

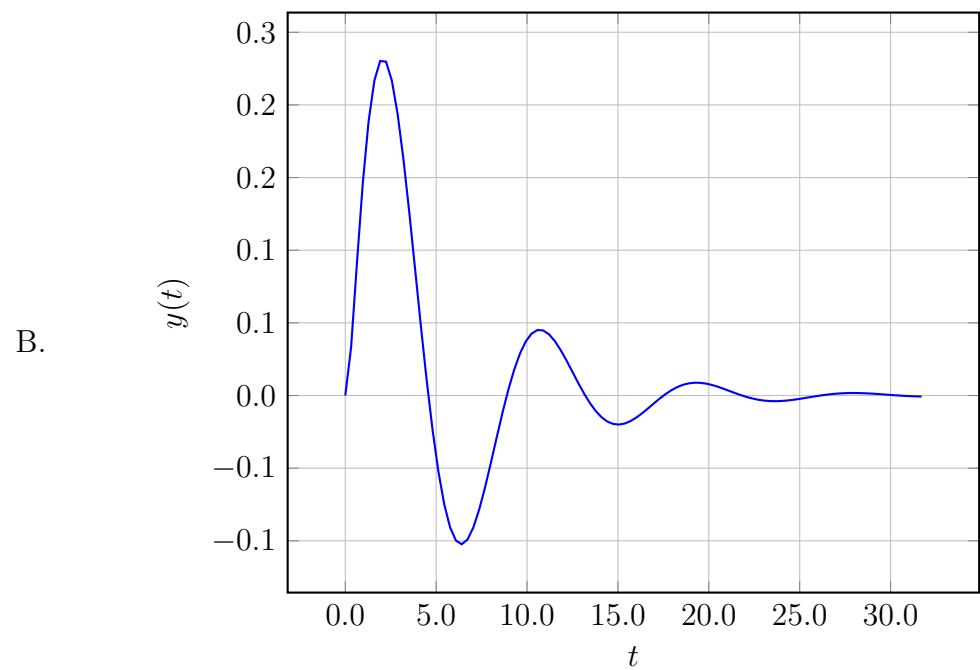
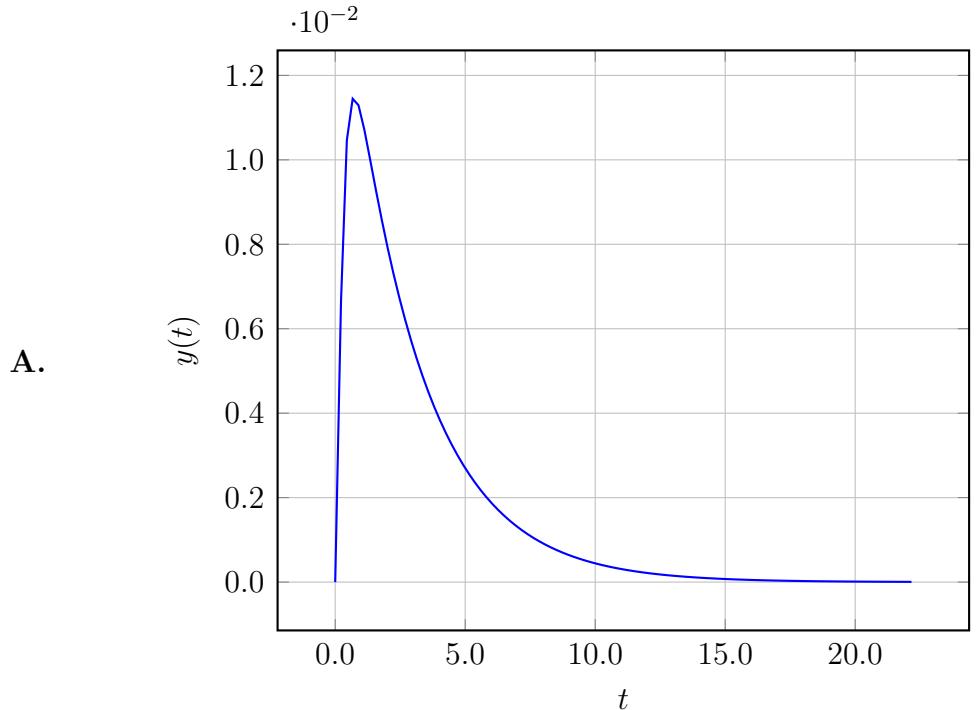
1. (35 points) An open-loop transfer function is given by,

$$G(s) = \frac{1}{s^3 + 2.0s^2 + 3.25252s + 7.25252}$$

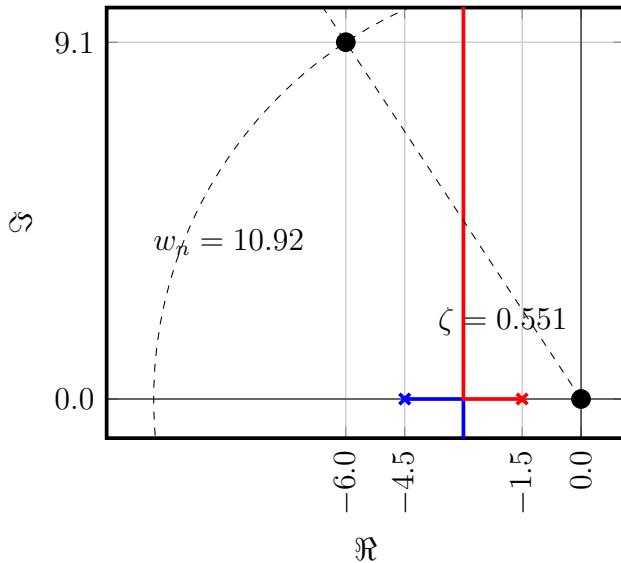
Which of the following PI controllers stabilizes the system in a unit-feedback closed-loop configuration?

- A. $F(s) = 2.01514 + \frac{1.50504}{s}$
- B. $F(s) = 1.51009 + \frac{3.00504}{s}$
- C. $F(s) = -8.48486 + \frac{3.00504}{s}$
- D. $F(s) = -8.98991 + \frac{1.50504}{s}$
- E. $F(s) = -3.00504 + \frac{0.75252}{s}$

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?

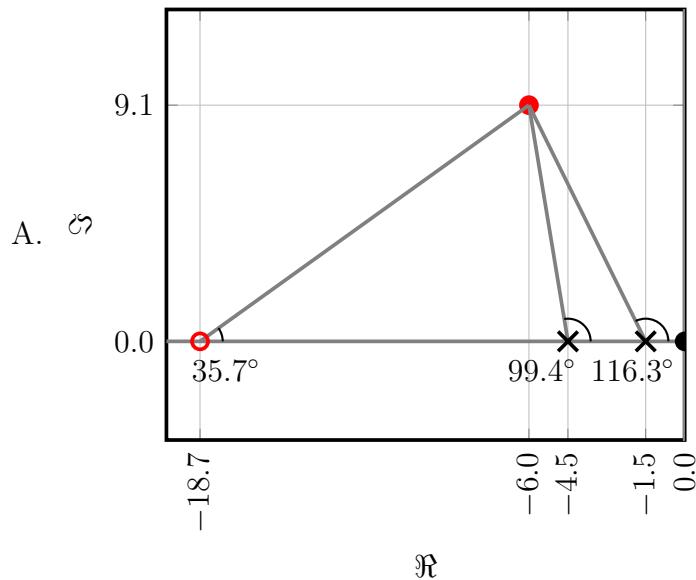


3. (30 points) A design point on the root-locus plot for a P-type controller is shown below.

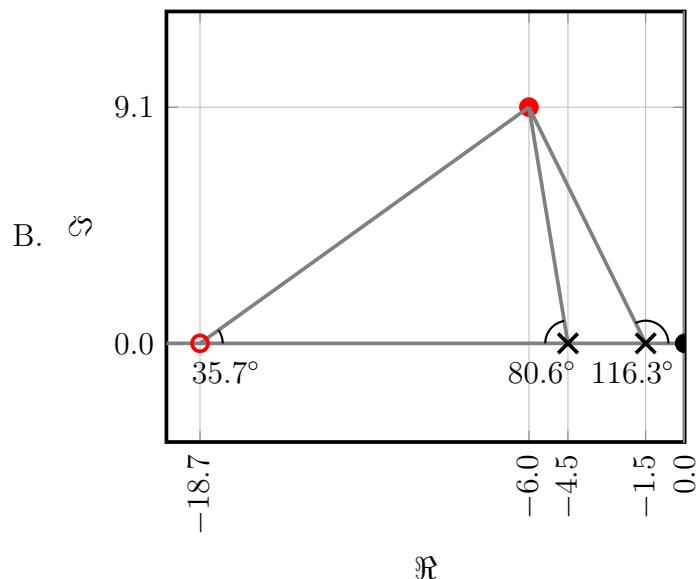


A zero is added so that the root-locus passes through this design point. Which of the following represents the correct angle condition for this design?

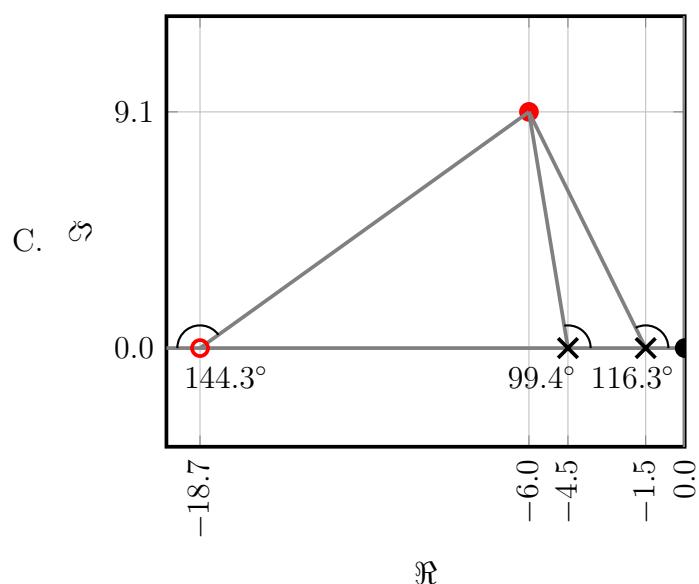
$$\sum \theta = 116.3^\circ + 99.4^\circ + 35.7^\circ = 251.4^\circ$$



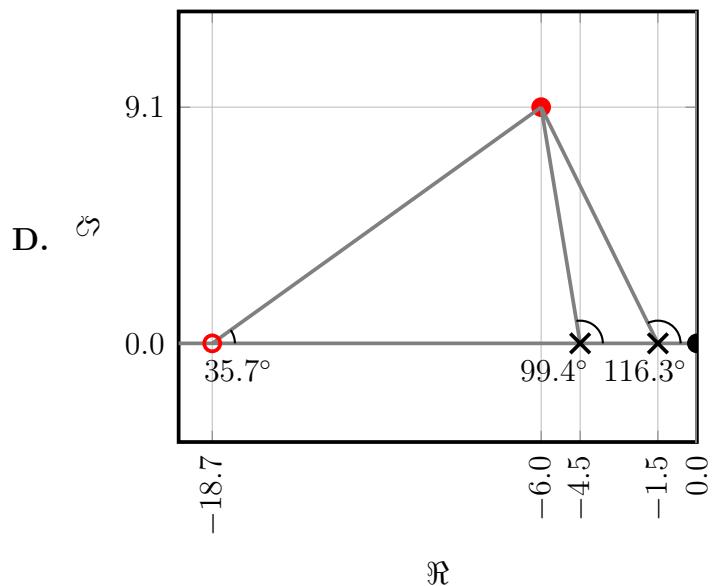
$$\sum \theta = 116.3^\circ + 80.6^\circ + 35.7^\circ = 232.6^\circ$$



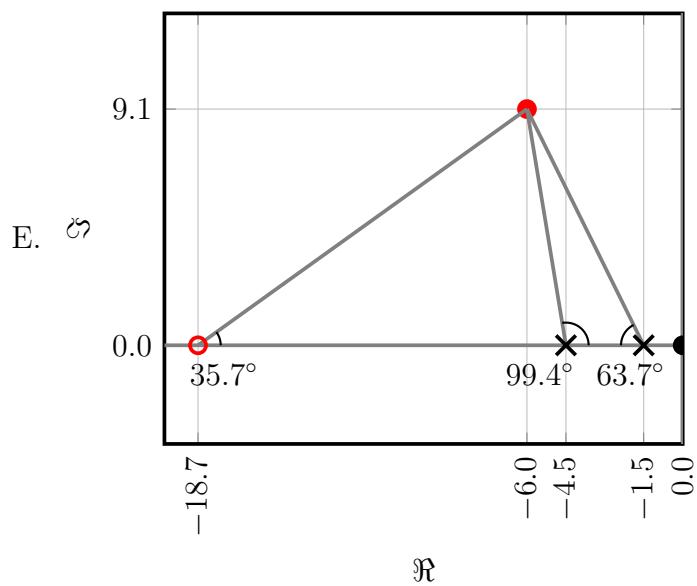
$$\sum \theta = 116.3^\circ + 99.4^\circ + 144.3^\circ = 360.0^\circ$$



$$\sum \theta = 116.3^\circ + 99.4^\circ - 35.7^\circ = 180.0^\circ$$



$$\sum \theta = 63.7^\circ + 99.4^\circ + 35.7^\circ = 198.8^\circ$$



| Q | A |
|---|---|
| 1 | E |
| 2 | A |
| 3 | D |