

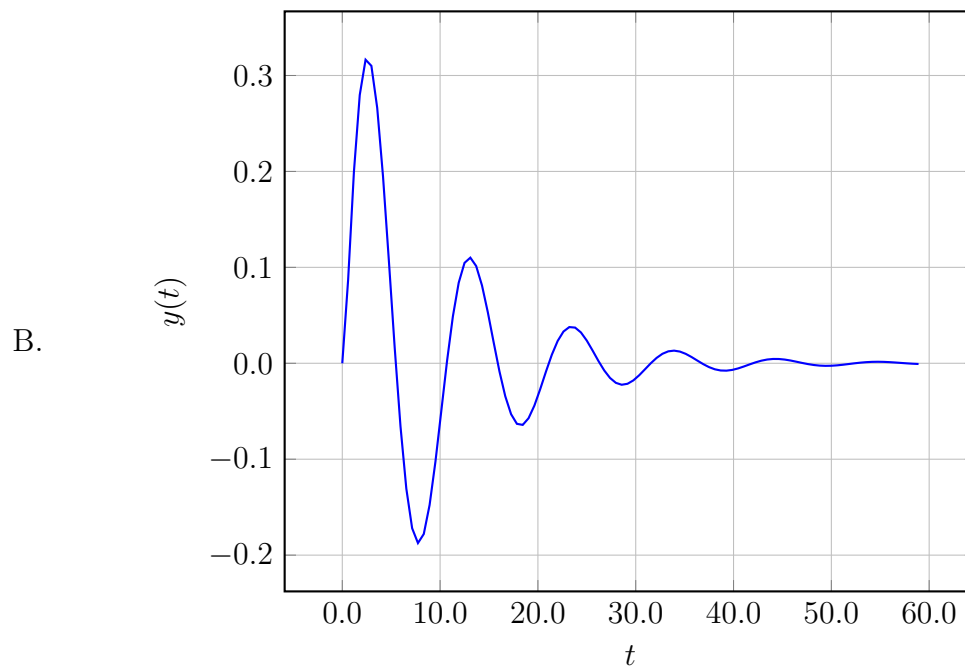
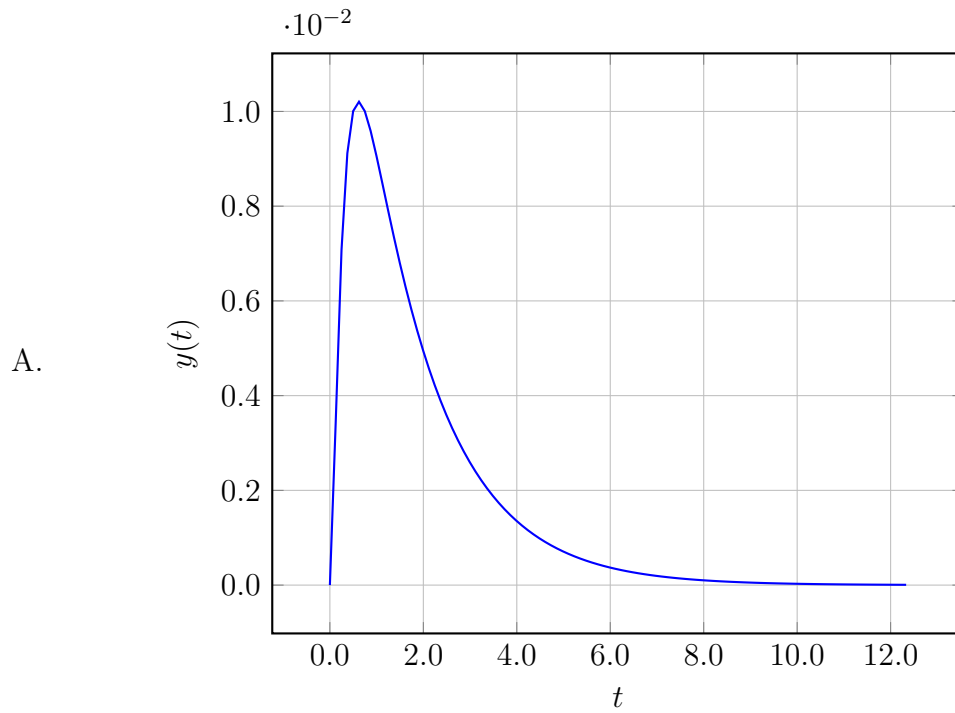
1. (35 points) An open-loop transfer function is given by,

$$G(s) = \frac{1}{s^3 + 2.0s^2 + 3.1111s + 7.1111}$$

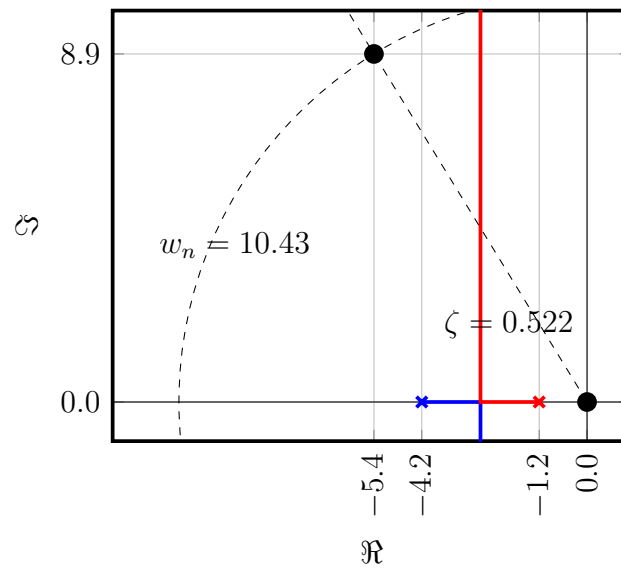
Which of the following PI controllers stabilizes the system in a unit-feedback closed-loop configuration?

- A.  $F(s) = -9.33334 + \frac{2.72221}{s}$
- B.  $F(s) = -2.72221 + \frac{0.6111}{s}$
- C.  $F(s) = 1.16666 + \frac{1.22221}{s}$
- D.  $F(s) = 0.94444 + \frac{2.72221}{s}$
- E.  $F(s) = -9.55556 + \frac{1.22221}{s}$

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?

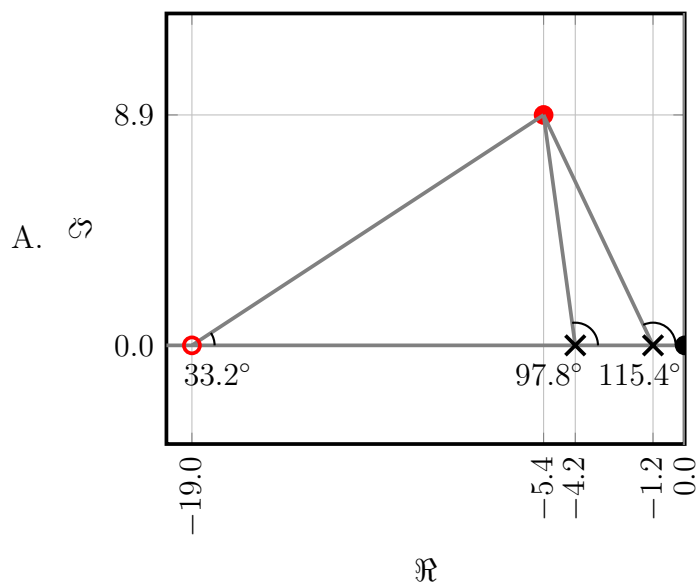


3. (30 points) A design point on the root-locus plot for a P-type controller is shown below.

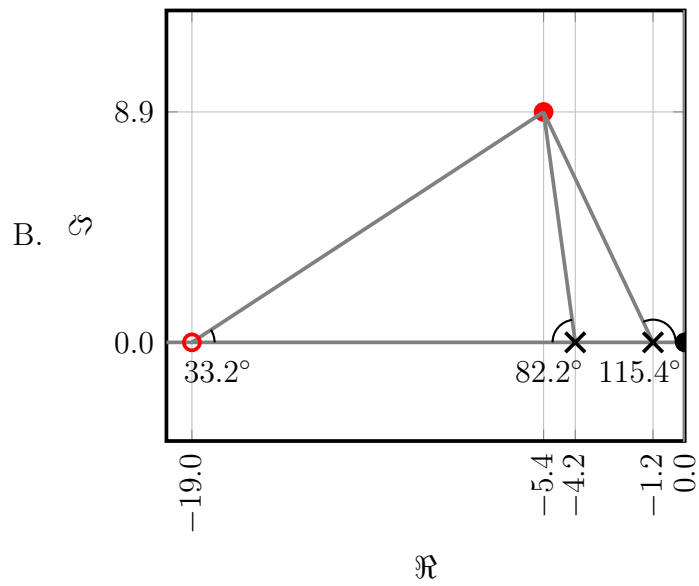


A zero is added so that the root-locus passes through this design point. Which of the following represents the correct angle condition for this design?

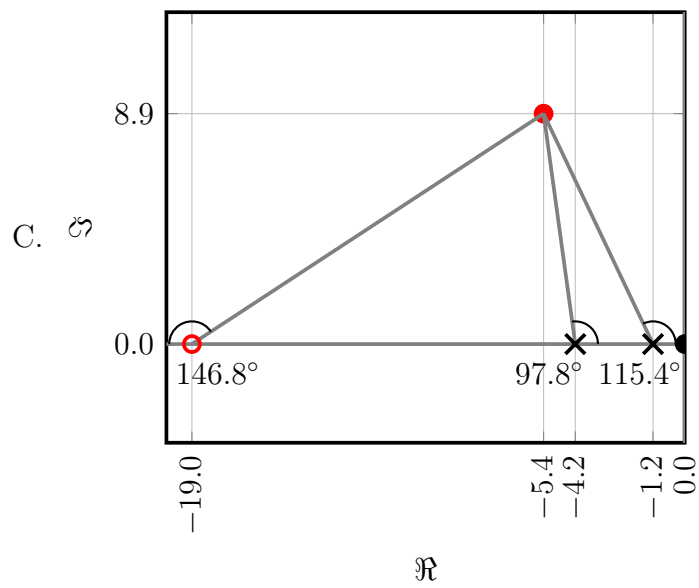
$$\sum \theta = 115.4^\circ + 97.8^\circ - 33.2^\circ =$$



$$\sum \theta = 115.4^\circ + 82.2^\circ + 33.2^\circ =$$



$$\sum \theta = 115.4^\circ + 97.8^\circ + 146.8^\circ =$$



$$\sum \theta = 64.6^\circ + 97.8^\circ + 33.2^\circ =$$

