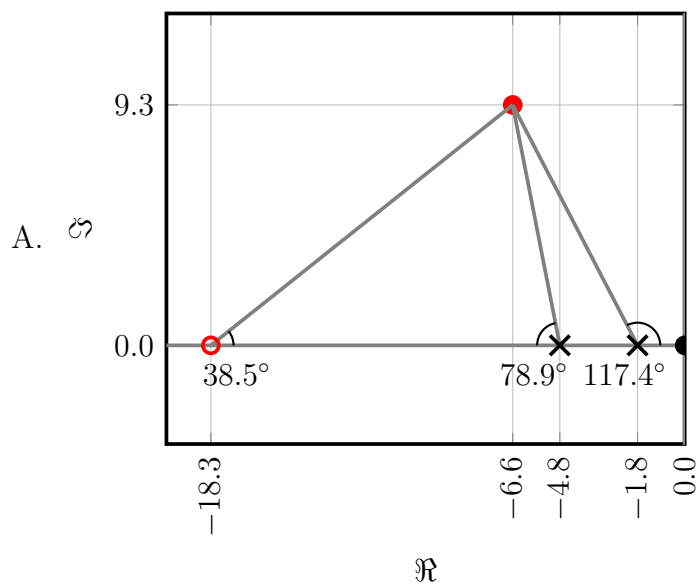
A.

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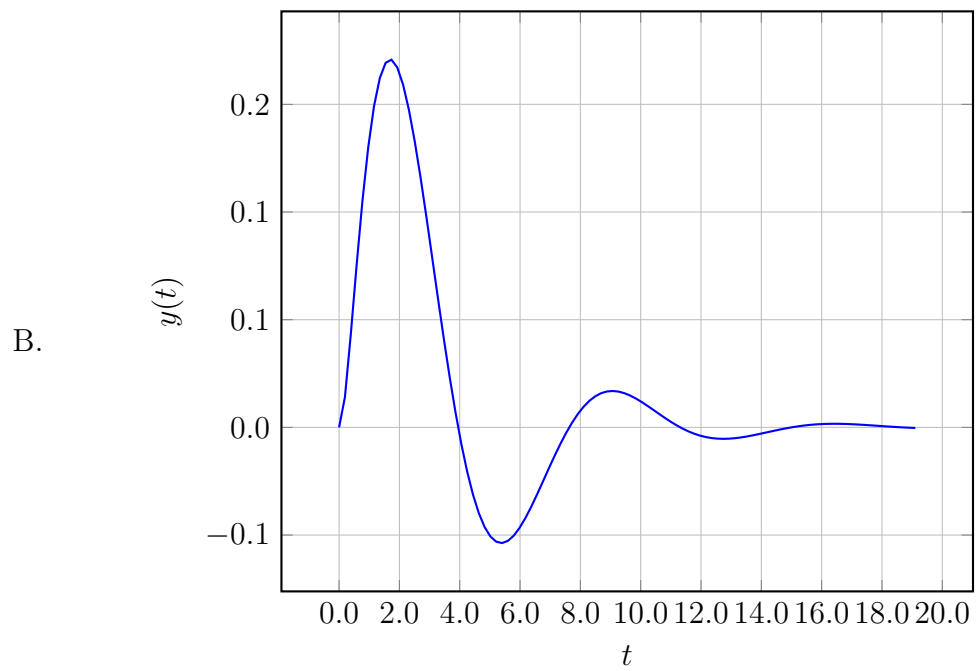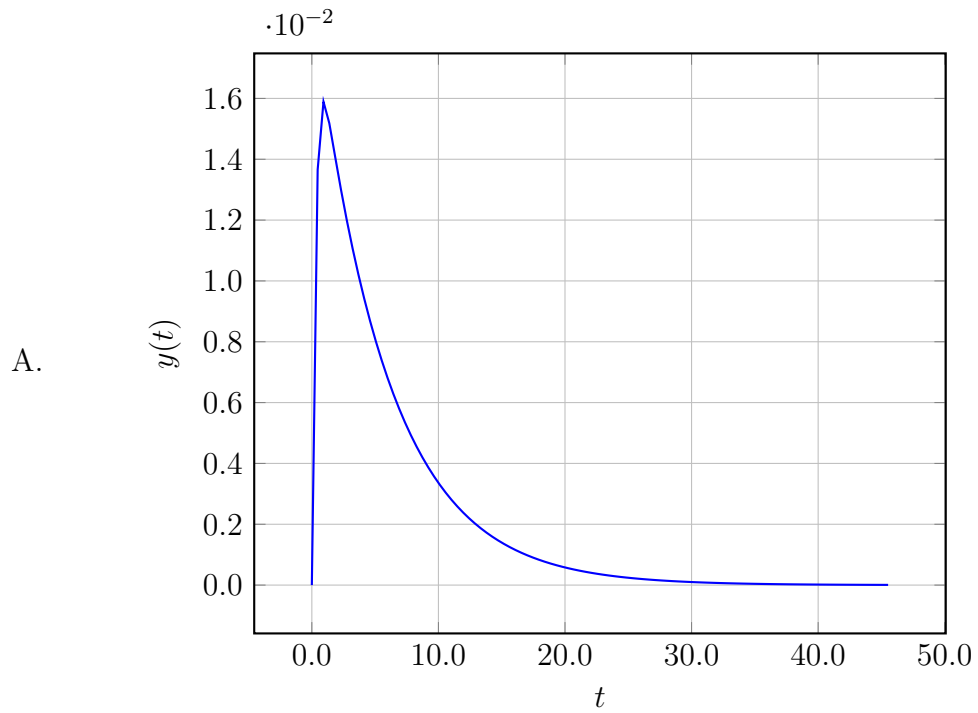
3. (30 points) A design point on the root-locus plot for a P-type controller is shown below.
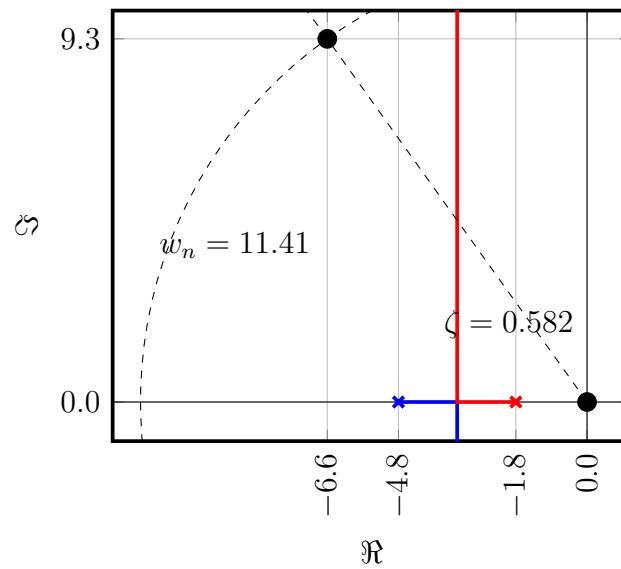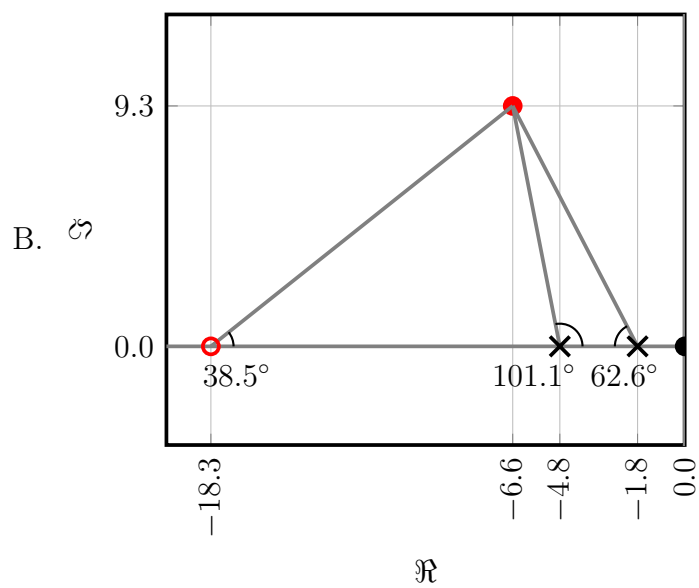

A zero is added so that the root-locus passes through this design point. Which of the following represents the correct angle condition for this design?
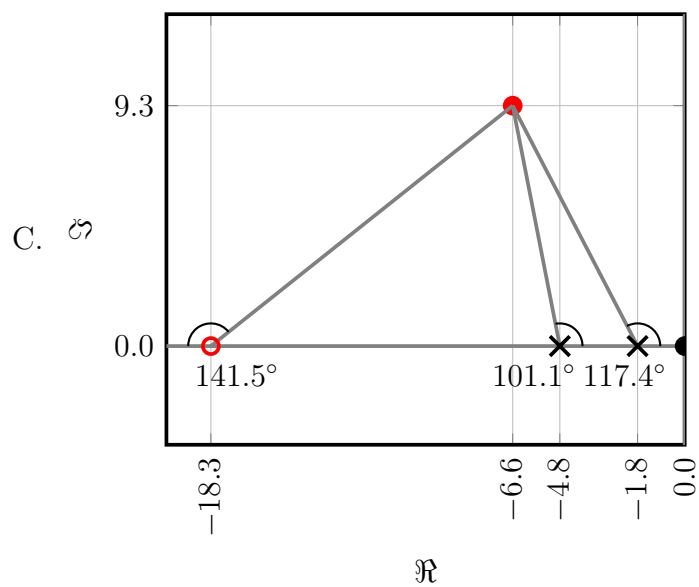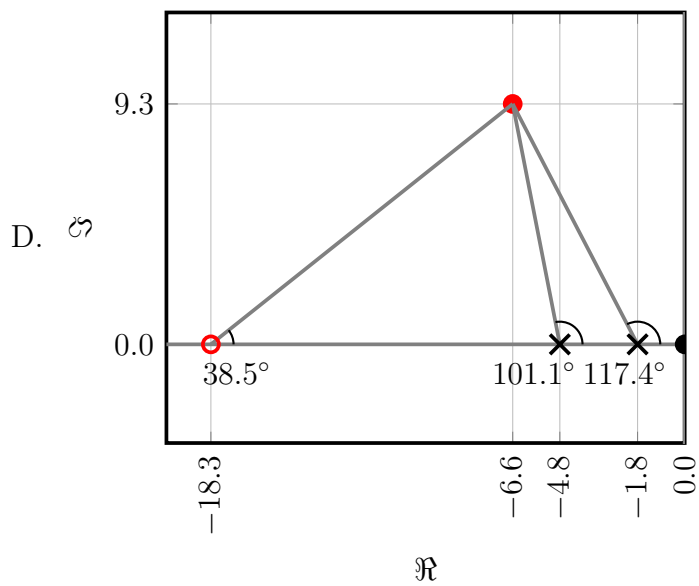
$$\sum \theta = 117.4° + 78.9° + 38.5° =$$

A.

$$\sum \theta = 62.6° + 101.1° + 38.5° =$$

B.

$$\sum \theta = 117.4° + 101.1° + 141.5° =$$

C.

$\sum \theta = 117.4° + 101.1° - 38.5° =$

D.

$\sum \theta = 117.4° + 101.1° + 38.5° =$

E.