◇「콘텐츠산업 진흥법 시행령」제33조에 의한 표시
1) 제작연월일 : 2016-10-25
2) 제작자 : 교육지대㈜
3) 이 콘텐츠는 「콘텐츠산업 진흥법」에 따라 최초 제작일부터 5년간 보호됩니다.

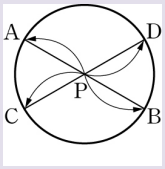
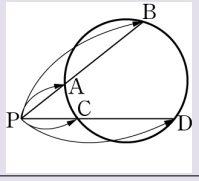
◇「콘텐츠산업 진흥법」외에도「저작권법」에 의하여 보호되는 콘텐츠의 경우, 그 콘텐츠의 전부 또는 일부를 무단으로 복제하거나 전송하는 것은 콘텐츠산업 진흥법 외에도 저작권법에 의한 법적 책임을 질 수 있습니다.

계산시 참고사항

1. 원에서의 비례관계

한 원의 두 현 AB, CD 또는 그 연장선이 서로 만나는 점을 P라 하면

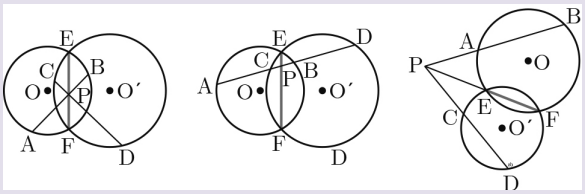
⇨ $\overline{PA}\times\overline{PB}=\overline{PC}\times\overline{PD}$

1) 교점 P가 원의 내부에 있을 때	2) 교점 P가 원의 외부에 있을 때
	

2. 두 원이 공통인 현을 가질 때의 비례관계

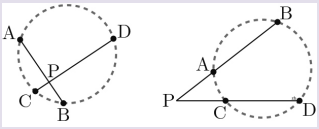
서로 다른 두 점 E, F에서 만날 때, 두 현 AB, CD와 $\overline{EF}$ 또는 두 현 AB, CD의 연장선과 $\overline{EF}$의 연장선이 만나는 점을 P라 하면

⇨ $\overline{PA}\times\overline{PB}=\overline{PC}\times\overline{PD}$



3. 네 점이 한 원 위에 있을 조건②-원과 비례

두 선분 AB, CD 또는 그 연장선이 점 P에서 만나고 $\overline{PA}\times\overline{PB}=\overline{PC}\times\overline{PD}$이면 네 점 ABCD는 한 원 위에 있다.



원에서 비례관계의 설명

◉ △PAC와 △PDB에서

∠CAP = ∠BDP, ∠APC = ∠DPB

이므로△PAC∽△PDB(AA 닮음)

따라서 $\overline{PA}:\overline{PD}=\overline{PC}:\overline{PB}$이므로

$\overline{PA}\times\overline{PB}=\overline{PC}\times\overline{PD}$

참고

◉ 삼각형의 닮음 조건

- SSS 닮음- 세 쌍의 대응변의 길이의 비가 같다.
- SAS 닮음- 두 쌍의 대응변의 길이의 비가 같고, 그 끼인각의 크기가 같다.
- AA 닮음- 두 쌍의 대응각의 크기가 각각 같다.

두 원에서 비례관계

◉ 원 O에서

$\overline{PA}\times\overline{PB}=\overline{PE}\times\overline{PF}$이고,

원 O′에서

$\overline{PC}\times\overline{PD}=\overline{PE}\times\overline{PF}$이므로

$\overline{PA}\times\overline{PB}=\overline{PE}\times\overline{PF}=\overline{PC}\times\overline{PD}$

원에서의 비례관계

◪ 다음 그림에서 x의 값을 구하여라.

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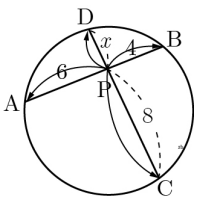

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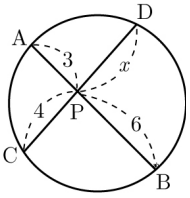

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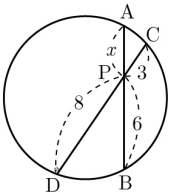

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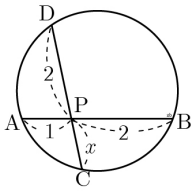

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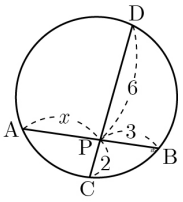

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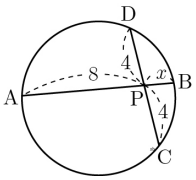

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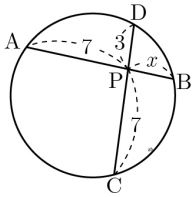

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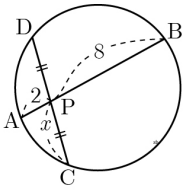

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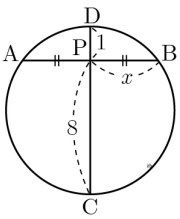

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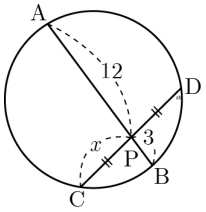

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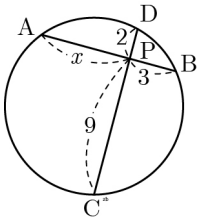

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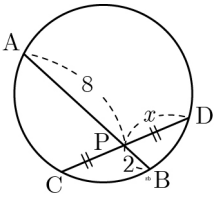

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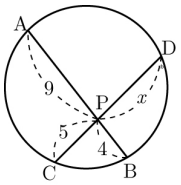

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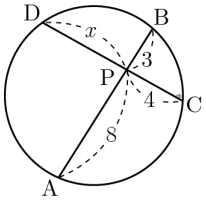

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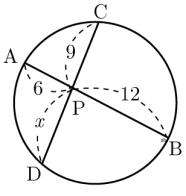

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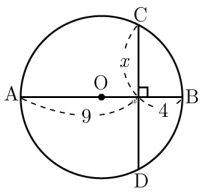

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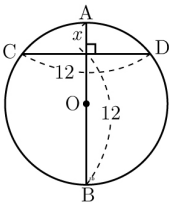

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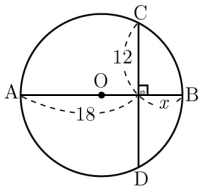

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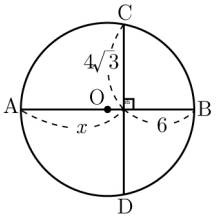

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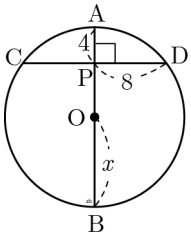

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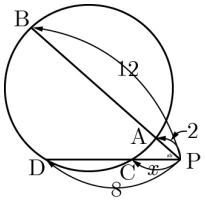

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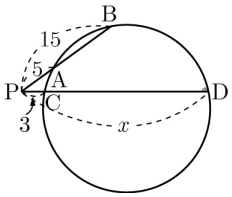

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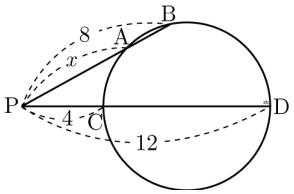

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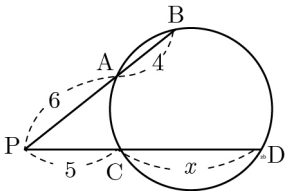

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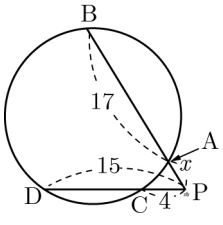

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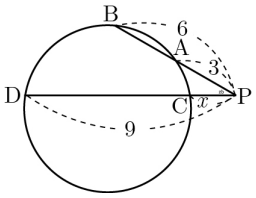

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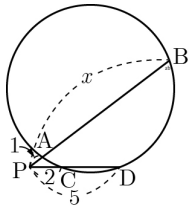

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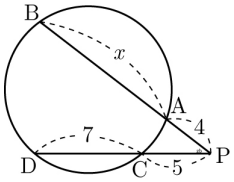

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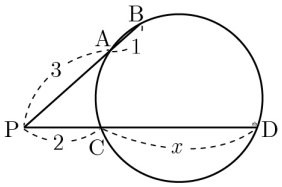

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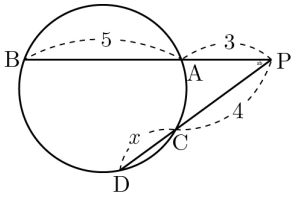

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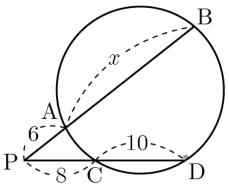

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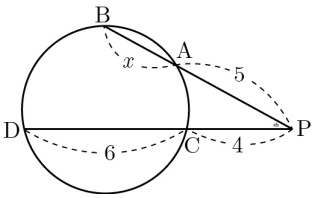

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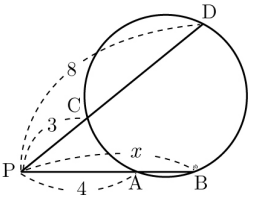

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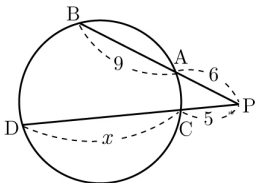

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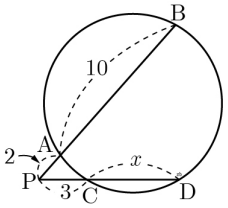

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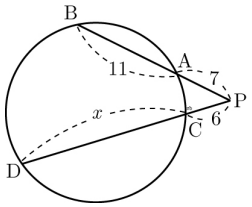

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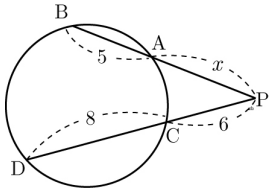

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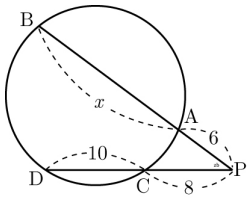

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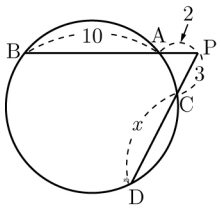

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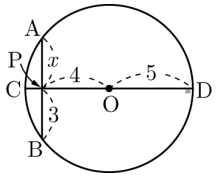

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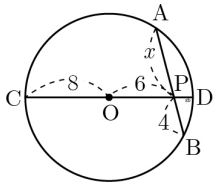
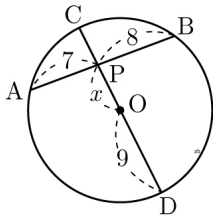
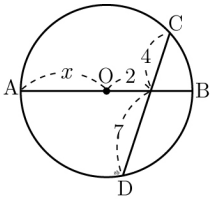


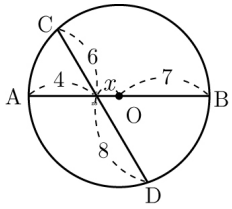
42.



43.



44.



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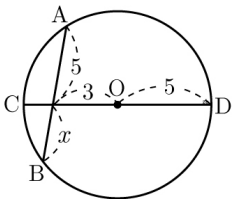
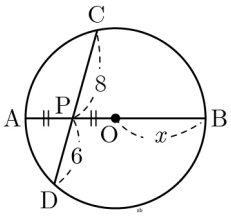
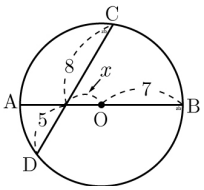
45.



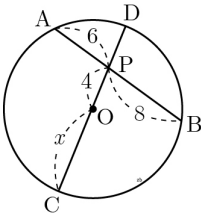
46.



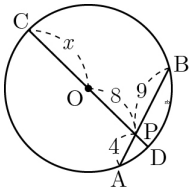
47.



48.

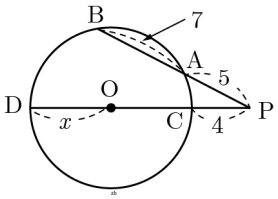


49.

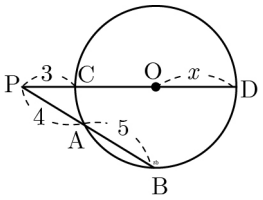


◪ 다음 그림에서 x의 값을 구하여라.

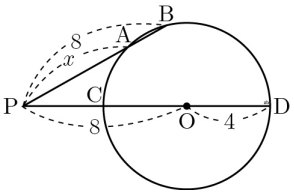
50.



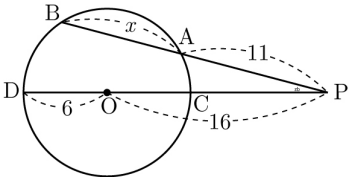
51.



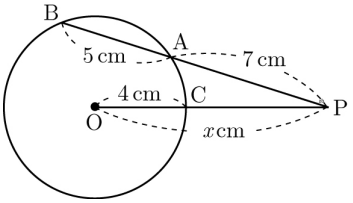
52.



53.



54.



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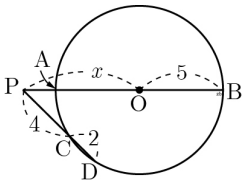
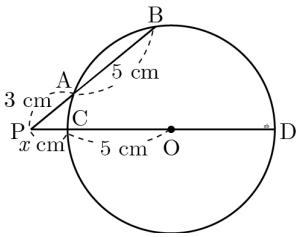
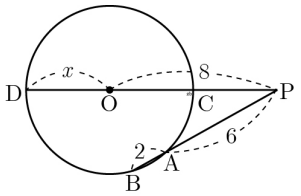
55.



56.

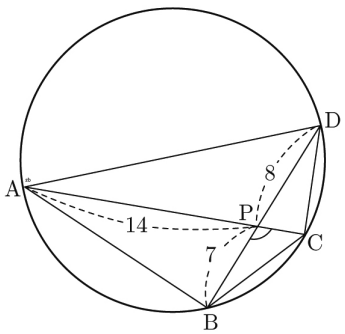


57.

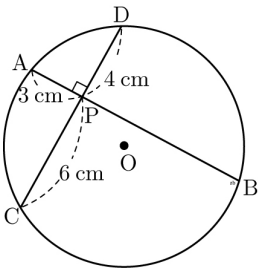


◪ 다음 물음에 답하여라.

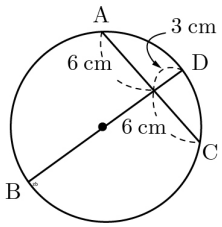
58. 다음 그림과 같이 원 O에 내접하는 □ABCD에서 두 대각선이 점 P에서 만나고, $\angle BPC = 135^\circ$, $\overline{PA}=14$, $\overline{PB}=7$, $\overline{PD}=8$일 때, □ABCD의 넓이를 구하여라.



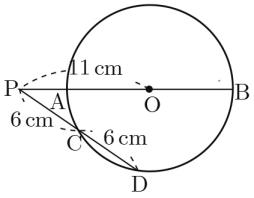
59. 다음 그림과 같이 원 O의 두 현 AB와 CD는 점 P에서 직교한다. $\overline{PA}=3\,\text{cm}$, $\overline{PC}=6\,\text{cm}$, $\overline{PD}=4\,\text{cm}$일 때, 원 O의 넓이를 구하여라.



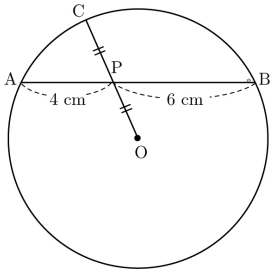
60. 다음 그림에서 $\overline{AC}\perp\overline{BD}$이고, $\overline{AM}=\overline{CM}=6\,\text{cm}$, $\overline{DM}=3\,\text{cm}$일 때, 원의 둘레의 길이를 구하여라.



61. 다음 그림에서 $\overline{PB}$는 원 O의 중심을 지나고 $\overline{PO}=11\text{cm}$, $\overline{PC}=\overline{CD}=6\text{cm}$일 때, 원 O의 둘레의 길이를 구하여라.



62. 다음 그림에서 $\overline{OP}=\overline{CP}$, $\overline{AP}=4\text{cm}$, $\overline{BP}=6\text{cm}$일 때, 원 O의 넓이를 구하여라.



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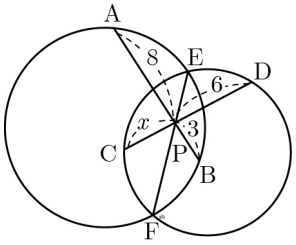
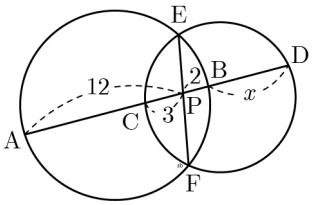
두 원이 공통인 현을 가질 때

◪ 다음 그림에서 $\overline{EF}$는 두 원 O와 O′의 공통현일 때, x의 값을 구하여라.

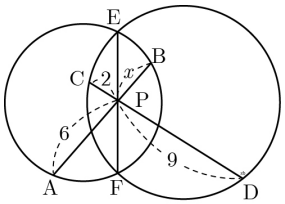
63.



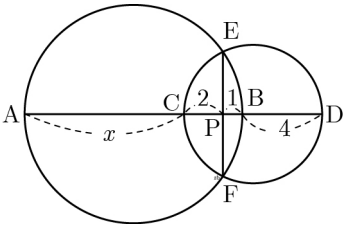
64.



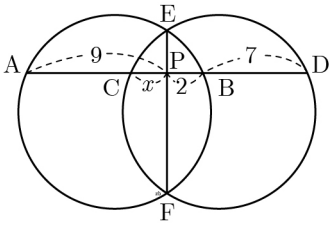
65.



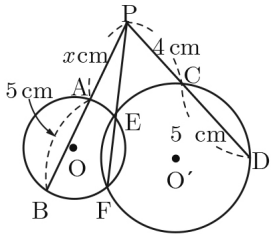
66.



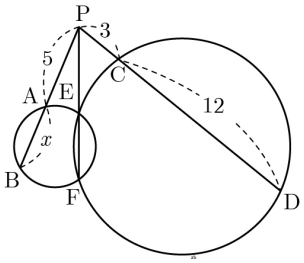
67.



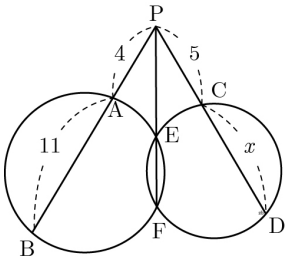
68.



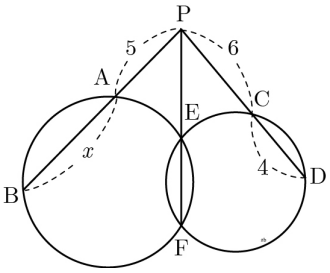
69.



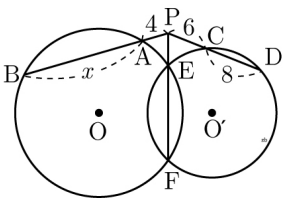
70.



71.



72.



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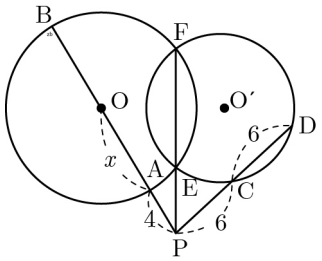
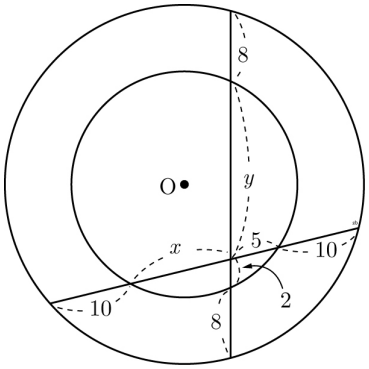
73.

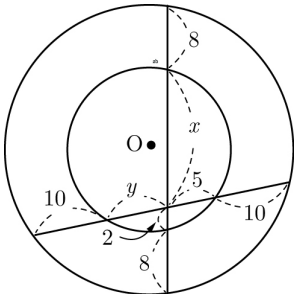


◪ 다음 물음에 답하여라.

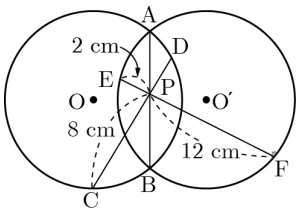
74. 다음 그림은 중심이 같은 두 원이다. 이 때, $x+4y$의 값을 구하여라.



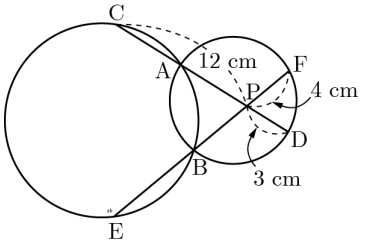
75. 다음 그림은 중심이 같은 두 원이다. x, y의 값을 각각 구하여라.



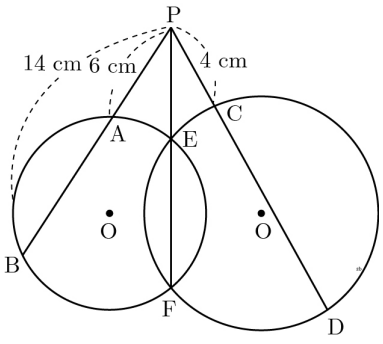
76. 다음 그림에서 두 원 O, O′이 두 점 A, B에서 만나고 $\overline{EP}=2\,\text{cm}$, $\overline{PC}=8\,\text{cm}$, $\overline{PF}=12\,\text{cm}$일 때, $\overline{PD}$의 길이를 구하여라.



77. 그림과 같이 두 원의 교점 A, B를 각각 지나는 두 직선이 점 P에서 만난다. $\overline{CP}=12\,\text{cm}$, $\overline{PD}=3\,\text{cm}$, $\overline{PF}=4\,\text{cm}$일 때, $\overline{PE}$의 길이를 구하여라.



78. 그림에서 $\overline{EF}$는 두 원 O, O′의 공통현이고, $\overline{PA}=6\text{cm}$, $\overline{PB}=14\text{cm}$, $\overline{PC}=4\text{cm}$일 때, $\overline{CD}$의 길이를 구하여라.



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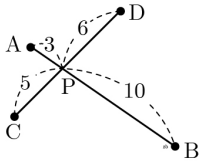
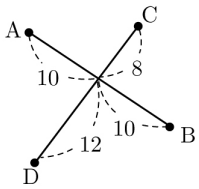
네 점이 한 원위에 있을 조건②

◪ 다음 그림에서 네 점 A, B, C, D가 한 원 위에 있으면 ○표, 한 원 위에 있지 않으면 ×표를 하여라.

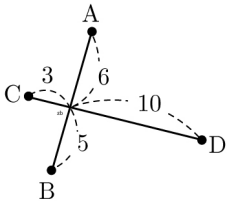
79. ( )



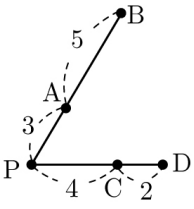
80. ( )



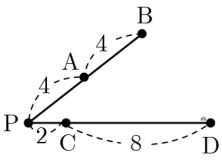
81. ( )



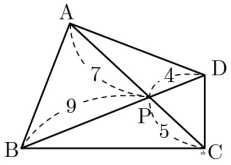
82. ( )



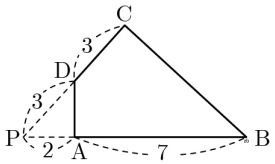
83. ( )



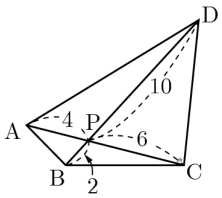
84. ( )



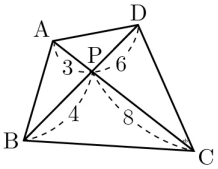
85. ( )



86. ( )



87. ( )



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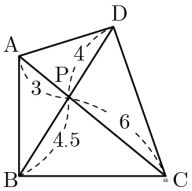

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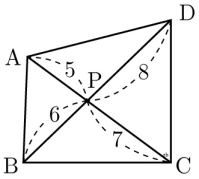

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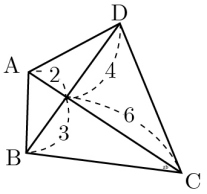
90. ( )



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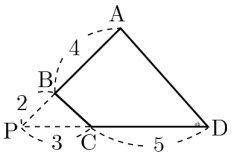

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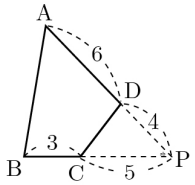

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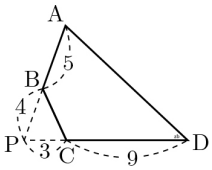

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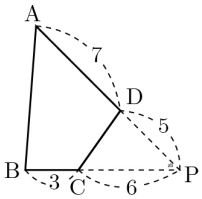

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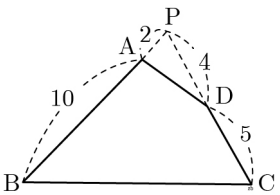
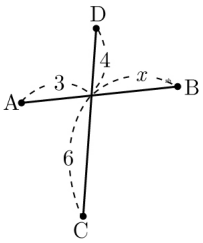


◪ 다음 그림에서 네 점 A, B, C, D가 한 원 위에 있도록 하는 x의 값을 구하여라.

96.



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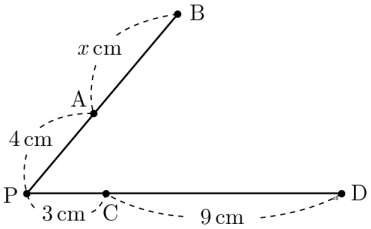

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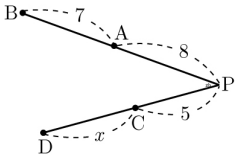

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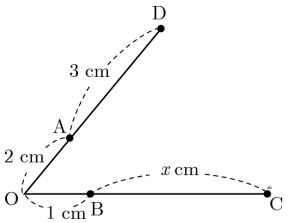

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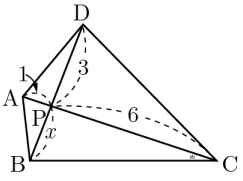

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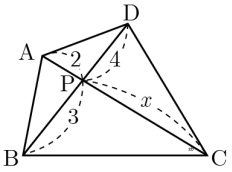
101



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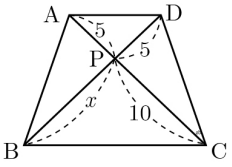

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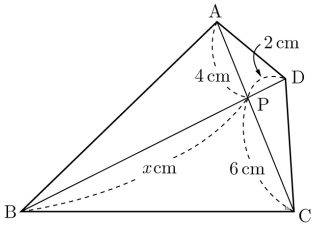

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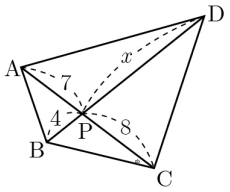

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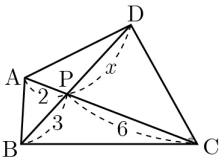

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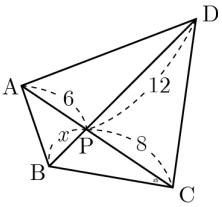

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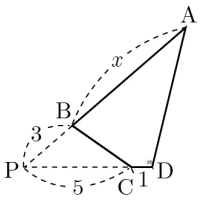

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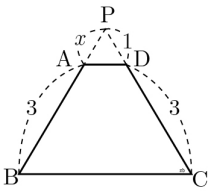

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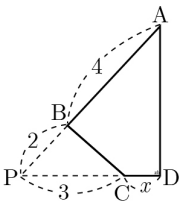

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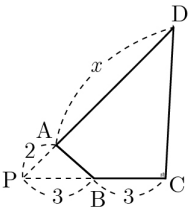

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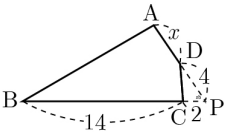

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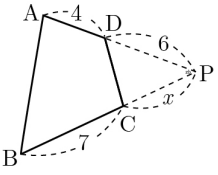

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정답 및 해설

1) 3
⇨ $6\times4=8\times x$ $\therefore\ x=3$

2) $\frac{9}{2}$
⇨ $4\times x=3\times6$ $\therefore x=\frac{9}{2}$

3) 4
⇨ $x\times6=3\times8$ $\therefore x=4$

4) 1
⇨ $1\times2=x\times2$ $\therefore\ x=1$

5) 4
⇨ $x\times3=2\times6$ $\therefore\ x=4$

6) 2
⇨ $8\times x=4\times4$ $\therefore\ x=2$

7) 3
⇨ $7\times x=7\times3$ $\therefore\ x=3$

8) 4
⇨ $x^2=2\times8$ $\therefore\ x=4(x>0)$

9) $2\sqrt{2}$
⇨ $x^2=8\times1$ $\therefore\ x=2\sqrt{2}(x>0)$

10) 6
⇨ $x^2=12\times3$ $\therefore\ x=6(x>0)$

11) 6
⇨ $x\times3=9\times2$ $\therefore x=6$

12) 4
⇨ $\overline{PC}=\overline{PD}=x$이므로
$8\times2=x\times x,\ x^2=16$ $\therefore x=4(\because x>0)$

13) $\frac{36}{5}$
⇨ $5\times x=9\times4$ $\therefore x=\frac{36}{5}$

14) 6
⇨ $8\times3=4\times x$ $\therefore x=6$

15) 9
⇨ $9\times x=6\times12$ $\therefore x=9$

16) 6
⇨ $x^2=9\times4=36$ $\therefore x=6$

17) 3
⇨ $x\times12=6^2$ $\therefore x=3$

18) 8
⇨ $18\times x=12^2$ $\therefore x=8$

19) 8
⇨ $x\times6=(4\sqrt{3})^2$ $\therefore x=8$

20) 10
⇨ $\overline{PC}=\overline{PD}=8,\ \overline{OA}=\overline{OB}=x$이므로 $\overline{OP}=x-4$
이때 $\overline{PA}\cdot\overline{PB}=\overline{PC}\cdot\overline{PD}$이므로
$4\times\{(x-4)+x\}=8\times8$
$4(2x-4)=64, 2x-4=16$ $\therefore x=10$

21) 3
⇨ $2\times12=x\times8$ $\therefore\ x=3$

22) 25
⇨ $5\times15=3\times x$ $\therefore\ x=25$

23) 6
⇨ $x\times8=4\times12$ $\therefore\ x=6$

24) 7
⇨ $6\times(6+4)=5\times(5+x)$에서
$5x=35$ $\therefore x=7$

25) 3
⇨ $x\times(x+17)=4\times15$에서
$x^2+17x-60=0,\ (x+20)(x-3)=0$
$\therefore x=3(\because x>0)$

26) 2
⇨ $3\times6=x\times9$ $\therefore\ x=2$

27) 10
⇨ $1\times x=2\times5$ $\therefore\ x=10$

28) 11
⇨ $4\times(4+x)=5\times(5+7)$
$4+x=15$ $\therefore\ x=11$

29) 4
⇨ $3\times(3+1)=2\times(2+x)$
$2+x=6$ $\therefore\ x=4$

30) 2
⇨ $3\times(3+5)=4\times(4+x), 4+x=6$ $\therefore\ x=2$

31) 18
⇨ $6\times(6+x)=8\times(8+10), 6+x=24$ $\therefore\ x=18$

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32) 3
⇨ $5\times(5+x)=4\times(4+6), 5+x=8 \quad \therefore\ x=3$

33) 6
⇨ $4\times x=3\times 8 \quad \therefore x=6$

34) 13
⇨ $5\times(5+x)=6\times 15 \quad \therefore x=13$

35) 5
⇨ $2\times(2+10)=3\times(3+x),\ 3+x=8 \quad \therefore x=5$

36) 15
⇨ $6\times(6+x)=7\times 18 \quad \therefore x=15$

37) 7
⇨ $x\times(x+5)=6\times 14,\ x^2+5x-84=0$
$(x-7)(x+12)=0 \quad \therefore x=7$

38) 18
⇨ $6\times(6+x)=8\times 18 \quad \therefore x=18$

39) 5
⇨ $3\times(3+x)=2\times 12 \quad \therefore x=5$

40) 3
⇨ $3\times x=5^2-4^2 \quad \therefore\ x=3$

41) 7
⇨ $4\times x=8^2-6^2 \quad \therefore\ x=7$

42) 5
⇨ $7\times 8=9^2-x^2, x^2=25 \quad \therefore\ x=5(x>0)$

43) $4\sqrt{2}$
⇨ $(x+2)(x-2)=4\times 7 \quad \therefore x=4\sqrt{2}$

44) 5
⇨ $4\times(x+7)=6\times 8 \quad \therefore x=5$

45) $\frac{16}{5}$
⇨ $2\times 8=5\times x \quad \therefore x=\frac{16}{5}$

46) 8
⇨ $\overline{OA}=\overline{OB}=x$이므로 $\overline{PA}=\overline{PO}=\frac{x}{2}$
이때 $\overline{PA}\cdot\overline{PB}=\overline{PC}\cdot\overline{PD}$이므로
$\frac{x}{2}\times\left(\frac{x}{2}+x\right)=8\times 6$
$\frac{3}{4}x^2=48, x^2=64 \quad \therefore x=8(\because x>0)$

47) 3
⇨ $(7-x)(7+x)=8\times 5 \quad \therefore x=3$

48) 8
⇨ $6\times 8=x^2-4^2, x^2=64 \quad \therefore x=8(x>0)$

49) 10
⇨ $4\times 9=x^2-8^2, x^2=100 \quad \therefore\ x=10(x>0)$

50) $\frac{11}{2}$
⇨ $\overline{OC}=\overline{OD}=x$이고, $\overline{PA}\cdot\overline{PB}=\overline{PC}\cdot\overline{PD}$이므로
$5\times(5+7)=4\times(2x+4)$
$2x+4=15 \quad \therefore x=\frac{11}{2}$

51) $\frac{9}{2}$
⇨ $\overline{OC}=\overline{OD}=x$이고, $\overline{PA}\cdot\overline{PB}=\overline{PC}\cdot\overline{PD}$이므로
$4\times(4+5)=3\times(3+2x)$
$3+2x=12 \quad \therefore x=\frac{9}{2}$

52) 6
⇨ $x\times 8=8^2-4^2 \quad \therefore\ x=6$

53) 9
⇨ $11\times(11+x)=16^2-6^2$
$11+x=20 \quad \therefore\ x=9$

54) 10
⇨ $\overline{OC}$의 연장선이 원과 만나는 점을 D라고 하면
$(x-4)(x+4)=7\times(7+5),\ x^2-16=84,$
$x^2=84+16=100 \quad \therefore\ x=10(x>0)$

55) 7
⇨ $4\times(4+2)=x^2-5^2 \quad \therefore\ x=7(x>0)$

56) 2
⇨ $\overline{PA}\times\overline{PB}=\overline{PC}\times\overline{PD}$이므로
$3\times 8=x(x+10),\ x^2+10x-24=0$
$(x+12)(x-2)=0 \quad \therefore\ x=2(\because x>0)$

57) 4
⇨ $6\times(6+2)=8^2-x^2 \quad \therefore\ x=4(x>0)$

58) $\frac{135\sqrt{2}}{2}$
⇨ 원과 비례의 성질에 의해서
$\overline{PC}\times 14=8\times 7,\ \overline{PC}=4$
(□ABCD의 넓이)
$=\frac{1}{2}\times 18\times 15\times\sin(180^\circ-135^\circ)$

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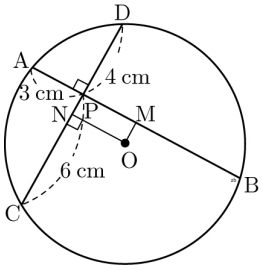
$= \frac{1}{2} \times 18 \times 15 \times \frac{\sqrt{2}}{2} = \frac{135\sqrt{2}}{2}$

59) $\frac{125}{4}\pi\ \mathrm{cm}^2$

⇨ 원과 비례에 의해서 $\overline{PA} \times \overline{PB} = \overline{PC} \times \overline{PD}$

$3 \times \overline{PB} = 4 \times 6 \quad \therefore\ \overline{PB} = 8$



원의 중심 O에서 현 AB, CD에 내린 수선의 발을 M, N이라 하면 현 AB, CD를 이등분하므로

$\overline{CN} = \frac{1}{2} \times \overline{CD} = \frac{1}{2} \times 10 = 5\,(\mathrm{cm})$,

$\overline{MB} = \frac{1}{2} \times \overline{AB} = \frac{11}{2}\,(\mathrm{cm})$

$\overline{PM} = \frac{11}{2} - 3 = \frac{5}{2}\,(\mathrm{cm})$이므로 $\overline{ON} = \frac{5}{2}\mathrm{cm}$이다.

$\triangle OCN$에서 $\overline{OC} = \sqrt{5^2 + \left(\frac{5}{2}\right)^2} = \frac{5\sqrt{5}}{2}(\mathrm{cm})$

따라서 원의 반지름의 길이가 $\frac{5\sqrt{5}}{2}\mathrm{cm}$이므로 원의 넓이는 $\frac{125}{4}\pi\mathrm{cm}^2$이다.

60) $15\pi\ \mathrm{cm}$

⇨ 원의 반지름의 길이를 r이라고 하면

$6 \times 6 = 3 \times (r - 3 + r),\ 2r - 3 = 12$

$2r = 15 \quad \therefore\ r = \frac{15}{2}(\mathrm{cm})$

따라서 원의 둘레의 길이는 $2\pi \times \frac{15}{2} = 15\pi(\mathrm{cm})$가 된다.

61) $14\pi\mathrm{cm}$

⇨ 원의 반지름의 길이를 $r\mathrm{cm}$라 하면

$6 \times (6+6) = (11-r)(11+r)$

$r^2 = 49 \quad \therefore\ r = 7 (r > 0)$

따라서 원 O의 둘레의 길이는 $14\pi\mathrm{cm}$이다.

62) $32\pi\mathrm{cm}^2$

⇨ 직선 CP가 원과 만나는 점을 D라 하면

$\overline{OD} = r,\ \overline{OP} = \overline{PC} = \frac{r}{2}$라 하면

$\overline{PA} \times \overline{PB} = \overline{PC} \times \overline{PD},\ 24 = \frac{r}{2} \times \frac{3}{2}r$

$\frac{3}{4}r^2 = 24 \quad \therefore\ r^2 = 32$

그러므로 원의 넓이는 $\pi r^2 = 32\pi(\mathrm{cm}^2)$이다.

63) 4

⇨ $8 \times 3 = x \times 6 \quad \therefore x = 4$

64) 6

⇨ $12 \times 2 = 3 \times (2+x)$에서

$2 + x = 8 \quad \therefore x = 6$

65) 3

⇨ $6 \times x = 2 \times 9 \quad \therefore x = 3$

66) 8

⇨ $(x+2) \times 1 = 2 \times (1+4)$에서

$x + 2 = 10 \quad \therefore x = 8$

67) 2

⇨ $9 \times 2 = x \times (2+7) \quad \therefore x = 2$

68) 4

⇨ $x(x+5) = 4 \times (4+5)$이므로

$x^2 + 5x - 36 = 0,\ (x+9)(x-4) = 0$

$\therefore\ x = 4\ (x > 0)$

69) 4

⇨ $5 \times (5+x) = 3 \times (3+12)$에서

$5 + x = 9 \quad \therefore x = 4$

70) 7

⇨ $4 \times (4+11) = 5 \times (5+x)$에서

$5 + x = 12 \quad \therefore x = 7$

71) 7

⇨ 왼쪽 원에서 $\overline{PA} \times \overline{PB} = \overline{PE} \times \overline{PF}$

오른쪽 원에서 $\overline{PE} \times \overline{PF} = \overline{PC} \times \overline{PD}$

$\therefore\ \overline{PA} \times \overline{PB} = \overline{PC} \times \overline{PD}$

$5(5+x) = 6 \times 10,\ 5 + x = 12 \quad \therefore\ x = 7$

72) 17

⇨ $4 \times (4+x) = 6 \times (6+8) \quad \therefore\ x = 17$

73) 7

⇨ $\overline{OA} = \overline{OB} = x$이므로 $4 \times (4+2x) = 6 \times (6+6)$

$4 + 2x = 18 \quad \therefore x = 7$

74) 77

⇨ 작은 원에서 $5x = 2y \quad \therefore\ y = \frac{5}{2}x$

큰 원에서 $15(x+10) = 10(y+8)$

$15x + 150 = 25x + 80,\ 10x = 70$

$\therefore\ x = 7,\ y = \frac{35}{2}$

$\therefore\ x + 4y = 7 + 70 = 77$

75) $x = \frac{35}{2},\ y = 7$

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76) 3cm

77) 16cm

78) 17
⇨ $\overline{CD}=x$ 라고 하자.
원과 비례의 성질에 의해서 $6\times14=4\times(4+x)$
$84=16+4x,\ 4x=68,\ x=17$
따라서 $\overline{CD}=17$ 이 된다.

79) ○
⇨ $3\times10=5\times6$이므로 네 점 A,B,C,D는 한 원 위에 있다.

80) ×
⇨ $10\times10\neq12\times8$

81) ○

82) ○

83) ×
⇨ $4\times(4+4)\neq2\times(2+8)$이므로 네 점 A,B,C,D는 한 원 위에 있지 않다.

84) ×
⇨ $7\times5\neq9\times4$이므로 네 점 A,B,C,D는 한 원 위에 있지 않다.

85) ○
⇨ $2\times(2+7)=3\times(3+3)$이므로 네 점 A,B,C,D는 한 원 위에 있다.

86) ×
⇨ $4\times6\neq2\times10$이므로 네 점A, B, C, D는 한 원위에 있지 않다.

87) ○
⇨ $3\times8=4\times6$이므로 네 점A, B, C, D는 한 원위에 있다.

88) ○
⇨ $3\times6=4\times4.5$이므로 네 점 A,B,C,D는 한 원 위에 있다.

89) ×
⇨ $5\times7\neq6\times8$이므로 네 점A, B, C, D는 한 원위에 있지 않다.

90) ○
⇨ $2\times6=3\times4$이므로 네 점A, B, C, D는 한 원위에 있다.

91) ×
⇨ $2\times(2+4)\neq3\times(3+5)$이므로 네 점A, B, C, D는 한 원 위에 있지 않다.

92) ○
⇨ $4\times(4+6)=5\times(5+3)$이므로 네 점A, B, C, D는 한 원 위에 있다.

93) ○
⇨ $4\times(4+5)=3\times(3+9)$이므로 네 점A, B, C, D는 한 원 위에 있다.

94) ×
⇨ $5\times(5+7)\neq6\times(6+3)$이므로 네 점A, B, C, D는 한 원 위에 있지 않다.

95) ×
⇨ $2\times(2+10)\neq4\times(4+5)$이므로 네 점 A,B,C,D는 한 원 위에 있지 않다.

96) 8
⇨ $3\times x=4\times6$ $\therefore x=8$

97) 5
⇨ 원과 비례의 성질에 의해서
$4\times(4+x)=3\times(3+9),\ 4+x=9,\ x=5$ 가 된다.

98) 19
⇨ $5\times(5+x)=8\times15$ $\therefore x=19$

99) 9
⇨ $\overline{OA}\times\overline{OD}=\overline{OB}\times\overline{OC},\ 2\times5=1\times(1+x)$
$1+x=10$ $\therefore\ x=9$

100) 2
⇨ $1\times6=x\times3$ $\therefore\ x=2$

101) 6
⇨ $2\times x=3\times4$ $\therefore\ x=6$

102) 10
⇨ $x\times5=5\times10$ $\therefore\ x=10$

103) 12
⇨ $x\times2=4\times6$ $\therefore x=12$

104) 14
⇨ $7\times8=4\times x$ $\therefore\ x=14$

105) 4
⇨ $3\times x=2\times6$ $\therefore\ x=4$

106) 4
⇨ $6\times8=x\times12$ $\therefore\ x=4$

107) 7
⇨ $3\times(3+x)=5\times(5+1)$
$3+x=10$ $\therefore\ x=7$

108) 1

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⇨ $x\times(x+3)=1\times(1+3)$, $x^2+3x-4=0$
$(x-1)(x+4)=0$ $\therefore x=1(x>0)$

109) 1
⇨ $2\times(2+4)=3\times(3+x)$
$3+x=4$ $\therefore\ x=1$

110) 7
⇨ $2\times(2+x)=3\times(3+3),2+x=9$ $\therefore\ x=7$

111) 4
⇨ $4\times(4+x)=2\times(2+14)$
$4+x=8$ $\therefore\ x=4$

112) 5
⇨ $6\times(6+4)=x\times(x+7)$, $x^2+7x-60=0$
$(x-5)(x+12)=0$ $\therefore x=5(x>0)$

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