

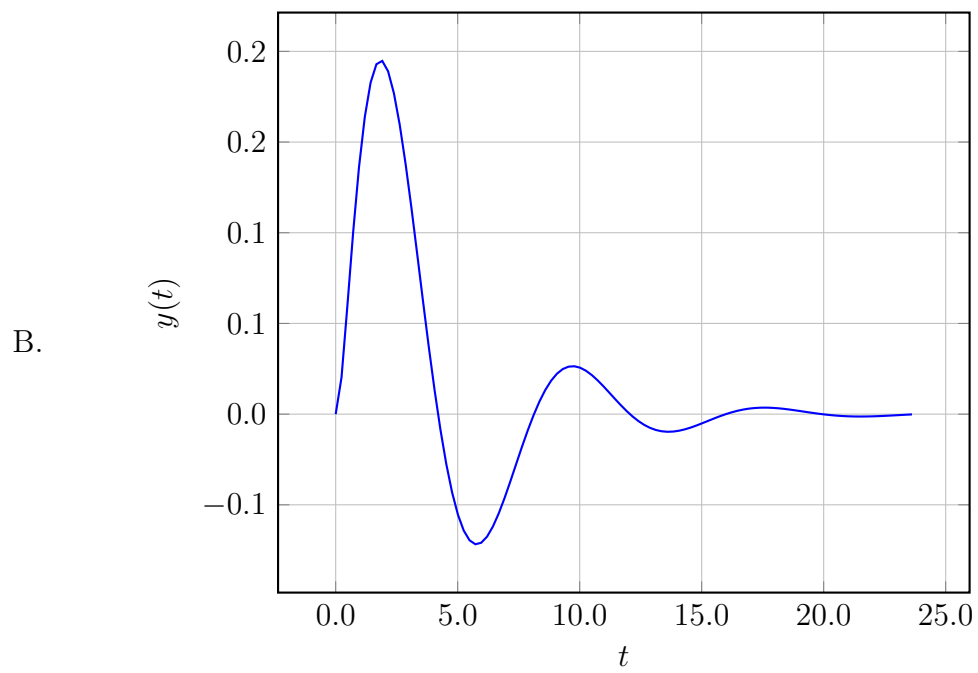
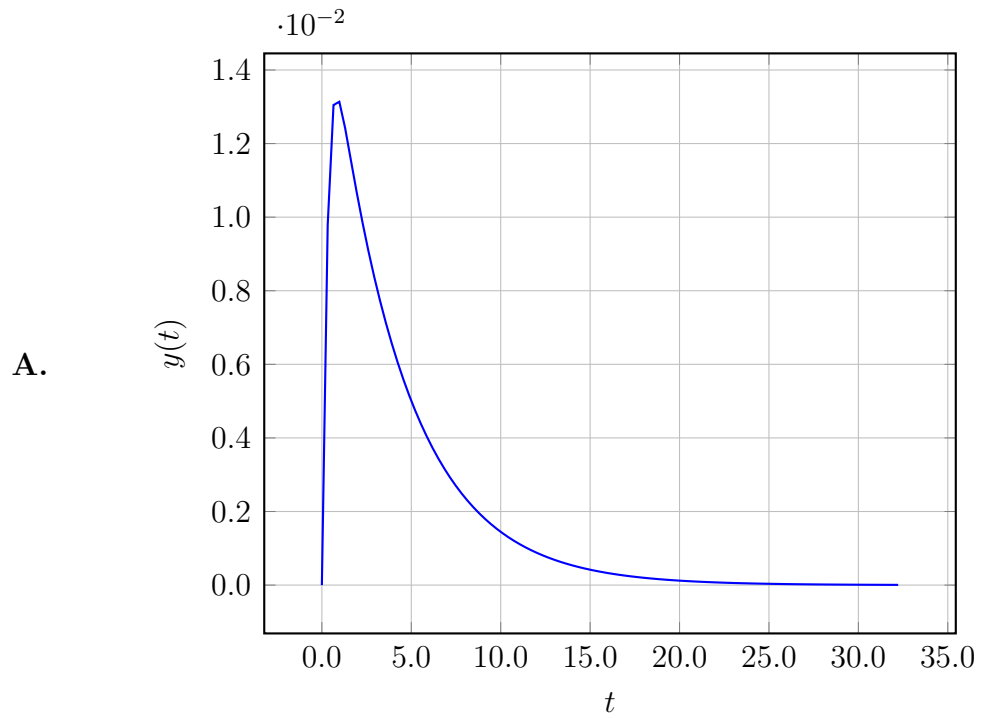
1. (35 points) An open-loop transfer function is given by,

$$G(s) = \frac{1}{s^3 + 2.0s^2 + 3.33838s + 7.33838}$$

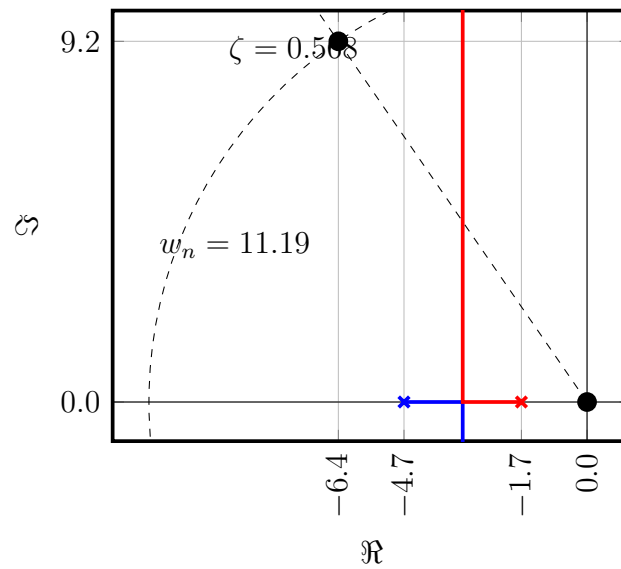
Which of the following PI controllers stabilizes the system in a unit-feedback closed-loop configuration?

- A.  $F(s) = -7.96971 + \frac{3.17676}{s}$
- B.  $F(s) = 1.85353 + \frac{3.17676}{s}$
- C.  $F(s) = -3.17676 + \frac{0.83838}{s}$
- D.  $F(s) = 2.53029 + \frac{1.67676}{s}$
- E.  $F(s) = -8.64647 + \frac{1.67676}{s}$

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?

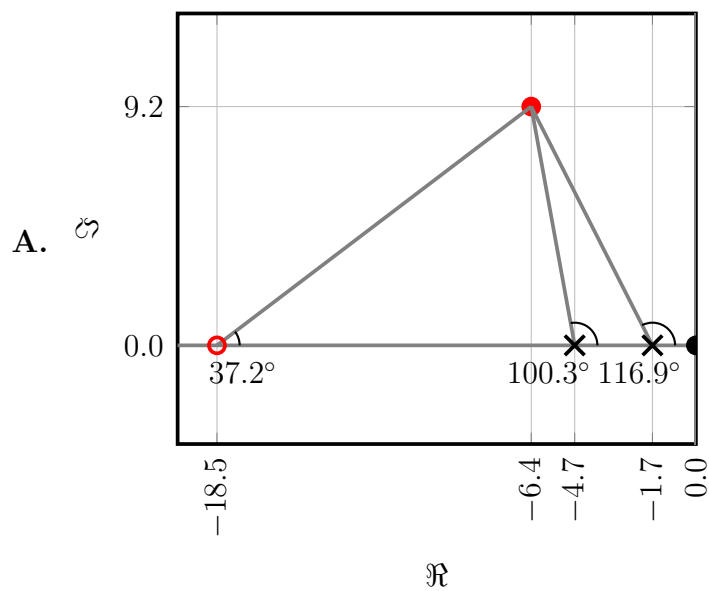


3. (30 points) A design point on the root-locus plot for a P-type controller is shown below.

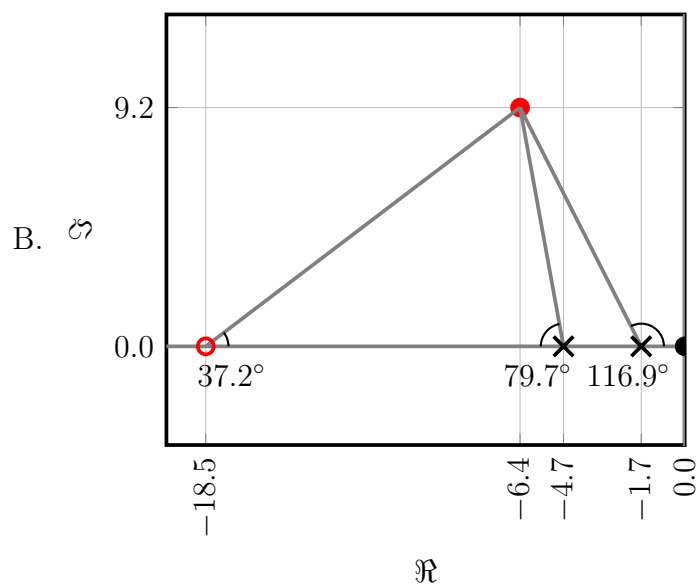


A zero is added so that the root-locus passes through this design point. Which of the following represents the correct angle condition for this design?

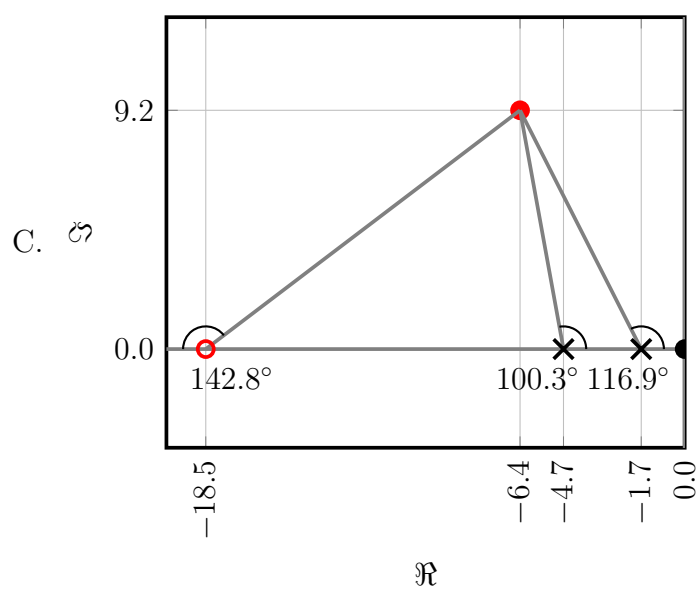
$$\sum \theta = 116.9^\circ + 100.3^\circ - 37.2^\circ = 180.0^\circ$$



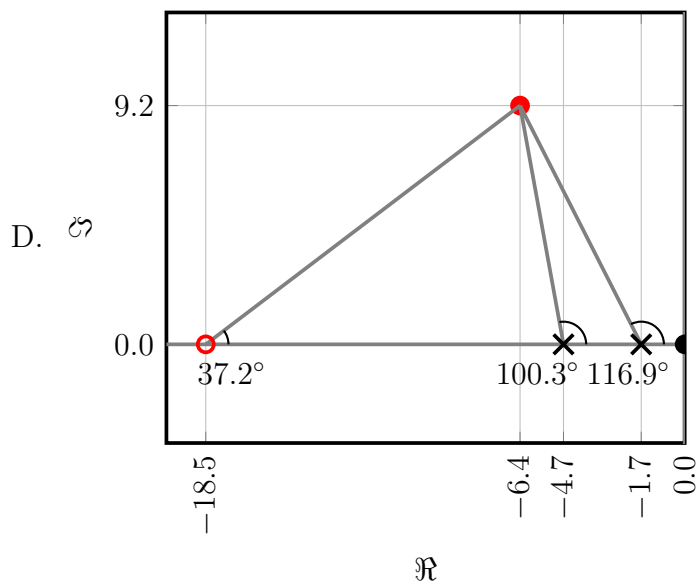
$$\sum \theta = 116.9^\circ + 79.7^\circ + 37.2^\circ = 233.8^\circ$$



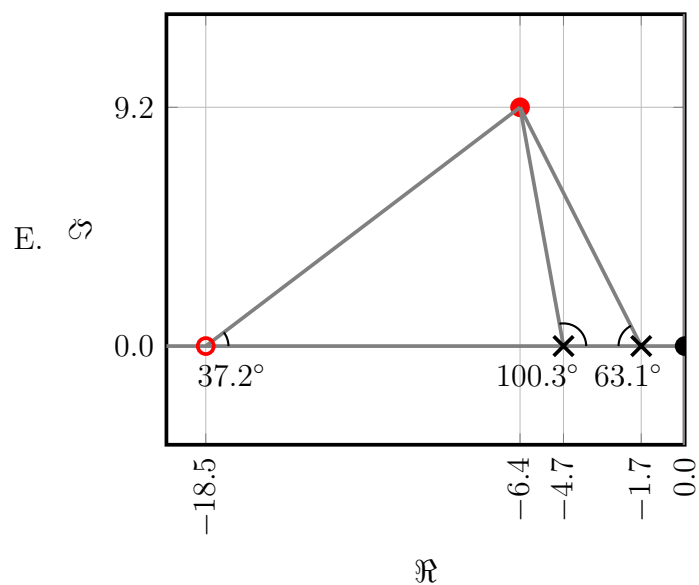
$$\sum \theta = 116.9^\circ + 100.3^\circ + 142.8^\circ = 360.0^\circ$$



$$\sum \theta = 116.9^\circ + 100.3^\circ + 37.2^\circ = 254.4^\circ$$



$$\sum \theta = 63.1^\circ + 100.3^\circ + 37.2^\circ = 200.6^\circ$$



|   |   |
|---|---|
| Q | A |
| 1 | C |
| 2 | A |
| 3 | A |