

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

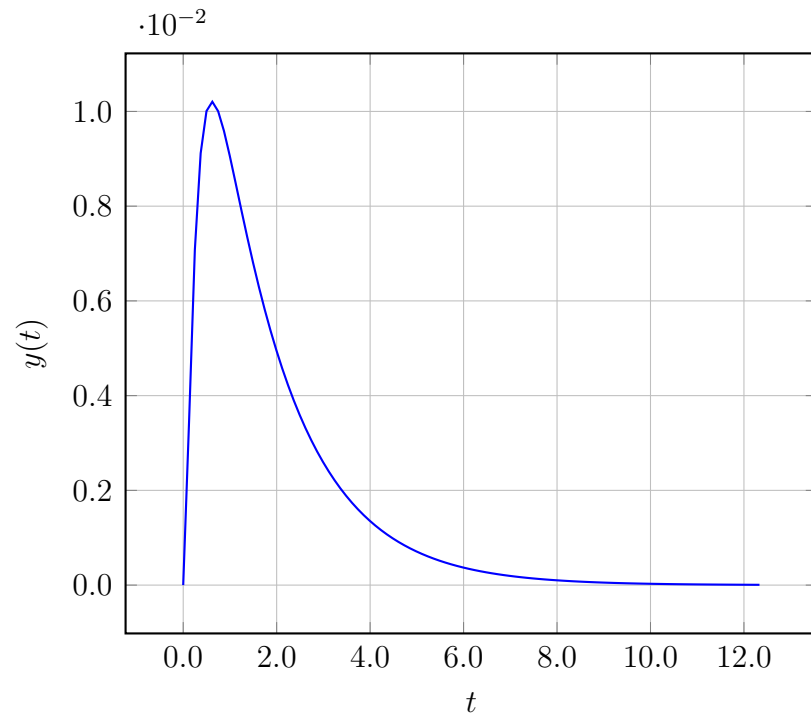
$$G(s) = \frac{1}{s^3 + 2.0s^2 + 3.1111s + 7.1111}$$

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

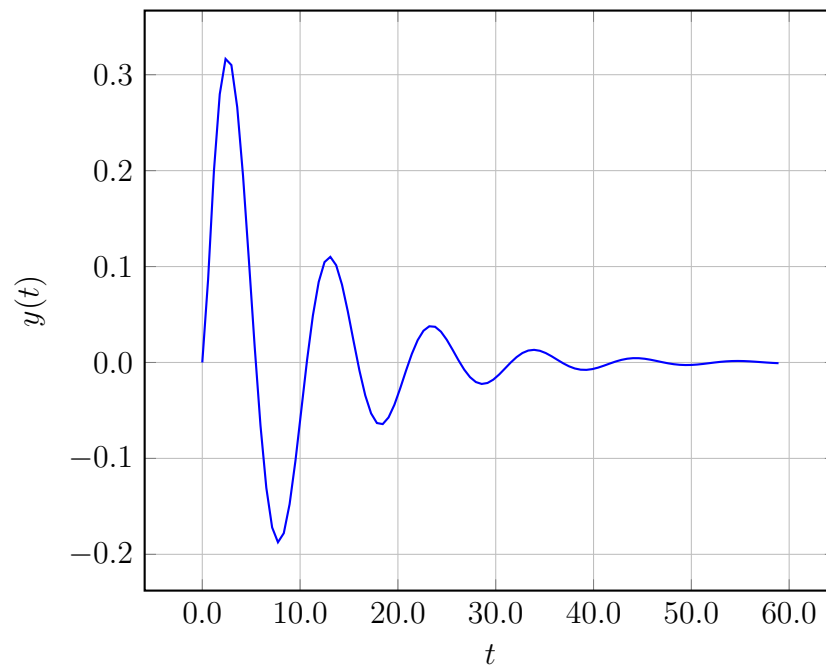
- A.  $F(s) = -9.33334 + \frac{2.72221}{s}$
- B.  $F(s) = -2.72221 + \frac{0.6111}{s}$**
- C.  $F(s) = 1.16666 + \frac{1.22221}{s}$
- D.  $F(s) = 0.94444 + \frac{2.72221}{s}$
- E.  $F(s) = -9.55556 + \frac{1.22221}{s}$

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?

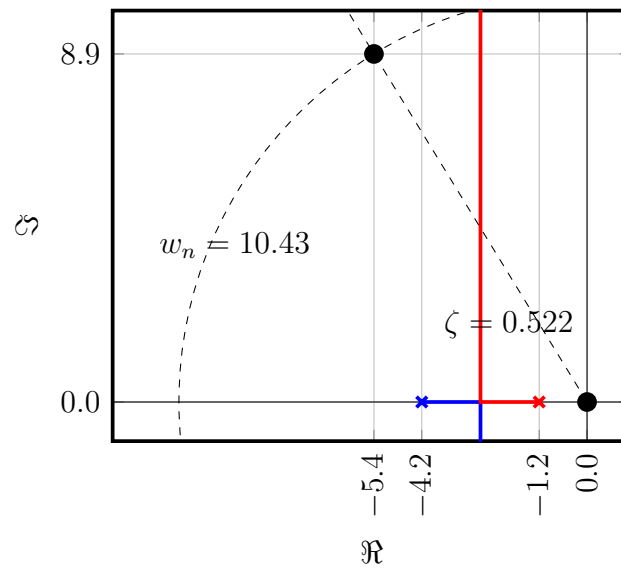
A.



B.

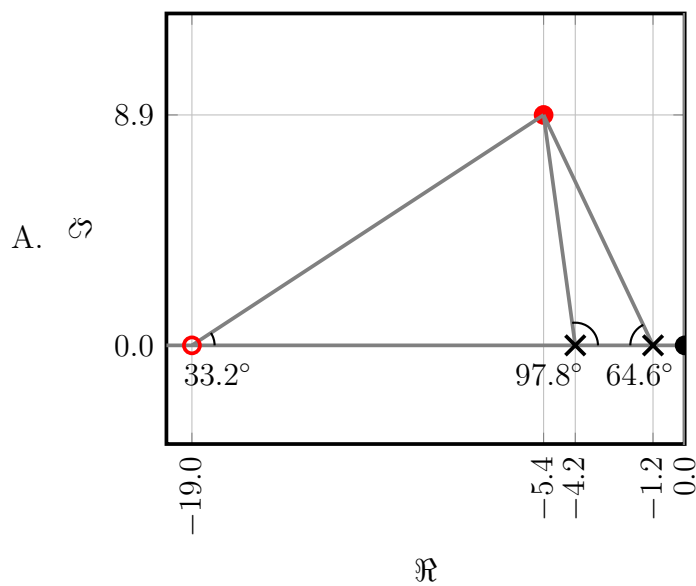


3. (30 points) A design point on the root-locus plot for a P-type controller is shown below.

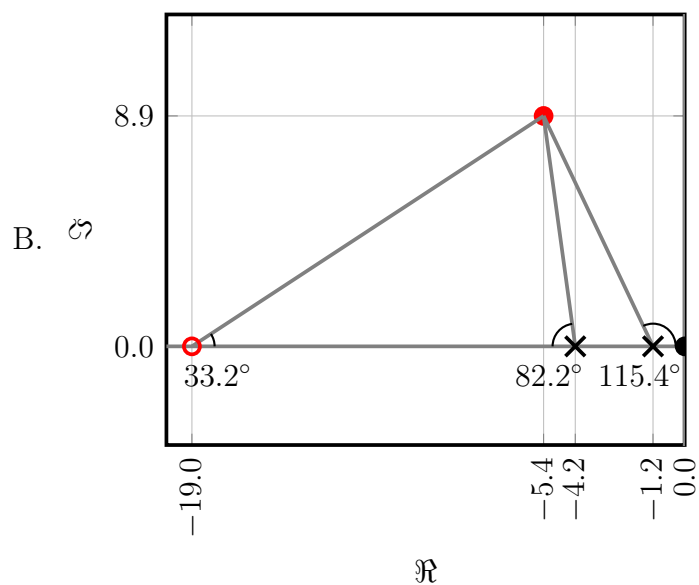


A zero is added so that the root-locus passes through this design point. Which of the following represents the correct angle condition for this design?

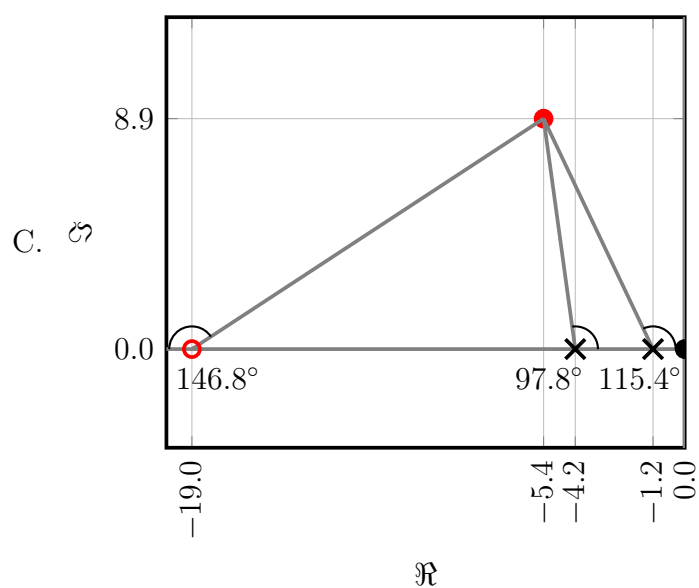
$$\sum \theta = 64.6^\circ + 97.8^\circ + 33.2^\circ = 195.7^\circ$$



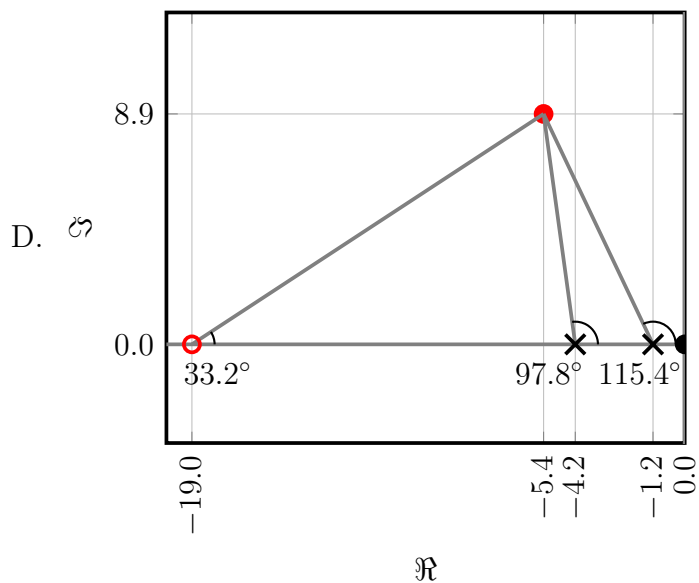
$$\sum \theta = 115.4^\circ + 82.2^\circ + 33.2^\circ = 230.8^\circ$$



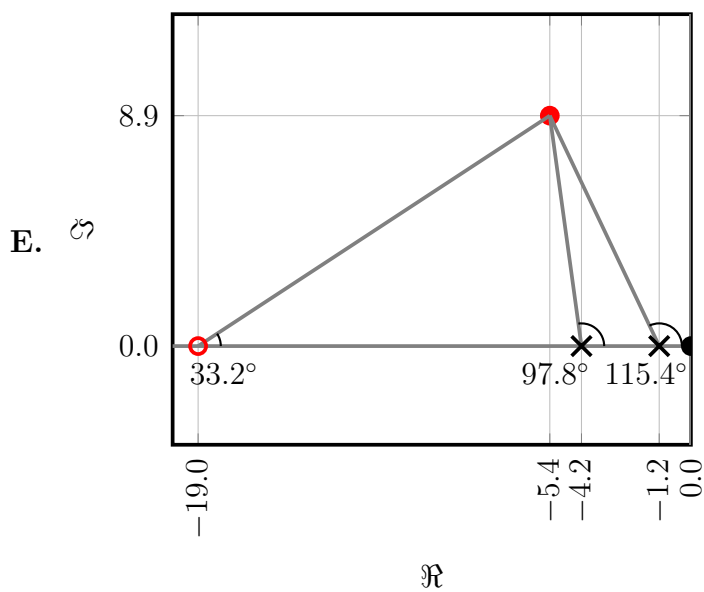
$$\sum \theta = 115.4^\circ + 97.8^\circ + 146.8^\circ = 360.0^\circ$$



$$\sum \theta = 115.4^{\circ} + 97.8^{\circ} + 33.2^{\circ} = 246.5^{\circ}$$



$$\sum \theta = 115.4^{\circ} + 97.8^{\circ} - 33.2^{\circ} = 180.0^{\circ}$$



Q	A
1	B
2	A
3	E