Part I

Answer 30 questions from this part. Each correct answer will receive 2 credits. No partial credit will be allowed. Write your answers in the spaces provided on the separate answer sheet. Where applicable, answers may be left in radical form.   [60]

1 If $e \odot f$ is defined as $\dfrac{e^2 + f}{2}$, find the value of $4 \odot 6$.

2 Using the table below, compute $6 \dagger (4 \dagger 8)$.

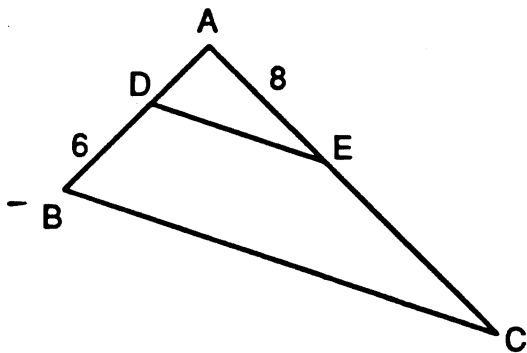| †	2	4	6	8
2	4	8	2	6
4	8	6	4	2
6	2	4	6	8
8	6	2	8	4

3 If a triangle has sides of 6, 8, and 12, what is the perimeter of the triangle formed by connecting the midpoints of the sides of the original triangle?

4 Solve the following system of equations for y:

$$y = x$$
$$2x + y = 3$$

5 If the letters of the word "MATHEMATICS" are rearranged at random, what is the probability of getting an M in the first position?
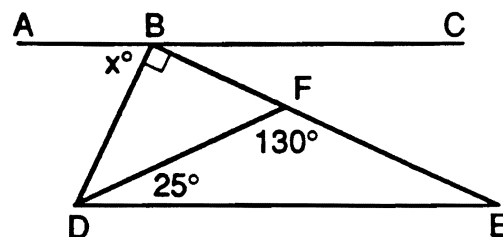
6 In the accompanying diagram, $\overline{DE} \parallel \overline{BC}$, $DB = 6$, and $AE = 8$. If EC is three times AD, find AD.

7 Find the slope of the line passing through the points (4,−1) and (2,5).

8 Find the distance between the points (3,2) and (15,−3).

9 In the accompanying diagram, $\overline{ABC} \parallel \overline{DE}$, $m\angle FDE = 25$, $m\angle DFE = 130$, and $m\angle ABD = x$. What is the value of x?

10 If the base of a rectangle is 8 and one diagonal is 10, what is the height of the rectangle?

11 Solve for x: $\dfrac{x}{2} + \dfrac{x}{3} = 40$

12 In rhombus $ABCD$, $AB = 2x + 15$ and $BC = 4x - 5$. Find x.

13 If $(x + k)^2 = x^2 + 10x + k^2$, find the value of k.

Directions (14–34): 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.

14 If Dianne gets an A in math and an A in science, then she is happy. Dianne is not happy, but she got an A in math. What is a logical conclusion?
(1) Dianne got an A in science.
(2) Dianne did not get an A in either math or science.
(3) Dianne got an A in both math and science.
(4) Dianne did not get an A in science.

15 Two complementary angles have measures in the ratio 5:4. What is the measure of the *smaller* angle?

(1) 40° (3) 80°
(2) 50° (4) 100°

16 Which value of x satisfies the equation $\sin 40° = \cos x$?
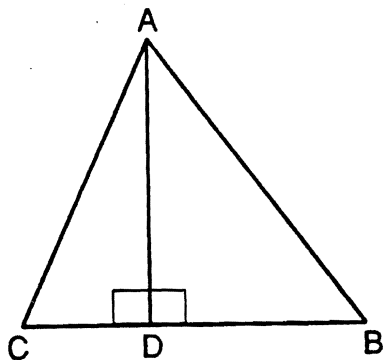
(1) 20° (3) 50°
(2) 40° (4) 80°

17 Which set of numbers may represent the lengths of the sides of a right triangle?

(1) {5,12,13} (3) {7,8,10}
(2) {4,5,6} (4) {5,5,10}

18 Statement a is false and statement b is true. Which statement is also true?

(1) $a \vee \sim b$ (3) $\sim a \rightarrow \sim b$
(2) $\sim a \wedge b$ (4) $a \rightarrow b$

19 In $\triangle ABC$, altitude $\overline{AD}$ is drawn to base $\overline{BC}$. If $AD = 12$, $AB = 15$, and $AC = 13$, what is BC?

(1) 5 (3) 14
(2) 9 (4) 42

20 Given four distinct quadrilaterals: square, rectangle, rhombus, and parallelogram. One is chosen at random. What is the probability that its diagonals are congruent?

(1) 1 (3) $\frac{2}{4}$
(2) $\frac{1}{4}$ (4) 0
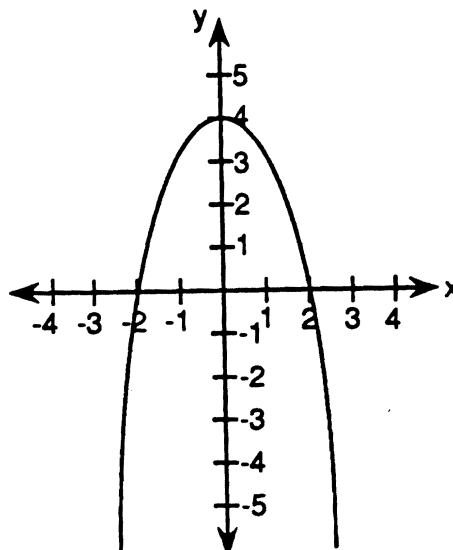
21 In a plane with line ℓ, point P is not on ℓ. How many lines pass through P parallel to ℓ?

(1) 1
(2) 2
(3) 0
(4) an infinite number

22 Which is an equation of the circle whose center is (2,−3) and whose radius is 4?

(1) $(x + 2)^2 + (y - 3)^2 = 4$
(2) $(x - 2)^2 + (y + 3)^2 = 4$
(3) $(x + 2)^2 + (y - 3)^2 = 16$
(4) $(x - 2)^2 + (y + 3)^2 = 16$

23 Which is an equation of the graph shown in the diagram below?

(1) $y = x^2 - 4$ (3) $x = y^2 - 4$
(2) $y = -x^2 + 4$ (4) $x = -y^2 + 4$

24 Which statement is true?

(1) $_{10}C_3 = 30$ (3) $_{10}C_3 = {_{10}P_3}$
(2) $_{10}C_3 = {_{10}C_7}$ (4) $_{10}C_3 = \frac{10!}{3!}$

25 If a point in Quadrant II is reflected in the y-axis, its image will lie in Quadrant

(1) I (3) III
(2) II (4) IV

26 In quadrilateral $ABCD$, if $\overline{AB} \cong \overline{DC}$ and $\overline{AD} \cong \overline{BC}$, then diagonals $\overline{AC}$ and $\overline{BD}$ must

(1) be perpendicular
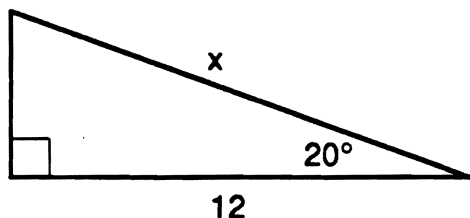(2) be parallel
(3) be congruent
(4) bisect each other

27 How many different six-letter arrangements can be formed from the letters in the word "BANANA"?

(1) 6   (3) 180
(2) 60   (4) 720

28 The sum of the measures of the interior angles of a pentagon is

(1) 270°   (3) 540°
(2) 360°   (4) 720°

29 Which equation can be used to find the value of x in the right triangle shown below?

(1) $\cos 20° = \dfrac{x}{12}$ (3) $\cos 20° = \dfrac{12}{x}$

(2) $\sin 20° = \dfrac{12}{x}$ (4) $\cos 70° = \dfrac{x}{12}$

30 Using the translation that maps $(3,-4)$ to its image $(1,0)$, what is the image of any point (x,y)?

(1) $(x + 2, y + 4)$ (3) $(x + 2, y - 4)$
(2) $(x - 2, y - 4)$ (4) $(x - 2, y + 4)$

31 On the coordinate plane, how many points are 5 units from the origin and satisfy the equation $x = 4$?

(1) 1   (3) 3
(2) 2   (4) 0

32 What are the roots of the equation $2x^2 - 5x + 1 = 0$?

(1) $\dfrac{5 \pm \sqrt{17}}{4}$ (3) $\dfrac{5 \pm \sqrt{33}}{-4}$

(2) $\dfrac{-5 \pm \sqrt{21}}{4}$ (4) $\dfrac{-5 \pm \sqrt{23}}{-4}$

33 The turning point of the graph of the function of $y = 2x^2 + 4x + 3$ is

(1) $(-1,1)$ (3) $(1,-1)$
(2) $(-1,-1)$ (4) $(1,1)$

34 Which is an equation of the line that passes through the point $(5,-2)$ and has a slope of -3?

(1) $y = -3x - 13$ (3) $y = -3x + 13$
(2) $y = 3x - 13$ (4) $y = 3x + 13$

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

35 *On the answer sheet*, construct a line through P perpendicular to $\overleftrightarrow{AB}$.

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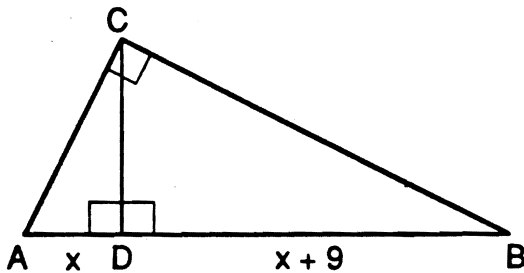
Part II

Answer three questions from this part. All work, including calculations, must be shown on your answer paper. [30]

36 *a* On graph paper, draw the graph of the parabola $y = x^2 + 6x + 5$, including all values of x in the interval $-6 \le x \le 0$. [5]

b On the same set of axes, draw the image of the parabola drawn in part *a* after a translation of $(x + 3, y - 3)$. [3]

c Using the graph, write the coordinates of the point of intersection of the parabolas drawn in parts *a* and *b*. [2]

37 In the accompanying diagram of right triangle *ABC*, *CD* = 6, and altitude $\overline{CD}$ divides hypotenuse $\overline{AB}$ into segments of lengths x and $(x + 9)$.

a Find the length of $\overline{AD}$. [5]

b Find the area of $\triangle ABC$. [2]

c Find the measure of $\angle A$ to the *nearest degree*. [3]

38 The vertices of $\triangle ABC$ are $A(7,1)$, $B(6,7)$, and $C(11,3)$.

a Find the area of $\triangle ABC$. [6]

b Find, in radical form, the length of the median from *B* to $\overline{AC}$. [4]

39 *a* For all values of x for which these expressions are defined, perform the indicated operations and express in simplest form:

$$\frac{x^2 + 4x + 4}{2x - 3} \div \frac{x^2 - 4}{2x^2 - 7x + 6} \quad [5]$$

b A box contains five red cubes, three blue cubes, and some yellow cubes. If the probability of choosing a yellow cube at random is $\frac{1}{3}$, how many yellow cubes are in the box? [5]

40 Given: If Grace goes shopping, then she buys a computer.
Either Grace goes shopping or she goes to the meeting.
If Grace goes to the meeting, she cannot attend class.
Either Grace attends class or Mary Ellen is unhappy.
Mary Ellen is happy.

Let *S* represent: "Grace goes shopping."
Let *C* represent: "Grace buys a computer."
Let *M* represent: "Grace goes to the meeting."
Let *A* represent: "Grace attends class."
Let *H* represent: "Mary Ellen is happy."

Use *S*, *C*, *M*, *A*, *H*, and proper connectives to express each sentence in symbolic form, and prove that Grace buys a computer. [10]
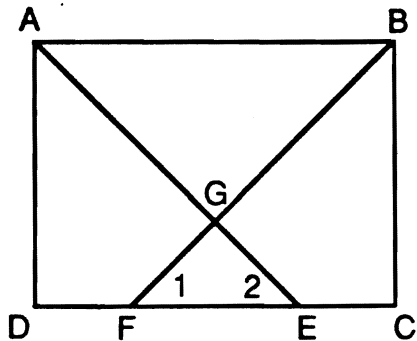
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Answers to the following questions are to be written on paper provided by the school.

Part III

Answer one question from this part. All work, including calculations, must be shown on your answer paper. [10]

41 Given: rectangle $ABCD$, $\overline{DFEC}$, $\overline{AGE}$, $\overline{BGF}$, and $\overline{DF} \cong \overline{CE}$.
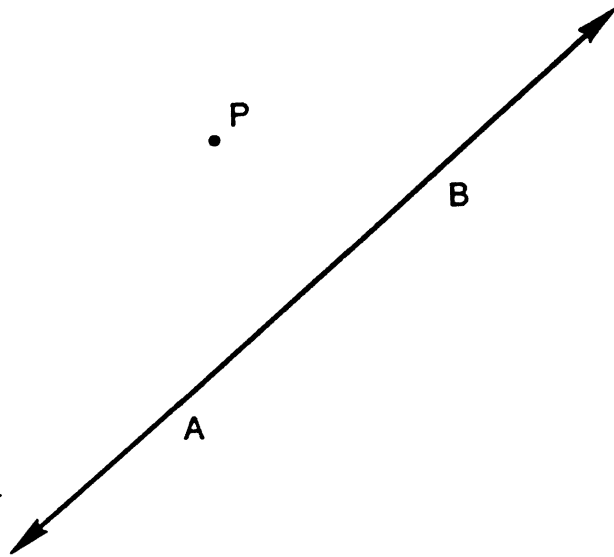

Prove: a $\triangle ADE \cong \triangle BCF$ [7]

b $\angle 1 \cong \angle 2$ [1]

c $\overline{GF} \cong \overline{GE}$ [2]

42 Quadrilateral $PQRS$ has vertices $P(-3,-4)$, $Q(9,5)$, $R(-1,10)$, and $S(-5,7)$. Prove that quadrilateral $PQRS$ is an isosceles trapezoid. [10]

35

P

B

A