_____ 1. Given that quadrilateral $ABCD$ in Figure 4 is a parallelogram, which of the following statements would lead to the conclusion that $ABCD$ is a rectangle?

  (A) AC and BD are the perpendicular bisectors of each other

  (B) $AB = CD$

  (C) $AB = BC$

  (D) $\angle DAB$ and $\angle CBA$ are supplementary

  (E) $\angle DAB$ and $\angle CBA$ are equal in measure

_____ 2. A set of points is said to "determine" a plane if there is exactly one plane that contains all of the points. Which of the following does not determine a plane?

  (A) A triangle

  (B) Any three points

  (C) A line and a point not on the line

  (D) A pair of intersecting rays

  (E) A pair of intersecting lines

_____ [3] If A and B are two different points that lie on line CD and also on line EF, which of the following statements must be true?

  I. Lines AC, BF, and ED are all parallel.

  II. Points A, B, C, D, E, and F all lie on the same line.

  III. Points A, B, C, and E all lie in the same plane.

  (A) I only

  (B) I and II only

  (C) II only

  (D) II and III only

  (E) III only

_____ [4] If A, B, C, and D are any four distinct points of a plane P, which of the following must be true?

  I. Line AB must intersect line CD.

  II. Line AB can contain a point not in plane P.

  III. Any point of intersection of any of the pairs of lines containing A, B, C, and D must lie in plane P.

  (A) I only

  (B) I and II only

  (C) II and III only

  (D) II ONLY

  (E) III only

_____ 5. In Figure 2, lines L_1 and L_2 are NOT parallel and will intersect at some point to the right of the page. Which of the following must be true?

  I. $c = e$

  II. $b > d$

  III. $a = c$

Figure 2

  (A) I only

  (B) II only

  (C) III only

  (D) I and II only

  (E) II and III only

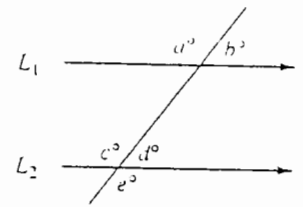_____ 6. If $A = (-1, 2)$ and $B = (2, -1)$, where A and B are two points in the coordinate plane, then what is the length of segment AB?

  (A) 1

  (B) 2

  (C) 3

  (D) 4.24

  (E) 3.46

_____ 7. An operation, $\circ$, on the numbers a and b is defined by the formula $a \circ b = 2(a + 2b)$. For what values of x and y is $x \circ y = y \circ x$?

  (A) All real values

  (B) Only when $x = y$

  (C) Only when both x and y are 0

  (D) Only when $x = -y$

  (E) Only when x and y are both 1

_____ 8. Which of the following statements about angles is NOT true?

  (A) An angle of a triangle may have a degree measure of 180.

  (B) An angle of a triangle may not have a degree measure greater than 180.

  (C) Two angles may be complementary without having a common side.

  (D) The degree measure of an angle does not depend on the lengths of its sides.

  (E) A triangle cannot have two right angles

____ 9. If (1) point P is in the interior of $\angle LMN$, (2) point W is in the interior of $\angle XYZ$, (3) the measures of $\angle LMN$ and $\angle XYZ$ are equal, and (4) the measures of $\angle PMN$ and $\angle WYZ$ are equal, which of the following must be true?

    I. $\angle LMP$ and $\angle PMN$ are adjacent angles.

    II. The measure of $\angle LMN$ equals the sum of the measures of $\angle LMP$ and $\angle PMN$.

   III. The measure of $\angle ZYW$ = measure of $\angle LMP$.

(A) I only

(B) II only

(C) I and II only

(D) II and III only

(E) I and III only

____ 10. If in the figure $\angle COE$ and $\angle BOD$ are right angles and the measure of $\angle BOC$ is three times the measure of $\angle COD$, then the measure of $\angle AOB$ is

(A) $20°$

(B) $22\frac{1}{2}°$

(C) $30°$

(D) $45°$

(E) $60°$
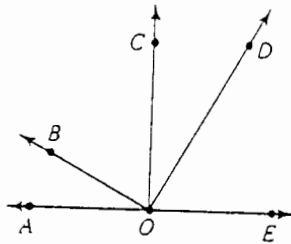
____ 11. If $\angle AOB$ is a right angle, decide whether you can conclude that $\angle AOD$ and $\angle BOC$ have the same measure. Which of the following justifies your conclusion?
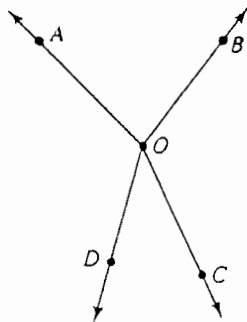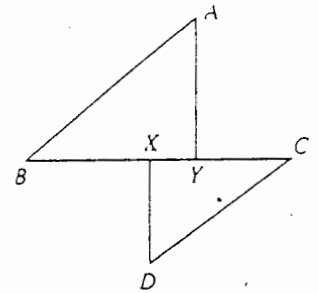

(Figure is not drawn to scale.)

(A) This conclusion cannot be justified from the information given.

(B) Complements of congruent angles are congruent.

(C) Supplements of congruent angles are congruent.

(D) Vertical angles are congruent.

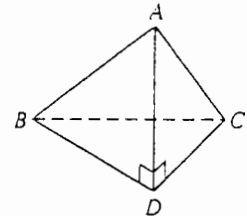(E) If two intersecting lines form one right angle, they must form four right angles.

____ 12. In the figure $\angle AYB$ and $\angle CXD$ are right angles, $AY = CX$, and $BX = DX = CY$. Each of the following is true EXCEPT

(A) $BX + XY = BY$

(B) $XY + CY = CX$

(C) $XY = BY - BX = CX - CY$

(D) $BX = CX$

(E) $BY = CX$

(Figure is not drawn to scale.)

____ 13. If, in the accompanying figure, $AD \perp DC$, $AD \perp BD$, and $DC = BD$, which of the following statements is NOT necessarily true?


(A) $\angle DBC$ and $\angle DCB$ are equal in measure.

(B) $\triangle ADB \cong \triangle ADC$.

(C) $AB = AC$.

(D) $\angle ABC$ and $\angle ACB$ are equal in measure.

(E) $\angle BAC$ and $\angle BDC$ have the same measure.

____ 14. If A, B, and C are any three points of a plane for which $AB = 5$ and $BC = 7$, which of the following can be the length of AC?

(A) 0

(B) 1

(C) 2

(D) 13

(E) 15

5. Segment AC is perpendicular to plane E. The angles have the measures indicated while $\angle ADB$ and $\angle ABD$ have measures 70 and 50 respectively. If segments AD, AC, AE, and AB are arranged in order from shortest to longest, which of the following is the result?
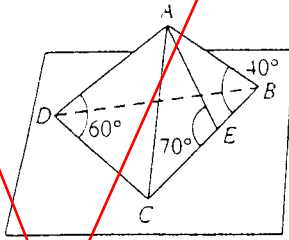
(A) AE, AD, AB, AC

(B) AE, AB, AC, AD

(C) AC, AB, AE, AD

(D) AC, AB, AD, AE

(E) AC, AE, AD, AB

[16] For a pentagon, 5 is the longest side and 2 is the shortest. Which of the following could not be the length of a diagonal?

(A) 3 H_{INT}: A Pentagon has 5 sides.
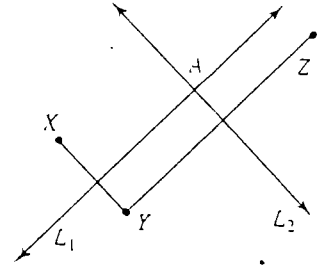
(B) 4

(C) 5

(D) 7

(E) 11

___ 17.
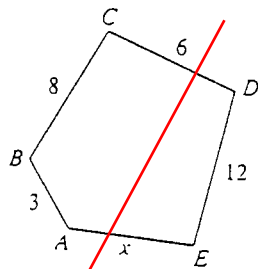
A pentagon has sides of lengths shown in the figure. The range of possible values of x is?

(A) $0 < x < 29$

(B) $11 < x < 18$

(C) $3 < x < 12$

(D) $6 < x < 8$

(E) $0 < x < 20$

[8] If L_1 and L_2 are the perpendicular bisectors of segments XY and YZ, which of the following must be true?

I. $AX = AY = AZ$

II. A, X, and Z are collinear

III. L_1 and L_2 lie in the plane determined by X, Y, and Z


(A) I only

(B) I and II only

(C) I and III only

(D) II and III only

(E) III only

[19] If it is given that an altitude of a triangle bisects its base, which of the following can be proved?

(A) the triangle is isosceles

(B) the triangle is equilateral

(C) the triangle is a right triangle

(D) the triangle has an obtuse angle

(E) the triangle has three acute angles

20. In the figure, $AB \parallel CD$, $AD \parallel BC$, and $DC \neq BC$. Which of the following is NOT a correct conclusion?
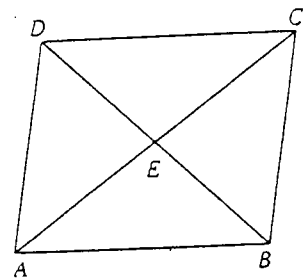
(A) $\triangle ADC \cong \triangle CBA$

(B) $\angle DCA$ has the same measure as $\angle BCA$

(C) $\angle ADC$ has the same measure as $\angle CBA$

(D) $AD = BC$

(E) $DE = BE$

___ 21. The statement $(p \lor q) \to p$ is false if

    (A) p is true and q is true
    (B) p is true and q is false
    (C) p is false and q is true
    (D) p is false and q is false
    (E) the statement is a tautology

___ 22. Which of the following is equivalent to the statement "Having equal radii is necessary for two circles to have equal areas"?

    I. Having equal areas is sufficient for two circles to have equal radii.
    II. Two circles have equal areas only if they have equal radii.
    III. Having equal radii implies that two circles have equal areas.

    (A) only I
    (B) only III
    (C) only I and II
    (D) only II and III
    (E) I, II, and III

___ 23. Given the statement "If $x = 2$, then $x^2 = 4$." The negation of this statement is

    (A) $x \neq 2$, and $x^2 \neq 4$
    (B) $x = 2$, and $x^2 \neq 4$
    (C) $x \neq 2$ or $x^2 = 4$
    (D) $x \neq 2$, and $x^2 = 4$
    (E) $x \neq 2$ or $x^2 \neq 4$

___ 24. Given these statements:

    I. Some numbers are not prime.
    II. No primes are squares.

    If *some* means "at least one," it can be concluded f
    I and II that

    (A) some numbers are squares
    (B) some squares are not numbers
    (C) some numbers are not squares
    (D) no numbers are squares
    (E) none of the above is a conclusion of I and II

___ 25. In a particular town the following facts are true:

    I. Some smarties do not smoke cigars.
    II. All men smoke cigars.

    A necessary conclusion is

    (A) some smarties are men
    (B) some smarties are not men
    (C) no smartie is a man
    (D) some men are not smarties
    (E) no man is a smartie

___ 26. Given the statement "The student will not pass the course only if he does not come to class," which one of the following can be concluded?

    (A) If the student does not pass the course, then he probably missed too many classes.
    (B) If a student comes to class, then he may pas course.
    (C) If a student comes to class, then he will pass the course.
    (D) If a student passes the course, then he came to class.
    (E) If a student does not come to class, then he will not pass the course.

___ 27. The contrapositive of $p \to q'$ is

    (A) $p' \to q$ note q' means $\sim q$
    (B) $p' \to q'$
    (C) $q' \to p$
    (D) $q \to p'$
    (E) $q' \to p'$