

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

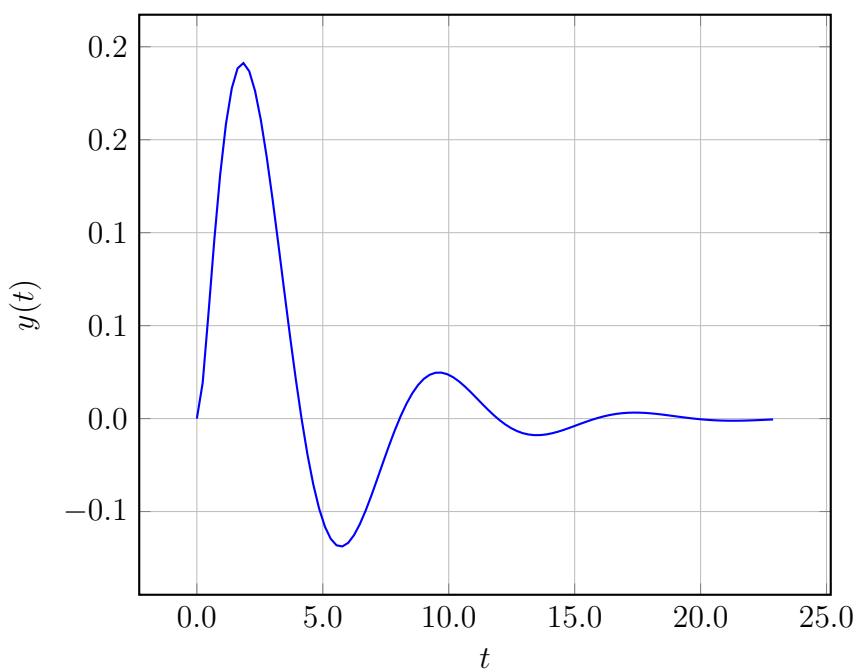
$$G(s) = \frac{1}{s^3 + 2.0s^2 + 3.34848s + 7.34848}$$

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

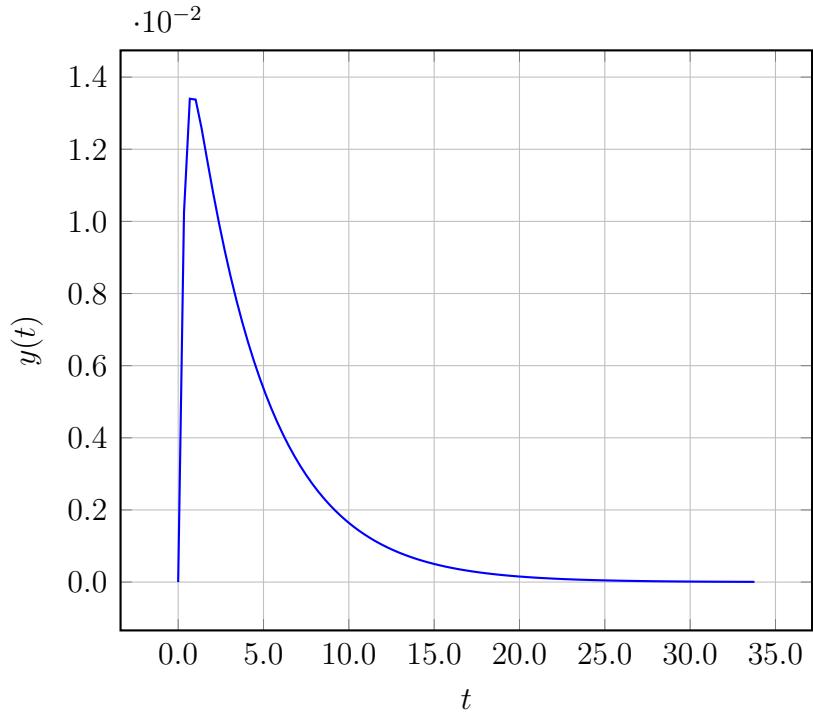
- A.  $F(s) = -3.19696 + \frac{0.84848}{s}$
- B.  $F(s) = -8.60606 + \frac{1.69696}{s}$
- C.  $F(s) = 2.5909 + \frac{1.69696}{s}$
- D.  $F(s) = -7.9091 + \frac{3.19696}{s}$
- E.  $F(s) = 1.89394 + \frac{3.19696}{s}$

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?

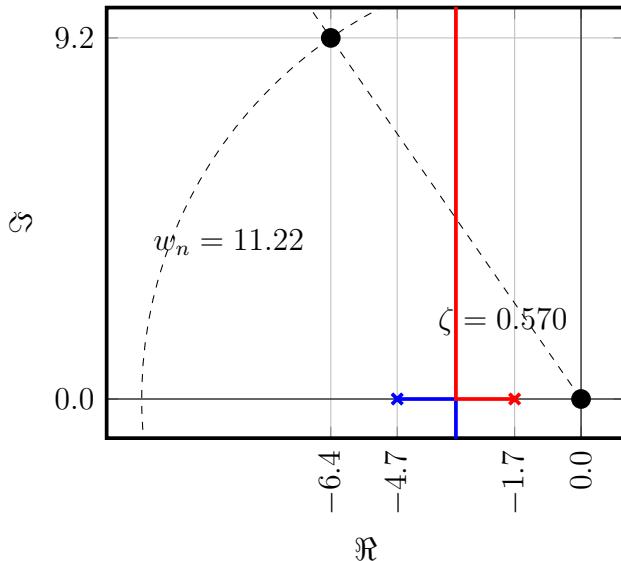
A.



B.

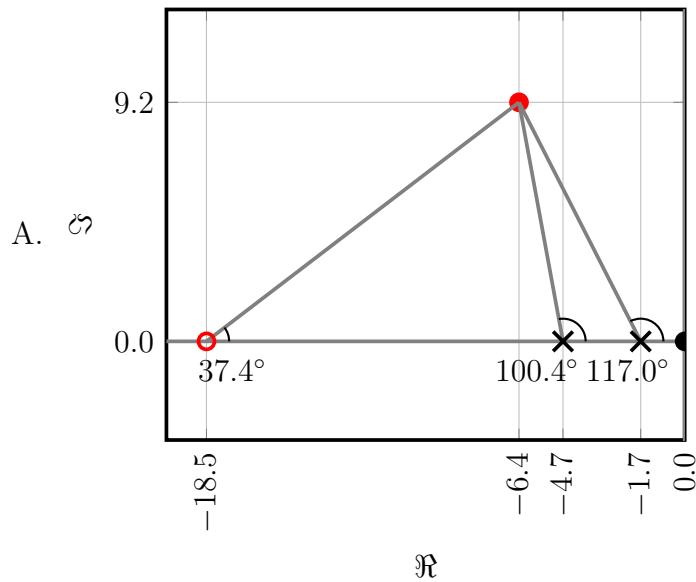


3. (30 points) A design point on the root-locus plot for a P-type controller is shown below.

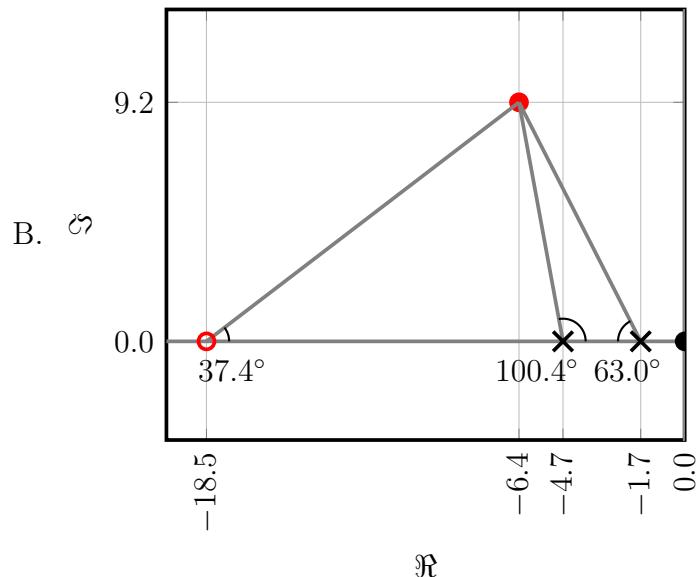


A zero is added so that the root-locus passes through this design point. Which of the following represents the correct angle condition for this design?

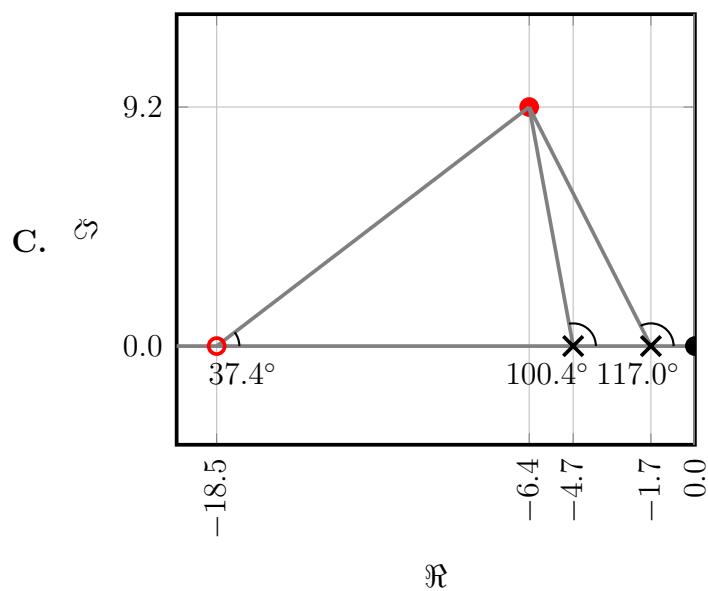
$$\sum \theta = 117.0^\circ + 100.4^\circ + 37.4^\circ = 254.8^\circ$$



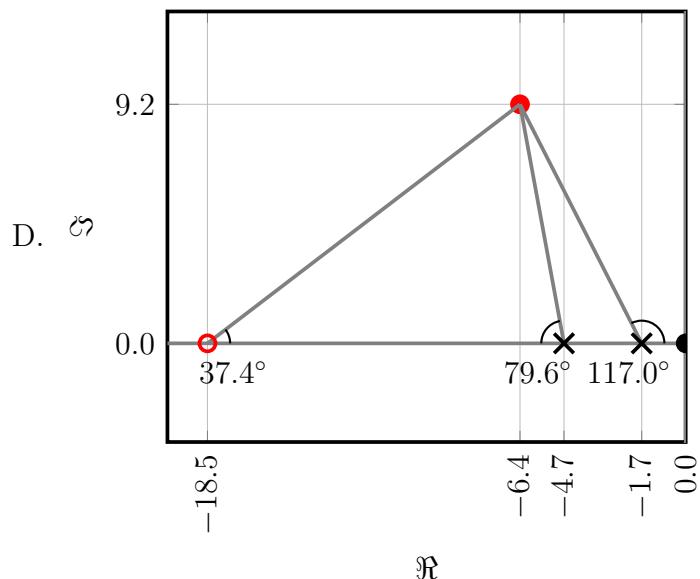
$$\sum \theta = 63.0^\circ + 100.4^\circ + 37.4^\circ = 200.8^\circ$$



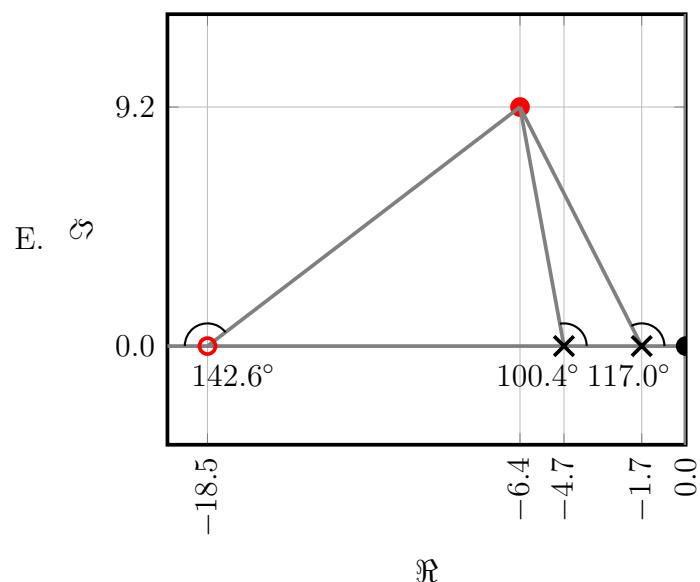
$$\sum \theta = 117.0^\circ + 100.4^\circ - 37.4^\circ = 180.0^\circ$$



$$\sum \theta = 117.0^\circ + 79.6^\circ + 37.4^\circ = 234.0^\circ$$



$$\sum \theta = 117.0^\circ + 100.4^\circ + 142.6^\circ = 360.0^\circ$$



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