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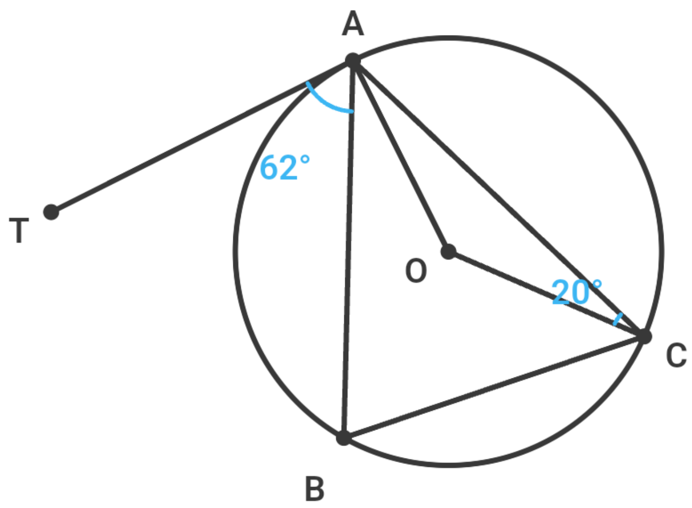
Secondary 6 - Mathematics

Tangents and Circle Angle Chasing

Name: ______________________________

Class: ______________________________

1. In the figure, O is the centre of the circle ABC and TA is the tangent to the circle at A. If $\angle BAT = 62^\circ$ and $\angle ACO = 20^\circ$, then $\angle ABC =$



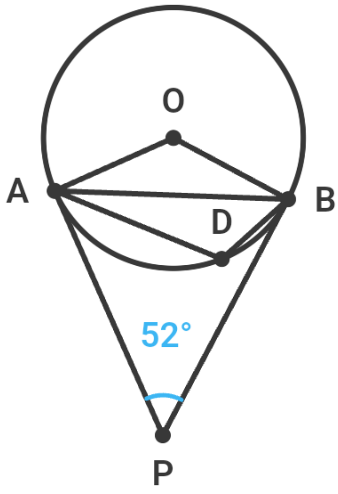
A. 40°

B. 48°

C. 62°

D. 70°

2. In the figure, PA and PB are the tangents to the circle with centre O at A and B respectively, and D is a point lying on the minor arc AB. If $\angle APB = 52^\circ$, then $\angle ADB =$



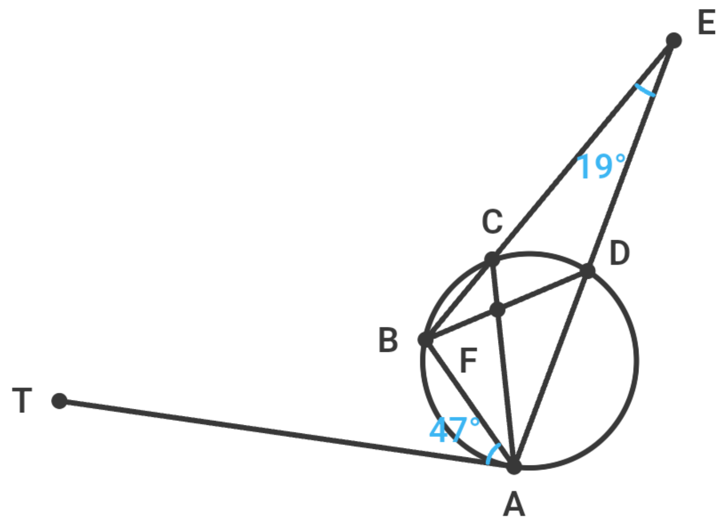
A. 64°

B. 104°

C. 116°

D. 128°

3. In the figure, $ABCD$ is a circle and TA is the tangent to the circle at A. AC and BD intersect at the point F, while AD produced and BC produced meet at the point E. If $\angle BAT = 47^\circ$ and $\angle AEB = 19^\circ$, then $\angle AFB =$



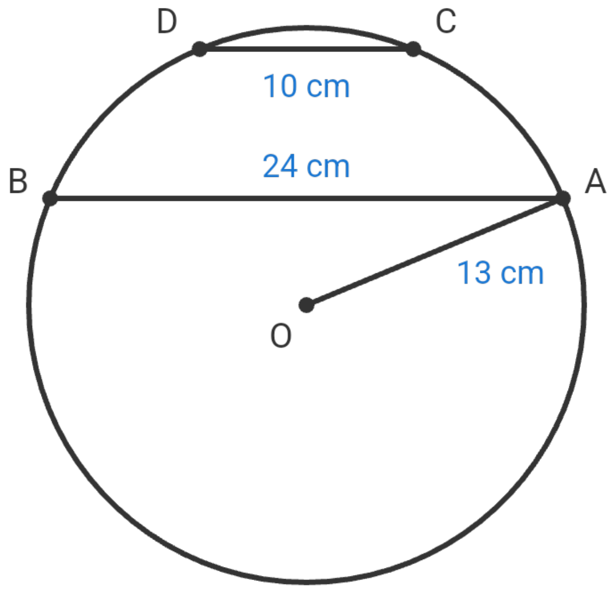
A. 66°

B. 75°

C. 94°

D. 105°

4. AB and CD are two parallel chords of a circle with centre O and radius $13\,\mathrm{cm}$. It is given that $AB = 24\,\mathrm{cm}$, $CD = 10\,\mathrm{cm}$ and the two chords lie on the same side of the centre. Find the distance between AB and CD.



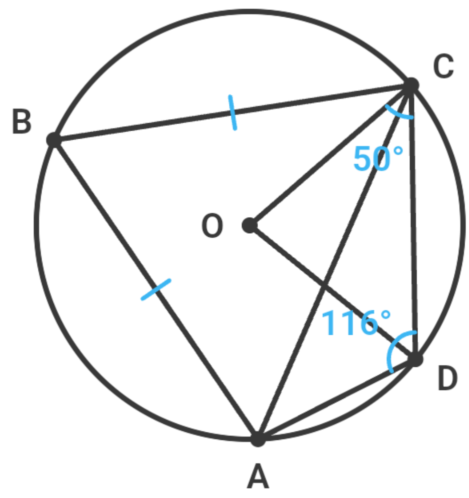
A. $7\,\mathrm{cm}$

B. $12\,\mathrm{cm}$

C. $14\,\mathrm{cm}$

D. $17\,\mathrm{cm}$

5. In the figure, O is the centre of the circle $ABCD$, where $AB = BC$. If $\angle ADC = 116^\circ$ and $\angle OCD = 50^\circ$, then $\angle BAD =$



A. 64°

B. 82°

C. 98°

D. 108°

Answers

1 **D**

This question links a tangent-chord angle, an isosceles triangle formed by two radii, and the angle at the centre.
Step 1 – tangent-chord angle (angle in the alternate segment).
The chord AB and the tangent AT make the angle $\angle BAT$, and the angle in the alternate segment standing on AB is $\angle ACB$:
$\angle ACB = \angle BAT = 62^\circ$
Step 2 – use the radii.
Since $OA = OC$ (radii), triangle OAC is isosceles, so $\angle OAC = \angle OCA = 20^\circ$. Hence
$\angle AOC = 180^\circ - 20^\circ - 20^\circ = 140^\circ$
Step 3 – angle at the centre is twice the angle at the circumference.
B lies on the major arc AC, so
$$\angle ABC = \frac{140^\circ}{2} = 70^\circ$$
So $\angle ABC = 70^\circ$.

2 **C**

The key facts are that a tangent is perpendicular to the radius through the point of contact, and that the angle at the centre is twice the angle at the circumference standing on the same arc.
Step 1 – right angles at the points of contact.
$OA \perp PA$ and $OB \perp PB$, so $\angle OAP = \angle OBP = 90^\circ$.
Step 2 – angles of quadrilateral $OAPB$.
$\angle AOB = 360^\circ - 90^\circ - 90^\circ - 52^\circ = 128^\circ$
Step 3 – D is on the minor arc, so use the reflex angle.
Because D lies on the minor arc AB, the angle $\angle ADB$ stands on the major arc AB, whose angle at the centre is the reflex angle
$360^\circ - 128^\circ = 232^\circ$
Therefore
$$\angle ADB = \frac{232^\circ}{2} = 116^\circ$$
So $\angle ADB = 116^\circ$.

3 **B**

Three facts are combined here: the tangent-chord angle, angles in the same segment, and the angle sum / exterior angle of a triangle.
Step 1 – tangent-chord angle.
The tangent AT and the chord AB give
$\angle ADB = \angle BAT = 47^\circ$
and since $\angle ACB$ stands on the same chord AB in the same segment,
$\angle ACB = \angle ADB = 47^\circ$
Step 2 – work inside triangle BDE.
A, D, E lie on a straight line, so
$\angle BDE = 180^\circ - 47^\circ = 133^\circ$
Then in triangle BDE:
$\angle DBE = 180^\circ - 133^\circ - 19^\circ = 28^\circ$
Since C lies on BE, this means $\angle DBC = 28^\circ$.
Step 3 – exterior angle at F.
In triangle FBC, the angle at B is $\angle DBC = 28^\circ$ and the angle at C is $\angle ACB = 47^\circ$.
As $\angle AFB$ is the exterior angle of this triangle at F,
$\angle AFB = 28^\circ + 47^\circ = 75^\circ$
So $\angle AFB = 75^\circ$.

4 **A**

The rule you need is: the perpendicular from the centre to a chord bisects the chord. Together with Pythagoras' theorem, this gives the distance from the centre to each chord.
Step 1 – distance from O to AB.
The perpendicular from O cuts AB into two halves of $12\,\mathrm{cm}$, so with radius $13\,\mathrm{cm}$:
$d_1 = \sqrt{13^2 - 12^2} = \sqrt{169 - 144} = \sqrt{25} = 5\,\mathrm{cm}$
Step 2 – distance from O to CD.
Half of CD is $5\,\mathrm{cm}$, so
$d_2 = \sqrt{13^2 - 5^2} = \sqrt{169 - 25} = \sqrt{144} = 12\,\mathrm{cm}$
Step 3 – combine correctly.
Both chords are on the same side of O, so the two distances are measured in the same direction and we subtract:
$12\,\mathrm{cm} - 5\,\mathrm{cm} = 7\,\mathrm{cm}$
The distance between the chords is $7\,\mathrm{cm}$.

5 C

Split $\angle BAD$ into $\angle BAC + \angle CAD$ and find each part.

Step 1 — opposite angles of a cyclic quadrilateral are supplementary.

$\angle ABC = 180^\circ - 116^\circ = 64^\circ$

Step 2 — equal chords give an isosceles triangle.

Since $AB = BC$, triangle ABC is isosceles, so

$$\angle BAC = \frac{180^\circ - 64^\circ}{2} = 58^\circ$$

Step 3 — use the two radii OC and OD.

$OC = OD$, so $\angle ODC = \angle OCD = 50^\circ$ and

$\angle COD = 180^\circ - 50^\circ - 50^\circ = 80^\circ$

Step 4 — angle at the centre is twice the angle at the circumference.

$\angle COD$ and $\angle CAD$ both stand on the chord CD, so

$$\angle CAD = \frac{80^\circ}{2} = 40^\circ$$

Step 5 — add the two parts.

$\angle BAD = 58^\circ + 40^\circ = 98^\circ$

So $\angle BAD = 98^\circ$. Notice that $\angle OCD = 50^\circ$ must first be turned into the central angle 80° before halving it.