The University of the State of New York

REGENTS HIGH SCHOOL EXAMINATION

ALGEBRA 2 /TRIGONOMETRY

Wednesday, January 25, 2017 — 1:15 to 4:15 p.m., only

Student Name: Mr. Sibol

School Name: JMAP

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

Print your name and the name of your school on the lines above.

A separate answer sheet for Part I has been provided to you. Follow the instructions from the proctor for completing the student information on your answer sheet.

This examination has four parts, with a total of 39 questions. You must answer all questions in this examination. Record 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. All work should be written in pen, except for graphs and drawings, which should be done in pencil. Clearly indicate the necessary steps, including appropriate formula substitutions, diagrams, graphs, charts, etc.

The formulas that you may need to answer some questions in this examination are found at the end of the examination. This sheet is perforated so you may remove it from this booklet.

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.

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 and a straightedge (ruler) must be available for you to use while taking this examination.

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

Part I

Answer all 27 questions in this part. Each correct answer will receive 2 credits. For each statement or question, choose the word or expression that, of those given, best completes the statement or answers the question. Record your answers on your separate answer sheet. [54]

Use this space for computations.

1 What is 510° expressed in radian measure?

(1) 2.83

(2) $\frac{5\pi}{6}$

(3) $\frac{17\pi}{6}$

(4) $\frac{17\pi}{12}$

$510 \cdot \frac{\pi}{180} = \frac{17\pi}{6}$

2 Four surveys are described below. Which survey methodology would lead to the *least* biased conclusion?

(1) One hundred randomly chosen heart surgeons were polled by telephone about how to get children to eat healthier foods.

(2) A country and western radio station asked one hundred of its listeners to call a telephone number and answer a question about rap music.

(3) From calls made to one hundred randomly generated telephone numbers, people replied to a question about television shows they watch.

(4) The first one hundred people who left the World of Baseball Bookstore replied to a question about the importance of baseball to society.

3 When factored completely, $x^4 - 13x^2 + 36$ is equivalent to

(1) $(x^2 - 6)(x^2 - 6)$

(2) $(x^2 - 4)(x^2 - 9)$

(3) $(x - 2)(x - 2)\,(x - 3)(x - 3)$

(4) $(x - 2)(x + 2)\,(x - 3)(x + 3)$

$(x^2-9)(x^2-4)$

$(x+3)(x-3)(x+2)(x-2)$

4 Which ordered pair is a solution to the system below?

$$x^2 - 4y^2 = 16$$
$$y = x - 4$$

(1) (0,−4)

(2) (4,0)

(3) (6,2)

(4) (2,−2)

$x^2 - 4(x-4)^2 = 16$

$x^2 - 4(x^2 - 8x + 16) = 16$

$x^2 - 4x^2 + 32x - 64 = 16$

$-3x^2 + 32x - 80 = 0$

$3x^2 - 32x + 80 = 0$

$(3x - 20)(x - 4) = 0$

$x = 4$

$y = 4 - 4 = 0$

Use this space for computations.

5 Three freshmen, five sophomores, and four juniors are on the school's chess team. The coach must select three students to attend the citywide tournament. Which expression could be used to determine how many different groups of three students can be made from this team?

(1) ${}_{12}C_3$

(2) ${}_{12}P_3$

(3) ${}_3C_1 \cdot {}_5C_1 \cdot {}_4C_1$

(4) ${}_3P_1 \cdot {}_5P_1 \cdot {}_4P_1$

6 A survey of high school girls found that the mean number of text messages sent per day by the girls was 62, with a standard deviation of 12. If a normal distribution is assumed, which interval represents the number of texts sent by 68.2% of the girls?

(1) 38–86

(2) 44–80

(3) 50–74

(4) 56–68

$62 \pm 12 = 50\text{-}74$

7 The expression $9^{\frac{3}{2}} \cdot 27^{\frac{1}{2}}$ is equivalent to

(1) 3^2

(2) $3^{\frac{9}{2}}$

(3) 243^2

(4) $243^{\frac{3}{4}}$

$(3^2)^{\frac{3}{2}} \cdot (3^3)^{\frac{1}{2}}$

$3^3 \cdot 3^{\frac{3}{2}}$

$3^{\frac{9}{2}}$

8 The ratio $\frac{\text{Arc}\cos\frac{1}{2}}{\text{Arc}\tan 1}$ is equal to

$\frac{\pi/3}{\pi/4} = \frac{4}{3}$

(1) $\frac{3}{4}$

(2) $\frac{3\pi}{4}$

(3) $\frac{4}{3}$

(4) $\frac{4\pi}{3}$

9 Which summation will *not* produce 2 + 4 + 6 + 8 + 10 + 12?

(1) $\sum_{b=2}^{12} b$

(2) $\sum_{a=1}^{6} 2a$

(3) $\sum_{d=2}^{7} (2d-2)$

(4) $2\sum_{c=0}^{5} (c+1)$

Use this space for computations.

10 The expression $\frac{1}{3}\sqrt{6}\left(3m\sqrt{2} - k\sqrt{3}\right)$ is equivalent to

(1) $2m\sqrt{3} - k\sqrt{2}$

(2) $2m\sqrt{3} - 3k\sqrt{2}$

(3) $2m - k\sqrt{2}$

(4) $12m - k\sqrt{6}$

11 If $\log_3 (x + 1) - \log_3 x = 2$, then x equals

(1) $-\frac{9}{8}$

(2) $-\frac{6}{5}$

(3) $\frac{1}{8}$

(4) $\frac{1}{5}$

12 Which relation is *not* a function?

(1) $xy = 4$

(2) $y = \log_4 x$

(3) $y = 4 \sin x$

(4) $4x^2 - y^2 = 4$

13 What is the area of parallelogram $ABCD$ if $AB = 4$, $AD = 5\sqrt{3}$, and $m\angle A = 60$?

(1) 15

(2) 30

(3) $5\sqrt{3}$

(4) $10\sqrt{3}$

14 The maximum point on the graph of the equation $y = f(x)$ is $(2,-3)$. What is the maximum point on the graph of the equation $y = f(x - 4)$?

(1) $(2,-7)$

(2) $(-2,-3)$

(3) $(6,-7)$

(4) $(6,-3)$

15 The formula of the nth term of the sequence 3, −6, 12, −24, 48. . . is

(1) $a_n = -2(3)^n$

(2) $a_n = 3(-2)^n$

(3) $a_n = -2(3)^{n-1}$

(4) $a_n = 3(-2)^{n-1}$

Use this space for computations.

16 The expression $\frac{3}{a-1} + \frac{3}{1-a}$ is equivalent to

(1) 0
(2) $\frac{6}{a^2-1}$
(3) 6
(4) $\frac{6}{1-a^2}$

$\frac{3}{a-1} - \frac{3}{a-1} = 0$

17 The product of $\left(2\sqrt{2}+5i\right)$ and $\left(5\sqrt{2}-2i\right)$ is

(1) 30
(2) $30 + 21i\sqrt{2}$
(3) $30 + 29i\sqrt{2}$
(4) $10 + 21i\sqrt{2}$

$10\sqrt{4} - 4i\sqrt{2} + 25i\sqrt{2} - 10i^2$
$30 + 21i\sqrt{2}$

18 Which quadratic equation has roots with a sum of $\frac{7}{6}$ and a product of $-\frac{1}{2}$?

(1) $6x^2 + 7x + 3 = 0$
(2) $6x^2 + 7x - 3 = 0$
(3) $6x^2 - 7x - 3 = 0$
(4) $6x^2 - 7x + 3 = 0$

S: $\frac{-b}{a} = -\left(\frac{-7}{6}\right) = \frac{7}{6}$
P: $\frac{c}{a} = \frac{-3}{6} = -\frac{1}{2}$

19 The range of the function $f(x) = 3|x - 4| - 5$ is

(1) $x \geq 0$
(2) $f(x) \geq 0$
(3) $x \geq -5$
(4) $f(x) \geq -5$

20 The graph of the equation $y = m^x$ passes through the point

(1) $(1,m)$
(2) $(0,m)$
(3) $(m,0)$
(4) $(m,1)$

21 If $\sin\theta = \frac{1}{2}$, and θ terminates in Quadrant II, what is the value of $\csc\theta \cdot \cot\theta$?

(1) $-2\sqrt{3}$
(2) $\frac{\sqrt{3}}{2}$
(3) -2
(4) $\frac{2\sqrt{3}}{3}$

II

$\sin\theta = \frac{1}{2}$ $\cos\theta = \frac{-\sqrt{3}}{2}$

$\frac{1}{\sin\theta} \cdot \frac{\cos\theta}{\sin\theta}$

$\frac{-\sqrt{3}/2}{\left(\frac{1}{2}\right)^2} = -2\sqrt{3}$

$r = \frac{s}{\theta}$

Use this space for computations.

22 A circle has a radius of 12 units. For this circle, which expression *incorrectly* states the length of the arc intercepted by the given central angle?

(1) angle = 120°
arc length = 8π

(2) angle = 6°
arc length = 72

(3) angle = $\frac{2}{3}$ radian
arc length = 8

(4) angle = $\frac{\pi}{3}$ radians
arc length = 4π

(1) $\frac{8\pi}{120 \cdot \frac{\pi}{180}} = 12$

(2) $\frac{72}{6 \cdot \frac{\pi}{180}} \neq 12$

23 How many different four-letter arrangements can be made from the letters in the word "CHAIRS," if the same letter may be used only once?

(1) 360
(2) 420
(3) 720
(4) 840

$_6P_4$

(3) $\frac{8}{2/3} = 12$

(4) $\frac{4\pi}{\pi/3} = 12$

24 The sets below represent test scores for two students in Mrs. Silvio's trigonometry class.

	$\bar{x}$	IQR	σ_x	R
Michelle: {71, 68, 84, 88}	77.8	16.5	8.4	20
Valerie: {78, 82, 76, 80}	79	4	2.2	6

Which statement correctly describes the relationship between the two students' test scores?

(1) Michelle's mean test score is greater and her test scores have a greater interquartile range.

(2) Michelle's population standard deviation is greater, but her range is smaller.

(3) Valerie's mean test score is greater and her interquartile range is greater.

(4) Valerie's mean test score is greater, but her population standard deviation is smaller.

25 A support wire 20 meters long runs from the top of a utility pole to a point on the ground 17 meters from the base of the pole. What is the measure, to the *nearest minute,* of the angle formed by the pole and the wire?

(1) 31° 47′
(2) 31° 48′
(3) 58° 12′
(4) 58° 13′

$\sin^{-1} \frac{17}{20} \approx 58.21$

Use this space for computations.

26 If $f(x) = 3x - 2$ and $f^{-1}(x) = \frac{x+2}{3}$, then $f \circ f^{-1}(x)$ equals

(1) x

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

(3) $(3x - 2) \div \left(\frac{x+2}{3}\right)$

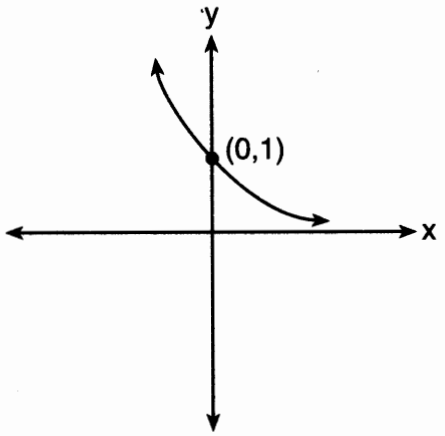
(4) $(3x - 2) \cdot \left(\frac{x+2}{3}\right)$

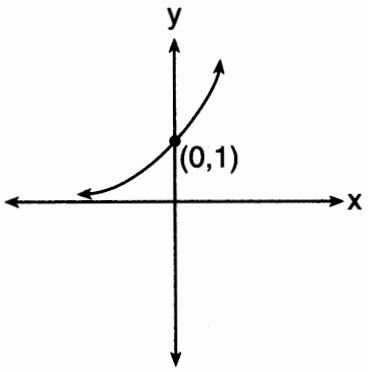
$3\left(\frac{x+2}{3}\right) - 2$

$x + 2 - 2$

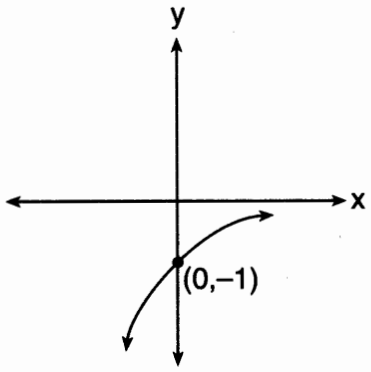
x

27 The graph of $f(x)$ is shown below. Which graph represents $f^{-1}(x)$?

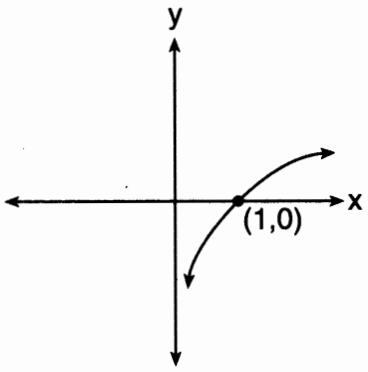




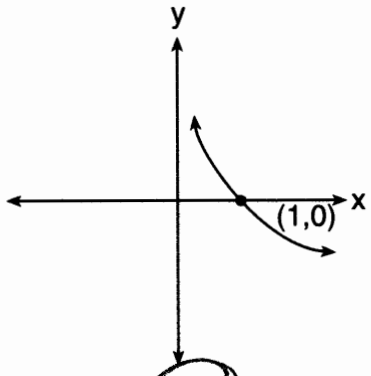
(1)



(3)



(2)



(4)

Part II

Answer all 8 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. All answers should be written in pen, except for graphs and drawings, which should be done in pencil. [16]

28 The number of bacteria that grow in a petri dish is approximated by the function $G(t) = 500e^{0.216t}$, where t is time, in minutes. Use this model to approximate, to the *nearest integer*, the number of bacteria present after one half-hour.

$G(30) = 500e^{(0.216)(30)} \approx 325,985$

29 Determine the exact value of $\left(\frac{27}{64}\right)^{-\frac{2}{3}}$ as a fraction in simplest form.

$\left(\frac{64}{27}\right)^{2/3} = \left(\frac{4}{3}\right)^2 = \frac{16}{9}$

30 State the conjugate of $7 - \sqrt{-48}$ expressed in simplest $a + bi$ form.

$7 + 4i\sqrt{3}$

31 Express $\frac{12x^{-5}y^{5}}{24x^{-3}y^{-2}}$ in simplest form, using only positive exponents.

$$\frac{y^7}{2x^2}$$

32 In a theater with 30 rows, the number of seats in a row increases by two with each successive row. The front row has 15 seats. Find the total seating capacity of the theater.

$a_n = 15 + 2(n-1)$

$a_{30} = 15 + 2(30-1)$

$a_{30} = 73$

$S_{30} = \frac{30(15+73)}{2}$

$S_{30} = 1320$

33 Given $f(x) = x^2$ and $g(x) = x - 3$, express $g(f(x + 2))$ as a polynomial in simplest form.

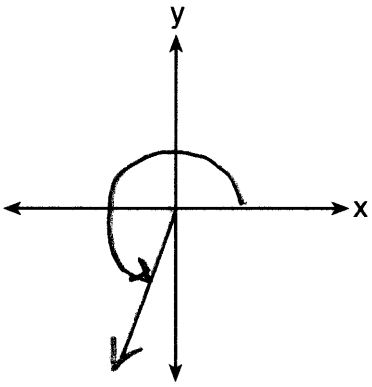
$F(x+2) = (x+2)^2$

$= x^2 + 4x + 4$

$g(F(x+2)) = x^2 + 4x + 4 - 3$

$= x^2 + 4x + 1$

34 Sketch an angle of 250° in standard position and then express cos 250° as a cosine function of a positive acute angle.



$-\cos 70°$

35 Solve the inequality $x^2 - 3x - 4 > 0$ algebraically for x.

$(x-4)(x+1) > 0$

$x-4>0$ and $x+1>0$ OR $x-4<0$ and $x+1<0$

$x>4$ and $x>-1$ ~~$x<4$~~ and $x<-1$

$x>4$ OR $x<-1$

Part III

Answer all 3 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. All answers should be written in pen, except for graphs and drawings, which should be done in pencil. [12]

36 The table below shows the minimum hourly wage, in U.S. dollars, for selected years since 1955.

Years Since 1955 (x)	0	5	10	15	20	25	30	35	40	45	50
Minimum Wage (y)	.75	1.00	1.25	1.45	2.00	3.10	3.35	3.80	4.25	5.15	5.15

Write the linear regression equation for this set of data, rounding all values to *three decimal places.*

$y = .098x + .402$

State the strength and direction indicated by the correlation coefficient.

high, positive correlation

37 Solve the system of equations algebraically for x and y:

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

$$y + 2 = x$$

$y = x - 2$

$$\frac{x-2}{x} = \frac{x-3}{2}$$

$2x - 4 = x^2 - 3x$

$x^2 - 5x + 4 = 0$

$(x-4)(x-1) = 0$

$x = 4, 1$

$y = 4 - 2 = 2$ $\quad$ $y = 1 - 2 = -1$

$(4, 2)$ $\quad$ $(1, -1)$

38 A rocket is shot vertically into the air. Its height, h, at any time, t, in seconds, can be modeled by the equation $h = -16t^2 + 184t$. Determine algebraically, the number of seconds it will take the rocket to reach a height of 529 feet.

$529 = -16t^2 + 184t$

$16t^2 - 184t + 529 = 0$

$t = \dfrac{184 \pm \sqrt{(-184)^2 - 4(16)(529)}}{2(16)}$

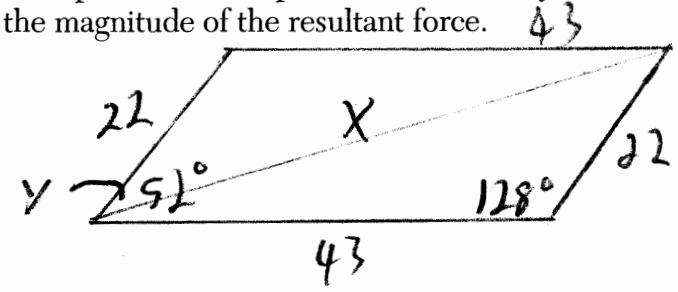
$t = \dfrac{184 \pm \sqrt{0}}{32}$

$t = 5.75$ sec

Part IV

Answer the question in this part. A correct answer will receive 6 credits. Clearly indicate the necessary steps, including appropriate formula substitutions, diagrams, graphs, charts, etc. A correct numerical answer with no work shown will receive only 1 credit. The answer should be written in pen. [6]

39 Forces of 22 pounds and 43 pounds act on an object at an angle of 52°. Determine, to the *nearest pound,* the magnitude of the resultant force.



$X = \sqrt{22^2 + 43^2 - 2(22)(43)\cos 128}$

$X \approx \sqrt{3497.83}$

$X \approx 59$

Find, to the *nearest degree,* the angle between the smaller force and the resultant force.

$\frac{\sin Y}{43} = \frac{\sin 128}{59}$

$Y = \sin^{-1}\left(\frac{43 \sin 128}{59}\right)$

$\approx 35°$