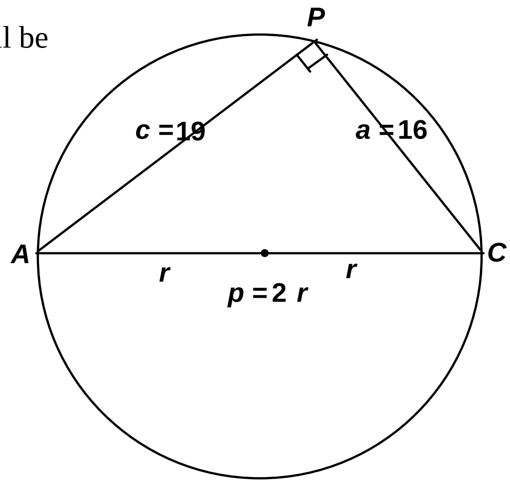
The original problem 5C intended P to be in the interior of the circle, but did not specify that restriction.

Certainly, if $B = P = D$ and $m\angle APC = 90$, then $\angle APC$ will be inscribed in a semi-circle and $r = \dfrac{AC}{2}$ and $AC = \sqrt{16^2 + 19^2} = \sqrt{617}$.



Comparing the squares,
$$\left(\frac{5}{2}\sqrt{17}\right)^2 = \frac{25\cdot 17}{4} = \frac{425}{4}$$
$$\left(\frac{\sqrt{617}}{2}\right)^2 = \frac{617}{4},$$
and we have an answer larger than the “official” answer.

Both answers were accepted.

Extension: Suppose point P had been specified to be on the circle, but the perpendicular condition were omitted. Could we draw any conclusions about the radius r?

By making the angle at P acute (or obtuse), what happens to r?

Consider the radius of a circle circumscribed about a triangle. Let K denote the area of the triangle.

Knowing that $r_{cc} = \dfrac{abc}{4K}$ and $K = \dfrac{1}{2}ab\sin\theta$, where θ is the included angle, we have

$r_{cc} = \dfrac{16\cdot 19\cdot p}{4\left(\frac{1}{2}\cdot 16\cdot 19\cdot \sin P\right)} = \dfrac{p}{2\sin P} = \boxed{\dfrac{p}{2}\cdot\dfrac{1}{\sin P}}$ which reduces to the above answer for $P = 90^\circ$. But,

for any inscribed angle, $\dfrac{1}{\sin P} \geq 1$. The problem is that P and p are not independent of each other.

Using the Law of Cosines and the fact that $\sin^2\theta + \cos^2\theta = 1$, for angle θ, we have

$p^2 = 16^2 + 19^2 - 2\cdot 16\cdot 19\cos P \Rightarrow \cos P = \dfrac{617 - p^2}{2\cdot 16\cdot 19}$ and $\sin^2 P = 1 - \left(\dfrac{617 - p^2}{2\cdot 16\cdot 19}\right)^2$. Consequently,

substituting in the boxed expression above, $r_{cc} = \dfrac{p}{2\sqrt{1 - \left(\dfrac{617 - p^2}{2\cdot 16\cdot 19}\right)^2}}$. Constructing a lookup table for integer values of c from 4 to 34 is enlightening. Mr. TI gives these results:

p	4	5	…	9	10	11	…	24	25
R	13.22	10.97		9.53	9.50	9.51		12.03	12.50
p	26	27	28	29	30	31	32	33	34
R	13.06	13.74	14.56	15.60	16.95	18.80	21.54	26.18	36.74

As P becomes very acute $(P \to 0 \Rightarrow p \to 3)$ and as P becomes very obtuse $(P \to 180^\circ \Rightarrow p \to 35)$, as expected from the Triangle Inequality. In either case, r becomes longer and longer $(r \to \infty)$.

Without the perpendicular restriction, there is no maximum value of r.