ALGEBRA

II

ALGEBRA II

Thursday, January 23, 2020 — 1:15 to 4:15 p.m., only

Student Name _____

School Name _____

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 37 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 graphs and drawings, which should be done in pencil. Clearly indicate the necessary steps, including appropriate formula substitutions, diagrams, graphs, charts, etc. Utilize the information provided for each question to determine your answer. Note that diagrams are not necessarily drawn to scale.

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 24 questions in this part. Each correct answer will receive 2 credits. No partial credit will be allowed. Utilize the information provided for each question to determine your answer. Note that diagrams are not necessarily drawn to scale. 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. [48]

Use this space for computations.

1 The expression $\sqrt[4]{81x^8y^6}$ is equivalent to

(1) $3x^2y^{\frac{3}{2}}$

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

(2) $3x^4y^2$

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

2 Chet has $1200 invested in a bank account modeled by the function $P(n) = 1200(1.002)^n$, where $P(n)$ is the value of his account, in dollars, after n months. Chet's debt is modeled by the function $Q(n) = 100n$, where $Q(n)$ is the value of debt, in dollars, after n months.

After n months, which function represents Chet's net worth, $R(n)$?

(1) $R(n) = 1200(1.002)^n + 100n$

(2) $R(n) = 1200(1.002)^{12n} + 100n$

(3) $R(n) = 1200(1.002)^n - 100n$

(4) $R(n) = 1200(1.002)^{12n} - 100n$

3 Emmeline is working on one side of a polynomial identity proof used to form Pythagorean triples. Her work is shown below:

$$(5x)^2 + (5x^2 - 5)^2$$

Step 1: $25x^2 + (5x^2 - 5)^2$

Step 2: $25x^2 + 25x^2 + 25$

Step 3: $50x^2 + 25$

Step 4: $75x^2$

What statement is true regarding Emmeline's work?

(1) Emmeline's work is entirely correct.

(2) There is a mistake in step 2, only.

(3) There are mistakes in step 2 and step 4.

(4) There is a mistake in step 4, only.

4 Susan won $2,000 and invested it into an account with an annual interest rate of 3.2%. If her investment were compounded monthly, which expression best represents the value of her investment after t years?

(1) $2000(1.003)^{12t}$

(3) $2064^{\frac{t}{12}}$

(2) $2000(1.032)^{\frac{t}{12}}$

(4) $\dfrac{2000(1.032)^t}{12}$

Use this space for computations.

5 Consider the end behavior description below.

- as $x \to -\infty, f(x) \to \infty$
- as $x \to \infty, f(x) \to -\infty$

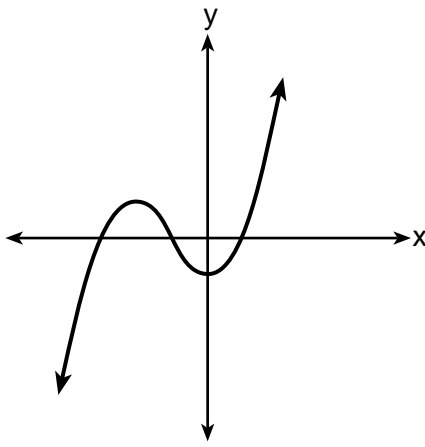Which function satisfies the given conditions?

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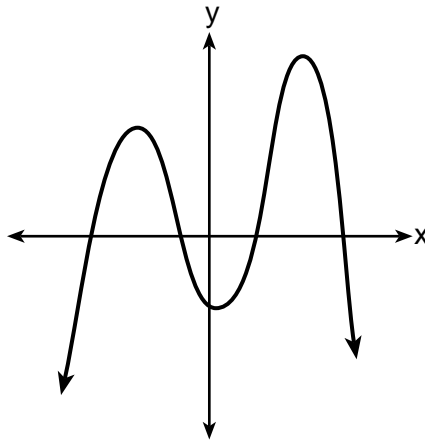
(1)   (3)

(2)   (4)

6 The expression $(x + a)^2 + 5(x + a) + 4$ is equivalent to

(1) $(a + 1)(a + 4)$

(3) $(x + a + 1)(x + a + 4)$

(2) $(x + 1)(x + 4)$

(4) $x^2 + a^2 + 5x + 5a + 4$

Algebra II – Jan. '20   [3]   [OVER]

7 Given $x \neq -2$, the expression $\dfrac{2x^2 + 5x + 8}{x + 2}$ is equivalent to

(1) $2x^2 + \dfrac{9}{x + 2}$ (3) $2x + 1 + \dfrac{6}{x + 2}$

(2) $2x + \dfrac{7}{x + 2}$ (4) $2x + 9 - \dfrac{10}{x + 2}$

8 Which situation best describes conditional probability?

(1) finding the probability of an event occurring two or more times

(2) finding the probability of an event occurring only once

(3) finding the probability of two independent events occurring at the same time

(4) finding the probability of an event occurring given another event had already occurred

9 Which expression is *not* a solution to the equation $2^t = \sqrt{10}$?

(1) $\dfrac{1}{2}\log_2 10$ (3) $\log_4 10$

(2) $\log_2 \sqrt{10}$ (4) $\log_{10} 4$

10 What is the solution set of $x = \sqrt{3x + 40}$?

(1) $\{-5,8\}$ (3) $\{-4,10\}$

(2) $\{8\}$ (4) $\{\ \}$

11 Consider the data in the table below.

	Right Handed	Left Handed
Male	87	13
Female	89	11

What is the probability that a randomly selected person is male given the person is left handed?

(1) $\dfrac{13}{200}$

(3) $\dfrac{13}{50}$

(2) $\dfrac{13}{100}$

(4) $\dfrac{13}{24}$

12 The function $N(x) = 90(0.86)^x + 69$ can be used to predict the temperature of a cup of hot chocolate in degrees Fahrenheit after x minutes. What is the approximate average rate of change of the temperature of the hot chocolate, in degrees per minute, over the interval $[0, 6]$?

(1) -8.93

(3) 0.11

(2) -0.11

(4) 8.93

13 A recursive formula for the sequence 40, 30, 22.5, … is

(1) $g_n = 40\left(\dfrac{3}{4}\right)^n$

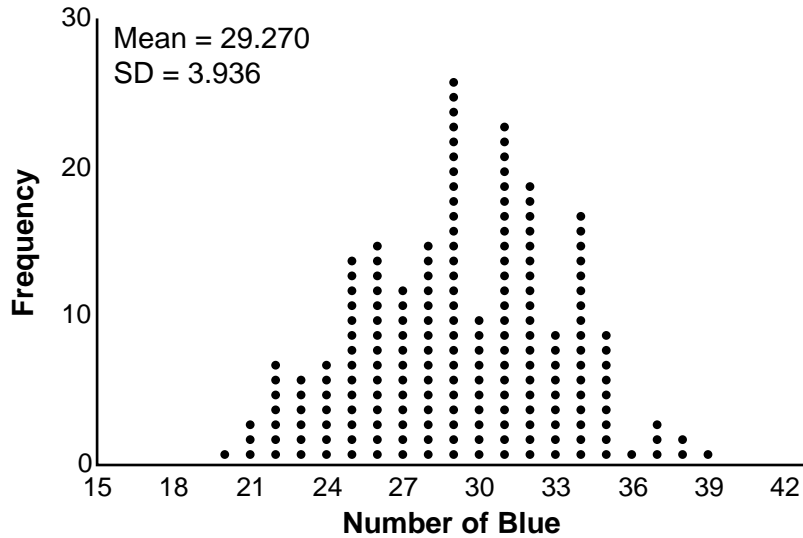(3) $g_n = 40\left(\dfrac{3}{4}\right)^{n-1}$

(2) $g_1 = 40$
$g_n = g_{n-1} - 10$

(4) $g_1 = 40$
$g_n = \dfrac{3}{4}g_{n-1}$

14 The J & B candy company claims that 45% of the candies it produces are blue, 30% are brown, and 25% are yellow. Each bag holds 65 candies. A simulation was run 200 times, each of sample size 65, based on the premise that 45% of the candies are blue. The results of the simulation are shown below.

Bonnie purchased a bag of J & B's candy and counted 24 blue candies. What inference can be made regarding a bag of J & B's with only 24 blue candies?

(1) The company is not meeting their production standard.

(2) Bonnie's bag was a rarity and the company should not be concerned.

(3) The company should change their claim to 37% blue candies are produced.

(4) Bonnie's bag is within the middle 95% of the simulated data supporting the company's claim.

15 Which investigation technique is most often used to determine if a single variable has an impact on a given population?

(1) observational study   (3) controlled experiment

(2) random survey   (4) formal interview

16 As θ increases from $-\dfrac{\pi}{2}$ to 0 radians, the value of cos θ will

(1) decrease from 1 to 0   (3) increase from -1 to 0

(2) decrease from 0 to -1 (4) increase from 0 to 1

17 Consider the following patterns:

I. $16, -12, 9, -6.75, \ldots$

II. $1, 4, 9, 16, \ldots$

III. $6, 18, 30, 42, \ldots$

IV. $\dfrac{1}{2}, \dfrac{2}{3}, \dfrac{3}{4}, \dfrac{4}{5}, \ldots$

Which pattern is geometric?

(1) I   (3) III

(2) II   (4) IV

18 Consider the system below.

$$x + y + z = 9$$
$$x - y - z = -1$$
$$x - y + z = 21$$

Which value is *not* in the solution, (x,y,z), of the system?

(1) -8 (3) 11

(2) -6 (4) 4

19 Which statement regarding polynomials and their zeros is true?

(1) $f(x) = (x^2 - 1)(x + a)$ has zeros of 1 and $-a$, only.

(2) $f(x) = x^3 - ax^2 + 16x - 16a$ has zeros of 4 and a, only.

(3) $f(x) = (x^2 + 25)(x + a)$ has zeros of ± 5 and $-a$.

(4) $f(x) = x^3 - ax^2 - 9x + 9a$ has zeros of ± 3 and a.

20 If a solution of $2(2x - 1) = 5x^2$ is expressed in simplest $a + bi$ form, the value of b is

(1) $\dfrac{\sqrt{6}}{5}i$ (3) $\dfrac{1}{5}i$

(2) $\dfrac{\sqrt{6}}{5}$ (4) $\dfrac{1}{5}$

21 Which value, to the *nearest tenth*, is the *smallest* solution of $f(x) = g(x)$ if $f(x) = 3\sin\left(\frac{1}{2}x\right) - 1$ and $g(x) = x^3 - 2x + 1$?

(1) -3.6 (3) -1.8

(2) -2.1 (4) 1.4

22 Expressed in simplest $a + bi$ form, $(7 - 3i) + (x - 2i)^2 - (4i + 2x^2)$ is

(1) $(3 - x^2) - (4x + 7)i$ (3) $(3 - x^2) - 7i$

(2) $(3 + 3x^2) - (4x + 7)i$ (4) $(3 + 3x^2) - 7i$

23 Written in simplest form, the fraction $\dfrac{x^3 - 9x}{9 - x^2}$, where $x \neq \pm 3$, is equivalent to

(1) $-x$ (3) $\dfrac{-x(x+3)}{(3+x)}$

(2) x (4) $\dfrac{x(x-3)}{(3-x)}$

24 According to a study, 45% of Americans have type O blood. If a random number generator produces three-digit values from 000 to 999, which values would represent those having type O blood?

(1) between 000 and 045, inclusive

(2) between 000 and 444, inclusive

(3) between 000 and 449, inclusive

(4) between 000 and 450, inclusive

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. Utilize the information provided for each question to determine your answer. Note that diagrams are not necessarily drawn to scale. 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]

25 For n and $p > 0$, is the expression $\left(p^2 n^{\frac{1}{2}} \right)^8 \sqrt{p^5 n^4}$ equivalent to $p^{18} n^6 \sqrt{p}$? Justify your answer.

26 Show why $x - 3$ is a factor of $m(x) = x^3 - x^2 - 5x - 3$. Justify your answer.

27 Describe the transformation applied to the graph of $p(x) = 2^x$ that forms the new function $q(x) = 2^{x-3} + 4$.

28 The parabola $y = -\dfrac{1}{20}(x - 3)^2 + 6$ has its focus at $(3,1)$. Determine and state the equation of the directrix.

(The use of the grid below is optional.)
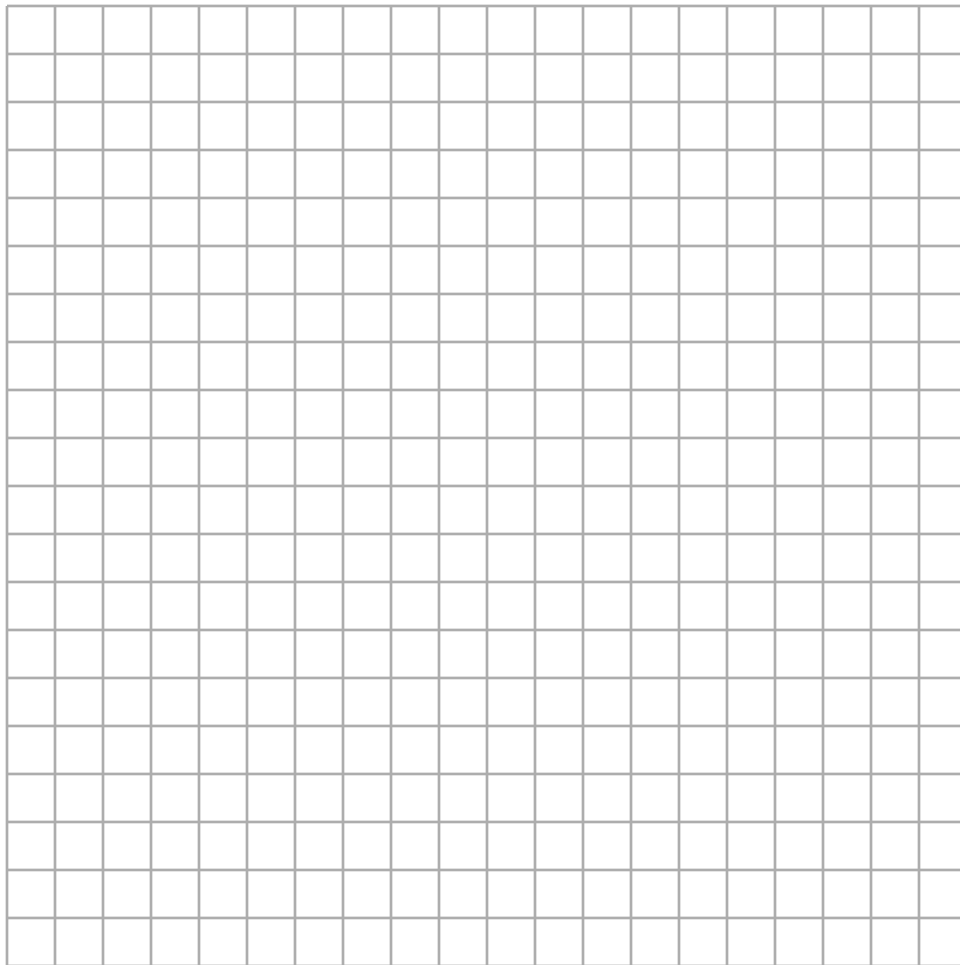
29 Given the geometric series $300 + 360 + 432 + 518.4 + ...$, write a geometric series formula, S_n, for the sum of the first n terms. Use the formula to find the sum of the first 10 terms, to the *nearest tenth*.

30 Visible light can be represented by sinusoidal waves. Three visible light waves are shown in the graph below. The midline of each wave is labeled ℓ.
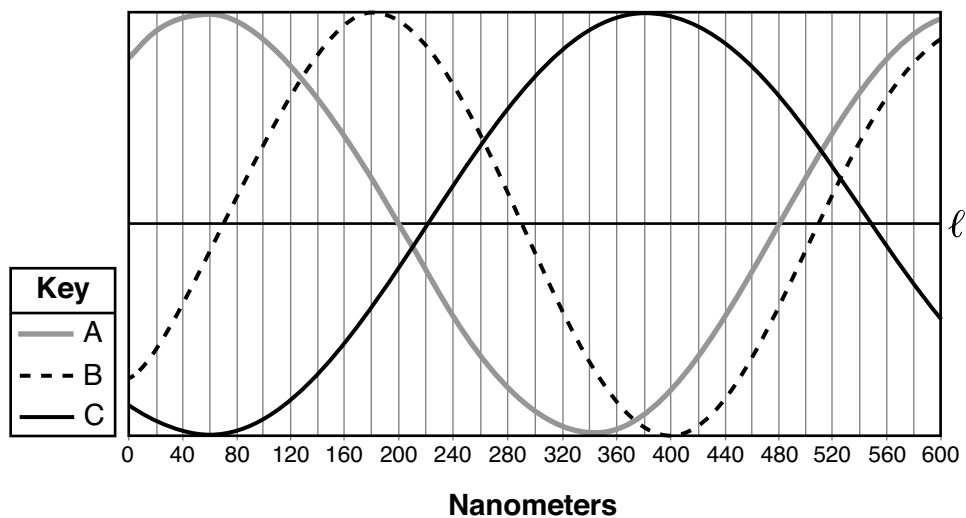
Based on the graph, which light wave has the longest period? Justify your answer.

31 Biologists are studying a new bacterium. They create a culture with 100 of the bacteria and anticipate that the number of bacteria will double every 30 hours. Write an equation for the number of bacteria, B, in terms of the number of hours, t, since the experiment began.

32 Graph $y = x^3 - 4x^2 + 2x + 7$ on the set of axes below.
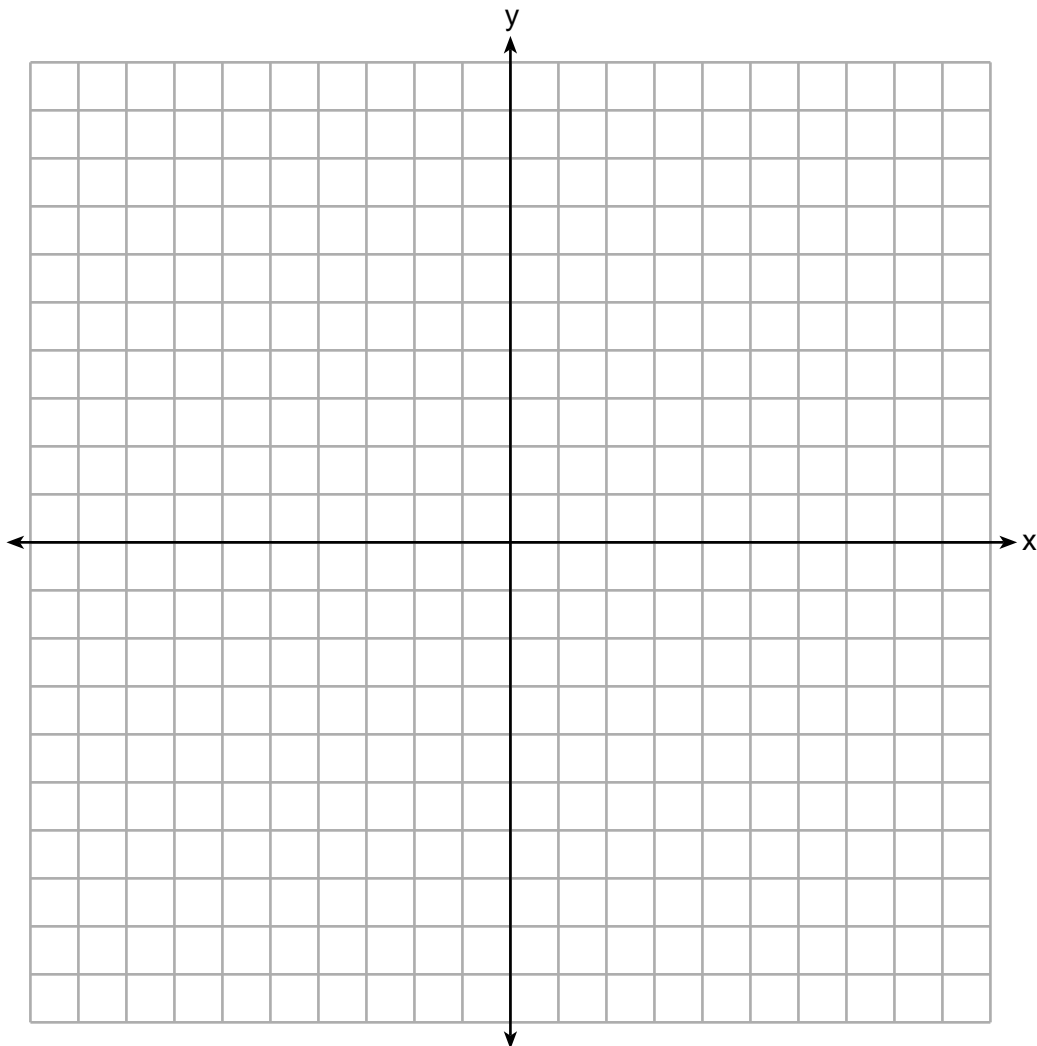
Part III

Answer all 4 questions in this part. Each correct answer will receive 4 credits. Clearly indicate the necessary steps, including appropriate formula substitutions, diagrams, graphs, charts, etc. Utilize the information provided for each question to determine your answer. Note that diagrams are not necessarily drawn to scale. 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]

33 Sonja is cutting wire to construct a mobile. She cuts 100 inches for the first piece, 80 inches for the second piece, and 64 inches for the third piece. Assuming this pattern continues, write an explicit equation for a_n, the length in inches of the nth piece.

Sonja only has 40 feet of wire to use for the project and wants to cut 20 pieces total for the mobile using her pattern. Will she have enough wire? Justify your answer.

34 Graph the following function on the axes below.
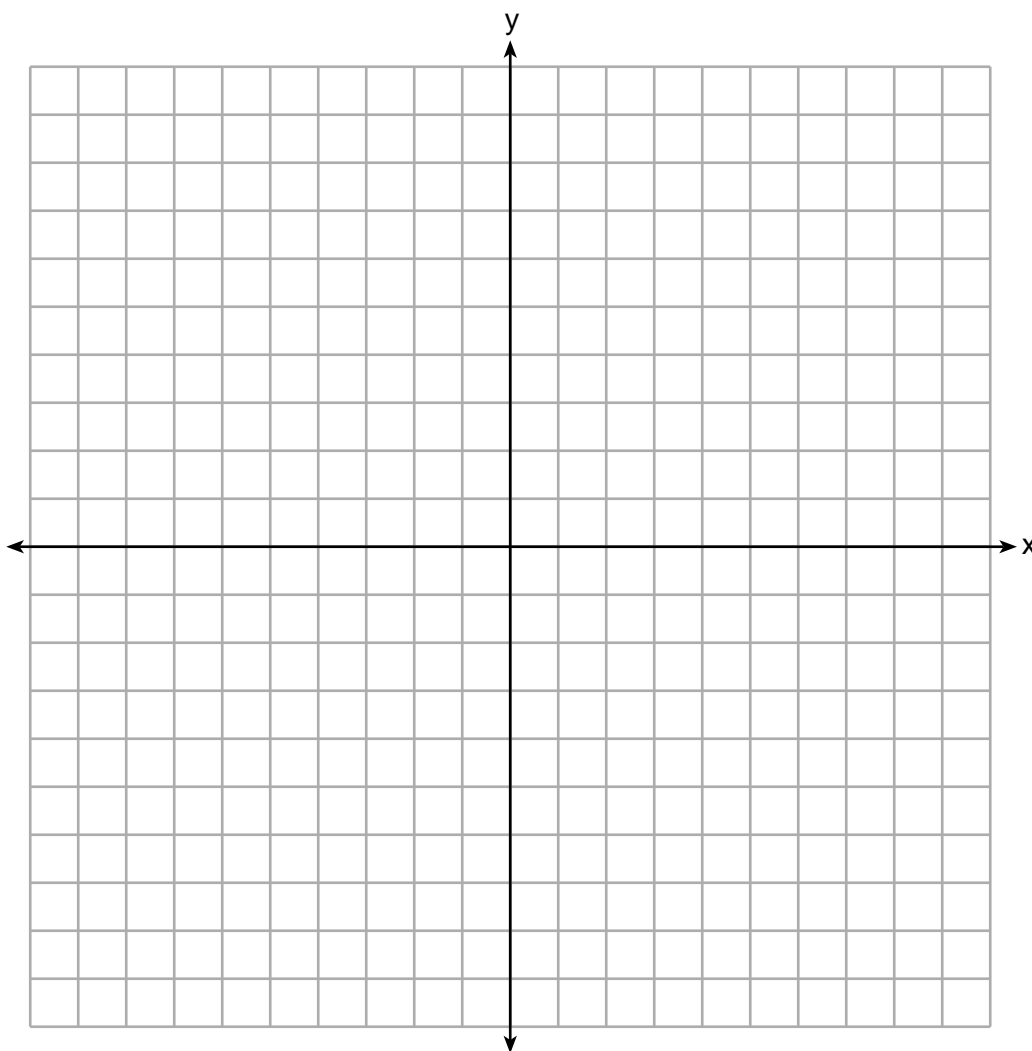
$$f(x) = \log_3(2 - x)$$

State the domain of f.

State the equation of the asymptote.

35 Algebraically solve the following system of equations.

$$(x - 2)^2 + (y - 3)^2 = 16$$
$$x + y - 1 = 0$$

36 The table below gives air pressures in kPa at selected altitudes above sea level measured in kilometers.

x	Altitude (km)	0	1	2	3	4	5
y	Air Pressure (kPa)	101	90	79	70	62	54

Write an exponential regression equation that models these data rounding all values to the *nearest thousandth*.

Use this equation to algebraically determine the altitude, to the *nearest hundredth* of a kilometer, when the air pressure is 29 kPa.

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. Utilize the information provided to determine your answer. Note that diagrams are not necessarily drawn to scale. 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. [6]

37 Sarah is fighting a sinus infection. Her doctor prescribed a nasal spray and an antibiotic to fight the infection. The active ingredients, in milligrams, remaining in the bloodstream from the nasal spray, $n(t)$, and the antibiotic, $a(t)$, are modeled in the functions below, where t is the time in hours since the medications were taken.

$$n(t) = \frac{t+1}{t+5} + \frac{18}{t^2 + 8t + 15}$$

$$a(t) = \frac{9}{t+3}$$

Determine which drug is made with a greater initial amount of active ingredient. Justify your answer.
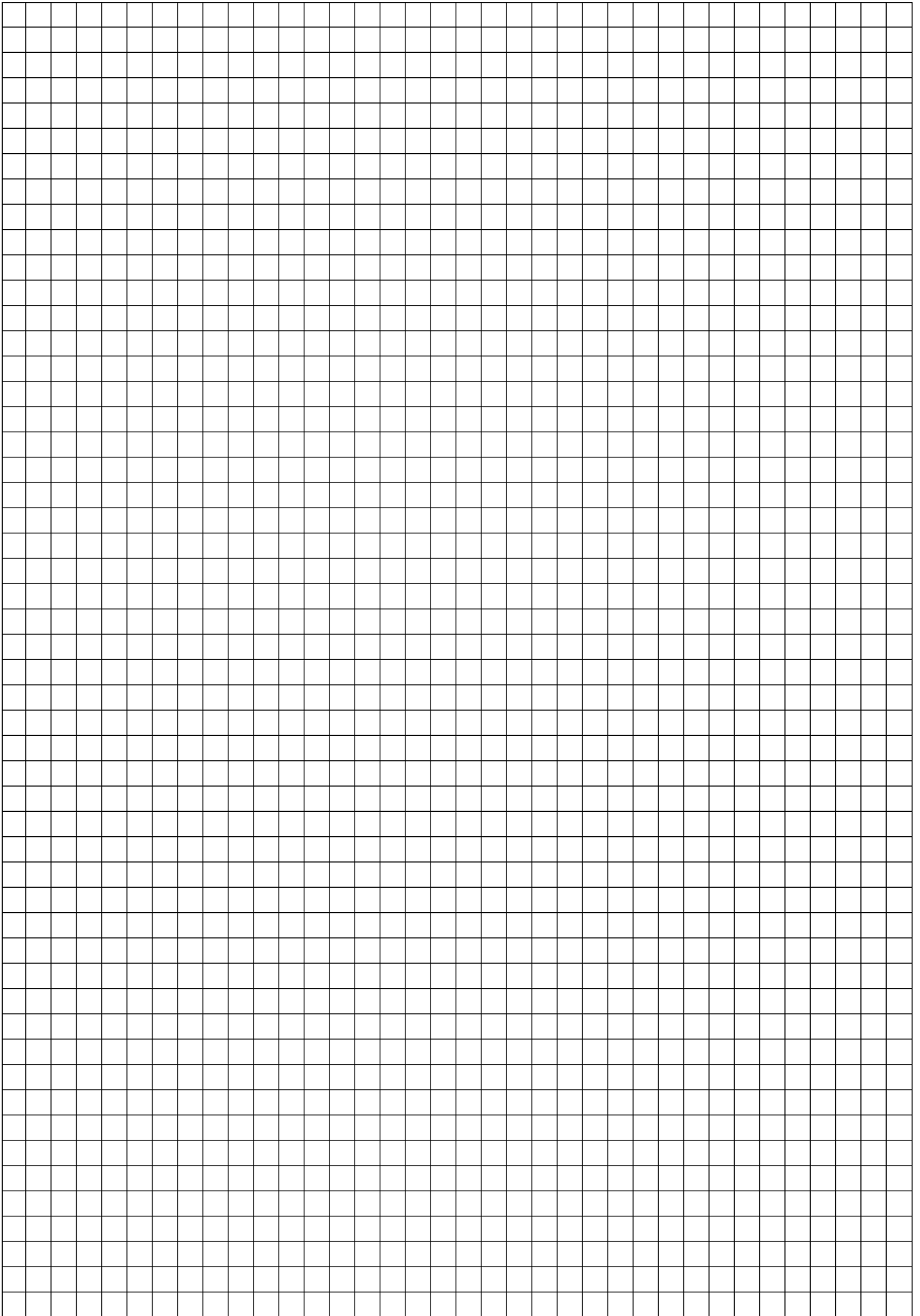
Question 37 is continued on the next page.

Sarah's doctor told her to take both drugs at the same time. Determine algebraically the number of hours after taking the medications when both medications will have the same amount of active ingredient remaining in her bloodstream.
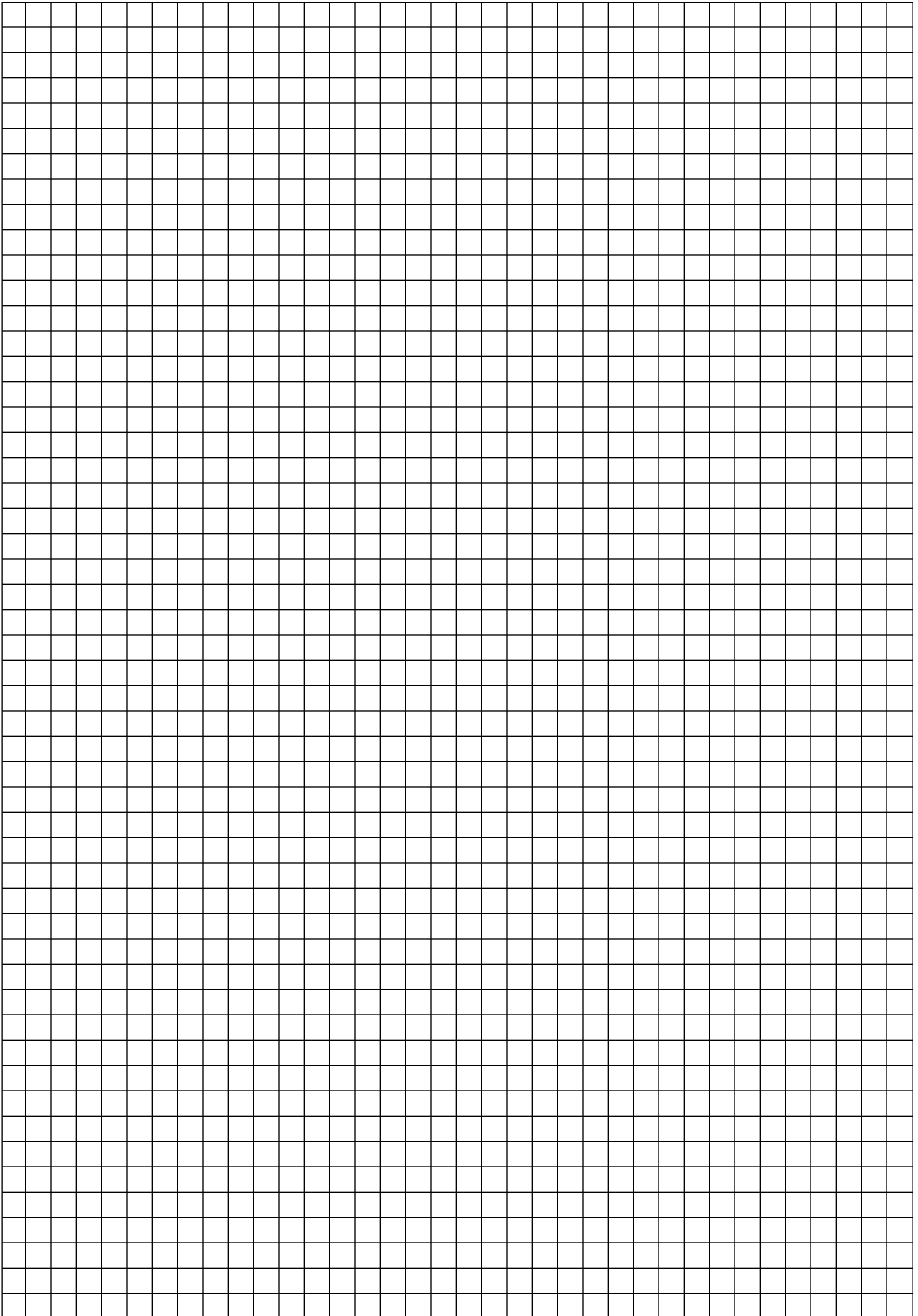
High School Math Reference Sheet

1 inch = 2.54 centimeters   1 kilometer = 0.62 mile   1 cup = 8 fluid ounces
1 meter = 39.37 inches   1 pound = 16 ounces   1 pint = 2 cups
1 mile = 5280 feet   1 pound = 0.454 kilogram   1 quart = 2 pints
1 mile = 1760 yards   1 kilogram = 2.2 pounds   1 gallon = 4 quarts
1 mile = 1.609 kilometers   1 ton = 2000 pounds   1 gallon = 3.785 liters
   1 liter = 0.264 gallon
   1 liter = 1000 cubic centimeters

Triangle	$A = \frac{1}{2}bh$
Parallelogram	$A = bh$
Circle	$A = \pi r^2$
Circle	$C = \pi d$ or $C = 2\pi r$
General Prisms	$V = Bh$
Cylinder	$V = \pi r^2 h$
Sphere	$V = \frac{4}{3}\pi r^3$
Cone	$V = \frac{1}{3}\pi r^2 h$
Pyramid	$V = \frac{1}{3}Bh$

Pythagorean Theorem	$a^2 + b^2 = c^2$
Quadratic Formula	$x = \dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$
Arithmetic Sequence	$a_n = a_1 + (n - 1)d$
Geometric Sequence	$a_n = a_1 r^{n-1}$
Geometric Series	$S_n = \dfrac{a_1 - a_1 r^n}{1 - r}$ where $r \neq 1$
Radians	1 radian = $\dfrac{180}{\pi}$ degrees
Degrees	1 degree = $\dfrac{\pi}{180}$ radians
Exponential Growth/Decay	$A = A_0 e^{k(t - t_0)} + B_0$

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ALGEBRA II

Printed on Recycled Paper

Regents Examination in Algebra II – January 2020
Scoring Key: Part I (Multiple-Choice Questions)

Examination	Date	Question Number	Scoring Key	Question Type	Credit	Weight
Algebra II	January '20	1	1	MC	2	1
Algebra II	January '20	2	3	MC	2	1
Algebra II	January '20	3	3	MC	2	1
Algebra II	January '20	4	1	MC	2	1
Algebra II	January '20	5	3	MC	2	1
Algebra II	January '20	6	3	MC	2	1
Algebra II	January '20	7	3	MC	2	1
Algebra II	January '20	8	4	MC	2	1
Algebra II	January '20	9	4	MC	2	1
Algebra II	January '20	10	2	MC	2	1
Algebra II	January '20	11	4	MC	2	1
Algebra II	January '20	12	1	MC	2	1
Algebra II	January '20	13	4	MC	2	1
Algebra II	January '20	14	4	MC	2	1
Algebra II	January '20	15	3	MC	2	1
Algebra II	January '20	16	4	MC	2	1
Algebra II	January '20	17	1	MC	2	1
Algebra II	January '20	18	1	MC	2	1
Algebra II	January '20	19	4	MC	2	1
Algebra II	January '20	20	2	MC	2	1
Algebra II	January '20	21	2	MC	2	1
Algebra II	January '20	22	1	MC	2	1
Algebra II	January '20	23	1	MC	2	1
Algebra II	January '20	24	3	MC	2	1

Regents Examination in Algebra II – January 2020
Scoring Key: Parts II, III, and IV (Constructed-Response Questions)

Examination	Date	Question Number	Scoring Key	Question Type	Credit	Weight
Algebra II	January '20	25	-	CR	2	1
Algebra II	January '20	26	-	CR	2	1
Algebra II	January '20	27	-	CR	2	1
Algebra II	January '20	28	-	CR	2	1
Algebra II	January '20	29	-	CR	2	1
Algebra II	January '20	30	-	CR	2	1
Algebra II	January '20	31	-	CR	2	1
Algebra II	January '20	32	-	CR	2	1
Algebra II	January '20	33	-	CR	4	1
Algebra II	January '20	34	-	CR	4	1
Algebra II	January '20	35	-	CR	4	1
Algebra II	January '20	36	-	CR	4	1
Algebra II	January '20	37	-	CR	6	1

Key
MC = Multiple-choice question
CR = Constructed-response question

The chart for determining students' final examination scores for the **January 2020 Regents Examination in Algebra II** will be posted on the Department's web site at: http://www.p12.nysed.gov/assessment/ on the day of the examination. Conversion charts provided for the previous administrations of the Regents Examination in Algebra II must NOT be used to determine students' final scores for this administration.

FOR TEACHERS ONLY

ALGEBRA II

Thursday, January 23, 2020 — 1:15 to 4:15 p.m., only

RATING GUIDE

Mechanics of Rating

The following procedures are to be followed for scoring student answer papers for the Regents Examination in Algebra II. More detailed information about scoring is provided in the publication *Information Booklet for Scoring the Regents Examination in Algebra II*.

Do *not* attempt to correct the student's work by making insertions or changes of any kind. In scoring the constructed-response questions, use check marks to indicate student errors. Unless otherwise specified, mathematically correct variations in the answers will be allowed. Units need not be given when the wording of the questions allows such omissions.

Each student's answer paper is to be scored by a minimum of three mathematics teachers. No one teacher is to score more than approximately one-third of the constructed-response questions on a student's paper. Teachers may not score their own students' answer papers. On the student's separate answer sheet, for each question, record the number of credits earned and the teacher's assigned rater/scorer letter.

Schools are not permitted to rescore any of the constructed-response questions on this exam after each question has been rated once, regardless of the final exam score. Schools are required to ensure that the raw scores have been added correctly and that the resulting scale score has been determined accurately.

Raters should record the student's scores for all questions and the total raw score on the student's separate answer sheet. Then the student's total raw score should be converted to a scale score by using the conversion chart that will be posted on the Department's web site at: http://www.p12.nysed.gov/assessment/ by Thursday, January 23, 2020. Because scale scores corresponding to raw scores in the conversion chart may change from one administration to another, it is crucial that, for each administration, the conversion chart provided for that administration be used to determine the student's final score. The student's scale score should be entered in the box provided on the student's separate answer sheet. The scale score is the student's final examination score.

General Rules for Applying Mathematics Rubrics

I. General Principles for Rating

The rubrics for the constructed-response questions on the Regents Examination in Algebra II are designed to provide a systematic, consistent method for awarding credit. The rubrics are not to be considered all-inclusive; it is impossible to anticipate all the different methods that students might use to solve a given problem. Each response must be rated carefully using the teacher's professional judgment and knowledge of mathematics; all calculations must be checked. The specific rubrics for each question must be applied consistently to all responses. In cases that are not specifically addressed in the rubrics, raters must follow the general rating guidelines in the publication *Information Booklet for Scoring the Regents Examination in Algebra II*, use their own professional judgment, confer with other mathematics teachers, and/or contact the State Education Department for guidance. During each Regents Examination administration period, rating questions may be referred directly to the Education Department. The contact numbers are sent to all schools before each administration period.

II. Full-Credit Responses

A full-credit response provides a complete and correct answer to all parts of the question. Sufficient work is shown to enable the rater to determine how the student arrived at the correct answer.

When the rubric for the full-credit response includes one or more examples of an acceptable method for solving the question (usually introduced by the phrase "such as"), it does not mean that there are no additional acceptable methods of arriving at the correct answer. Unless otherwise specified, mathematically correct alternative solutions should be awarded credit. The only exceptions are those questions that specify the type of solution that must be used; e.g., an algebraic solution or a graphic solution. A correct solution using a method other than the one specified is awarded half the credit of a correct solution using the specified method.

III. Appropriate Work

Full-Credit Responses: The directions in the examination booklet for all the constructed-response questions state: "Clearly indicate the necessary steps, including appropriate formula substitutions, diagrams, graphs, charts, etc." The student has the responsibility of providing the correct answer ***and*** showing how that answer was obtained. The student must "construct" the response; the teacher should not have to search through a group of seemingly random calculations scribbled on the student paper to ascertain what method the student may have used.

Responses With Errors: Rubrics that state "Appropriate work is shown, but…" are intended to be used with solutions that show an essentially complete response to the question but contain certain types of errors, whether computational, rounding, graphing, or conceptual. If the response is incomplete; i.e., an equation is written but not solved or an equation is solved but not all of the parts of the question are answered, appropriate work has ***not*** been shown. Other rubrics address incomplete responses.

IV. Multiple Errors

Computational Errors, Graphing Errors, and Rounding Errors: Each of these types of errors results in a 1-credit deduction. Any combination of two of these types of errors results in a 2-credit deduction. No more than 2 credits should be deducted for such mechanical errors in a 4-credit question and no more than 3 credits should be deducted in a 6-credit question. The teacher must carefully review the student's work to determine what errors were made and what type of errors they were.

Conceptual Errors: A conceptual error involves a more serious lack of knowledge or procedure. Examples of conceptual errors include using the incorrect formula for the area of a figure, choosing the incorrect trigonometric function, or multiplying the exponents instead of adding them when multiplying terms with exponents.

If a response shows repeated occurrences of the same conceptual error, the student should not be penalized twice. If the same conceptual error is repeated in responses to other questions, credit should be deducted in each response.

For 4- and 6-credit questions, if a response shows one conceptual error and one computational, graphing, or rounding error, the teacher must award credit that takes into account both errors. Refer to the rubric for specific scoring guidelines.

Part II

For each question, use the specific criteria to award a maximum of 2 credits. Unless otherwise specified, mathematically correct alternative solutions should be awarded appropriate credit.

(25)   **[2]** A positive response is indicated, and a correct justification is given.

   [1] Appropriate work is shown, but one computational error was made.

or

   [1] Appropriate work is shown, but one conceptual error was made.

or

   [1] An incomplete justification is given.

   [0] Yes, but no justification is given.

or

   [0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously incorrect procedure.

(26)   **[2]** A correct justification is given.

   [1] Appropriate work is shown, but one computational error is made.

or

   [1] Appropriate work is shown, but one conceptual error is made.

or

   [1] An incomplete justification is given.

   [0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously incorrect procedure.

(27)   **[2]** A correct description is given, such as 3 right and 4 up.

   [1] One conceptual error is made.

or

   [1] An incomplete description is given.

or

   [1] 3 right or 4 up is stated.

   [0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously incorrect procedure.

(28)   **[2]** $y = 11$, and correct work is shown.

      [1] Appropriate work is shown, but one computational error is made.

or

      [1] Appropriate work is shown, but one conceptual error is made.

or

      [1] $y = 11$, but no work is shown.

      [0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously incorrect procedure.

(29)   **[2]** A correct geometric series formula in terms of n is written, 7787.6.

      [1] Appropriate work is shown, but one computational, notation, or rounding error is made.

or

      [1] Appropriate work is shown, but one conceptual error is made.

or

      [1] A correct geometric series formula is written, but no further correct work is shown.

or

      [1] 7787.6, but no work is shown.

      [0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously incorrect procedure.

(30)   **[2]** *C* and a correct justification is given.

[1] Appropriate work is shown, but one computational error is made.

or

[1] Appropriate work is shown, but one conceptual error is made.

or

[1] *C*, but the justification is incomplete, incorrect, or missing.

[0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously incorrect procedure.

(31)   **[2]** $B = 100(2)^{\frac{t}{30}}$ or equivalent is written.

[1] One computational or notation error is made.

or

[1] One conceptual error is made.

[0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously incorrect procedure.

(32)   **[2]** A correct graph is drawn.

[1] Appropriate work is shown, but one graphing error is made.

or

[1] Appropriate work is shown, but one conceptual error is made.

[0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously incorrect procedure.

_____

Part III

For each question, use the specific criteria to award a maximum of 4 credits. Unless otherwise specified, mathematically correct alternative solutions should be awarded appropriate credit.

(33)   **[4]** $a_n = 100(0.8)^{n-1}$ or an equivalent equation, a negative response is indicated, and correct algebraic work is shown.

    [3] Appropriate work is shown, but one computational or notation error is made.

    [2] Appropriate work is shown, but two or more computational or notation errors are made.

or

    [2] Appropriate work is shown, but one conceptual error is made.

or

    [2] $a_n = 100(0.8)^{n-1}$, but no further correct work is shown.

or

    [2] A negative response is indicated and a correct justification is given, but no further correct work is shown.

    [1] Appropriate work is shown, but one conceptual error and one computational or notation error are made.

or

    [1] An appropriate value is found for the amount of wire needed, but no further correct work is shown.

    [0] No, but no work is shown.

or

    [0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously incorrect procedure.

(34)   **[4]** A correct graph is drawn, $x < 2$ or equivalent and $x = 2$ are written.

[3] Appropriate work is shown, but one computational, graphing, or labeling error is made.

[2] Appropriate work is shown, but two or more computational, graphing, or labeling errors are made.

or

[2] Appropriate work is shown, but one conceptual error is made.

or

[2] A correct graph is drawn, but no further correct work is shown.

or

[2] $x < 2$ and $x = 2$ are written, but no further correct work is shown.

[1] Appropriate work is shown, but one conceptual error and one computational, graphing, or labeling error are made.

or

[1] $x < 2$ or $x = 2$, but no further correct work is shown.

[0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously incorrect procedure.

(35)   **[4]** $(-2,3)$ and $(2,-1)$, or equivalent solutions and correct algebraic work is shown.

[3] Appropriate work is shown, but one computational, factoring, or substitution error is made.

or

[3] Appropriate work is shown, but only one correct solution is found or only the x-values or y-values are found.

[2] Appropriate work is shown, but two or more computational, factoring, or substitution errors are made.

or

[2] Appropriate work is shown, but one conceptual error is made.

or

[2] A correct quadratic equation in standard form is written, but no further correct work is shown.

or

[2] $(-2,3)$ and $(2,-1)$, but a method other than algebraic is used.

[1] Appropriate work is shown, but one conceptual error and one computational, factoring, or substitution error are made.

or

[1] A correct quadratic equation in one variable is written, but no further correct work is shown.

or

[1] $(-2,3)$ and $(2,-1)$, but no work is shown.

[0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously incorrect procedure.

(36) **[4]** $y = 101.523(0.883)^x$ and 10.07 and correct algebraic work is shown.

[3] Appropriate work is shown, but one computational, notation, or rounding error is made.

or

[3] Appropriate work is shown, but a method other than algebraic is used to find 10.07.

[2] Appropriate work is shown, but two or more computational, notation, or rounding errors are made.

or

[2] Appropriate work is shown, but one conceptual error is made.

or

[2] $y = 101.523(0.883)^x$, but no further correct work is shown.

[1] Appropriate work is shown, but one conceptual error and one computational, notation, or rounding error are made.

or

[1] 10.07, but no work is shown.

[0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously incorrect procedure.

_____

Part IV

For each question, use the specific criteria to award a maximum of 6 credits. Unless otherwise specified, mathematically correct alternative solutions should be awarded appropriate credit.

(37)   **[6]** Antibiotic is indicated and a correct justification is given, and 8 and correct algebraic work is shown.

[5] Appropriate work is shown, but one computational or factoring error is made.

or

[5] Antibiotic with a correct justification and 8 with correct algebraic work, but -3 is not rejected.

[4] Appropriate work is shown, but two computational or factoring errors are made.

or

[4] Appropriate work is shown, but one conceptual error is made.

or

[4] Appropriate work is shown to find 8, but no further correct work is shown.

or

[4] Antibiotic with a correct justification and 8, but a method other than algebraic is used.

[3] Appropriate work is shown, but three or more computational or factoring errors are made.

or

[3] Appropriate work is shown, but one conceptual error and one computational or factoring error are made.

[2] Antibiotic and a correct justification is given, but no further correct work is shown.

or

[2] Appropriate work is shown to find $t^2 - 5t - 24 = 0$, but no further correct work is shown.

or

[2] Appropriate work is shown, but one conceptual error and two computational or factoring errors are made.

[1] 8, but no work is shown.

[0] Antibiotic, but no work is shown.

or

[0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously incorrect procedure.

Map to the Learning Standards
Algebra II
January 2020

Question	Type	Credits	Cluster
1	Multiple Choice	2	N-RN.A
2	Multiple Choice	2	F-BF.A
3	Multiple Choice	2	A-APR.C
4	Multiple Choice	2	A-SSE.B
5	Multiple Choice	2	F-IF.B
6	Multiple Choice	2	A-SSE.A
7	Multiple Choice	2	A-APR.D
8	Multiple Choice	2	S-CP.A
9	Multiple Choice	2	F-LE.A
10	Multiple Choice	2	A-REI.A
11	Multiple Choice	2	S-CP.B
12	Multiple Choice	2	F-IF.B
13	Multiple Choice	2	F-IF.A
14	Multiple Choice	2	S-IC.B
15	Multiple Choice	2	S-IC.B
16	Multiple Choice	2	F-TF.A
17	Multiple Choice	2	F-BF.A
18	Multiple Choice	2	A-REI.C
19	Multiple Choice	2	A-APR.B
20	Multiple Choice	2	N-CN.C

21	Multiple Choice	2	A-REI.D
22	Multiple Choice	2	N-CN.A
23	Multiple Choice	2	A-SSE.A
24	Multiple Choice	2	S-IC.B
25	Constructed Response	2	N-RN.A
26	Constructed Response	2	A-APR.B
27	Constructed Response	2	F-BF.B
28	Constructed Response	2	G-GPE.A
29	Constructed Response	2	A-SSE.B
30	Constructed Response	2	F-IF.B
31	Constructed Response	2	F-LE.A
32	Constructed Response	2	F-IF.C
33	Constructed Response	4	F-BF.A
34	Constructed Response	4	F-IF.C
35	Constructed Response	4	A-REI.C
36	Constructed Response	4	S-ID.B
37	Constructed Response	6	A-REI.A

Regents Examination in Algebra II

January 2020

Chart for Converting Total Test Raw Scores to
Final Examination Scores (Scale Scores)

The *Chart for Determining the Final Examination Score for the January 2020 Regents Examination in Algebra II* will be posted on the Department's web site at: http://www.p12.nysed.gov/assessment/ by Thursday, January 23, 2020. Conversion charts provided for previous administrations of the Regents Examination in Algebra II must NOT be used to determine students' final scores for this administration.

Online Submission of Teacher Evaluations of the Test to the Department

Suggestions and feedback from teachers provide an important contribution to the test development process. The Department provides an online evaluation form for State assessments. It contains spaces for teachers to respond to several specific questions and to make suggestions. Instructions for completing the evaluation form are as follows:

1. Go to http://www.forms2.nysed.gov/emsc/osa/exameval/reexameval.cfm.

2. Select the test title.

3. Complete the required demographic fields.

4. Complete each evaluation question and provide comments in the space provided.

5. Click the SUBMIT button at the bottom of the page to submit the completed form.

The University of the State of New York
REGENTS HIGH SCHOOL EXAMINATION

ALGEBRA II

Thursday, January 23, 2020 — 1:15 to 4:15 p.m., only

MODEL RESPONSE SET

Table of Contents

25 For n and $p > 0$, is the expression $\left(p^2 n^{\frac{1}{2}}\right)^8 \sqrt{p^5 n^4}$ equivalent to $p^{18} n^6 \sqrt{p}$? Justify your answer.

$$\left(p^{16} n^4\right)\left(p^{\frac{5}{2}} n^{\frac{4}{2}}\right) = p^{18} \cdot n^6 \cdot p^{\frac{1}{2}}$$

$$p^{16+\frac{5}{2}} n^{4+2} = p^{18+\frac{1}{2}} n^6$$

$$p^{\frac{37}{2}} n^6 = p^{\frac{37}{2}} n^6$$

Yes, they are equivalent

Score 2: The student gave a complete and correct response.

25 For n and $p > 0$, is the expression $\left(p^2 n^{\frac{1}{2}}\right)^8 \sqrt{p^5 n^4}$ equivalent to $p^{18} n^6 \sqrt{p}$? Justify your answer.

$\sqrt{p^4 \cdot p^1}$

$p^2 \sqrt{p}$

$\sqrt{n^4}$

n^2

$\left(p^2 n^{\frac{1}{2}}\right)^8 \sqrt{p^5 n^4} = p^{18} n^6 \sqrt{p}$

$p^{16} n^4 \sqrt{p^5 n^4} = p^{18} n^6 \sqrt{p}$

$p^{18} n^6 \sqrt{p} \overset{\checkmark}{=} p^{18} n^6 \sqrt{p}$

They are equivalent because when you simplify the left hand side you get $p^{18} n^6 \sqrt{p}$.

Score 2: The student gave a complete and correct response.

25 For n and $p > 0$, is the expression $\left(p^2 n^{\frac{1}{2}}\right)^8 \sqrt{p^5 n^4}$ equivalent to $p^{18} n^6 \sqrt{p}$? Justify your answer.

$$\left(p^2 n^{\frac{1}{2}}\right)^8 \sqrt{p^5 n^4} = p^{18} n^6 \sqrt{p}$$

$$p^{16} \, n^4 \, p^2 n^2 \sqrt{p} = p^{18} \, n^6 \sqrt{p}$$

$$\boxed{p^{18} \, n^4 \sqrt{p} \neq p^{18} \, n^6 \sqrt{p}}$$

Score 1: The student made a computational error in the last line.

25 For n and $p > 0$, is the expression $\left(p^2 n^{\frac{1}{2}}\right)^8 \sqrt{p^5 n^4}$ equivalent to $p^{18} n^6 \sqrt{p}$? Justify your answer.

$(n^4)(n^2)$

$$p^{16} n^4 \sqrt{p^5 n^4} = p^{18} n^6 \sqrt{p}$$

$$p^{16} n^4 \sqrt{p^5 \ n^2}$$

$$p^{16} n^6 \sqrt{p^5} = p^{18} n^6 \sqrt{p}$$

Score 1: The student did not completely simplify the left side of the equation.

25 For n and $p > 0$, is the expression $\left(p^2 n^{\frac{1}{2}}\right)^8 \sqrt{p^5 n^4}$ equivalent to $p^{18} n^6 \sqrt{p}$? Justify your answer.

$p^3 n^6 \sqrt{p}$

$\left(p^{10} n^{8.5}\right)\left(\sqrt{p^5 n^4}\right)$

$\times \quad \sqrt{p^{15} n^{12.5}} = p^{18} n^6 \sqrt{p}$

No, because $\left(p^2 n^{1/2}\right)^8 \sqrt{p^5 n^4}$ does not equal $p^{18} n^6 \sqrt{p}$ when reduced.

Score 0: The student made multiple errors.

25 For n and $p > 0$, is the expression $\left(p^2 n^{\frac{1}{2}}\right)^8 \sqrt{p^5 n^4}$ equivalent to $p^{18} n^6 \sqrt{p}$? Justify your answer.

$p = 1$

$n = 2$

$\left((1)^2 (2)^{\frac{1}{2}}\right)^8 \sqrt{(1)^5 (2)^4}$

$(1 \cdot 1.414)^8 \sqrt{1 \quad 16}$

$16 \qquad 4$

$64 \checkmark$

$(1)^{18} (2)^6 \sqrt{1}$

$1 \cdot 64 \sqrt{1}$

$64 \sqrt{1}$

$64 \checkmark$

Score 0: The student did not indicate a positive response and did not provide a correct justification.

26 Show why $x - 3$ is a factor of $m(x) = x^3 - x^2 - 5x - 3$. Justify your answer.

$$
\begin{array}{r}
x^2 + 2x + 1 \\
x - 3 \overline{\smash{\big)}\, x^3 - x^2 - 5x - 3} \\
+\, x^3 + 3x^2 \\
\hline
2x^2 - 5x \\
+\, 2x^2 + 6x \\
\hline
x - 3 \\
+\, ^-x + 3 \\
\hline
0
\end{array}
$$

$x-3$ is a factor of $x^3 - x^2 - 5x - 3$ when it is multiplied by $x^2 + 2x + 1$.

	x	-3	
	x^3	$-3x^2$	x^2
	$2x^2$	$-6x$	$2x$
	x	-3	1

x^3 $-x^2$ $-5x$ -3

Score 2: The student gave a complete and correct response.

26 Show why $x - 3$ is a factor of $m(x) = x^3 - x^2 - 5x - 3$. Justify your answer.

$$3)\qquad x^3 - x^2 - 5x - 3$$

$$x + 3 = 0$$
$$\underline{-3 \quad -3}$$
$$x = 3$$

$$\begin{array}{ccc|c}
1 & -1 & -5 & -3 \\
\downarrow & 3 & 6 & 3 \\
\hline
1 & 2 & 1 & 0
\end{array}$$

remainder

$$x^2 + 2x + 1$$

Score 2: The student gave a complete and correct response.

26 Show why $x - 3$ is a factor of $m(x) = x^3 - x^2 - 5x - 3$. Justify your answer.

$$(3)^3 - (3)^2 - 5(3) - 3$$

$$\downarrow$$

$$\boxed{0}$$

Since we plugged $x-3$ in
(as $x=3$, the opposite) and
the remainder is 0, $\therefore$
$x-3$ is a factor.

Score 2: The student gave a complete and correct response.

26 Show why $x - 3$ is a factor of $m(x) = x^3 - x^2 - 5x - 3$. Justify your answer.

$$X - 3 = 0$$
$$\underline{+3 \ +3}$$
$$X = 3$$

$$(3)^3 - (3)^2 - 5(3) - 3 = 0$$
$$27 - 9 - 15 - 3$$
$$18 - 12$$
$$\boxed{6}$$

Score 1: The student received one credit for substituting 3 and setting the expression equal to zero.

26 Show why $x - 3$ is a factor of $m(x) = x^3 - x^2 - 5x - 3$. Justify your answer.

$$x^2 + 2x - \frac{3}{x-3}$$
$$x-3 \overline{)\ x^3 - x^2 - 5x - 3}$$
$$\underline{x^3 - 3x^2}$$
$$2x^2 - 5x$$
$$\underline{-\ 2x^2 - 5x}$$
$$\bigcirc x - 3$$

∴ $x^2 + 2x - \frac{3}{x-3}$ is the quotient and $x-3$ is a factor of $m(x) = x^3 - x^2 - 5x - 3$.

Score 0: The student made multiple errors.

27 Describe the transformation applied to the graph of $p(x) = 2^x$ that form the new function $q(x) = 2^{x-3} + 4$.

q(x) would be 4 spaces higher and would be shifted to the right by 3.

Score 2: The student gave a complete and correct response.

27 Describe the transformation applied to the graph of $p(x) = 2^x$ that form the new function $q(x) = 2^{x-3} + 4$.
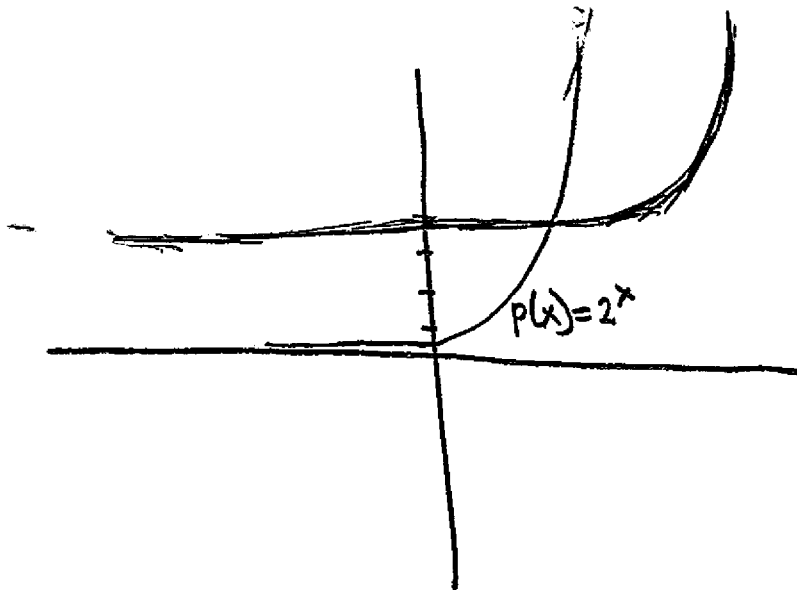
$p(x) = 2^x$

Up 4
shifts to the
right by 3

Score 2: The student gave a complete and correct response.

27 Describe the transformation applied to the graph of $p(x) = 2^x$ that form the new function $q(x) = 2^{x-3} + 4$.

$x \ne 2^x$ $x = 2^{x-3} + 4$
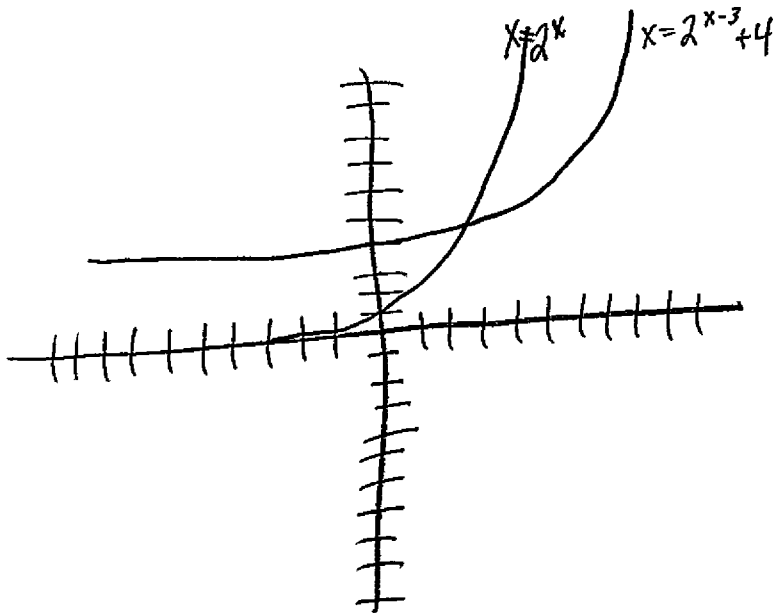
The graph shifts 3 units up and 3 units to the right.

Score 1: The student made one error in describing the vertical shift.

27 Describe the transformation applied to the graph of $p(x) = 2^x$ that form the new function $q(x) = 2^{x-3} + 4$.

$$\text{left} \quad 4, \text{up } 3$$

Score 0: The student made multiple errors in the transformation.

28 The parabola $y = -\dfrac{1}{20}(x - 3)^2 + 6$ has its focus at $(3,1)$. Determine and state the equation of the
directrix.

$\underset{h}{} \quad \underset{k}{}$

(The use of the grid below is optional.)

directrix

$y = 11$
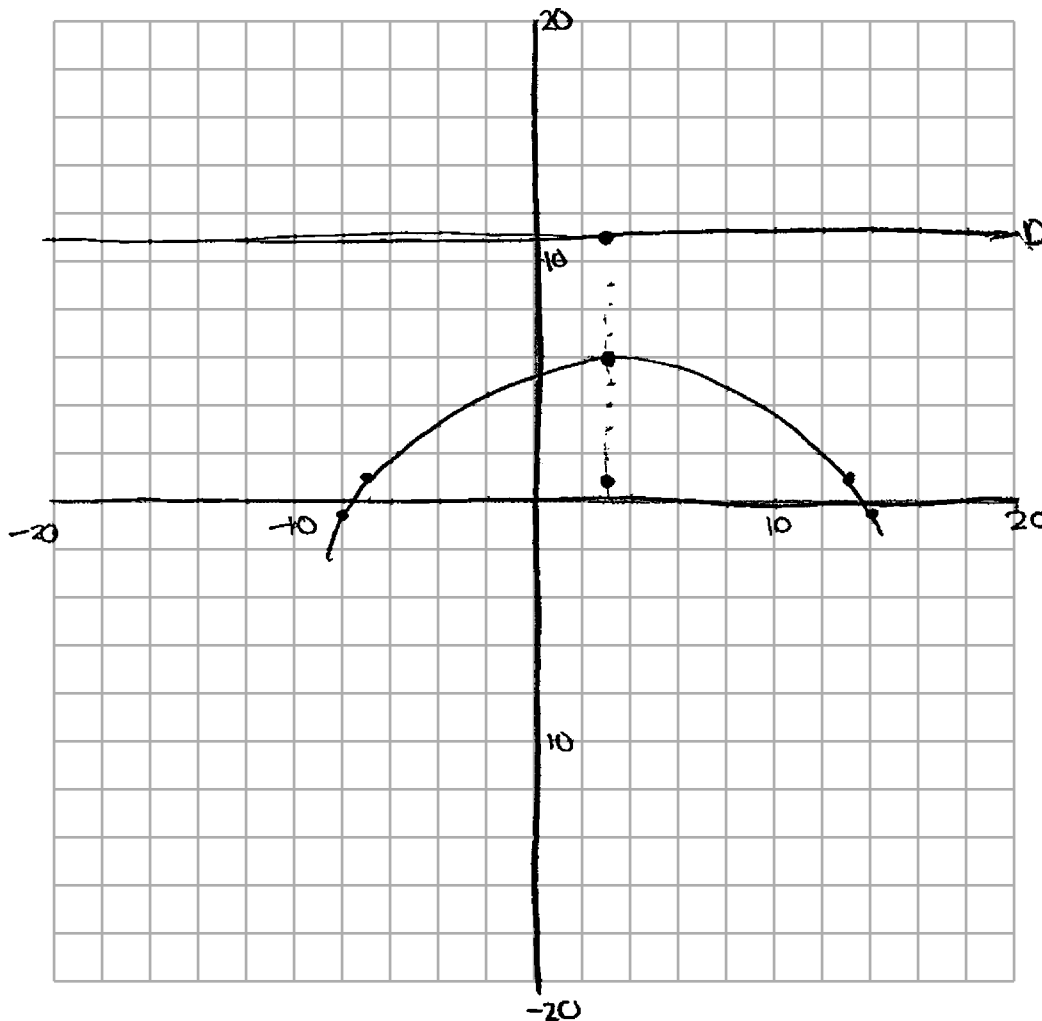
Score 2: The student gave a complete and correct response.

28 The parabola $y = -\dfrac{1}{20}(x - 3)^2 + 6$ has its focus at $(3,1)$. Determine and state the equation of the directrix.

(The use of the grid below is optional.)

plug in find vertex

$V = (3,6)$

$y = 11$
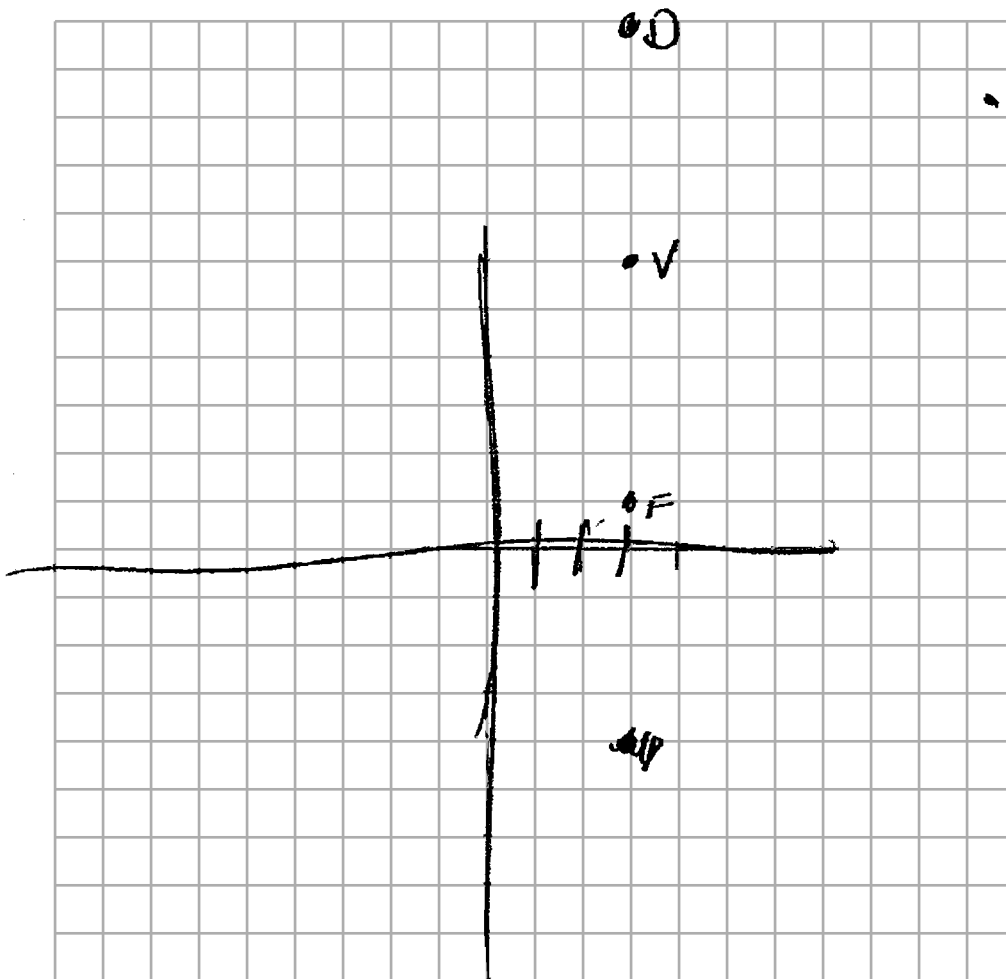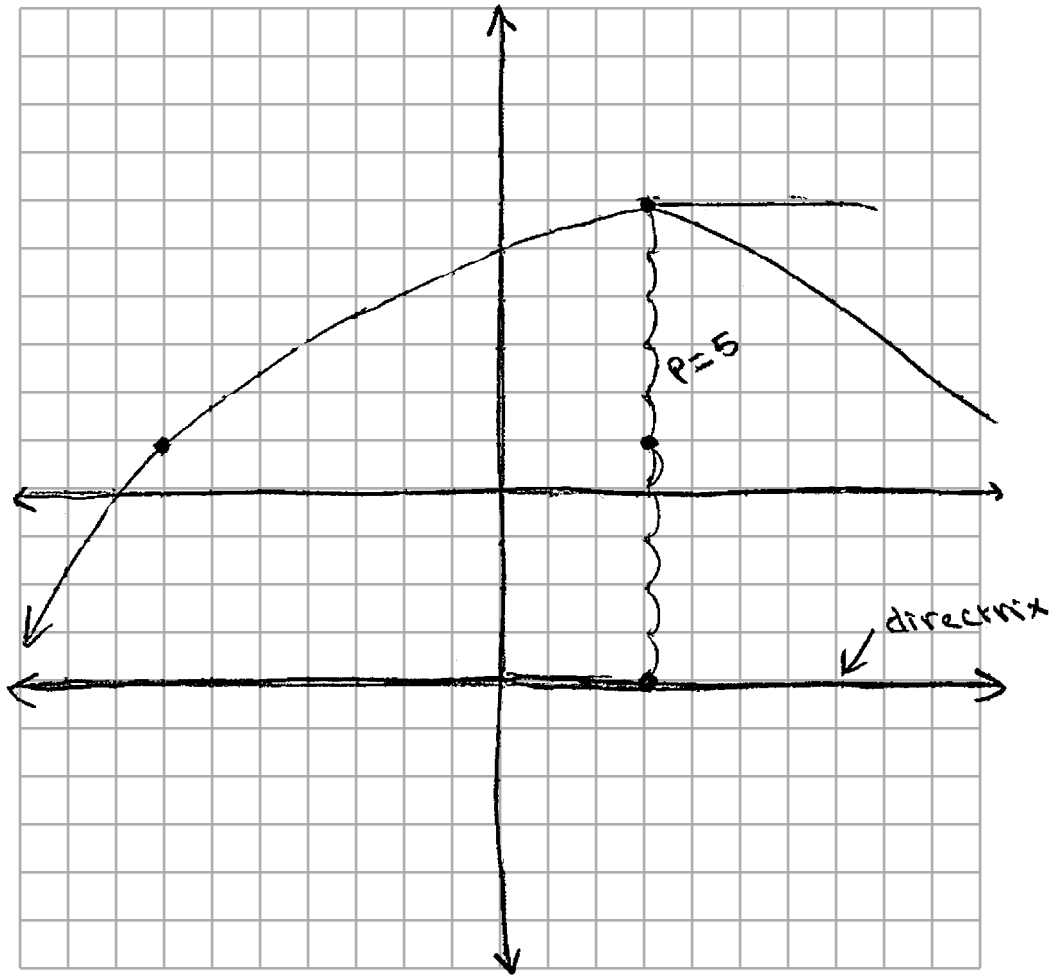

Score 2: The student gave a complete and correct response.

28 The parabola $y = -\dfrac{1}{20}(x-3)^2 + 6$ has its focus at $(3,1)$. Determine and state the equation of the directrix.

(The use of the grid below is optional.)

$$(3, 11)$$
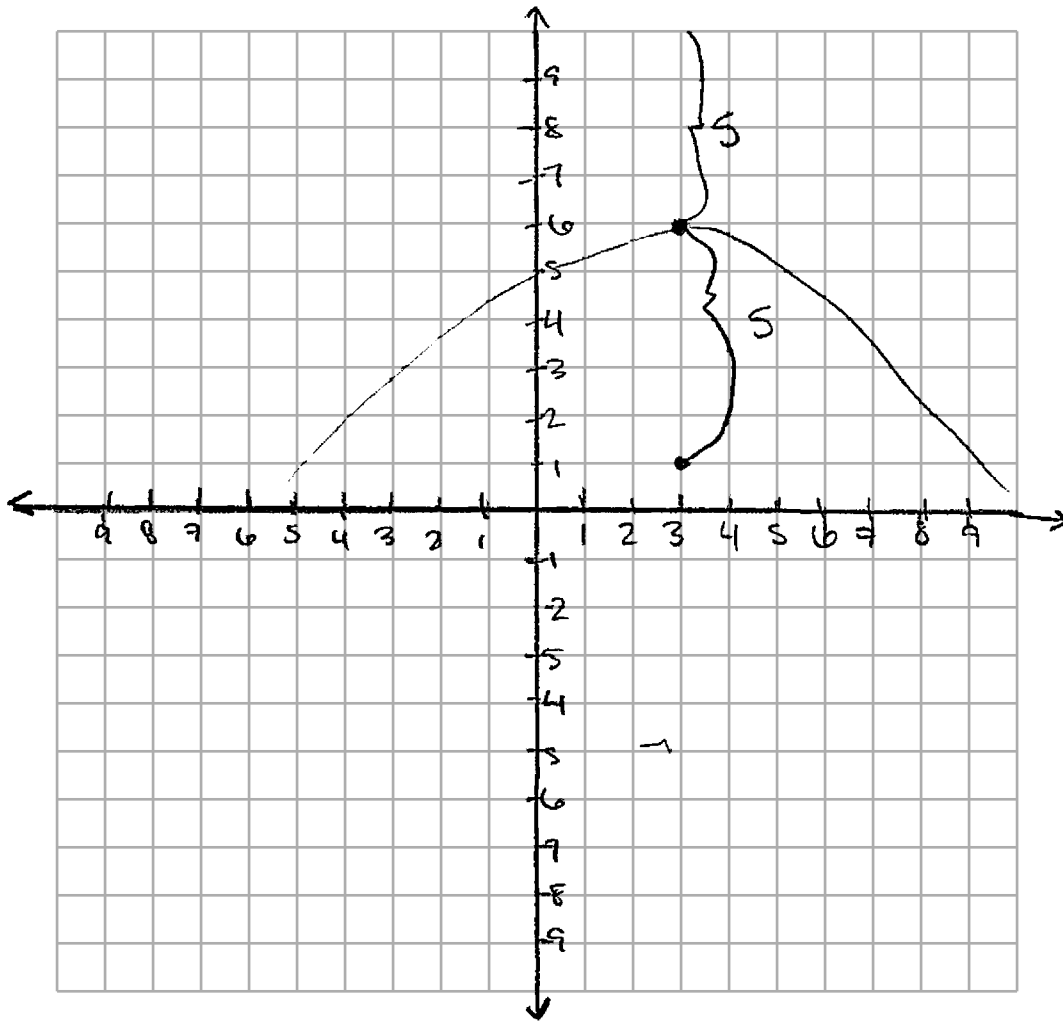
**Score 1:** The student stated the directrix as a coordinate.

28 The parabola $y = -\frac{1}{20}(x - 3)^2 + 6$ has its focus at $(3,1)$. Determine and state the equation of the directrix.

(The use of the grid below is optional.)

$$y = 12$$
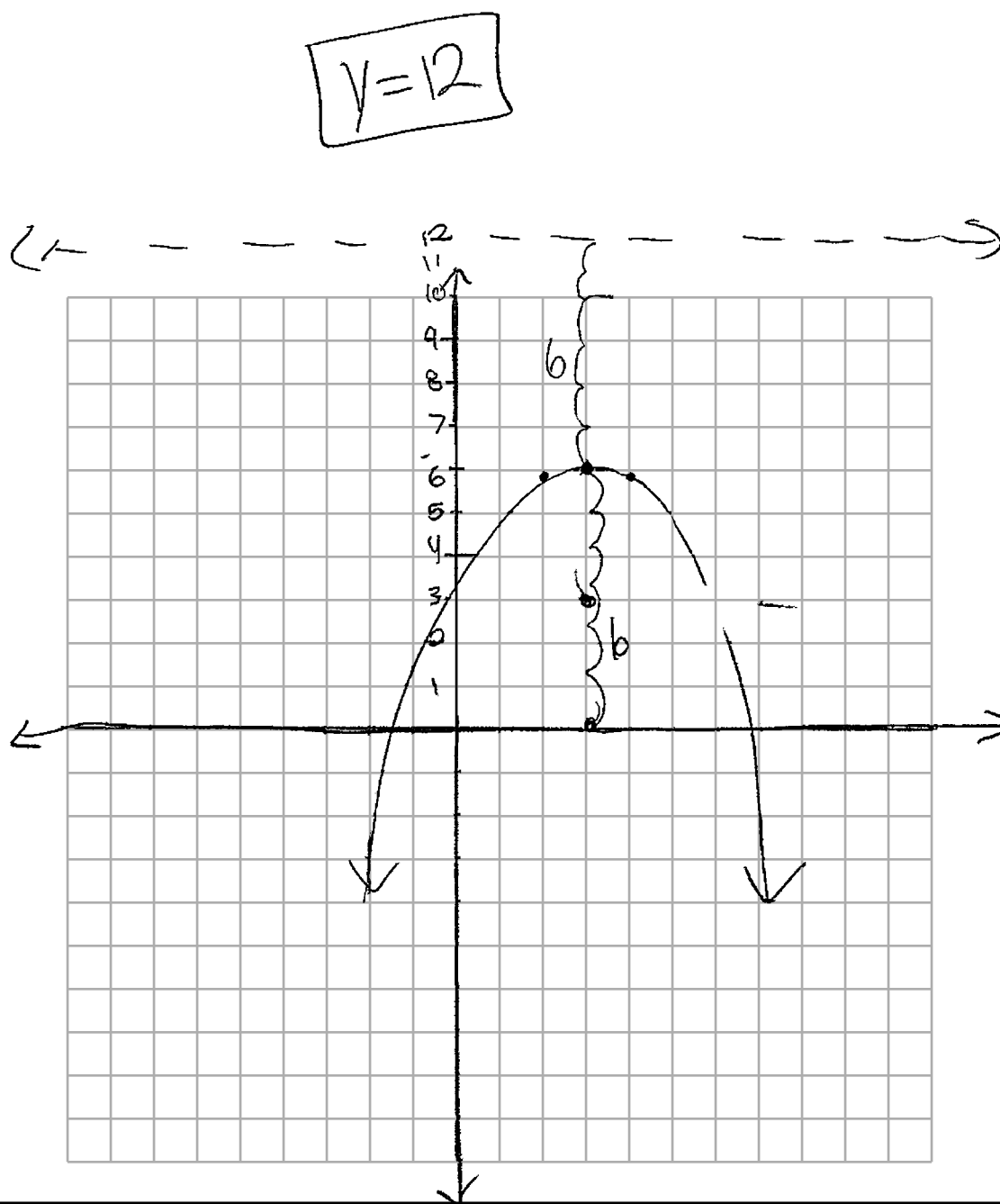
Score 1: The student used an incorrect focus to find the value of p.

28 The parabola $y = -\dfrac{1}{20}(x-3)^2 + 6$ has its focus at $(3,1)$. Determine and state the equation of the directrix.

(The use of the grid below is optional.)

max of parabola y
is (3,6)

$6-1=\boxed{5}$

↓
p-value

directrix: $y = -4$

$P=5$

directrix

Score 1: The student incorrectly placed the directrix below the focus.

28 The parabola $y = -\frac{1}{20}(x - 3)^2 + 6$ has its focus at $(3,1)$. Determine and state the equation of the directrix.

(The use of the grid below is optional.)

V $(-3, 6)$

directrix $(3, 3.5)$
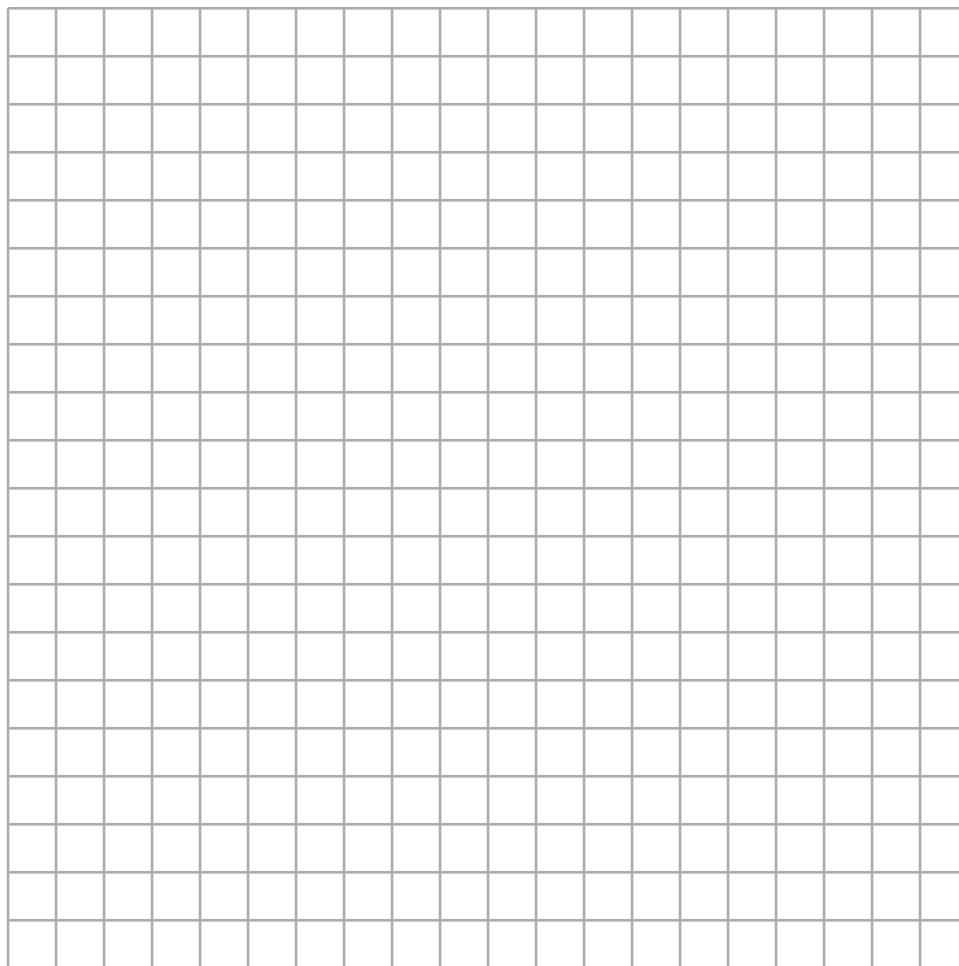
Score 0: The student made multiple errors.

29 Given the geometric series $300 + 360 + 432 + 518.4 + \ldots$, write a geometric series formula, S_n, for the sum of the first n terms. Use the formula to find the sum of the first 10 terms, to the *nearest tenth*.

$$S_n = \frac{300 - 300(1.2)^n}{1 - 1.2}$$

$$S(10) = \frac{300 - 300(1.2)^{10}}{1 - 1.2}$$

$$S_{10} = 7787.6$$

Score 2: The student gave a complete and correct response.

29 Given the geometric series $300 + 360 + 432 + 518.4 + ...$, write a geometric series formula, S_n, for the sum of the first n terms. Use the formula to find the sum of the first 10 terms, to the *nearest tenth*.

$$S_n = \sum_{i=1}^{n} 300 (1.2)^{i-1}$$

$$S_{10} = \sum_{i=1}^{10} 300(1.2)^{i-1} = 7787.6$$

Score 2: The student gave a complete and correct response.

29 Given the geometric series $300 + 360 + 432 + 518.4 + \ldots$, write a geometric series formula, S_n, for the sum of the first n terms. Use the formula to find the sum of the first 10 terms, to the *nearest tenth*.

$$\frac{300 = 300r^2}{300 = 300r}$$

$$\frac{6}{5} = r$$

$$S_n = \frac{a_1 - a_1 r^n}{1 - r}$$

$$S_n = \frac{300 - 300\left(\frac{6}{5}\right)^n}{1 - \frac{6}{5}}$$

$$S_{10} = \frac{300 - 300\left(\frac{6}{5}\right)^{10}}{1 - \frac{6}{5}}$$

$$S_{10} = \frac{-1857.520927}{-.2}$$

$$S_{10} = 9287.604634$$

$$\boxed{9287.6}$$

Score 1: The student made one computational error.

29 Given the geometric series $300 + 360 + 432 + 518.4 + ...$, write a geometric series formula, S_n, for the sum of the first n terms. Use the formula to find the sum of the first 10 terms, to the *nearest tenth*.

$$S_n = \frac{a_1 - a_1 r^n}{1 - r}$$

Geometric Series formula

$$S_n = \frac{300 - 300(1.2)^n}{1 - 1.2}$$

$$S_{10} = \frac{300 - 300(1.2)^{10}}{1 - 1.2}$$

$$S_{10} = \frac{300 - 300(6.19173642 z 2)}{-.2}$$

$$S_{10} = \frac{300 - 1857.5}{-.2}$$ Final answer

$$S_{10} = \frac{-1557.5}{-.2} \rightarrow S_{10} = \boxed{7787.5}$$

Score 1: The student made a rounding error.

29 Given the geometric series 300 + 360 + 432 + 518.4 + ..., write a geometric series formula, S_n, for the sum of the first n terms. Use the formula to find the sum of the first 10 terms, to the *nearest tenth*.

$a_1 = 300$

$S_n = 300 (n \cdot 1.2)$

$300, 360, 432, 518.4, 622.08, 746.496,$

$895.7952, 1074.95424, 1289.945088, 1547.934106$

7787.6046

≈ 7787

Score 0: The student wrote an incorrect geometric series formula and made a rounding error.

29 Given the geometric series $300 + 360 + 432 + 518.4 + ...$, write a geometric series formula, S_n, for the sum of the first n terms. Use the formula to find the sum of the first 10 terms, to the *nearest tenth*.

$$S_n = \frac{a_1 - a_1 r^n}{1 - r}$$

$$\frac{518.4 - 432 \cdot \therefore^{10}}{1 - 4} =$$

Score 0: The student did not show enough correct work to receive any credit.

30 Visible light can be represented by sinusoidal waves. Three visible light waves are shown in the graph below. The midline of each wave is labeled ℓ.


Nanometers
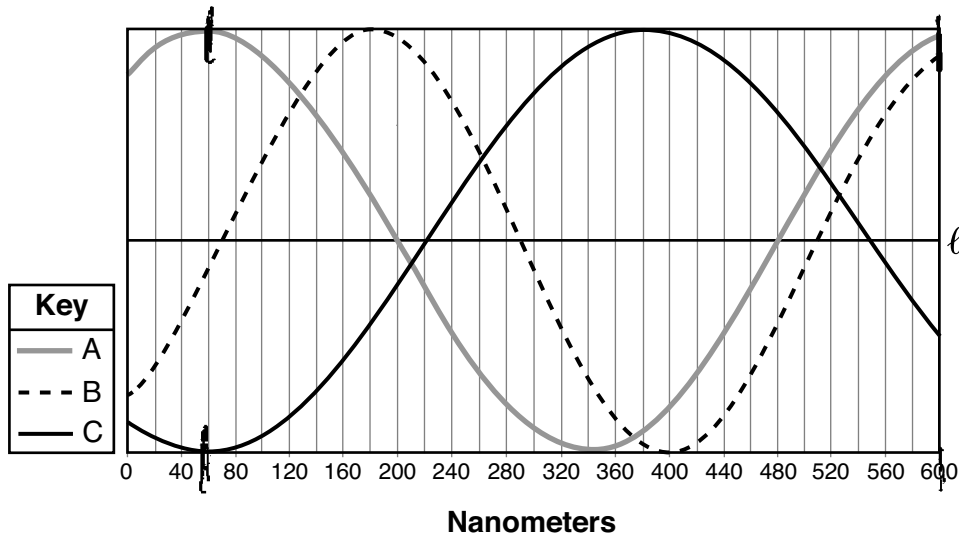
Based on the graph, which light wave has the longest period? Justify your answer.

Light C because its the only wave that does not go through 1 full period on the graph, meaning its· longer and cant fit on the graph.

Score 2: The student gave a complete and correct response.

30 Visible light can be represented by sinusoidal waves. Three visible light waves are shown in the graph below. The midline of each wave is labeled ℓ.
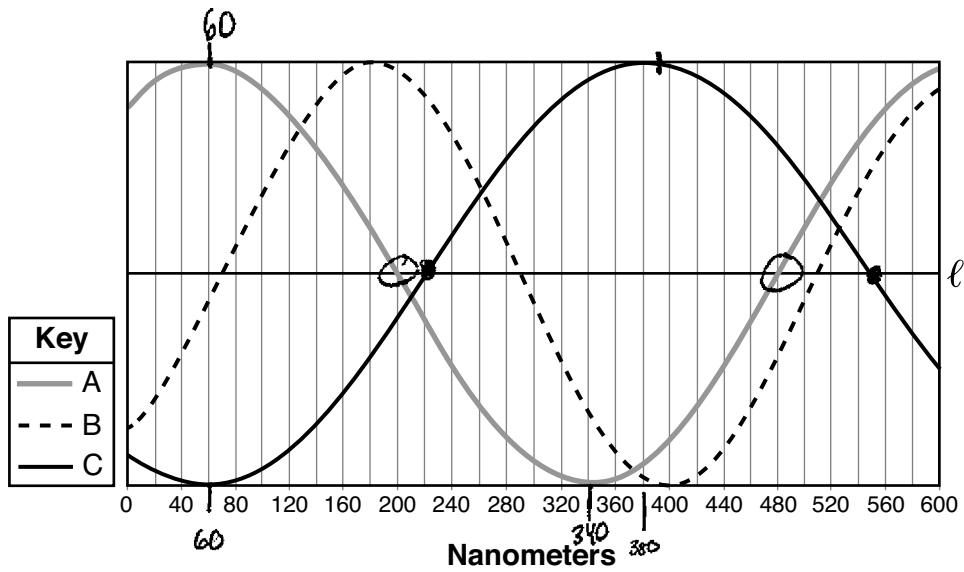
Based on the graph, which light wave has the longest period? Justify your answer.

Line C because it has the greatest distance between its minimum and maximum 320 nm
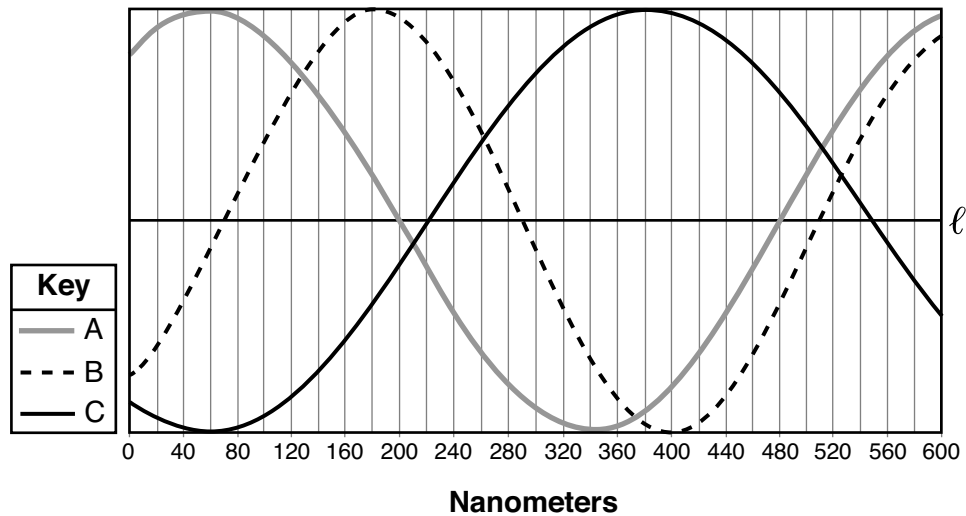
Line B   2 20 nm
Line A   280 nm

Score 2: The student gave a complete and correct response.

30 Visible light can be represented by sinusoidal waves. Three visible light waves are shown in the graph below. The midline of each wave is labeled ℓ.
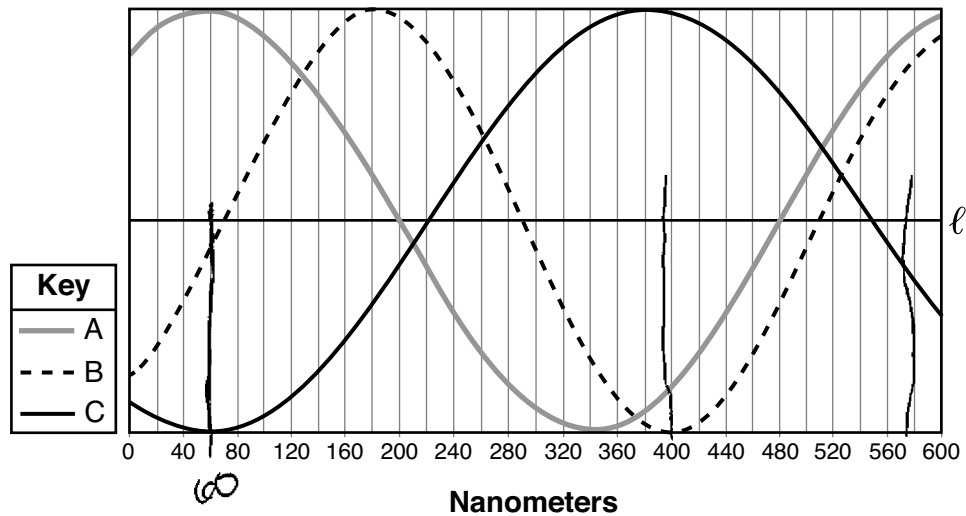

Based on the graph, which light wave has the longest period? Justify your answer.

Light wave C has the longest period
because one period is about 330
nanometers while light waves A and
B have shorter periods.

Score 1: The student received no credit for the justification.

30 Visible light can be represented by sinusoidal waves. Three visible light waves are shown in the graph below. The midline of each wave is labeled ℓ.

Based on the graph, which light wave has the longest period? Justify your answer.

A because it's period takes
up the most nanometers.

Score 0: The student did not show any correct work.

31 Biologists are studying a new bacterium. They create a culture with 100 of the bacteria and anticipate that the number of bacteria will double every 30 hours. Write an equation for the number of bacteria, B, in terms of the number of hours, t, since the experiment began.

double every 30hrs

$\left(\dfrac{t}{30}\right)^2$

start w/ 100

$$B(t) = 100(2)^{t/30}$$

Score 2: The student gave a complete and correct response.

31 Biologists are studying a new bacterium. They create a culture with 100 of the bacteria and anticipate that the number of bacteria will double every 30 hours. Write an equation for the number of bacteria, B, in terms of the number of hours, t, since the experiment began.

$$200 = 100e^{R(30)}$$

$$\frac{\ln 2 = \ln e^{30r}}{30}$$

$$B(t) = 100e^{\left(\frac{\ln 2}{30}\right)(t)}$$

Score 2:   The student gave a complete and correct response.

31 Biologists are studying a new bacterium. They create a culture with 100 of the bacteria and anticipate that the number of bacteria will double every 30 hours. Write an equation for the number of bacteria, B, in terms of the number of hours, t, since the experiment began.

$$B = 100(2)^{30t}$$

Score 1: The student applied the doubling time incorrectly.

31 Biologists are studying a new bacterium. They create a culture with 100 of the bacteria and anticipate that the number of bacteria will double every 30 hours. Write an equation for the number of bacteria, B, in terms of the number of hours, t, since the experiment began.

$$100\left(2^{\frac{t}{30}}\right) =$$

**Score 1:** The student made a notation error by writing an expression, not an equation.

31 Biologists are studying a new bacterium. They create a culture with 100 of the bacteria and anticipate that the number of bacteria will double every 30 hours. Write an equation for the number of bacteria, B, in terms of the number of hours, t, since the experiment began.

$$y = 100(2)^{\frac{30}{t}}$$

Score 0: The student made multiple errors.
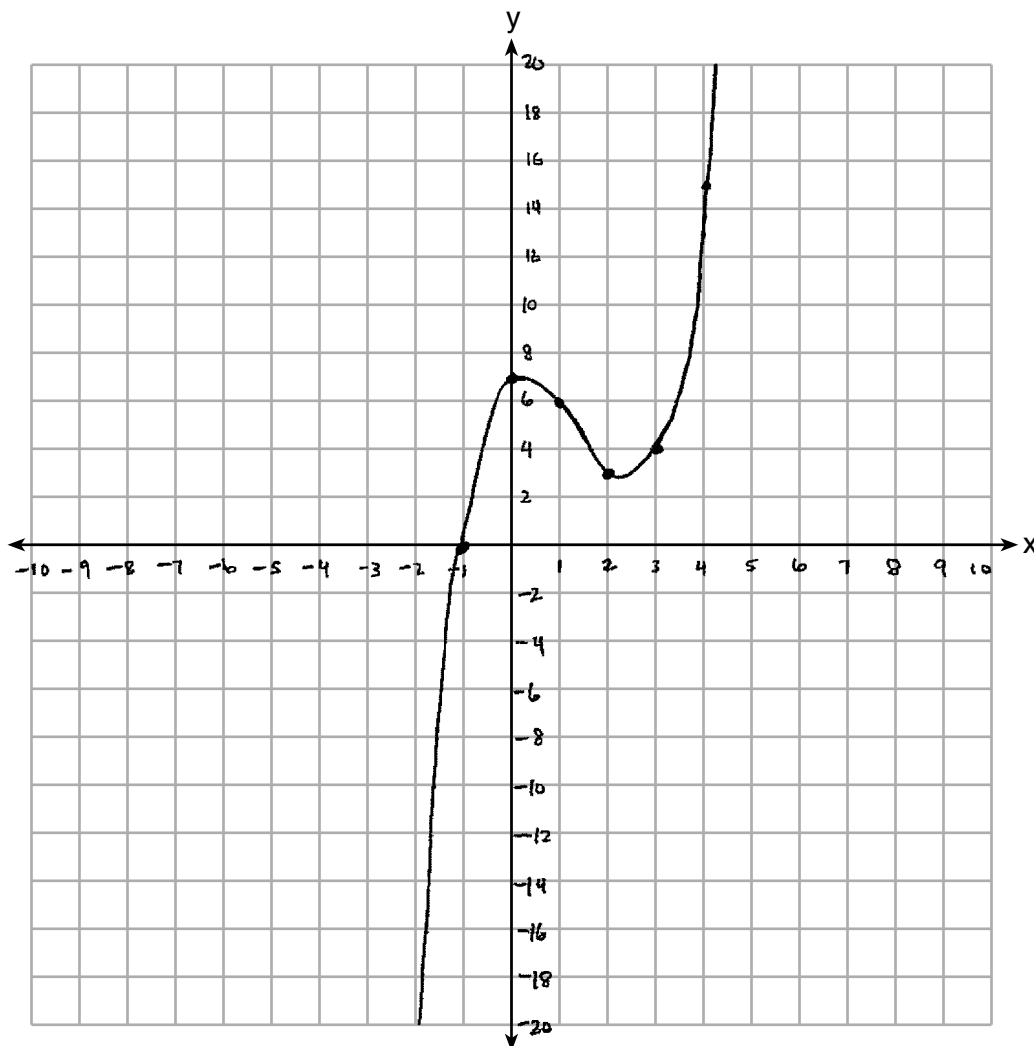
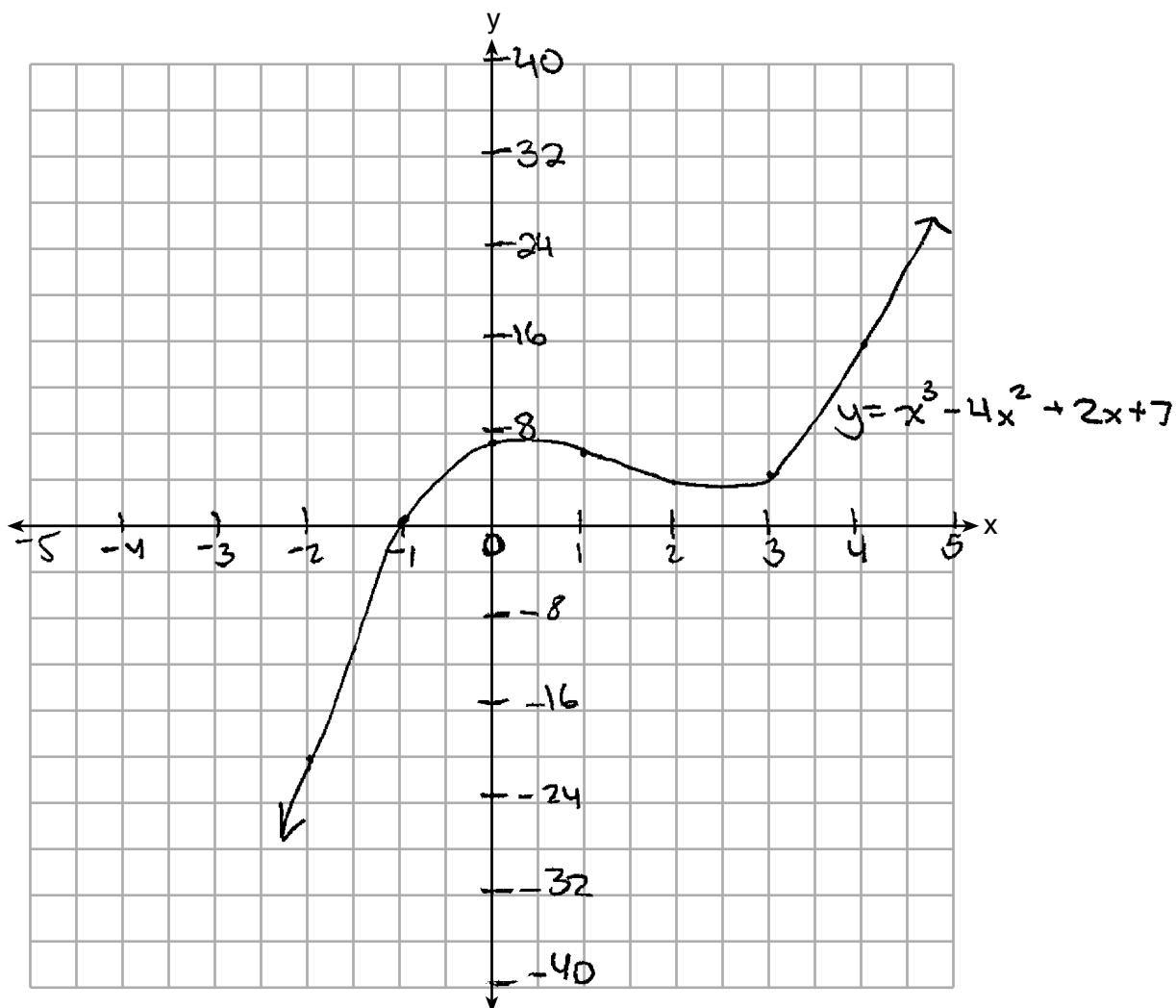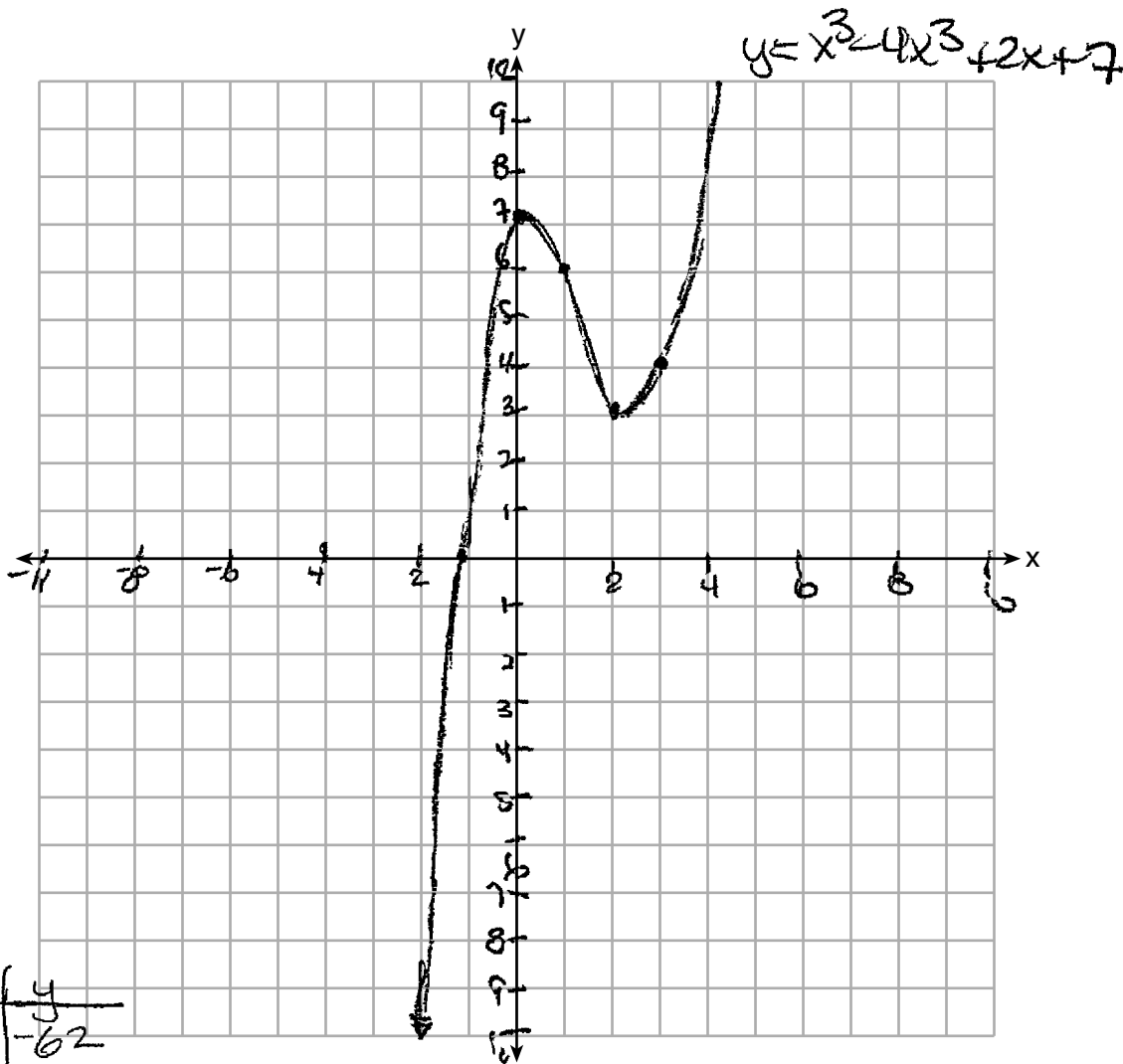**32** Graph $y = x^3 - 4x^2 + 2x + 7$ on the set of axes below.

Score 2: The student gave a complete and correct response.

32 Graph $y = x^3 - 4x^2 + 2x + 7$ on the set of axes below.

$y = x^3 - 4x^2 + 2x + 7$

Score 2:   The student gave a complete and correct response.

32 Graph $y = x^3 - 4x^2 + 2x + 7$ on the set of axes below.

$y = x^3 - 4x^3 + 2x + 7$

x	y
−3	−62
−2	21
−1	0
0	7
1	6
2	3
3	

Score 1: The student made one graphing error at the relative minimum.

32 Graph $y = x^3 - 4x^2 + 2x + 7$ on the set of axes below.
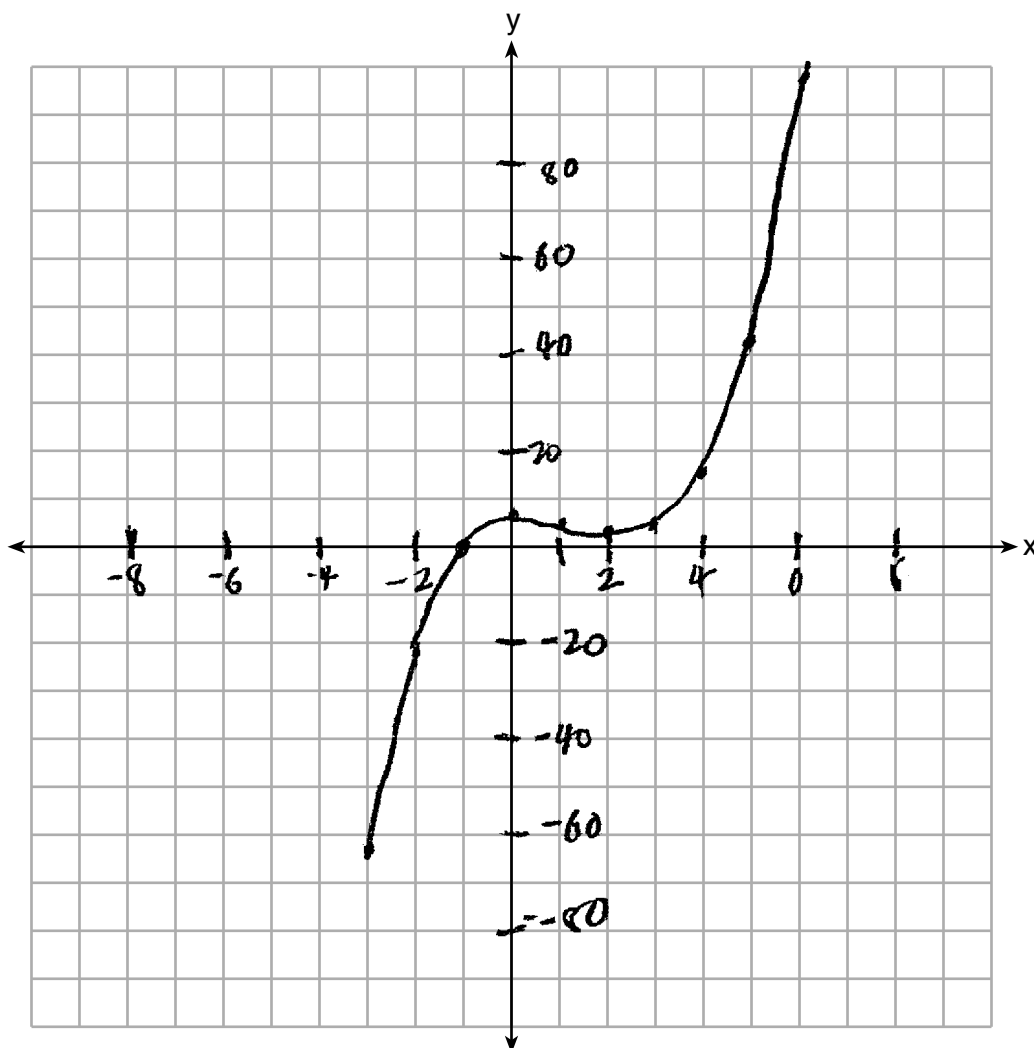
Score 0: The student made multiple graphing errors.

33 Sonja is cutting wire to construct a mobile. She cuts 100 inches for the first piece, 80 inches for the second piece, and 64 inches for the third piece. Assuming this pattern continues, write an explicit equation for a_n, the length in inches of the nth piece.

$$r = \frac{4}{5}$$

$$a_n = 100\left(\frac{4}{5}\right)^{n-1}$$

Sonja only has 40 feet of wire to use for the project and wants to cut 20 pieces total for the mobile using her pattern. Will she have enough wire? Justify your answer.

$$S_n = \frac{100 - 100\left(\frac{4}{5}\right)^{20}}{1 - \frac{4}{3}}$$

$$S_n = 494.235 \text{ inches}$$

$$40 \times 12 \text{ in} = 480$$

She will not have enough wire because for 20 pieces she needs about 494.24 inches but she only has 480 inches of wire

Score 4: The student gave a complete and correct response.

33 Sonja is cutting wire to construct a mobile. She cuts 100 inches for the first piece, 80 inches for the second piece, and 64 inches for the third piece. Assuming this pattern continues, write an explicit equation for a_n, the length in inches of the nth piece.

$$\frac{100}{a_1}, \frac{80}{a_2}, \frac{64}{a_3}$$

$$\boxed{a_n = 100\,(0.8)^{n-1}}$$

$$r = 0.8$$
$$\left(\tfrac{80}{100}\right)$$

Sonja only has 40 feet of wire to use for the project and wants to cut 20 pieces total for the mobile using her pattern. Will she have enough wire? Justify your answer.

$$40\,ft \rightarrow 480\,in$$

Geometric Series $= \dfrac{100 - 100\,(0.8)^n}{1 - 0.8}$

$$= \dfrac{100 - 100\,(0.8)^{20}}{0.2}$$

$$= 494.2353925$$

She will not have enough, she needs 494 inches of wire and she only has 480 in.

Score 4: The student gave a complete and correct response.

33 Sonja is cutting wire to construct a mobile. She cuts 100 inches for the first piece, 80 inches for the second piece, and 64 inches for the third piece. Assuming this pattern continues, write an explicit equation for a_n, the length in inches of the nth piece.

$$a_n = 100(.8)^{n-1}$$

480 inches

Sonja only has 40 feet of wire to use for the project and wants to cut 20 pieces total for the mobile using her pattern. Will she have enough wire? Justify your answer.

$a_n = 100(.8)^{n-1}$

$a_4 = 100(.8)^3$

$= 51.2$

$a_5 \ 41$

$a_6 \ 33$

$a_7 \ 26$

$a_8 \ 21$

$a_9 \ 17$

$a_{10} \ 13$

$a_{11} \ 11$

$a_{12} \ 9$

$a_{13} \ 7$

100
+80
+64
+51.2

$a_{14} \ 5$

$a_{15} \ 4$

$a_{16} \ 3.5$

$a_{17} \ 3$

$a_{18} \ 2.25$

$a_{19} \ 1.8$

$a_{20} \ 1.4$

no because it would use about 494 inches and she only has 480in.

Score 4: The student gave a complete and correct response.

33 Sonja is cutting wire to construct a mobile. She cuts 100 inches for the first piece, 80 inches for the second piece, and 64 inches for the third piece. Assuming this pattern continues, write an explicit equation for a_n, the length in inches of the nth piece.

$$\frac{80}{100} = .8$$

$$r = .8$$

$$100\,(.8)^{n-1}$$

Sonja only has 40 feet of wire to use for the project and wants to cut 20 pieces total for the mobile using her pattern. Will she have enough wire? Justify your answer.

$$\begin{array}{r} 40 \\ \times\ 12 \\ \hline 480 \end{array}$$

$$Sn = \frac{a_1 - a_1 r^n}{1 - r}$$

$$Sn = \frac{100 - 100(.8)^{20}}{1 - .8}$$

$$Sn = \frac{100 - 1.152921505}{.2}$$

$$Sn = 494.2353905$$

she will not have enough wire.

Score 3: The student made a notation error by writing an expression, not an equation.

33 Sonja is cutting wire to construct a mobile. She cuts 100 inches for the first piece, 80 inches for the second piece, and 64 inches for the third piece. Assuming this pattern continues, write an explicit equation for a_n, the length in inches of the nth piece.

$$a_1 = 100$$
$$a_n = a_{n-1} \cdot \left(\tfrac{4}{5}\right)$$

Sonja only has 40 feet of wire to use for the project and wants to cut 20 pieces total for the mobile using her pattern. Will she have enough wire? Justify your answer.

$$a_1 = 100$$

$$100, 80, 64, 51.2, 40.96, 32.768$$

$$a_n = \frac{a_1 - a_1 r^n}{1-r}$$

$$\frac{100 - 100\left(\tfrac{4}{5}\right)^n}{\left(1-\tfrac{4}{5}\right)}$$

No she does not have enough wire to cut 20 pieces because it comes out to be more than 40 feet.

$$494.235 \text{ inches}$$

$1 ft = 12 in$

$$\frac{494.2353925}{12} \quad 41.18628271$$
$$\boxed{41.2}$$

Score 3: The student wrote a recursive formula in the first part.

33 Sonja is cutting wire to construct a mobile. She cuts 100 inches for the first piece, 80 inches for the second piece, and 64 inches for the third piece. Assuming this pattern continues, write an explicit equation for a_n, the length in inches of the nth piece.

$$a_n = 100(.8)^{n-1}$$

Sonja only has 40 feet of wire to use for the project and wants to cut 20 pieces total for the mobile using her pattern. Will she have enough wire? Justify your answer.

$$a_n = 100(.8)^{19}$$

Score 2:   The student answered the first part correctly.

33 Sonja is cutting wire to construct a mobile. She cuts 100 inches for the first piece, 80 inches for the second piece, and 64 inches for the third piece. Assuming this pattern continues, write an explicit equation for a_n, the length in inches of the nth piece.

$$a_n = a_{n-1} \, (0.8)$$

Sonja only has 40 feet of wire to use for the project and wants to cut 20 pieces total for the mobile using her pattern. Will she have enough wire? Justify your answer.

$$S_n \, a_n = \frac{a_1 - a_1 r^n}{1-r}$$

$$S_{20} = \frac{100 - 100(0.8)^{20}}{1-0.8}$$

$$= 494.2$$

Score 1: The student earned credit for correctly finding the amount of wire needed.

33 Sonja is cutting wire to construct a mobile. She cuts 100 inches for the first piece, 80 inches for the second piece, and 64 inches for the third piece. Assuming this pattern continues, write an explicit equation for a_n, the length in inches of the nth piece.

$$100, 80, 64$$

$$a_n = ?$$

$$a_1 = 100$$

$$a_2 = 80$$

$$a_3 = 64$$

$$a_n = a_1 + (n-1)d$$

$$a_n = 100 + (n-1)d$$

Sonja only has 40 feet of wire to use for the project and wants to cut 20 pieces total for the mobile using her pattern. Will she have enough wire? Justify your answer.
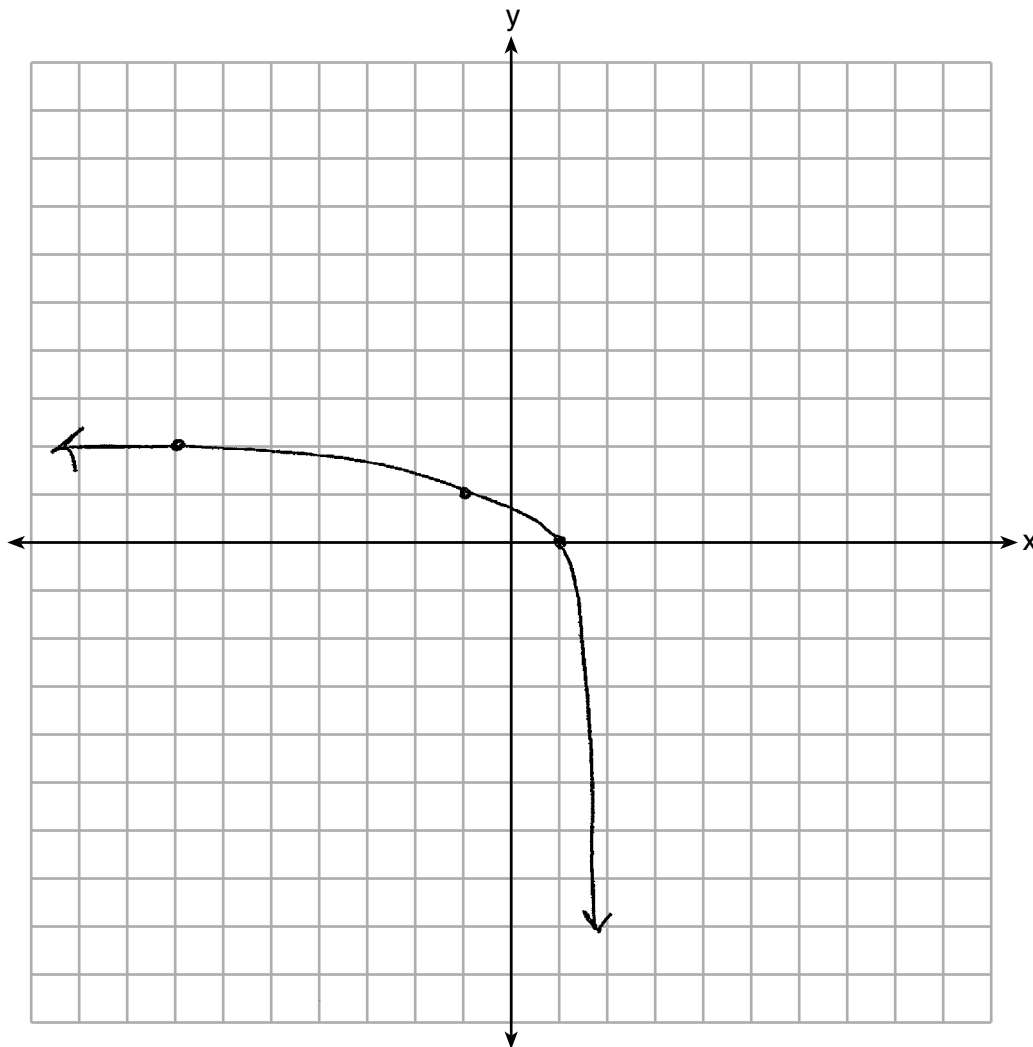
No because according to the geometric sequence formula it won't be enough.

Score 0: The student did not do enough correct work to receive any credit.

34 Graph the following function on the axes below.

$$f(x) = \log_3(2 - x)$$

State the domain of f.

Domain: $(-\infty, 2)$

State the equation of the asymptote.

asymptote $X = 2$

Score 4: The student gave a complete and correct response.

Question 34

34 Graph the following function on the axes below.

$$f(x) = \log_3(2 - x)$$

State the domain of *f*.

The domain is all real numbers less than 2.

State the equation of the asymptote.

The equation of the asymptote is x=2

Score 4: The student gave a complete and correct response.

34 Graph the following function on the axes below.
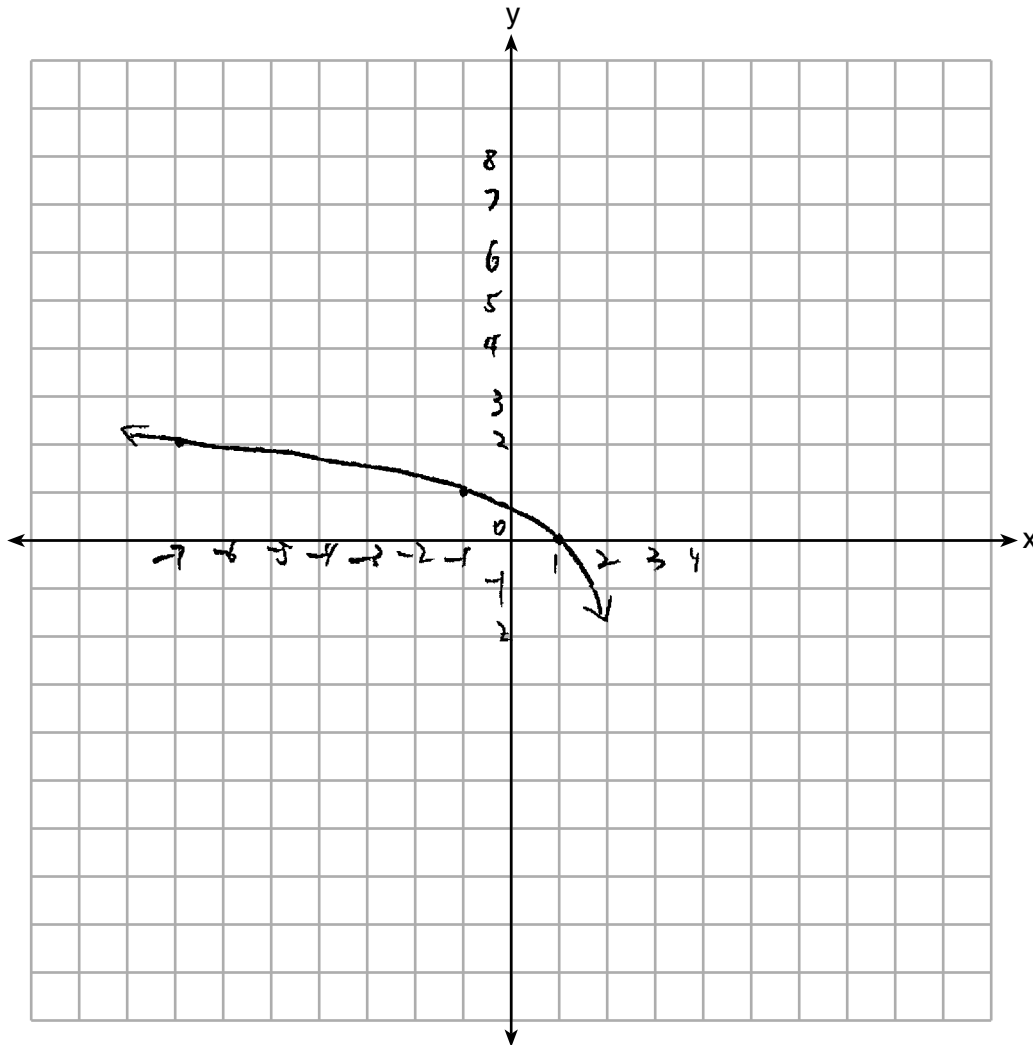
$$f(x) = \log_3(2 - x)$$

State the domain of f.
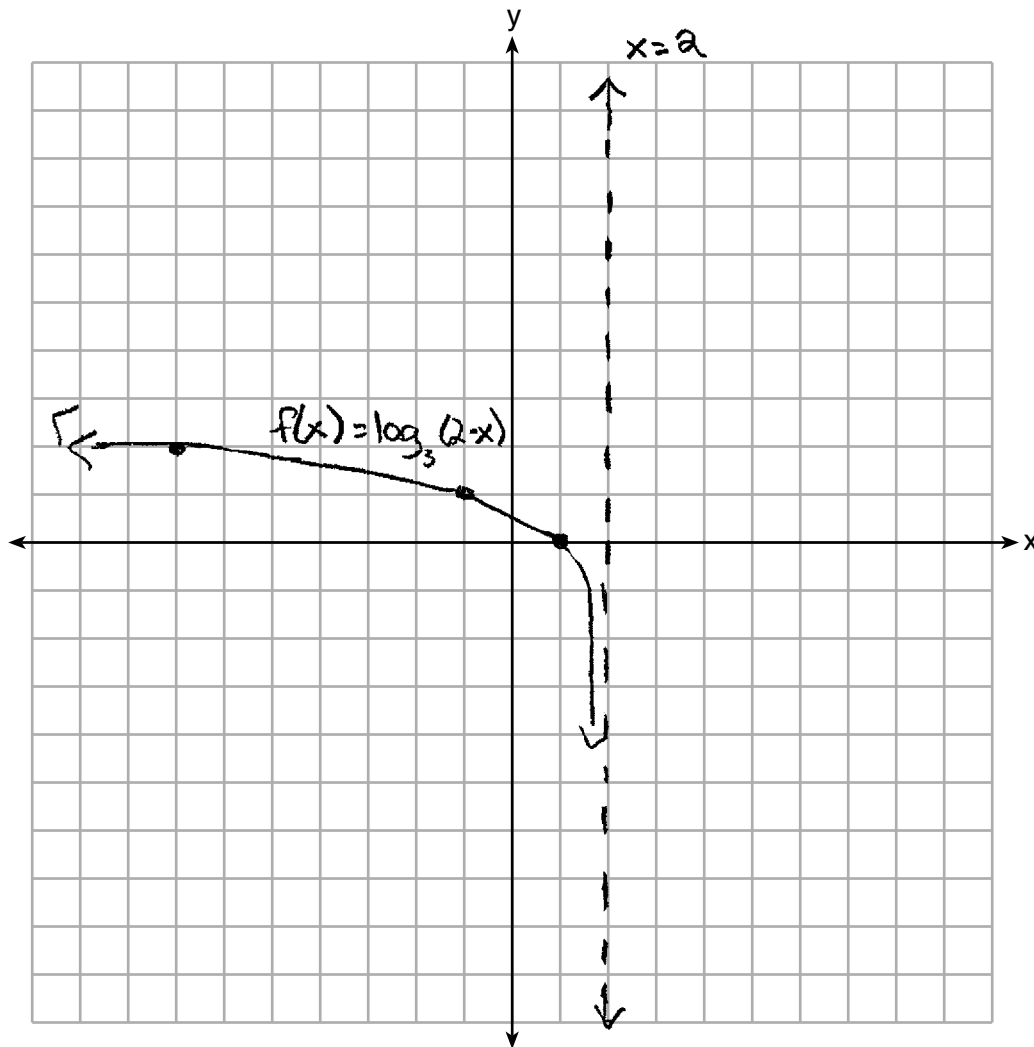
Domain: $x < 2$.

State the equation of the asymptote.

Equation of the asymptote: $y = \lim \log_3(2-x)$.

Score 3: The student did not state the correct equation of the asymptote.

Question 34

34 Graph the following function on the axes below.

$$f(x) = \log_3(2 - x)$$

State the domain of f.

$$\text{domain of } f: \quad x < 2$$

State the equation of the asymptote.

$$\text{asymptote} = x = 2$$

Score 3:   The student made one graphing error.

Question 34

34 Graph the following function on the axes below.

$$f(x) = \log_3(2 - x)$$

State the domain of f.

$$d(f) \qquad (-\infty, 1]$$

State the equation of the asymptote.

$$X = 2$$

Score 2: The student made one graphing error and stated an incorrect domain.

34 Graph the following function on the axes below.
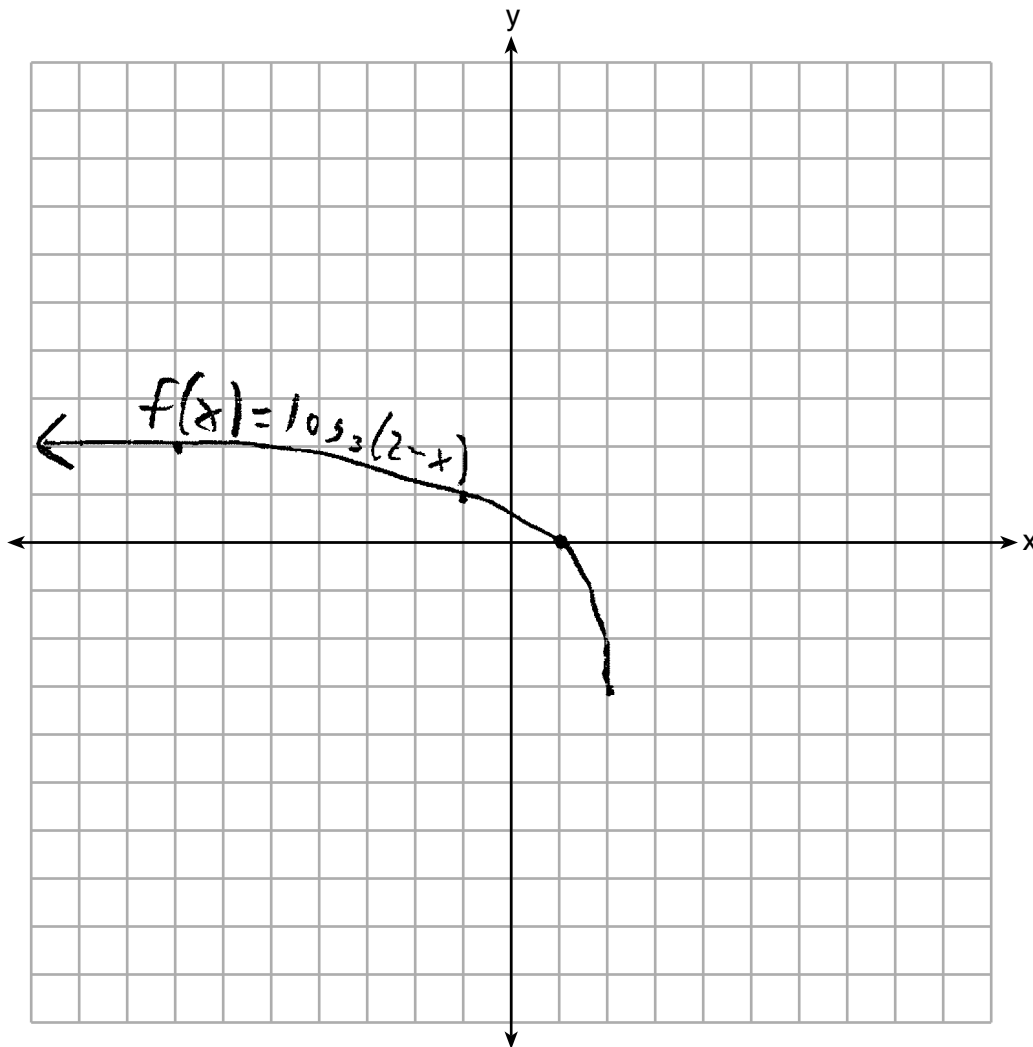
$$f(x) = \log_3(2 - x)$$

State the domain of f.

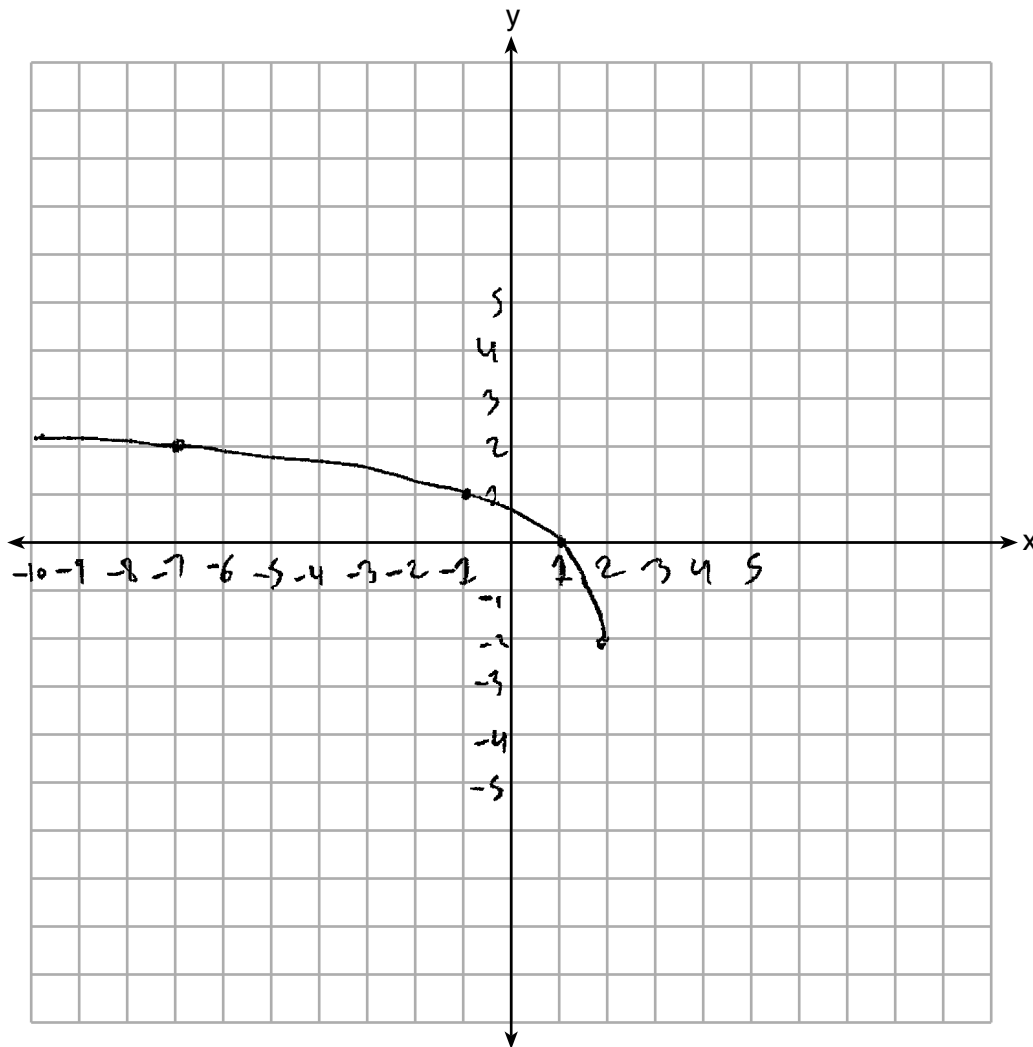$$-\infty \le x \le 2$$

State the equation of the asymptote.
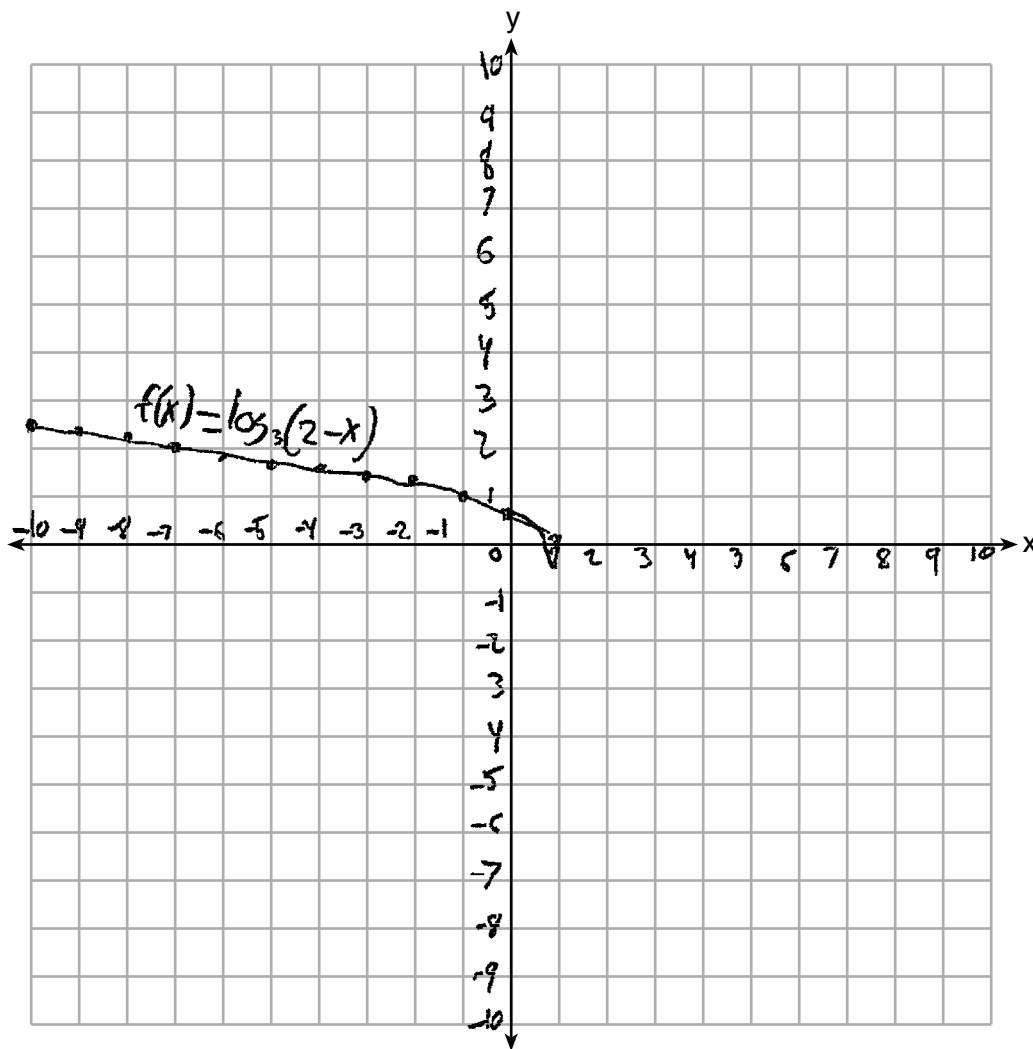
Score 1: The student received one credit for the graph.
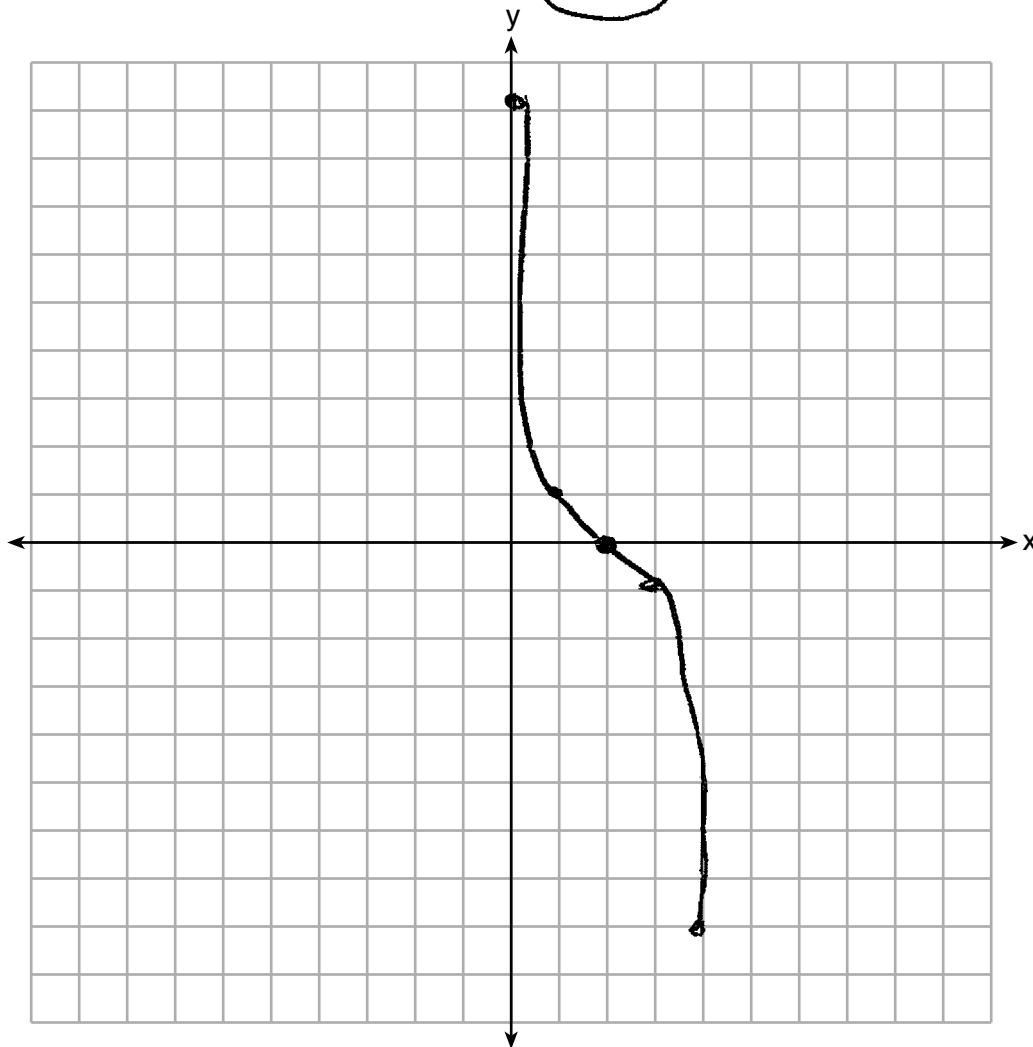
34 Graph the following function on the axes below.

$$f(x) = \log_3(2 - x)$$

State the domain of f.

$$\left(-\infty, \infty\right)$$

State the equation of the asymptote.

35 Algebraically solve the following system of equations.

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

$$x + y - 1 = 0$$

$$y = -x + 1$$

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

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

$$\frac{2x^2 + 8}{2} = \frac{16}{2}$$

$$x^2 + 4 = 8$$

$$2 + y - 1 = 0 \qquad x^2 = 4$$

$$y + 1 = 0 \qquad x = \pm 2$$

$$y = -1$$

$$-2 + y - 1 = 0 \qquad \#(2, -1) \text{ or } (-2, 3)$$

$$y = +3$$

Score 4: The student gave a complete and correct response.

Question 35

35 Algebraically solve the following system of equations.

$$(x-2)^2 + (y-3)^2 = 16$$
$$x + y - 1 = 0$$

$(y-1)(-y-1)$
$y^2 + y + y + 1$

$x = -y + 1$

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

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

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

$y^2 + 2y + 1 + y^2 - 6y + 9 = 16$

$2y^2 - 4y + 10 = 16$

$y^2 - 2y + 5 = 8$

$y^2 - 2y - 3 = 0$

$(y-3)(y+1) = 0$

$y = 3 \quad | \quad y = -1$

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

$\boxed{(-2, 3)}$

$x = -y + 1$
$x = -(-1) + 1$
$x = 1 + 1$
$x = 2$

$\boxed{(2, -1)}$

Score 4: The student gave a complete and correct response.

35 Algebraically solve the following system of equations.

$$(x - 2)^2 + (y - 3)^2 = 16$$
$$x + y - 1 = 0$$

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

$y = -x+1$

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

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

$(x^2-4x+4 + (-x-2)\cdot(-x-2) = 16$

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

$2x^2+8 = 16$

$2x^2-8 = 0$

$2(x^2-4) = 0$

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

$\boxed{y=-1}$

$\boxed{y=3}$

$x-2=0$

$\boxed{y=2}$

$x+2=0$

$\boxed{x=-2}$

Score 3: The student did not show solutions that are paired.

Question 35

35 Algebraically solve the following system of equations.

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

$$x + y - 1 = 0$$

$$x + y = 1 \rightarrow y = -x + 1$$

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

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

$$2x^2 + 4x + 20 = 16$$

$$\frac{2x^2 + 4x + 4}{2} = 0$$

$$x^2 + 2x + 2 = 0$$

$$(x + 2)(x + 2) = 0$$

$$x = 2 \qquad x = -2$$

$$y = -(-2) + 1 \qquad y = -(-2) + 1$$

$$y = 3 \qquad y = 3$$

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

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

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

$$(2x + 2)(x + 2)$$
$$2x^2 + 4x + 2x + 4$$

$$(x + 2)(x + 1)$$
$$x^2 + 2x + x + 2$$

$$(2x + 2)(x + 1)$$
$$2x^2 + 2x + 2x + 2$$
$$2x^2 + 4x + 2$$

$$\frac{2x + 2 = 0}{2} \quad -2$$

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

$$x = -1$$

Score 2:   The student made a transcription error and a factoring error.

35 Algebraically solve the following system of equations.

$$(x - 2)^2 + (y - 3)^2 = 16$$
$$x + y - 1 = 0 \quad y = -x + 1$$

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

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

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

$$2x^2 + 8 - 16 = 0$$

$$2x^2 - 16 = 0$$

$$2(x^2 - 8) = 0$$

$$\boxed{X = 2}$$

$$x^2 - 8 = 0$$
$$+8 \quad 8$$

$$\overline{}$$

$$X = \sqrt{8}$$

$$\boxed{X = 2\sqrt{2}}$$

$$\frac{-x - 2}{x^2 \quad 2x} \Big| -x$$
$$2x \quad 4 \Big| -2$$

$$\frac{x - 2}{x^2 \quad -2x} \Big| x$$
$$-2x + 4 \Big| -2$$

?

Score 1: The student wrote a correct quadratic equation in one variable.

35 Algebraically solve the following system of equations.

$$(x - 2)^2 + (y - 3)^2 = 16$$
$$x + y - 1 = 0$$

$$x^2 \underset{+4}{-4} + y^2 - 9 = \underset{+4}{16}$$

$$x^2 + y^2 \underset{+9}{-9} = \underset{+9}{20}$$

$$x^2 + y^2 = 29$$

Score 0:   The student did not show any relevant correct work.

35 Algebraically solve the following system of equations.

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

$$x + y - 1 = 0$$

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

$(x-2)(x-2)$

$x^2 - 2x - 2x + 4$

$x^2 - 4x + 4$

$x - 2 \sqrt{x+2}$

$x + 2$

$x = -2$

$y^2 - 3y - 3y + 9$

$y^2 - 6y + 9$

$y + 3$

$y + 3$

$=$

$y = 3$

$x = -2$

Score 0: The student obtained one correct solution by an obviously incorrect procedure.

36 The table below gives air pressures in kPa at selected altitudes above sea level measured in kilometers.

x	Altitude (km)	0	1	2	3	4	5
y	Air Pressure (kPa)	101	90	79	70	62	54

Write an exponential regression equation that models these data rounding all values to the *nearest thousandth*.

$$y = 101.523 \times .883^{x}$$

Use this equation to algebraically determine the altitude, to the *nearest hundredth* of a kilometer, when the air pressure is 29 kPa.

when air pressure is 29 kPa, altitude is 10.07 (km)

$$\frac{29}{101.523} = \frac{101.523 \times .883^{x}}{101.523}$$

$$.28565 = .883^{x}$$

$$\frac{\log(.28565)}{\log(.883)} = \frac{x \log(.883)}{\log(.883)}$$

$$\boxed{10.07 \quad = x}$$

Score 4: The student gave a complete and correct response.

36 The table below gives air pressures in kPa at selected altitudes above sea level measured in kilometers.

x	**Altitude** (km)	0	1	2	3	4	5
y	**Air Pressure** (kPa)	101	90	79	70	62	54

Write an exponential regression equation that models these data rounding all values to the *nearest thousandth.*

stat, calc, exp reg

$$y = 101.523(.883)^x$$

Use this equation to algebraically determine the altitude, to the *nearest hundredth* of a kilometer, when the air pressure is 29 kPa.

$$\frac{29}{101.523} = \frac{101.523(.883)^x}{101.523}$$

$$.2856\ldots = .883^x$$

$$x = \log_{.883} .2856\ldots$$

$$x = 10.07 \text{ km}$$

Score 4: The student gave a complete and correct response.

36 The table below gives air pressures in kPa at selected altitudes above sea level measured in kilometers.

x	Altitude (km)	0	1	2	3	4	5
y	Air Pressure (kPa)	101	90	79	70	62	54

Write an exponential regression equation that models these data rounding all values to the *nearest thousandth*.

$$101.523(.883)^x$$

Use this equation to algebraically determine the altitude, to the *nearest hundredth* of a kilometer, when the air pressure is 29 kPa.

$$101(.883)^{29}$$

2.75 km

$$29 = 101.523 (.883)^x$$

$$.286 = .883^x$$

$$\frac{\log .286}{} = \frac{\log .883 \, x}{}$$

$$X = 10.07$$

Score 3: The student made a notation error by writing an expression, not an equation.

36 The table below gives air pressures in kPa at selected altitudes above sea level measured in kilometers.

x	Altitude (km)	0	1	2	3	4	5
y	Air Pressure (kPa)	101	90	79	70	62	54

Write an exponential regression equation that models these data rounding all values to the *nearest thousandth*.

$$y = 101.523 \, (0.883)^x$$

Use this equation to algebraically determine the altitude, to the *nearest hundredth* of a kilometer, when the air pressure is 29 kPa.

$$y = 101.523(0.883)^x$$

$$\frac{29 = 101.523(0.883)^x}{101.523}$$

$$\boxed{x = 10 \ km}$$

$$.2856 = (.883)^x$$

$$\frac{\log .2856 = x \log .88x}{\log .883}$$

Score 3: The student made a rounding error.

36 The table below gives air pressures in kPa at selected altitudes above sea level measured in kilometers.

x	**Altitude** (km)	0	1	2	3	4	5
y	**Air Pressure** (kPa)	101	90	79	70	62	54

Write an exponential regression equation that models these data rounding all values to the *nearest thousandth*.

$$y = ab^x$$
$$a = 101.523$$
$$b = 0.883$$

$$y = 101.523(0.883)^x$$

Use this equation to algebraically determine the altitude, to the *nearest hundredth* of a kilometer, when the air pressure is 29 kPa.

$$y = 101.523(0.883)^x$$
$$\frac{29}{101.523} = \frac{101.523(0.883)^x}{101.523}$$
$$0.286 = (0.883)^x$$
$$\frac{\ln 0.286}{\ln 0.883} = \frac{\ln x \cdot 0.883}{\ln 0.883}$$
$$x = \boxed{10.06 \text{ KM}}$$

Score 2: The student made one rounding error and one notation error writing the logarithm.

36 The table below gives air pressures in kPa at selected altitudes above sea level measured in kilometers.

x	Altitude (km)	0	1	2	3	4	5
y	Air Pressure (kPa)	101	90	79	70	62	54

Write an exponential regression equation that models these data rounding all values to the *nearest thousandth*.

$$y = a(b)^x$$

$$y = 101.523(.883)^x$$

Use this equation to algebraically determine the altitude, to the *nearest hundredth* of a kilometer, when the air pressure is 29 kPa.

$$\frac{29}{101.523} \geq \frac{101.523(.883)^x}{101.523}$$

$$.286 \geq (.883)^x$$

Score 2: The student earned credit for the correct exponential regression equation.

36 The table below gives air pressures in kPa at selected altitudes above sea level measured in kilometers.

x	Altitude (km)	0	1	2	3	4	5
y	Air Pressure (kPa)	101	90	79	70	62	54

Write an exponential regression equation that models these data rounding all values to the *nearest thousandth.*

$$y = a(b)^x$$

$$y = 101.438(.883)^x$$

Use this equation to algebraically determine the altitude, to the *nearest hundredth* of a kilometer, when the air pressure is 29 kPa.

$$y = 101.438(.883)^{29}$$

$$\boxed{2.75 \text{ km}}$$

Score 1: The student made a computation error in the first part and earned no credit for the second part.

36 The table below gives air pressures in kPa at selected altitudes above sea level measured in kilometers.

x	Altitude (km)	0	1	2	3	4	5
y	Air Pressure (kPa)	101	90	79	70	62	54

Write an exponential regression equation that models these data rounding all values to the *nearest thousandth*.

$$y = -9.37x + 99.43$$

Use this equation to algebraically determine the altitude, to the *nearest hundredth* of a kilometer, when the air pressure is 29 kPa.

$$y = -9.37(29) + 99.43$$

$$y = -172.3$$

Score 0: The student did not show enough correct relevant work to receive any credit.

37 Sarah is fighting a sinus infection. Her doctor prescribed a nasal spray and an antibiotic to fight the infection. The active ingredients, in milligrams, remaining in the bloodstream from the nasal spray, $n(t)$, and the antibiotic, $a(t)$, are modeled in the functions below, where t is the time in hours since the medications were taken.

$$n(t) = \frac{t+1}{t+5} + \frac{18}{t^2 + 8t + 15}$$

$$a(t) = \frac{9}{t+3}$$

Determine which drug is made with a greater initial amount of active ingredient. Justify your answer.

$$n(t) = \frac{0+1}{0+5} + \frac{18}{0+0+15} = \frac{1}{5} + \frac{18}{15} = \frac{21}{15} = 1.4 \quad \text{at time} = 0$$

$$a(t) = \frac{9}{3} = 3$$

the antibiotic is made with more active ingredient because at t=0 3>1 ~

Score 6: The student gave a complete and correct response.

Sarah's doctor told her to take both drugs at the same time. Determine algebraically the number of hours after taking the medications when both medications will have the same amount of active ingredient remaining in her bloodstream.

$$\frac{t+1}{t+5} + \frac{18}{t^2+8t+15} = \frac{9}{t+3}$$

$$t^2 - 5t - 24 = 0$$

$$(t+3)(t+5)\frac{t+1}{t+5} + \frac{18}{(t+3)(t+5)} = \frac{9}{t+3}$$

$$(t-8)(t+3)$$

Can't have (−) time

$$t = 8 \qquad t = -3$$

$$(t+1)(t+3) + 18 = 9(t+5)$$

$$t^2 + 4t + 3 + 18 = 9t + 45$$

$$t^2 + 4t + 21 = 9t + 45$$
$$-9t - 45 \qquad -9t - 45$$

After 8 hours the 2 drugs will have the same amount of active ingredient in the blood

37 Sarah is fighting a sinus infection. Her doctor prescribed a nasal spray and an antibiotic to fight the infection. The active ingredients, in milligrams, remaining in the bloodstream from the nasal spray, $n(t)$, and the antibiotic, $a(t)$, are modeled in the functions below, where t is the time in hours since the medications were taken.

$$n(t) = \frac{t+1}{t+5} + \frac{18}{t^2 + 8t + 15}$$

$$a(t) = \frac{9}{t+3}$$

Determine which drug is made with a greater initial amount of active ingredient. Justify your answer.

$$n(0)$$
$$a(0)$$

antibiotic

Score 5:   The student gave an incomplete justification for "antibiotic".

Sarah's doctor told her to take both drugs at the same time. Determine algebraically the number of hours after taking the medications when both medications will have the same amount of active ingredient remaining in her bloodstream.

$$\frac{t+1}{t+5} + \frac{18}{t^2+8t+15} = \frac{9}{t+3}$$

$$(t+1)(t+3) + 18 = 9(t+5)$$

$$t^2 + 4t + 3 + 18 = 9t + 45$$

$$t^2 + 4t + 21 = 9t + 45$$

$$t^2 - 5t - 24 = 0$$

$$(t-8)(t+3) = 0$$

$$t = 8 \qquad \cancel{t = -3}$$

After
8 hours
$t = 8$ hours

37 Sarah is fighting a sinus infection. Her doctor prescribed a nasal spray and an antibiotic to fight the infection. The active ingredients, in milligrams, remaining in the bloodstream from the nasal spray, $n(t)$, and the antibiotic, $a(t)$, are modeled in the functions below, where t is the time in hours since the medications were taken.

$$n(t) = \frac{t+1}{t+5} + \frac{18}{t^2 + 8t + 15}$$

$$a(t) = \frac{9}{t+3}$$

Determine which drug is made with a greater initial amount of active ingredient. Justify your answer.

$t=1$

$$\frac{1+1}{1+5} + \frac{18}{1^2 + 8(1) + 15} = \frac{13}{12}$$

$$\frac{9}{1+3} = \frac{9}{4} \times \frac{3}{3} = \boxed{\frac{27}{12}}$$

If you plug in 1 for both equation you see that equation $a(t)$ has a higher fraction hence its made with a greater amount

Score 4: The student mistakenly substituted 1 for the initial time and did not reject $t = -3$.

Sarah's doctor told her to take both drugs at the same time. Determine algebraically the number of hours after taking the medications when both medications will have the same amount of active ingredient remaining in her bloodstream.

$$\frac{t+3}{(t+3)}\left(\frac{t+1}{(t+5)}\right) + \frac{18}{\frac{t^2+8t+15}{(t+5)(t+3)}} = \frac{(9)}{(t+3)(t+5)} \frac{t+5}{}$$

$$\frac{t+3}{t+1}{\Big/}\frac{3}{1}$$

$$t^2 \quad 3$$

$$(t+3)(t+1) + 18 = 9t + 45$$

$$t^2 + 4t + 3 + 18 = 9t + 45$$
$$ -9t - 45$$
$$-9t + 45$$

$$t^2 - 5t - 24 = 0$$
$$(t+3)(t-8)$$
$$\boxed{t = -3 \not\! 8}$$

37 Sarah is fighting a sinus infection. Her doctor prescribed a nasal spray and an antibiotic to fight the infection. The active ingredients, in milligrams, remaining in the bloodstream from the nasal spray, $n(t)$, and the antibiotic, $a(t)$, are modeled in the functions below, where t is the time in hours since the medications were taken.

$$n(t) = \frac{t+1}{t+5} + \frac{18}{t^2 + 8t + 15}$$

$$a(t) = \frac{9}{t+3}$$

Determine which drug is made with a greater initial amount of active ingredient. Justify your answer.

$n(t) = \text{nasal}$
$a(t) = \text{anti}$

$(t) = \frac{t+1}{t+5} + \frac{18}{t^2 + 8t + 15}$

Question 37 is continued on the next page.

Score 4: The student earned credit for correctly solving for $t = 8$.

Sarah's doctor told her to take both drugs at the same time. Determine algebraically the number of hours after taking the medications when both medications will have the same amount of active ingredient remaining in her bloodstream.

$$\left(\frac{t+1}{t+5}\right) + \left(\frac{18}{(t+5)(t+3)}\right) = \left(\frac{9}{t+3}\right)$$

$$(t+1)(t+3) + 18 = 9(t+5)$$

$$t^2 + 4t + 3 + 18 = 9t + 45$$

$$t^2 - 5t - 24 = 0$$

$$(t-8)(t+3) = 0$$

$$t = -3, 8$$

$$t = 8$$

∴ after 8 hours, they will have the same amount of active ingredient

37 Sarah is fighting a sinus infection. Her doctor prescribed a nasal spray and an antibiotic to fight the infection. The active ingredients, in milligrams, remaining in the bloodstream from the nasal spray, $n(t)$, and the antibiotic, $a(t)$, are modeled in the functions below, where t is the time in hours since the medications were taken.

$$n(t) = \frac{t+1}{t+5} + \frac{18}{t^2 + 8t + 15}$$

$$a(t) = \frac{9}{t+3}$$

Determine which drug is made with a greater initial amount of active ingredient. Justify your answer.

$$n(t) \quad \frac{t+1}{t+5} + \frac{18}{t^2 + 8t + 13}$$

$$a(t) = \frac{9}{t+3}$$

Question 37 is continued on the next page.

Score 3: The student did not earn any credit in the first part and did not reject $t = -3$ in the second part.

Sarah's doctor told her to take both drugs at the same time. Determine algebraically the number of hours after taking the medications when both medications will have the same amount of active ingredient remaining in her bloodstream.

$$\frac{t+1}{t+5} + \frac{18}{t^2+8t+15} = \frac{9}{t+3}$$

$$\frac{(t+1)(t+3)}{(t+5)(t+3)} + \frac{18}{(t+5)(t+3)} = \frac{9(t+5)}{(t+5)(t+3)}$$

$t^2 + 3t + t + 3$

$(t+1)(t+3) + 18 - 9(t+5)$ $8 ; -3$

$t^2 + 4t + 3 \quad +18 - 9t + 45$

$t^2 - 5t - 42 + 18$

$4 \quad t^2 - 5t - 24 =) \quad (t - 8)(t+3)$

37 Sarah is fighting a sinus infection. Her doctor prescribed a nasal spray and an antibiotic to fight the infection. The active ingredients, in milligrams, remaining in the bloodstream from the nasal spray, $n(t)$, and the antibiotic, $a(t)$, are modeled in the functions below, where t is the time in hours since the medications were taken.

$$n(t) = \frac{t+1}{t+5} + \frac{18}{t^2 + 8t + 15}$$

$$a(t) = \frac{9}{t+3}$$

Determine which drug is made with a greater initial amount of active ingredient. Justify your answer.

$a(t)$ has a greater amount of active ingredient, because when both equations are plugged into the calculator at $t=0$, $n(t)$ has 7/5 milligrams of active ingredient and $a(t)$ has 3 milligrams.

Question 37 is continued on the next page.

Score 3: The student did not provide enough work to justify $t = 8$.

Sarah's doctor told her to take both drugs at the same time. Determine algebraically the number of hours after taking the medications when both medications will have the same amount of active ingredient remaining in her bloodstream.

$$\frac{(t+3)}{(t+3)} \frac{t+1}{t+5} + \frac{18(t}{t^2+8t+15} = \frac{9}{t+3}$$

$$(t+3)(t+5)$$

$$t = 8$$

37 Sarah is fighting a sinus infection. Her doctor prescribed a nasal spray and an antibiotic to fight the infection. The active ingredients, in milligrams, remaining in the bloodstream from the nasal spray, $n(t)$, and the antibiotic, $a(t)$, are modeled in the functions below, where t is the time in hours since the medications were taken.

$$n(t) = \frac{t+1}{t+5} + \frac{18}{t^2 + 8t + 15}$$

$$a(t) = \frac{9}{t+3}$$

Determine which drug is made with a greater initial amount of active ingredient. Justify your answer.

The antibiolic is made with a greater amount of the active ingredient because it has a greater y-intercept, (0,3) compared to the nasal spray's (0, 1.4)

Score 2: The student only earned credit for the first part.

Sarah's doctor told her to take both drugs at the same time. Determine algebraically the number of hours after taking the medications when both medications will have the same amount of active ingredient remaining in her bloodstream.

$$\frac{t+1}{t+5} + \frac{18t}{t^2+8t+15} = \frac{9}{t+3}$$

37 Sarah is fighting a sinus infection. Her doctor prescribed a nasal spray and an antibiotic to fight the infection. The active ingredients, in milligrams, remaining in the bloodstream from the nasal spray, $n(t)$, and the antibiotic, $a(t)$, are modeled in the functions below, where t is the time in hours since the medications were taken.

$$n(t) = \frac{t+1}{t+5} + \frac{18}{t^2 + 8t + 15}$$

$$a(t) = \frac{9}{t+3}$$

Determine which drug is made with a greater initial amount of active ingredient. Justify your answer.

Question 37 is continued on the next page.

Score 1: The student earned credit by stating 8.

Sarah's doctor told her to take both drugs at the same time. Determine algebraically the number of hours after taking the medications when both medications will have the same amount of active ingredient remaining in her bloodstream.

8 hours

37 Sarah is fighting a sinus infection. Her doctor prescribed a nasal spray and an antibiotic to fight the infection. The active ingredients, in milligrams, remaining in the bloodstream from the nasal spray, $n(t)$, and the antibiotic, $a(t)$, are modeled in the functions below, where t is the time in hours since the medications were taken.

$$n(t) = \frac{t+1}{t+5} + \frac{18}{t^2 + 8t + 15}$$

$$a(t) = \frac{9}{t+3}$$

Determine which drug is made with a greater initial amount of active ingredient. Justify your answer.

n(T) is the one that has the greater amount of active ingrediant becuse when you solve for T you end up getting a higher number the A(T)

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Question 37 is continued on the next page.

</div>

Score 0: The student did not provide enough correct work to earn any credit.

Sarah's doctor told her to take both drugs at the same time. Determine algebraically the number of hours after taking the medications when both medications will have the same amount of active ingredient remaining in her bloodstream.

$$n(t) = \frac{T+1}{t+5} + \frac{.18}{T^2 + 8T + 15} \qquad a(T) = \frac{9}{t+3}$$

$$\frac{9}{T+5} = \frac{T+1}{T+5} + \frac{18}{T^2 + 8T + 15}$$

$$\frac{9}{T+5} = \frac{T+1}{T+5} + \frac{18}{(T+5)(T+3)}$$

$$9 = T + 1 + 18$$

$$9 = T + 19$$
$$-19 \qquad -19$$

$$\boxed{T = 10}$$

Regents Examination in Algebra II – January 2020

Chart for Converting Total Test Raw Scores to Final Exam Scores (Scale Scores)

(Use for the January 2020 exam only.)

Raw Score	Scale Score	Performance Level	Raw Score	Scale Score	Performance Level	Raw Score	Scale Score	Performance Level
86	100	5	57	81	4	28	65	3
85	99	5	56	81	4	27	64	2
84	98	5	55	80	4	26	63	2
83	96	5	54	80	4	25	62	2
82	95	5	53	80	4	24	60	2
81	95	5	52	79	4	23	59	2
80	94	5	51	79	4	22	57	2
79	93	5	50	79	4	21	55	2
78	92	5	49	78	4	20	54	1
77	91	5	48	78	4	19	52	1
76	90	5	47	77	3	18	51	1
75	90	5	46	77	3	17	49	1
74	89	5	45	77	3	16	47	1
73	88	5	44	76	3	15	44	1
72	88	5	43	76	3	14	42	1
71	87	5	42	75	3	13	40	1
70	87	5	41	75	3	12	37	1
69	86	5	40	74	3	11	35	1
68	86	5	39	74	3	10	32	1
67	85	5	38	73	3	9	29	1
66	84	4	37	73	3	8	27	1
65	84	4	36	72	3	7	24	1
64	84	4	35	71	3	6	21	1
63	83	4	34	71	3	5	17	1
62	83	4	33	70	3	4	14	1
61	82	4	32	69	3	3	11	1
60	82	4	31	68	3	2	8	1
59	82	4	30	67	3	1	4	1
58	81	4	29	66	3	0	0	1

To determine the student's final examination score (scale score), find the student's total test raw score in the column labeled "Raw Score" and then locate the scale score that corresponds to that raw score. The scale score is the student's final examination score. Enter this score in the space labeled "Scale Score" on the student's answer sheet.

Schools are not permitted to rescore any of the open-ended questions on this exam after each question has been rated once, regardless of the final exam score. Schools are required to ensure that the raw scores have been added correctly and that the resulting scale score has been determined accurately.

Because scale scores corresponding to raw scores in the conversion chart change from one administration to another, it is crucial that for each administration the conversion chart provided for that administration be used to determine the student's final score. The chart above is usable only for this administration of the Regents Examination in Algebra II.