1. The area of a first circle is 3 times that of a second circle. The ratio of the radius of the first circle to the radius of the second circle is

   (A) $\sqrt{3} : 1$
   (B) $9 : 1$
   (C) $3\pi : 1$
   (D) $1 : \sqrt{3}$
   (E) $1 : 9$

2. Among the sets of integers $A = \{2,5,8\}$, $B = \{3,4,5\}$, $C = \{5,12,13\}$, and $D = \{1,10,10\}$, which CANNOT be the lengths of sides of a triangle?

   (A) A only
   (B) B and C
   (C) C only
   (D) A and D
   (E) B, C, and D

3. If the hypotenuse of a 30˚-60˚-90˚right triangle has length 4, then the area of the triangle is

   (A) $4\sqrt{3}$
   (B) $2\sqrt{3}$
   (C) 12
   (D) 6
   (E) None of these

4. A regular hexagon has sides of length 4. What is the area of the triangle formed by connecting alternate vertices? (Compute to the nearest tenth)

   (A) 18.0
   (B) 20.8
   (C) 26.8
   (D) 31.2
   (E) 36.0

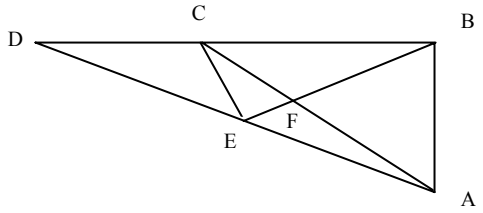
5. If the hypotenuse of a right triangle has length 7 meters and the sum of the lengths of the legs is 8 meters, then the area of the triangle is

   (A) 3.5 square meters
   (B) 4 square meters
   (C) 7.5 square meters
   (D) 3.75 square meters
   (E) 10/3 square meters

6. How many of the following statements are true?
   a) Adjacent angles are angles whose sides form two pairs of opposite rays;
   b) The complement of an acute angle is an acute angle;
   c) B lies in the interior of $\angle APC$. If the measure of $\angle APC = 70^\circ$ and the measure of $\angle APB = 20^\circ$, then $\angle CPB = 50^\circ$;
   d) If $\overleftrightarrow{AB}$, the perpendicular bisector of $\overline{CD}$, intersects $\overline{CD}$ at point M, then $AM = MD$;
   e) If $\angle RST$ is a right angle, then $\overline{RS} \perp \overline{ST}$.

   (A) 2 (B) 3 (C) 4 (D) 5 (E) 1

Problems 7-8 refer to the diagram below. (graph not to scale) Suppose that $\angle DCE = 110^\circ$, $\angle CFB = 120^\circ$, $\angle CBA = 90^\circ$, $CB = 10$, $AB = 10$.



7. The measure of $\angle BCE$ is

   (A) 45° (B) 60° (C) 70° (D) 75° (E) 65°

8. The measure of $\angle ABE$ is

   (A) 45° (B) 60° (C) 70° (D) 75° (E) 65°

9. An integral point on the real number line is a point with an integer coordinate. If a line segment AB of length 2003 is drawn on the real axis, the number of integral points covered by AB is

   (A) 2002 or 2003 (B) 2002 or 2004 (C) 2003 or 2004 (D) 2003 or 2005 (E) 2002 only

10. The measure of $\angle A$ is four times the measure of its complement, $\angle B$. Then $2 \cdot m\angle A + 3 \cdot m\angle B$ is

    (A) 180° (B) 190° (C) 196° (D) 198° (E) None of the above

11. How many statements in the following about plane geometry are true?

a. Two lines that have no points in common are parallel;
b. If two lines are cut by a transversal so that the interior angles on one side of the transversal are supplementary, then the lines are parallel;
c. If a transversal is perpendicular to one of two parallel lines, then it is perpendicular to the other line;
d. If the measure of an exterior angle of a triangle is 90°, the triangle is a right triangle;
e. Through a point on a line, there is exactly one line perpendicular to the given line.

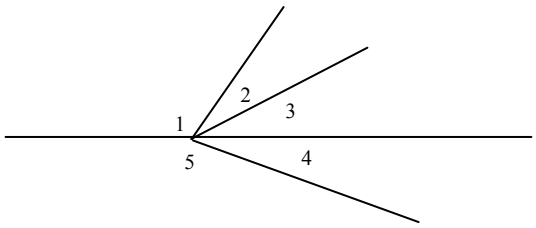
(A) 1 (B) 2 (C) 3 (D) 4 (E) 5

12. How many of the following sets of conditions determine a plane?

a. A line and a point not on the line;
b. Three distinct points;
c. Two distinct lines;
d. Two perpendicular lines;
e. Two non intersecting line segments.

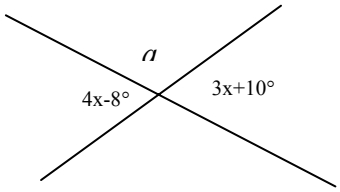
(A) 1 (B) 2 (C) 3 (D) 4 (E) 5

13. In the following diagram $m\angle 2 = m\angle 3 = m\angle 4$ and $m\angle 5 = 150^\circ$. Then $\angle 1$ is



(A) 130° (B) 150° (C) 120° (D) 75° (E) 100°

14. As in the diagram the measure of $\angle a$ is

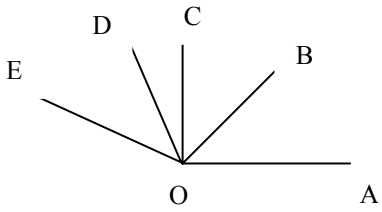


(A) 112° (B) 114° (C) 116° (D) 118° (E) 120°

15. If A, B, C and D are 4 distinct points in that order on the real axis, then which of the following equalities is always true?

(A) $AD \cdot BC + AB \cdot CD = AC \cdot BD$ (B) $AD \cdot BC - AB \cdot CD = AC \cdot BD$
(C) $AB \cdot BC + AC \cdot CD = AC \cdot BD$ (D) $AB \cdot BC - AC \cdot CD = AC \cdot BD$

16. In the figure $\angle AOC$ is a right angle, $\angle COD = 21.5^\circ$, OB and OD are angle bisectors of $\angle AOC$ and $\angle BOE$, respectively. Then $\angle AOE$ is



(A) 111.5° (B) 133° (C) 134.5°
(D) 178° (E) None of the above

17. How many statements are true in the following?

a. The congruence of triangles is symmetric;
b. The ratio of the areas of two similar triangles is the ratio of the corresponding sides;
c. The segment from a vertex of a triangle to the midpoint of the opposite side is called an altitude;
d. The non-congruent side of an isosceles triangle is called the base;
e. If the lengths of two sides of a triangle are unequal, then the measures of the angles opposite those sides are unequal.

(A) 1 (B) 2 (C) 3 (D) 4 (E) 5

18. How many statements are true in the following?

a. The median of a trapezoid is parallel to the base;
b. If the diagonals of a parallelogram are congruent, the parallelogram is a rectangle;
c. Opposite angles of a rhombus are congruent;
d. A rhombus is both a parallelogram and a square;
e. If two sides of a quadrilateral are congruent, then the quadrilateral is a parallelogram.

(A) 1 (B) 2 (C) 3 (D) 4 (E) 5

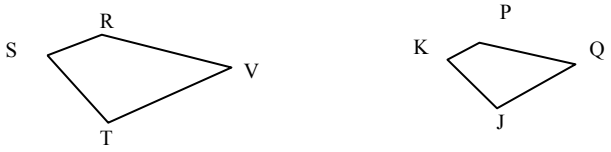
19. Let $ABCD$ be a parallelogram. Suppose that E is the midpoint of $\overline{AD}$, F is the midpoint of $\overline{AB}$ and $BD = 12$, then EF is

(A) 12 (B) 10 (C) 8 (D) 6 (E) None of the above

20. Let $ABCD$ be a parallelogram. Suppose that E is the midpoint of $\overline{AD}$, F is the midpoint of $\overline{AB}$, $m\angle C = 100^\circ$ and $m\angle CDB = 30^\circ$. Then $m\angle AEF$ is

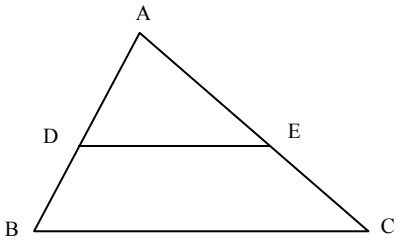
(A) 30° (B) 40° (C) 50° (D) 60° (E) None of the above

21. Convex quadrilaterals RSTV and PKJQ are similar (in that order). Suppose that $ST = 9$, $PK = 2$, $PQ = 4$, and the perimeters of $RSTV$ and $PKJQ$ are 24 and 16, respectively. Then TV is



(A) 7 (B) 5 (C) 4 (D) 6 (E) 8

22. In the following figure $\overline{BC} // \overline{DE}$, $AB = 40$, $DE = 20$, $BC = 30$ and $CE = 14$. Then AD is



(A) $\frac{80}{3}$ (B) $\frac{70}{3}$ (C) $\frac{69}{4}$ (D) $\frac{110}{9}$ (E) None of the above

23. In triangle ABC let D be a point on $\overline{BC}$. Suppose that $\overline{AD}$ bisects $\angle BAC$, $BC = 24$, $BD = 16$. Then $\frac{AB}{AC}$ is

(A) 1 (B) 2 (C) $1\frac{1}{2}$ (D) $2\frac{1}{2}$ (E) None of the above

24. In triangle ABC $\angle A = 50^\circ$, H is the orthocenter and H is not B nor C. Then the measure of $\angle BHC$ is

(A) 50° or 130° (B) 50° or 120° (C) 100° or 150° (D) 130° or 150°

25. How many statements are true in the following?
   a. A circle can be circumscribed about any rhombus;
   b. If an angle inscribed in a circle measures 78°, then its intercepted arc measures 39°;
   c. If a quadrilateral is inscribed in a circle, its opposite angles are complementary;
   d. If a line is tangent to a circle, then the line is perpendicular to the radius drawn to the point of tangency;
   e. If two inscribed angles intercept arcs of the same measure, then the angles are congruent.

(A) 1 (B) 2 (C) 3 (D) 4 (E) 5

26. Suppose that in a triangle the lengths of all sides are integers. If the difference of two sides is 7 and the perimeter of triangle is an odd integer, then which of the following can be the length of the third side?

(A) 13 (B) 10 (C) 7 (D) 6 (E) 5

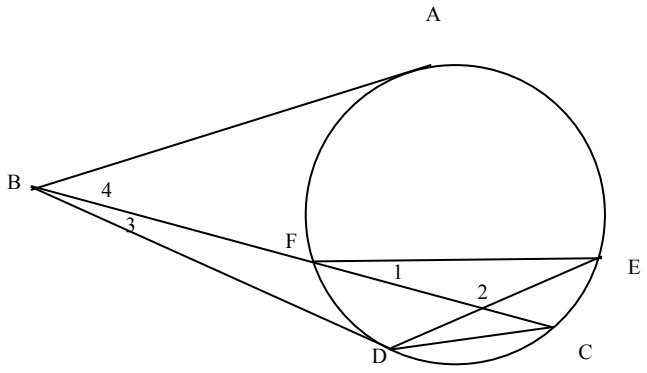
27. If D is the incenter of triangle ABC, E is the incenter of triangle ABD, and F the incenter of BDE. If the measure in degrees of $\angle BFE$ is an integer, then the minimal possible measure (in degrees) of $\angle BFE$ is

(A) 92° (B) 107° (C) 113° (D) 132° (E) None of the above

28. Let $\overline{BA}$ and $\overline{BD}$ be tangent segments to the circle in the following diagram and C, E and F be points on the circle and A and D are tangent points. Then how many of the following statements are true?

a. If the measure of the arc EC is 30°, then the measure of $\angle 1$ is 30°;

b. If the measure of the arc CD is 100° and the measure of the arc DF is 40°, then the measure of $\angle 3$ is 10°;



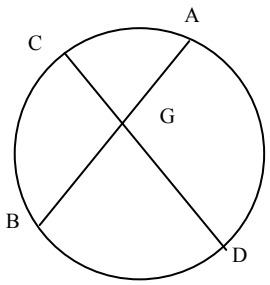
c. If the measure of the arc AEC is 160° and the measure of the arc AF is 90°, then the measure of the arc CAF is $250°$;

d. If $m\angle 2 = 150^\circ$, and the measure of the arc CD is 90°, then the measure of the arc EAF is 200°;

e. If $AB = 12$ and $BF = 10$, then $FC = 4.4$

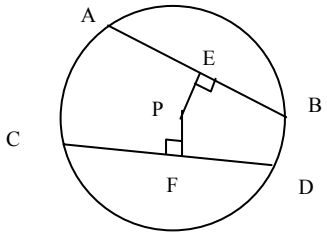
(A) 1 (B) 2 (C) 3 (D) 4 (E) 5

29. Let *A, B, C* and *D* be points on a circle such that the cords AB and CD intersect at G. If $CG = 2$, $GD = 6$, $AG = 3$, then AB is



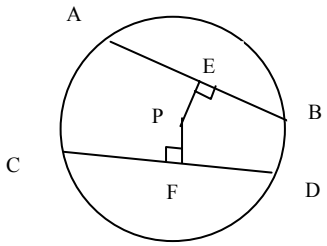
(A) 3 (B) 4 (C) 5 (D) 6 (E) 7

30. Given $\overline{AB} \cong \overline{CD}$ and $CF = 4$. Suppose that P is the center of the circle, then $AB =$



(A) 5 (B) 6 (C) 8 (D) 10 (E) 12

31. Given $PE = PF = 2$ and $AB = 6$ in the following diagram where P is the center of the circle. Then $CF =$

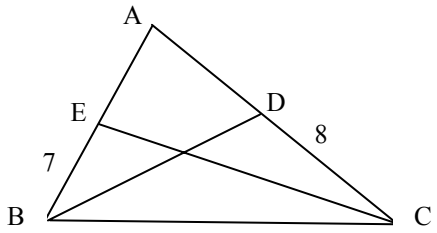


(A) 6 (B) 2 (C) 4 (D) 5 (E) 3

32. In triangle ABC, if AB = 5, AC = 3, and D is the mid point of BC, then the value of AD must be

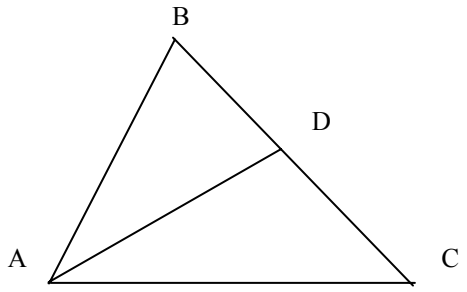
(A) $1 < AD < 4$ (B) $0 < AD < 3$ (C) $3 < AD < 5$ (D) $2 < AD < 8$ (E) $AD = 4$

33. In triangle ABC, $\angle A = 60^\circ$, BD and CE are angle bisectors of $\angle B$ and $\angle C$, respectively. If BE = 7 and CD = 8, then BC is



(A) 15 (B) 23 (C) 25 (D) 30 (E) 35

34. In triangle ABC, D is on BC and AD is the angle bisector of $\angle A$. If $AC = AB + BD$ and $\angle C = 30^\circ$, then $\angle ABC$ is



(A) 30° (B) 45° (C) 60° (D) 75° (E) 90°

35. How many correct statements are there in the following?

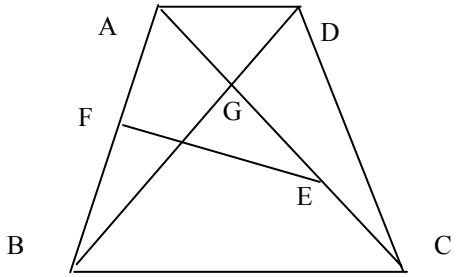
a. There is at least one acute interior angle for every quadrilateral;
b. There is at least one non acute interior angle for every quadrilaterals;
c. There is a pair of opposite angles in every quadrilateral whose sum is 180°;
d. There must be two interior angles that are less than or equal to a right angle in any quadrilateral.

(A) 0 (B) 1 (C) 2 (D) 3 (E) 4

36. In a polygon of *n* sides the sum of all interior angles except one measures 8940°. Then *n* is

(A) 51 (B) 52 (C) 53 (D) 54 (E) 55

37. In a trapezoid ABCD $AD \,//\, BC$ and $AB = DC = 10$. If G is the intersection of AC and BD, E is the midpoint of CG, F is the midpoint of AB with $\angle AGD = 60^\circ$, then EF is



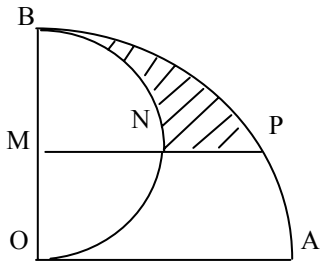
(A) 4 (B) 5 (C) 6 (D) 7 (E) 8

38. The area of a parallelogram ABCD is 1. Let E, F be the midpoints of AB, BC, respectively. Suppose that G, H are the intersections of AF with CE and DE, respectively. Then the area of triangle EGH is

(A) $\frac{1}{12}$ (B) $\frac{1}{4}$ (C) $\frac{1}{20}$ (D) $\frac{1}{30}$ (E) None of the above

39. The circular sector OAB is a quarter of a disk with radius 2 and with center O. Let M be the center of the circle with diameter OB and P be on the arc AB such that $MP \,//\, OA$. Let N be the point of intersection of MP with the semicircle (inside of the region OAB) with diameter OB. Then the area of the region BNP is closest to

(A) 0 (B) 0.5 (C) 1 (D) 1.5 (E) 2



40. In triangle ABC, CH is the altitude. Let R and S be on CH be the points of tangent of the incircles of ΔACH and ΔBCH, respectively. If AB = 2003, AC = 2002, and BC = 2001, then RS is closest to

(A) 0.45 (B) 0.47 (C) 0.49 (D) 0.51 (E) 0.53