The University of the State of New York

REGENTS HIGH SCHOOL EXAMINATION

MATHEMATICS B

Tuesday, January 26, 2010 — 9:15 a.m. to 12:15 p.m., only

Print Your Name: Mr. Sibol

Print Your School's Name: JMAP

Print your name and the name of your school in the boxes above. Then turn to the last page of this booklet, which is the answer sheet for Part I. Fold the last page along the perforations and, slowly and carefully, tear off the answer sheet. Then fill in the heading of your answer sheet.

Scrap paper is not permitted for any part of this examination, but you may use the blank spaces in this booklet as scrap paper. A perforated sheet of scrap graph paper is provided at the end of this booklet for any question for which graphing may be helpful but is not required. You may remove this sheet from this booklet. Any work done on this sheet of scrap graph paper will *not* be scored. Write all your work in pen, except graphs and drawings, which should be done in pencil.

The formulas that you may need to answer some questions in this examination are found on page 19. This sheet is perforated so you may remove it from this booklet.

This examination has four parts, with a total of 34 questions. You must answer all questions in this examination. Write your answers to the Part I multiple-choice questions on the separate answer sheet. Write your answers to the questions in Parts II, III, and IV directly in this booklet. Clearly indicate the necessary steps, including appropriate formula substitutions, diagrams, graphs, charts, etc.

When you have completed the examination, you must sign the statement printed at the end of the answer sheet, indicating that you had no unlawful knowledge of the questions or answers prior to the examination and that you have neither given nor received assistance in answering any of the questions during the examination. Your answer sheet cannot be accepted if you fail to sign this declaration.

Notice. . .

A graphing calculator, a straightedge (ruler), and a compass must be available for you to use while taking this examination.

The use of any communications device is strictly prohibited when taking this examination. If you use any communications device, no matter how briefly, your examination will be invalidated and no score will be calculated for you.

DO NOT OPEN THIS EXAMINATION BOOKLET UNTIL THE SIGNAL IS GIVEN.

Part I

Answer all questions in this part. Each correct answer will receive 2 credits. No partial credit will be allowed. For each question, write on the separate answer sheet the numeral preceding the word or expression that best completes the statement or answers the question. [40]

Use this space for computations.

1 If $\sqrt{x-4} = 7$, what is the value of x?

(1) 11
(2) 18
(3) 45
(4) 53

$x - 4 = 49$
$x = 53$

2 The coordinates of $\triangle ABC$ are $A(1,1)$, $B(2,3)$, and $C(3,1)$. If $\triangle A'B'C'$ is the result of the transformation $D_2 \circ r_{y\text{-axis}}$, then $\triangle A'B'C'$ is

(1) similar to $\triangle ABC$
(2) congruent to $\triangle ABC$
(3) a right triangle
(4) an equilateral triangle

Angle measure remains the same after a reflection or dilation.

3 What is the value of $3\sum_{n=2}^{6} \frac{n}{2}$?

(1) 10
(2) 13
(3) 30
(4) 60

n	$n/2$
2	2/2
3	3/2
4	4/2
5	5/2
6	6/2

$= \frac{20}{2} = 10 \times 3 = 30$

4 An equation of a parabola that has $x = -2$ as its axis of symmetry is

(1) $y = x^2 - 4x + 1$
(2) $y = x^2 - 2x + 3$
(3) $y = 2x^2 + 8x - 3$
(4) $y = 2x^2 + 4x - 7$

$x = \frac{-b}{2a} = \frac{-8}{2(2)} = -2$

5 What is the solution set for the equation $|3 - 2x| = 5$?

(1) $\{-1,4\}$
(2) $\{1,-4\}$
(3) $\{-1\}$
(4) $\{4\}$

$3 - 2x = 5$ $\quad$ $3 - 2x = -5$
$-2x = 2$ $\quad$ $-2x = -8$
$x = -1$ $\quad$ $x = 4$

6 A central angle of $\frac{4\pi}{15}$ radians intercepts an arc whose degree measure is

(1) 48
(2) 72
(3) 96
(4) $\frac{4\pi}{15}$

$\frac{4\pi}{15} \cdot \frac{180}{\pi} = 48$

Use this space for computations.

7 If $\cos 2\theta = 1$, a value of θ is

(1) 45°
(2) 90°
(3) 180°
(4) 270°

$2\theta = \cos^{-1} 1$

$\frac{2\theta}{2} = \frac{360}{2}$

$\theta = 180$

8 If $\cos x = -0.7$ and $\csc x > 0$, the terminal side of angle x is located in Quadrant

$\sin x > 0$

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

9 The graph of the equation $xy = 12$ is best described as

(1) a circle
(2) two lines
(3) an ellipse
(4) a hyperbola

10 The image of function $f(x)$ is found by mapping each point on the function (x,y) to the point (y,x). This image is a reflection of $f(x)$ in

(1) the x-axis
(2) the y-axis
(3) the line whose equation is $y = x$
(4) the line whose equation is $y = -x$

11 What is the inverse of the function $y = 3x - 2$?

(1) $y = -3x + 2$
(2) $y = \frac{x + 2}{3}$
(3) $y = \frac{x - 2}{3}$
(4) $3y = 2x$

$x = 3y - 2$

$\frac{x+2}{3} = \frac{3y}{3}$

12 Which equation represents the circle whose center is (3,–1) and whose radius is $\sqrt{6}$?

(1) $(x + 3)^2 + (y - 1)^2 = 36$
(2) $(x - 3)^2 + (y + 1)^2 = 36$
(3) $(x + 3)^2 + (y - 1)^2 = 6$
(4) $(x - 3)^2 + (y + 1)^2 = 6$

$(\sqrt{6})^2 = 6$

Use this space for computations.

13 Which expression is equivalent to $\frac{y-x}{x^2-y^2}$?

(1) $\frac{1}{x-y}$

(2) $\frac{-1}{x-y}$

(3) $\frac{1}{x+y}$

(4) $\frac{-1}{x+y}$

14 If $\log x = 3\log a - \log b$, then x is equal to

(1) $\frac{3a}{b}$

(2) $\frac{a^3}{b}$

(3) $3a - b$

(4) $a^3 - b$

15 Which expression is equivalent to b in the equation $V = \sqrt{a^4 b^{\frac{1}{3}}}$?

(1) $\frac{V^6}{a^{12}}$

(2) $\frac{V^5}{a^7}$

(3) $\frac{V^2}{a^4}$

(4) $\frac{V}{a^2}$

16 In the binomial expansion of $(x+y)^8$, what is the coefficient of the term containing x^3y^5?

(1) 15
(2) 28
(3) 56
(4) 70

17 If R is inversely proportional to A, and $R = 4$ when $A = 100$, what is the value of R when $A = 250$?

(1) 0.625
(2) 1.6
(3) 10
(4) 6,250

Use this space for computations.

18 If $m\angle A = 35$, $b = 3$, and $a = 4$, how many different triangles can be constructed?

(1) No triangles can be constructed.
(2) two triangles
(3) one right triangle, only
(4) one obtuse triangle, only

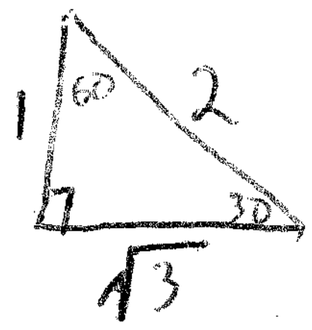
$\frac{4}{\sin 35} = \frac{3}{\sin B}$

$B = 25 + 35$ is possible

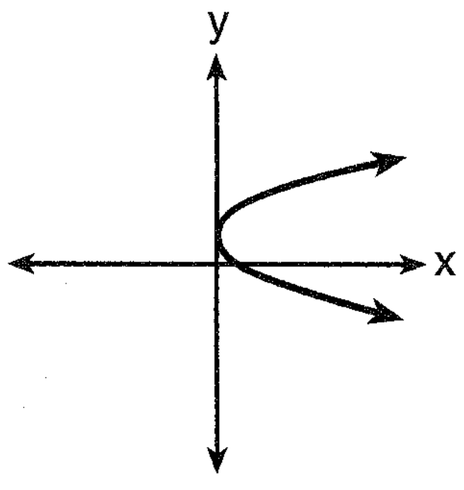
supplement $B = 155 + 35$ is not possible

19 In a right triangle where one of the angles measures 30°, what is the ratio of the length of the side opposite the 30° angle to the length of the side opposite the 90° angle?

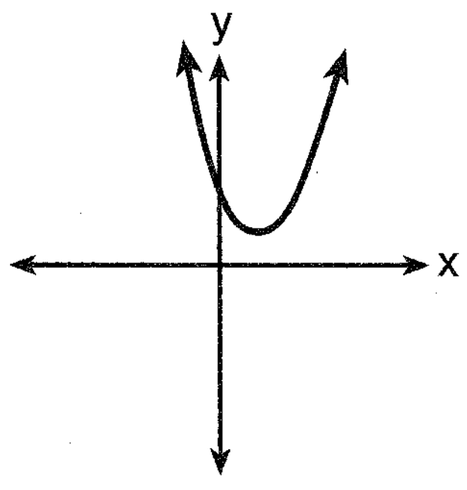
(1) $1:\sqrt{2}$
(2) 1:2
(3) 1:3
(4) $1:\sqrt{3}$



20 If zero is the value of the discriminant of the equation $ax^2 + bx + c = 0$, which graph best represents $y = ax^2 + bx + c$?



(1)



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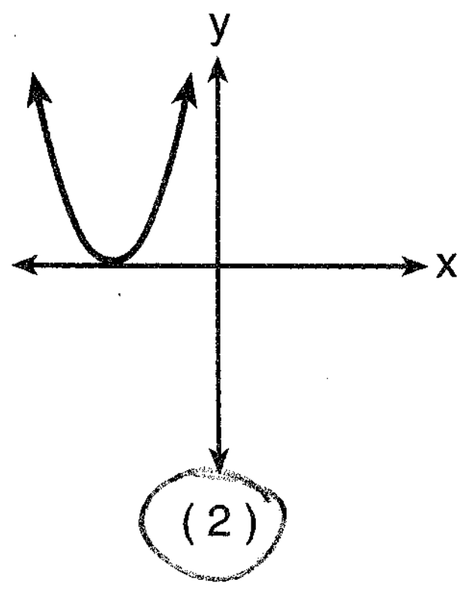

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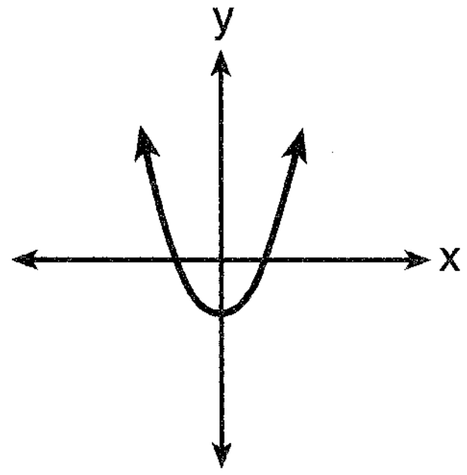


(4)

Part II

Answer all questions in this part. Each correct answer will receive 2 credits. Clearly indicate the necessary steps, including appropriate formula substitutions, diagrams, graphs, charts, etc. For all questions in this part, a correct numerical answer with no work shown will receive only 1 credit. [12]

21 If $f(x) = 3x + 1$ and $g(x) = x^2 - 1$, find $(f \circ g)(2)$.

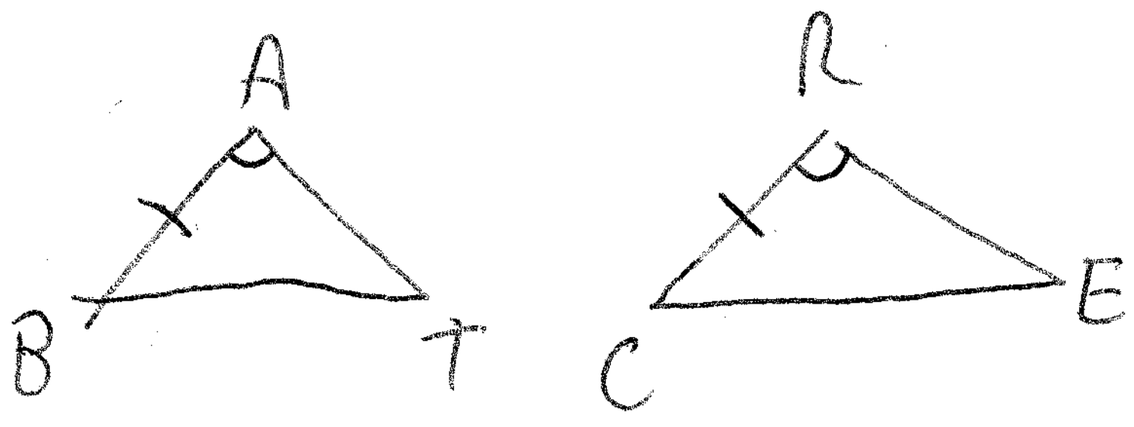
$g(2) = 2^2 - 1 = 3$

$F(3) = 3(3) + 1 = 10$

22 In $\triangle BAT$ and $\triangle CRE$, $\angle A \cong \angle R$ and $\overline{BA} \cong \overline{CR}$.

Write *one* additional statement that could be used to prove that the two triangles are congruent.

State the method that would be used to prove that the triangles are congruent.

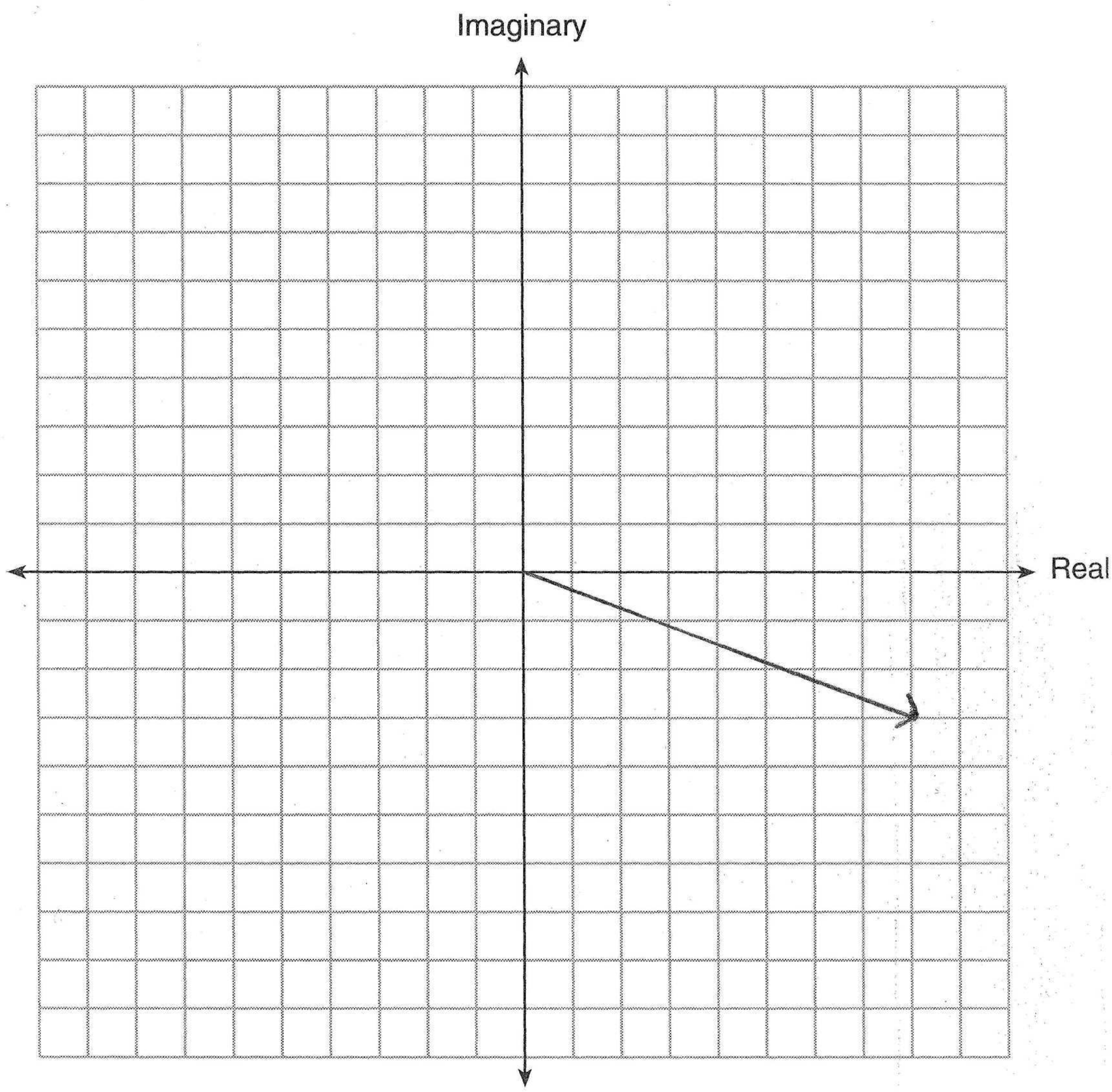


$\angle T \cong \angle E$

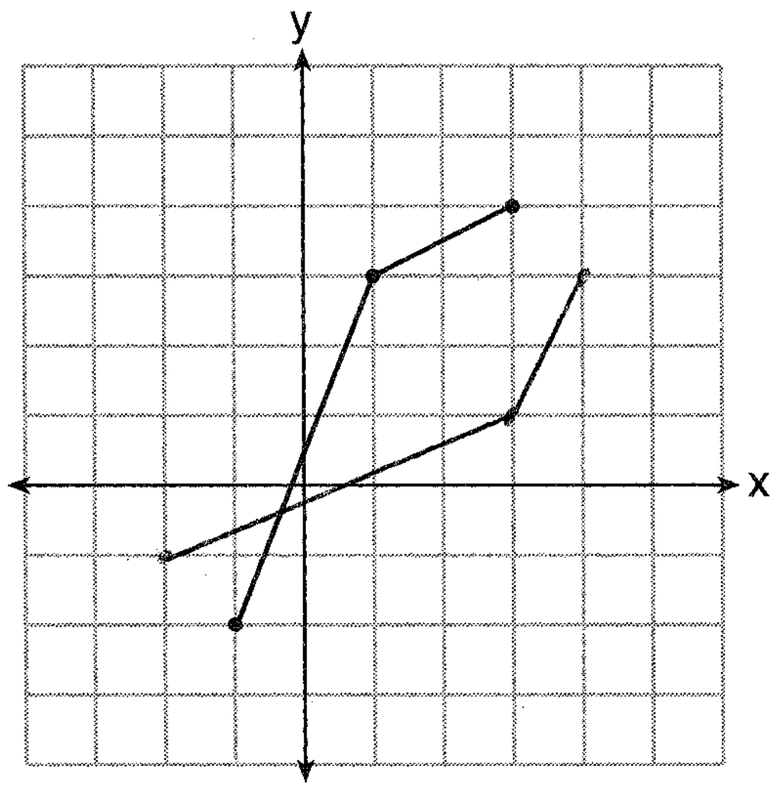
AAS

23 Given the complex numbers $z_1 = 3 + 2i$ and $z_2 = -5 + 5i$. Find $z_1 - z_2$ and graph the result on the accompanying set of axes.

$= 8 - 3i$



24 The function, f, is drawn on the accompanying set of axes. On the same set of axes, sketch the graph of f^{-1}, the inverse of f.



25 Express the sum of $4\sqrt{-12}$ and $3\sqrt{-27}$ in simplest radical form, in terms of i.

$4\sqrt{4}\sqrt{-3} + 3\sqrt{9}\sqrt{-3}$

$4(2)\sqrt{-3} + 3(3)\sqrt{-3}$

$8i\sqrt{3} + 9i\sqrt{3}$

$17i\sqrt{3}$

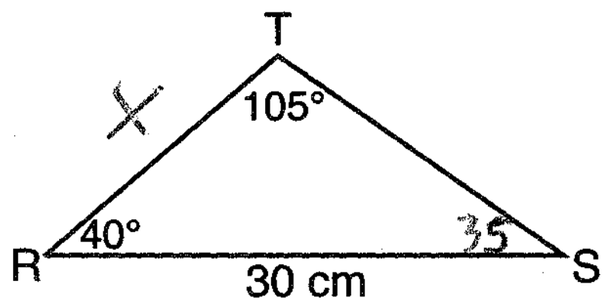
26 Express the reciprocal of $3 - \sqrt{7}$ in simplest radical form with a rational denominator.

$\frac{1}{3-\sqrt{7}} \cdot \frac{3+\sqrt{7}}{3+\sqrt{7}} = \frac{3+\sqrt{7}}{9-7} = \frac{3+\sqrt{7}}{2}$

Part III

Answer all questions in this part. Each correct answer will receive 4 credits. Clearly indicate the necessary steps, including appropriate formula substitutions, diagrams, graphs, charts, etc. For all questions in this part, a correct numerical answer with no work shown will receive only 1 credit. [24]

27 In the accompanying diagram of $\triangle RST$, $RS = 30$ centimeters, $m\angle T = 105$, and $m\angle R = 40$. Find the area of $\triangle RST$, to the *nearest square centimeter.*



$$\frac{30}{\sin 105} = \frac{x}{\sin 35}$$

$$x = 17.8$$

$$K = \frac{1}{2}ab\sin C$$

$$= \frac{1}{2}(17.8)(30)\sin 40$$

$$= 172$$

28 The mid-September statewide average gas prices, in dollars per gallon, (y), for the years since 2000, (x), are given in the table below.

Year Since 2000 (x)	Price Per Gallon (y)
1	1.345
2	1.408
3	1.537
4	1.58

Write a linear regression equation for this set of data. $y = .0834x + 1.259$

Using this equation, determine how much *more* the actual 2005 gas price was than the predicted gas price if the actual mid-September gas price for the year 2005 was \$2.956.

$= .0834(5) + 1.259$

$= 1.676$

$2.956 - 1.676 = 1.28$

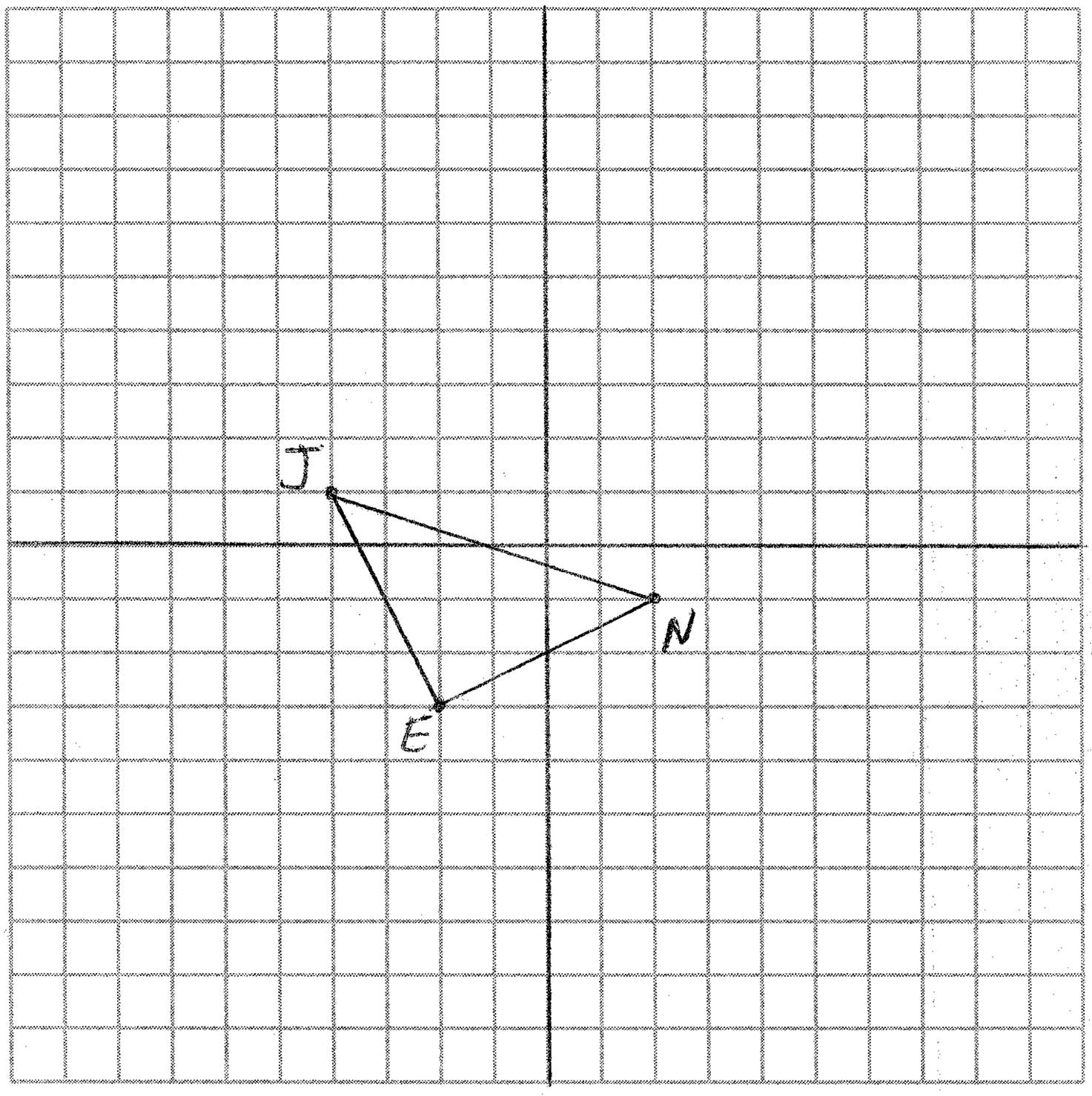
29 Given: $J(-4,1)$, $E(-2,-3)$, $N(2,-1)$

Prove: $\triangle JEN$ is an isosceles right triangle.

[The use of the grid on the next page is optional.]

	STATEMENT	REASON
(1)	$J(-4,1), E(-2,-3), N(2,-1)$	(1) Given
(2)	$m_{\overline{JE}} = \frac{1--3}{-4--2} = \frac{4}{-2} = -2$	(2) Definition of slope
	$m_{\overline{EN}} = \frac{-3--1}{-2-2} = \frac{-2}{-4} = \frac{1}{2}$	
(3)	$\overline{JE} \perp \overline{EN}$	(3) Perpendicular lines have slopes that are opposite reciprocals
(4)	$\angle JEN$ is a right angle	(4) Perpendicular lines form right angles
(5)	$\triangle JEN$ is a right triangle	(5) Definition of right triangle
(6)	$d_{\overline{JE}} = \sqrt{(-4--2)^2+(1--3)^2} = \sqrt{20}$	(6) Definition of distance
	$d_{\overline{EN}} = \sqrt{(-2-2)^2+(-3--1)^2} = \sqrt{20}$	
(7)	$\overline{JE} \cong \overline{EN}$	(7) Lines of equal length are congruent
(8)	$\triangle JEN$ is an isosceles right triangle	(8) Definition of isosceles right triangle

Question 29 continued



30 According to a federal agency, when a lie detector test is given to a truthful person, the probability that the test will show that the person is not telling the truth is 20%. If a company interviews five truthful candidates for a job and asks about thefts from prior employers, what is the probability a lie detector test will show that *at most* one candidate is *not* telling the truth?

$n = 5$

$r = 0, 1$

$p = .2$

$q = .8$

$${}_5C_0 (.2)^0 (.8)^5 = \frac{1024}{3125}$$

$${}_5C_1 (.2)^1 (.8)^4 = \frac{1280}{3125}$$

$$+$$

$$\frac{2304}{3125}$$

31 Currently, the population of the metropolitan Waterville area is 62,700 and is increasing at an annual rate of 3.25%. This situation can be modeled by the equation $P(t) = 62{,}700(1.0325)^t$, where $P(t)$ represents the total population and t represents the number of years from now.

Find the population of the Waterville area, to the *nearest hundred*, seven years from now. $P(7) = 62{,}700(1.0325)^7 = 78{,}400$

Determine how many years, to the *nearest tenth*, it will take for the original population to reach 100,000.

[Only an algebraic solution can receive full credit.]

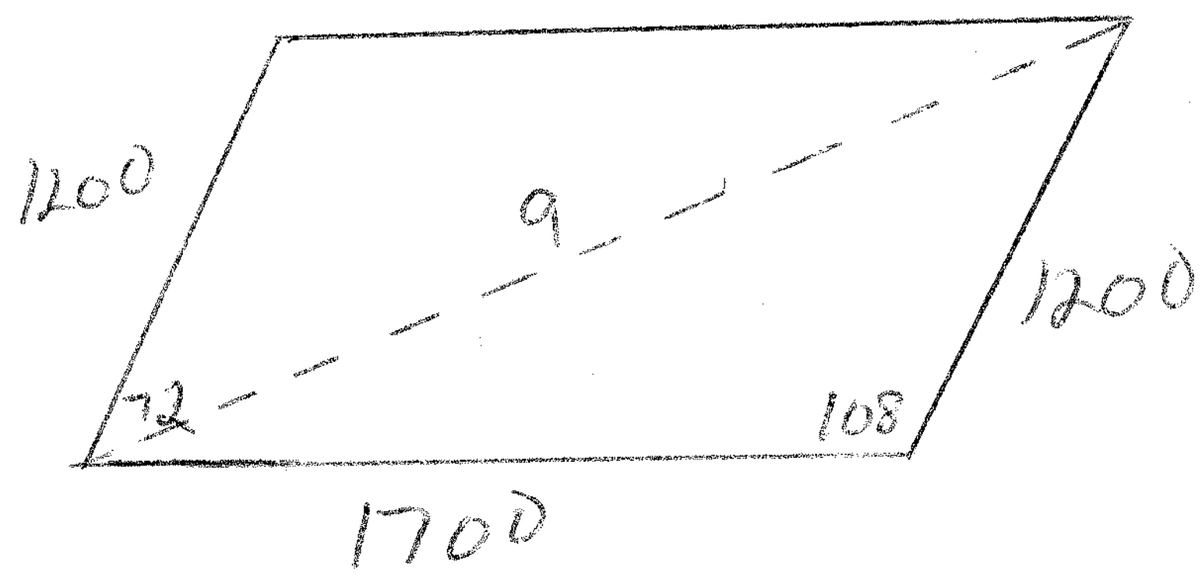
$$\frac{100{,}000}{62{,}700} = \frac{62{,}700(1.0325)^t}{62{,}700}$$

$$\log \frac{1000}{627} = \log 1.0325^t$$

$$\frac{\log \frac{1000}{627}}{\log 1.0325} = t$$

$$14.6 = t$$

32 A tractor stuck in the mud is being pulled out by two trucks. One truck applies a force of 1,200 pounds, and the other truck applies a force of 1,700 pounds. The angle between the forces applied by the two trucks is 72°. Find the magnitude of the resultant force, to the *nearest pound*.

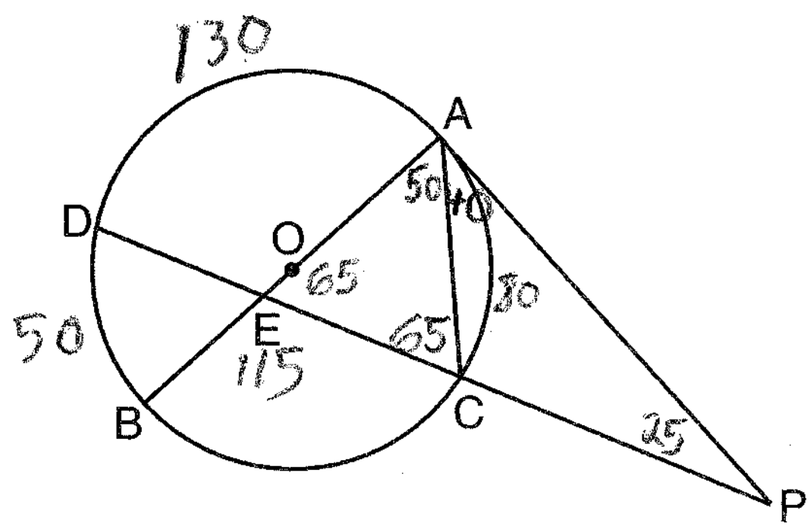


$q = \sqrt{1200^2 + 1700^2 - 2(1200)(1700)\cos 108} = 2364$

Part IV

Answer all questions in this part. Each correct answer will receive 6 credits. Clearly indicate the necessary steps, including appropriate formula substitutions, diagrams, graphs, charts, etc. For all questions in this part, a correct numerical answer with no work shown will receive only 1 credit. [12]

33 In the accompanying diagram, $\overline{PA}$ is tangent to circle O at A, chord $\overline{AC}$ and secant $\overline{PCED}$ are drawn, and chords $\overline{AOB}$ and $\overline{CD}$ intersect at E. If $\text{m}\overset{\frown}{AD} = 130$ and $\text{m}\angle BAC = 50$, find $\text{m}\angle P$, $\text{m}\angle BEC$, and $\text{m}\angle PCA$.



$\frac{50+\overset{\frown}{AC}}{2} = 65$

$\overset{\frown}{AC} = 80$

$\text{m}\angle P = \frac{130-80}{2} = 25$

$\text{m}\angle BEC = 180-65 = 115$

$\text{m}\angle PCA = 180-(40+25)$

$= 115$

34 Solve for all values of x, to the *nearest tenth*:

$$\frac{1}{x} + \frac{1}{x+3} = 3$$

[Only an algebraic solution can receive full credit.]

$$\frac{x+3+x}{x(x+3)} = 3$$

$$\frac{2x+3}{x^2+3x} = 3$$

$$3x^2+9x = 2x+3$$

$$3x^2+7x-3 = 0$$

$$x = \frac{-7 \pm \sqrt{7^2-4(3)(3)}}{2(3)}$$

$$x = \frac{-7 \pm \sqrt{49+36}}{6}$$

$$= \frac{-7 \pm \sqrt{85}}{6}$$

$$= .4 \text{ and } -2.7$$