P2 Circles: exam questions

10 questions · 34 marks · full mark schemes

Name _____ Date _____ Score / 34

- Equation of a circle in Cartesian form, tangent-radius perpendicularity, geometric problem solving.
- Try every question before you look at the mark schemes. They start after the questions: M marks for method, A marks for accuracy, B marks for a correct result on its own.
- Online, with more practice: alevelmathrevision.com/alevel-frontend/units/p2/circles-questions

1. **2 marks · warm-up**

Find the equation of the circle with centre $(5, -2)$ and radius 6.

2. **2 marks · warm-up**

Write down the coordinates of the centre of the circle $x^2 + (y - 4)^2 = 9$.

3. **2 marks · standard**

The points C and D have coordinates $(2a, -b)$ and $(4a, 5b)$ respectively. Find the coordinates of the midpoint of CD in terms of a and b.

4. **3 marks · standard**

A circle has centre $(3, 4)$ and passes through the origin. Find the equation of the circle.

5. **4 marks · standard**

The points $A(-1, 4)$ and $B(5, -4)$ are the endpoints of a diameter of a circle. Find the equation of the circle.

6. **5 marks · standard**

Find the centre and radius of the circle $x^2 + y^2 - 6x + 4y - 12 = 0$.

7. **2 marks · harder**

A circle with radius 4 touches the positive x-axis and the positive y-axis. Write down the equation of the circle.

8. 4 marks · harder

A tangent is drawn from the external point $P(8, 0)$ to the circle $x^2 + y^2 = 15$. Find the exact distance from P to the point of tangency.

9. 5 marks · harder

The line $y = x + k$ is a tangent to the circle $x^2 + y^2 = 8$. Find the possible exact values of the constant k.

10. 5 marks · harder

A circle has diameter AB where A is $(2, 1)$ and B is $(8, 9)$. A point C lies on the circle such that the lengths AC and BC are equal. Find the exact length of AC.

Answers and worked solutions

Question 1 — 2 marks

1. M1 for using the standard circle equation format $(x-a)^2+(y-b)^2=r^2$.
2. A1 for the correct equation: $(x-5)^2+(y+2)^2=36$.

Question 2 — 2 marks

Answer: Centre $(0, 4)$

Compare with $(x-a)^2+(y-b)^2=r^2$ **M1**. $(a, b)=(0, 4)$ **A1**.

Question 3 — 2 marks

1. M1 for forming the midpoint expressions: $(\frac{2a+4a}{2}, \frac{-b+5b}{2})$.
2. A1 for simplifying to $(3a, 2b)$.

Question 4 — 3 marks

1. M1 for using the distance formula to find the radius squared: $r^2=(3-0)^2+(4-0)^2$.
2. M1 for evaluating $r^2=9+16=25$.
3. A1 for the correct equation: $(x-3)^2+(y-4)^2=25$.

Question 5 — 4 marks

1. M1 for finding the centre as the midpoint of AB: $(\frac{-1+5}{2}, \frac{4-4}{2})=(2, 0)$.
2. M1 for finding the radius squared using the distance from the centre to A: $r^2=(-1-2)^2+(4-0)^2$.
3. M1 for evaluating $r^2=(-3)^2+4^2=25$.
4. A1 for the final equation: $(x-2)^2+y^2=25$.

Question 6 — 5 marks

Answer: Centre $(3, -2)$; radius 5

Complete the square: $(x^2-6x)+(y^2+4y)=12$ **M1**. $(x-3)^2-9+(y+2)^2-4=12$ **M1**. $(x-3)^2+(y+2)^2=25$ **A1**. Centre $(3, -2)$ **A1**, radius 5 **A1**.

Question 7 — 2 marks

1. M1 for deducing that if the circle touches both positive axes and has radius 4, its centre must be at $(4, 4)$.
2. A1 for writing the correct equation: $(x-4)^2+(y-4)^2=16$.

Question 8 — 4 marks

1. M1 for identifying the circle's centre as the origin $O(0, 0)$ and radius squared $r^2=15$.
2. M1 for calculating the distance squared from the centre to P: $OP^2=8^2+0^2=64$.
3. M1 for applying Pythagoras' theorem to the right-angled triangle formed by the radius, tangent, and line to the centre: $d^2+r^2=OP^2 \implies d^2+15=64$.
4. A1 for solving to find $d^2=49 \implies d=7$.

Question 9 — 5 marks

1. M1 for substituting the line into the circle equation: $x^2+(x+k)^2=8$.
2. M1 for expanding and arranging into a standard quadratic: $2x^2+2kx+(k^2-8)=0$.
3. M1 for using the condition for a tangent that the discriminant $b^2-4ac=0$.
4. M1 for evaluating the discriminant: $(2k)^2-4(2)(k^2-8)=0 \implies 4k^2-8k^2+64=0 \implies 4k^2=64$.
5. A1 for solving to find $k=\pm 4$.

Question 10 — 5 marks

1. M1 for recognising that angle C in the semicircle is $90°$, so triangle ABC is a right-angled isosceles triangle.
2. M1 for finding the length squared of the hypotenuse AB: $AB^2=(8-2)^2+(9-1)^2=36+64=100$.
3. M1 for applying Pythagoras' theorem with $AC=BC$: $AC^2+BC^2=AB^2 \implies 2AC^2=100$.
4. M1 for solving for AC^2: $AC^2=50$.
5. A1 for taking the square root to find $AC=\sqrt{50}=5\sqrt{2}$.

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