1. (35 points) An open-loop transfer function is given by,
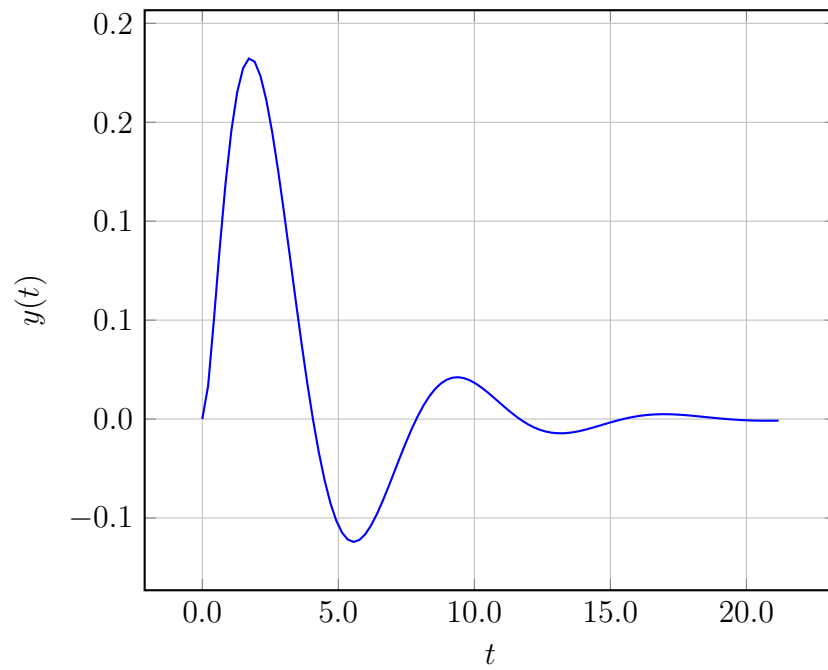
$$G(s) = \frac{1}{s^3 + 2.0s^2 + 3.37373s + 7.37373}$$

Which of the following PI controllers stabilizes the system in a unit-feedback closed-loop configuration?
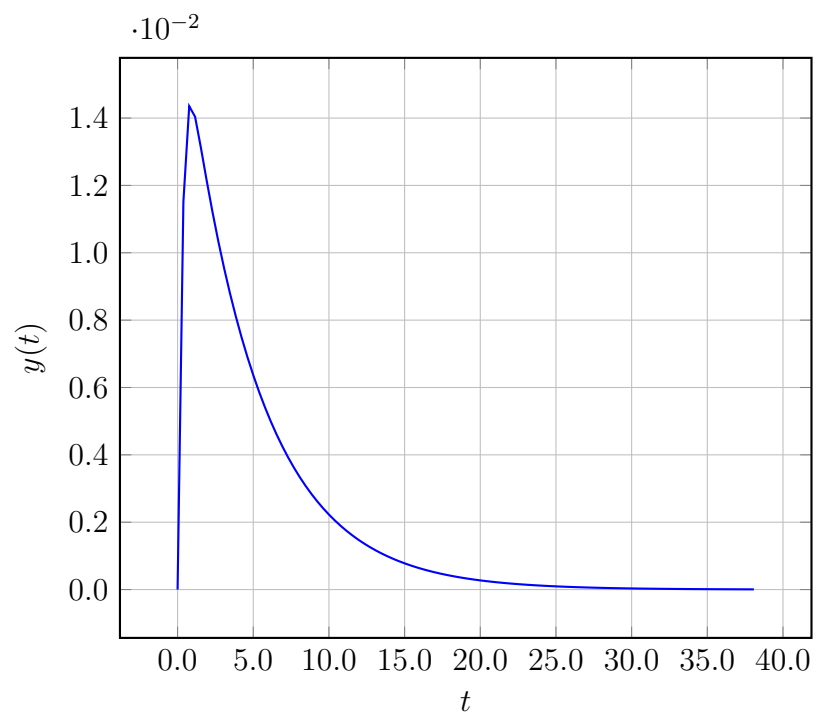
    A. $F(s) = -3.24747 + \frac{0.87373}{s}$

    B. $F(s) = -7.75758 + \frac{3.24747}{s}$

    C. $F(s) = -8.50505 + \frac{1.74747}{s}$

    D. $F(s) = 1.99495 + \frac{3.24747}{s}$

    E. $F(s) = 2.74242 + \frac{1.74747}{s}$

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?
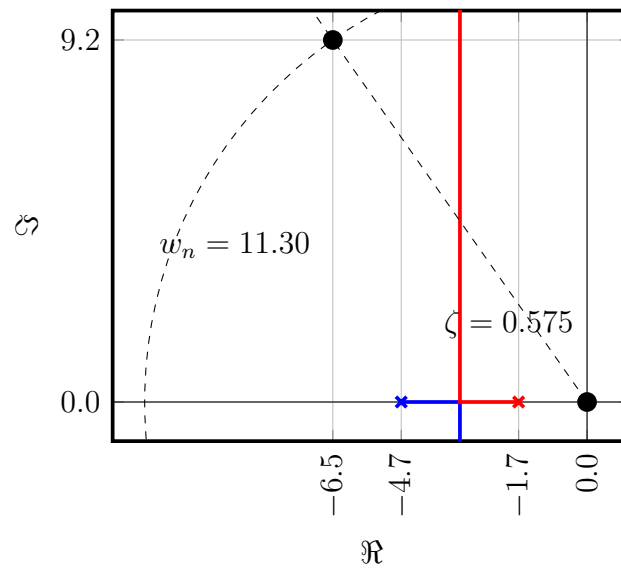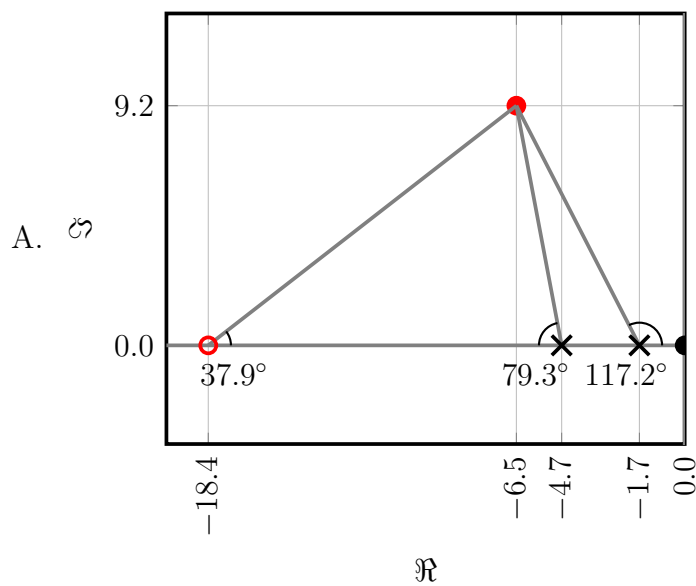
A.



B.

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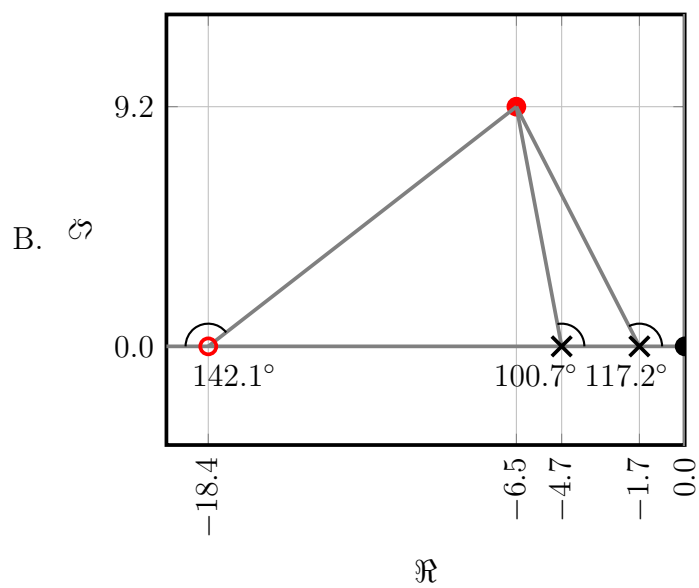


A zero is added so that the root-locus passes through this design point. Which of the following represents the correct angle condition for this design?
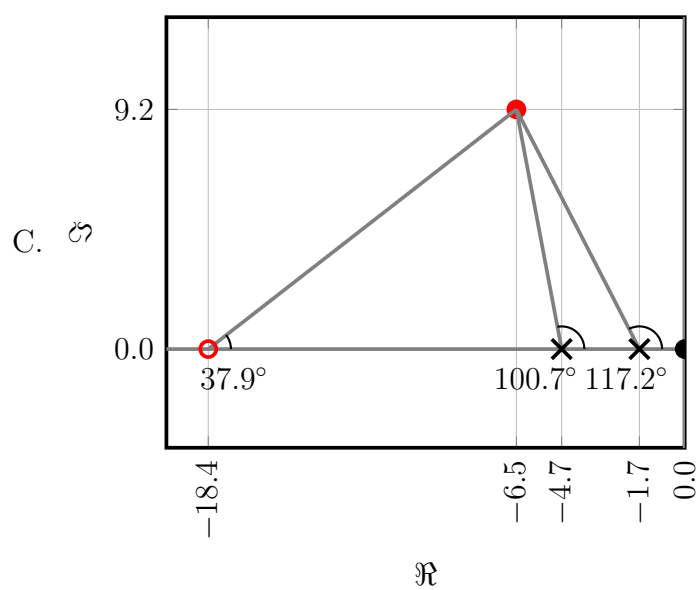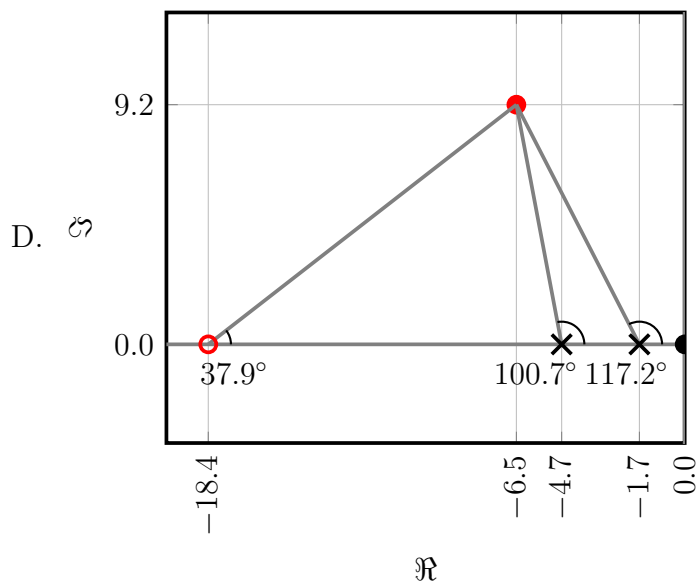
$$\sum \theta = 117.2° + 79.3° + 37.9° =$$

A.

$$\sum \theta = 117.2° + 100.7° + 142.1° =$$

B.



$$\sum \theta = 117.2° + 100.7° + 37.9° =$$

C.

D.

$$\sum \theta = 117.2° + 100.7° - 37.9° =$$



E.

$$\sum \theta = 62.8° + 100.7° + 37.9° =$$