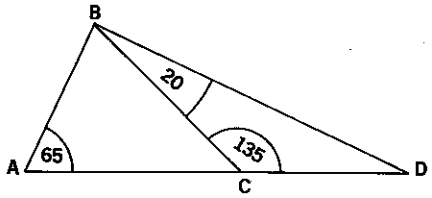
Part I

Answer 30 questions from this part. Each correct answer will receive 2 credits. Write your answers in the spaces provided on the separate answer sheet. Where applicable, answers may be left in radical form.

1. An exterior angle at the base of an isosceles triangle measures 130. Find the number of degrees in the vertex angle.

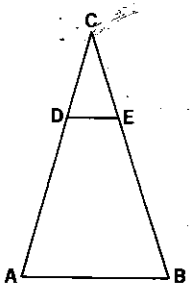
2. In parallelogram $ABCD$, $m\angle A = 2x$ and $m\angle B = 2x + 20$. Find x.

3. In accompanying figure $\triangle ABD$, C is between A and D and $\overline{BC}$ is drawn. If $m\angle A = 65$, $m\angle BCD = 135$, and $m\angle CBD = 20$, which is the *longest* side of $\triangle ABC$?



4. Two triangles are similar. The sides of the smaller triangle are 4, 6, and 8, and the perimeter of the larger triangle is 27. Find the length of the *shortest* side of the larger triangle.

5. In accompanying figure $\triangle ABC$, D is a point on $\overline{AC}$ and E is a point on $\overline{BC}$ such that $\overline{DE} \parallel \overline{AB}$. If $DE = 8$, $AB = 24$, and $EC = 12$, find BC.



6. Write an equation of the form $ax^2 + bx + c = 0$, for which the solution set is $\{3, -4\}$.

7. Find an x-intercept of the function $f(x) = x^2 - 4$.

8. In parallelogram $ABCD$, the coordinates of A are (4, 5) and the coordinates of C are (10, 1). What are the coordinates of the point of intersection of the diagonals?

9. A circle whose center is at (7, 2) passes through the point (2, 14). Find the radius of the circle.

10. What are the coordinates of the point at which the graph of $2x - 3y = 9$ intersects the y-axis?

11. Write an equation of a circle whose center is at the origin and which passes through the point (2, 0).

12. If a and b represent respectively the slopes of two perpendicular lines, then what is the numerical value of $a \cdot b$?

13. A set contains 4 quadrilaterals consisting of a parallelogram, a rectangle, a rhombus, and a square. If one of these is selected at random, what is the probability that the quadrilateral must have congruent diagonals?

14. How many different 3-digit numerals may be formed using the digits 1, 2, and 3 if repetition is *not* allowed?

15. How many different committees (combinations) of 3 students may be chosen from 8 students?

16. Solve the equation $4 \odot x = 3$ for x within the following system:

$\odot$	1	2	3	4
1	1	2	3	4
2	2	4	1	3
3	3	1	4	2
4	4	3	2	1

17. Determine the value of $(c * b) * b$ within the following system:

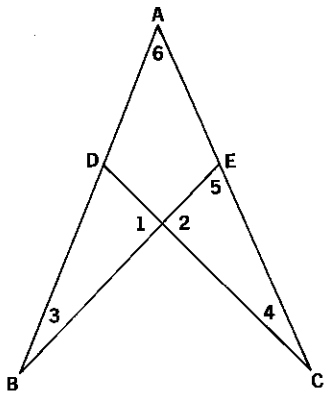
$*$	a	b	c	d
a	a	b	c	d
b	b	c	d	a
c	c	d	a	b
d	d	a	b	c

Directions (18–34): For *each* question chosen, write on the separate answer sheet the *numeral* preceding the word or expression that best completes the statement or answers the question.

18. If the measures of a pair of corresponding angles of parallel lines are represented as $2x + 14$ and $3x + 6$, then x equals
(1) 40 (2) 32 (3) 14 (4) 8

19. An angle has a measure of $2x - 10$. The measure of its complement is
(1) $80 - 2x$ (2) $100 - 2x$ (3) $2x - 100$ (4) $190 - 2x$

20. In the accompanying figure, $\overline{ADB} \cong \overline{AEC}$ and it can be proved that $\overline{CD} \cong \overline{BE}$ if what else is also known?
(1) $\angle 1 \cong \angle 2$ (3) $\angle 3 \cong \angle 5$
(2) $\angle 3 \cong \angle 4$ (4) $\angle 4 \cong \angle 6$

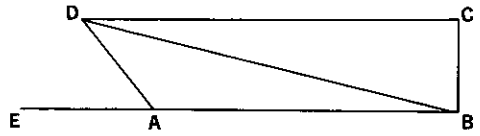


21. The number of points equidistant from two parallel lines and also equidistant from two points on one of the lines is exactly
(1) 1 (2) 2 (3) 3 (4) 4

22. The diagonals of a rhombus are 6 and 8, respectively. The length of a side of the rhombus is
(1) 10 (2) 5 (3) $5\sqrt{3}$ (4) $5\sqrt{2}$

23. In right triangle ABC, the right angle is at C and $\overline{CD}$ is the altitude to $\overline{AB}$. If $AD = 3$ and $DB = 9$, AC equals
(1) 12 (2) $\sqrt{108}$ (3) 3 (4) 6

24. In the accompanying figure, $ABCD$ is a quadrilateral with diagonal $\overline{DB}$ and side $\overline{AB}$ extended to point E. Which *must* be true?
(1) $m\angle DAE > m\angle DAB$
(2) $m\angle DAE > m\angle ADB$
(3) $m\angle DBA < m\angle ADB$
(4) $m\angle ADB < m\angle CBD$



25. If the graphs of the equations of $x^2 + y^2 = 9$ and $y = 3$ are drawn on the same axes, what is the total number of points common to both?
(1) 1 (2) 2 (3) 3 (4) 0

26. Which of the following equations represents a line parallel to the line $y = -x + 4$?
(1) $y = x - 4$ (2) $y - 4 = x$ (3) $y + x = 1$ (4) $y - x = 1$

27. The solution set of $(2x - 8)(5x - 4) = 0$ is
(1) $\{-8, 4\}$ (2) $\{4, -\frac{1}{5}\}$ (3) $\{-4, \frac{4}{5}\}$ (4) $\{4, \frac{4}{5}\}$

28. The sum of the roots of the equation $x^2 - 3x + 2 = 0$ is
(1) -3 (2) 2 (3) 3 (4) -2

29. In a 52-card deck, the probability of drawing either a jack or three in one draw is
(1) $\frac{4}{52}$ (2) $\frac{8}{52}$ (3) $\frac{13}{52}$ (4) $\frac{26}{52}$

30. The solution to the quadratic equation $2x^2 - 5x - 1 = 0$ is
(1) $\frac{5 \pm \sqrt{17}}{4}$ (2) $\frac{-5 \pm \sqrt{17}}{4}$ (3) $\frac{5 \pm \sqrt{33}}{4}$ (4) $\frac{-5 \pm \sqrt{33}}{4}$

31. Which statement is true?
(1) $\exists_x\ x^2 + 2x + 1 = 0$
(2) $\forall_x\ x^2 + 2x + 1 = 0$
(3) $\exists_x\ x > x + 1$
(4) $\forall_x\ x^2 < 0$

32. The statement $\sim(p \wedge \sim q)$ is logically equivalent to
(1) $\sim p \wedge q$ (2) $\sim p \vee q$ (3) $\sim p \rightarrow q$ (4) $\sim p \vee \sim q$

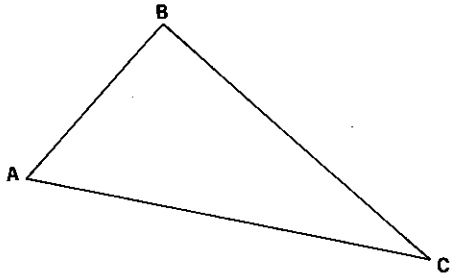
33. If the temperature in my room is above 80 degrees, the air conditioner goes on. The air conditioner is not on. Which is a valid conclusion?
(1) The temperature in my room is going up.
(2) The temperature in my room is going down.
(3) The temperature in my room is above 80 degrees.
(4) The temperature in my room is not above 80 degrees.

34. If set $T = \{2, 4, 6, 8\}$ and the operation $\circledast$ is defined by the accompanying table, then what is the identity element of the group?
(1) 6 (2) 2 (3) 8 (4) 4

$\circledast$	2	4	6	8
2	4	8	2	6
4	8	6	4	2
6	2	4	6	8
8	6	2	8	4

Directions (35): Leave all construction lines on the answer sheet.

35. *On the answer sheet*, construct and *label* the median $\overline{BM}$ from B to $\overline{AC}$ in $\triangle ABC$.



Answers to the following questions are to be written on paper provided by the school.

Part II

Answer three questions from this part. Show all work unless otherwise directed.

36. *a.* Draw the graph of the equation $y = 5 - x^2$, using all integral values of x from $x = -3$ to $x = 3$, inclusive. [4]
    b. On the same axes used in part *a*, draw the graph of the equation $y = x + 3$. [3]
    c. Determine the coordinates of the points of intersection of the graphs in parts *a* and *b*. [3]

37. The table at the right represents ADDITION in mod 4. List the letters *a* to *e* on your answer paper. Using the table, answer the following questions:
    a. What is the value of 3 + 2? [2]
    b. What is the identity element? [2]
    c. Is the operation commutative? [2]
    d. Is the operation closed? [2]
    e. What is the inverse of 3? [2]

+	0	1	2	3
0	0	1	2	3
1	1	2	3	0
2	2	3	0	1
3	3	0	1	2

38. In right triangle ABC, $\overline{CD}$ is the altitude drawn to hypotenuse $\overline{AB}$. The length of $\overline{DB}$ is 5 units longer than the length of $\overline{AD}$.
    a. If $AD = x$, express the length of $\overline{DB}$ in terms of x. [1]
    b. If $CD = 6$, write an equation in terms of x which can be used to find AD. [2]
    c. Solve the equation written in answer to part *b* for the positive value of x. [5]
    d. Find AC. [*Answer may be left in radical form.*] [2]

39. A committee of 4 is to be chosen from 2 men and 4 women.
    a. How many different 4-member committees are possible? [3]
    b. How many committees from part *a* contain 1 man and 3 women? [4]
    c. What is the probability that if a committee of 4 is chosen it will contain exactly 1 man? [2]
    d. What is the probability that a woman will be on the committee? [1]

40. Answer *a* through *d*.
    a. Find the slope of the line through $A(1, -1)$ and $B(5, 7)$. [2]
    b. Express, in terms of K, the slope of the line through $C(0, 4)$ and $D(3, K)$. [3]
    c. If $\overleftrightarrow{AB}$ is parallel to $\overleftrightarrow{CD}$, find K. [2]
    d. Write an equation of $\overleftrightarrow{CD}$. [3]

41. Given the following sentences:

    Either I do the geometry question or I do the algebra question.
    If I do the algebra question, I get it correct.
    If I get the algebra question correct, I do not lose points.
    However, it is known that I lost points.

    Therefore, I did the geometry question.

    Let G represent "I do the geometry question."
    Let A represent "I do the algebra question."
    Let C represent "I get the algebra question correct."
    Let P represent "I lose points."

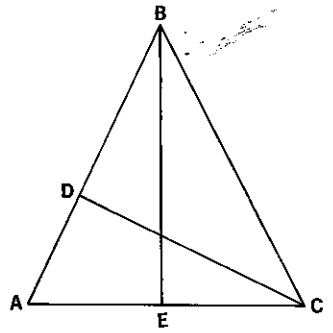
    a. Using G, A, C, P, and proper logic connectives, express *each* sentence in symbolic form. [5]
    b. Using laws of inference, show that a valid conclusion has been reached. [5]

Answers to the following questions are to be written on paper provided by the school.

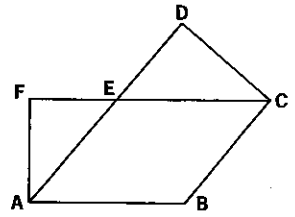
Part III

Answer one question from this part. Show all work unless otherwise directed.

42. *Given:* Isosceles $\triangle ABC$ with $\overline{AB} \cong \overline{BC}$. Altitudes $\overline{BE}$ and $\overline{CD}$ are drawn.
    Prove: $BC \times DA = CA \times EC$ [10]



43. *Given:* $ABCE$ is a rhombus, $\overline{FEC}$, $\overline{AED}$, $\angle FAB \cong \angle DCB$.
    Prove: $\overline{FE} \cong \overline{ED}$ [10]



44. Given triangle ABC with vertices $A(0, 0)$, $B(2a, 0)$, and $C(2b, 2c)$. If D is the midpoint of $\overline{AB}$ and E is the midpoint of $\overline{CB}$, show by coordinate geometry that:
    a. $\overline{DE} \parallel \overline{AC}$ and state a reason for your conclusion. [5]
    b. $DE = \frac{1}{2}AC$ [5]