

ALGEBRA  
**II**

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

# ALGEBRA II

Wednesday, January 24, 2018 — 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 operator of the local mall wants to find out how many of the mall's employees make purchases in the food court when they are working. She hopes to use these data to increase the rent and attract new food vendors. In total, there are 1023 employees who work at the mall. The best method to obtain a random sample of the employees would be to survey

- (1) all 170 employees at each of the larger stores
- (2) 50% of the 90 employees of the food court
- (3) every employee
- (4) every 30th employee entering each mall entrance for one week

2 What is the solution set for  $x$  in the equation below?

$$\sqrt{x+1} - 1 = x$$

- (1) {1}
- (2) {0}
- (3) {-1,0}
- (4) {0,1}

3 For the system shown below, what is the value of  $z$ ?

$$\begin{aligned}y &= -2x + 14 \\3x - 4z &= 2 \\3x - y &= 16\end{aligned}$$

- (1) 5
- (2) 2
- (3) 6
- (4) 4

**Use this space for  
computations.**

**4** The hours of daylight,  $y$ , in Utica in days,  $x$ , from January 1, 2013 can be modeled by the equation  $y = 3.06\sin(0.017x - 1.40) + 12.23$ . How many hours of daylight, to the *nearest tenth*, does this model predict for February 14, 2013?

- (1) 9.4                                      (3) 12.1  
(2) 10.4                                      (4) 12.2

**5** A certain pain reliever is taken in 220 mg dosages and has a half-life of 12 hours. The function  $A = 220\left(\frac{1}{2}\right)^{\frac{t}{12}}$  can be used to model this situation, where  $A$  is the amount of pain reliever in milligrams remaining in the body after  $t$  hours.

According to this function, which statement is true?

- (1) Every hour, the amount of pain reliever remaining is cut in half.  
(2) In 12 hours, there is no pain reliever remaining in the body.  
(3) In 24 hours, there is no pain reliever remaining in the body.  
(4) In 12 hours, 110 mg of pain reliever is remaining.

**6** The expression  $(x + a)(x + b)$  can *not* be written as

- (1)  $a(x + b) + x(x + b)$                       (3)  $x^2 + (a + b)x + ab$   
(2)  $x^2 + abx + ab$                               (4)  $x(x + a) + b(x + a)$

**7** There are 440 students at Thomas Paine High School enrolled in U.S. History. On the April report card, the students' grades are approximately normally distributed with a mean of 79 and a standard deviation of 7. Students who earn a grade less than or equal to 64.9 must attend summer school. The number of students who must attend summer school for U.S. History is closest to

- (1) 3    (3) 10  
(2) 5    (4) 22

**Use this space for  
computations.**

**8** For a given time,  $x$ , in seconds, an electric current,  $y$ , can be represented by  $y = 2.5(1 - 2.7^{-.10x})$ . Which equation is *not* equivalent?

(1)  $y = 2.5 - 2.5(2.7^{-.10x})$

(2)  $y = 2.5 - 2.5((2.7^2)^{-.05x})$

(3)  $y = 2.5 - 2.5\left(\frac{1}{2.7^{.10x}}\right)$

(4)  $y = 2.5 - 2.5(2.7^{-2})(2.7^{.05x})$

**9** What is the quotient when  $10x^3 - 3x^2 - 7x + 3$  is divided by  $2x - 1$ ?

(1)  $5x^2 + x + 3$

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

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

(4)  $5x^2 + x - 3$

**10** Judith puts \$5000 into an investment account with interest compounded continuously. Which approximate annual rate is needed for the account to grow to \$9110 after 30 years?

(1) 2%

(3) 0.02%

(2) 2.2%

(4) 0.022%

**11** If  $n = \sqrt{a^5}$  and  $m = a$ , where  $a > 0$ , an expression for  $\frac{n}{m}$  could be

(1)  $a^{\frac{5}{2}}$

(3)  $\sqrt[3]{a^2}$

(2)  $a^4$

(4)  $\sqrt{a^3}$

Use this space for  
computations.

12 The solutions to  $x + 3 - \frac{4}{x-1} = 5$  are

- (1)  $\frac{3}{2} \pm \frac{\sqrt{17}}{2}$                       (3)  $\frac{3}{2} \pm \frac{\sqrt{33}}{2}$   
(2)  $\frac{3}{2} \pm \frac{\sqrt{17}}{2}i$                       (4)  $\frac{3}{2} \pm \frac{\sqrt{33}}{2}i$

13 If  $ae^{bt} = c$ , where  $a$ ,  $b$ , and  $c$  are positive, then  $t$  equals

- (1)  $\ln\left(\frac{c}{ab}\right)$                       (3)  $\frac{\ln\left(\frac{c}{a}\right)}{b}$   
(2)  $\ln\left(\frac{cb}{a}\right)$                       (4)  $\frac{\ln\left(\frac{c}{a}\right)}{\ln b}$

14 For which values of  $x$ , rounded to the *nearest hundredth*, will  $|x^2 - 9| - 3 = \log_3 x$ ?

- (1) 2.29 and 3.63                      (3) 2.84 and 3.17  
(2) 2.37 and 3.54                      (4) 2.92 and 3.06

15 The terminal side of  $\theta$ , an angle in standard position, intersects the unit circle at  $P\left(-\frac{1}{3}, -\frac{\sqrt{8}}{3}\right)$ . What is the value of  $\sec \theta$ ?

- (1)  $-3$                                       (3)  $-\frac{1}{3}$   
(2)  $-\frac{3\sqrt{8}}{8}$                                   (4)  $-\frac{\sqrt{8}}{3}$

16 What is the equation of the directrix for the parabola  $-8(y - 3) = (x + 4)^2$ ?

- (1)  $y = 5$                                   (3)  $y = -2$   
(2)  $y = 1$                                   (4)  $y = -6$

**Use this space for computations.**

- 17** The function below models the average price of gas in a small town since January 1st.

$$G(t) = -0.0049t^4 + 0.0923t^3 - 0.56t^2 + 1.166t + 3.23,$$

where  $0 \leq t \leq 10$ .

If  $G(t)$  is the average price of gas in dollars and  $t$  represents the number of months since January 1st, the absolute maximum  $G(t)$  reaches over the given domain is about

- (1) \$1.60                                      (3) \$4.01  
(2) \$3.92                                      (4) \$7.73

- 18** Written in simplest form,  $\frac{c^2 - d^2}{d^2 + cd - 2c^2}$  where  $c \neq d$ , is equivalent to

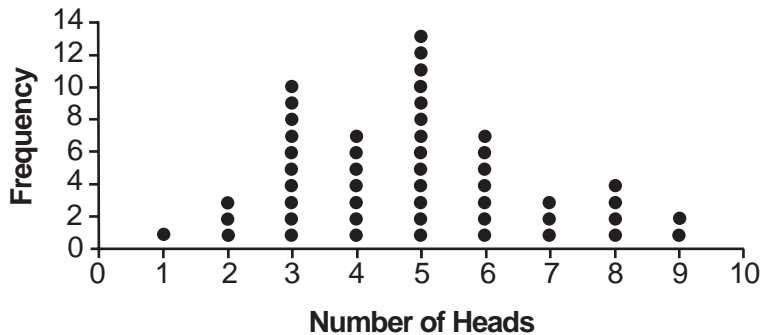
- (1)  $\frac{c + d}{d + 2c}$                                       (3)  $\frac{-c - d}{d + 2c}$   
(2)  $\frac{c - d}{d + 2c}$                                       (4)  $\frac{-c + d}{d + 2c}$

- 19** If  $p(x) = 2x^3 - 3x + 5$ , what is the remainder of  $p(x) \div (x - 5)$ ?

- (1) -230                                      (3) 40  
(2) 0    (4) 240

Use this space for computations.

- 20 The results of simulating tossing a coin 10 times, recording the number of heads, and repeating this 50 times are shown in the graph below.



Based on the results of the simulation, which statement is *false*?

- (1) Five heads occurred most often, which is consistent with the theoretical probability of obtaining a heads.
  - (2) Eight heads is unusual, as it falls outside the middle 95% of the data.
  - (3) Obtaining three heads or fewer occurred 28% of the time.
  - (4) Seven heads is not unusual, as it falls within the middle 95% of the data.
- 21 What is the inverse of  $f(x) = -6(x - 2)$ ?

(1)  $f^{-1}(x) = -2 - \frac{x}{6}$

(2)  $f^{-1}(x) = 2 - \frac{x}{6}$

(3)  $f^{-1}(x) = \frac{1}{-6(x - 2)}$

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

**Use this space for  
computations.**

**22** Brian deposited 1 cent into an empty non-interest bearing bank account on the first day of the month. He then additionally deposited 3 cents on the second day, 9 cents on the third day, and 27 cents on the fourth day. What would be the total amount of money in the account at the end of the 20th day if the pattern continued?

- (1) \$11,622,614.67                      (3) \$116,226,146.80  
(2) \$17,433,922.00                      (4) \$1,743,392,200.00

**23** If the function  $g(x) = ab^x$  represents exponential growth, which statement about  $g(x)$  is *false*?

- (1)  $a > 0$  and  $b > 1$                       (3) The asymptote is  $y = 0$ .  
(2) The  $y$ -intercept is  $(0, a)$ .                      (4) The  $x$ -intercept is  $(b, 0)$ .

**24** At her job, Pat earns \$25,000 the first year and receives a raise of \$1000 each year. The explicit formula for the  $n$ th term of this sequence is  $a_n = 25,000 + (n - 1)1000$ . Which rule best represents the equivalent recursive formula?

- (1)  $a_n = 24,000 + 1000n$                       (3)  $a_1 = 25,000, a_n = a_{n-1} + 1000$   
(2)  $a_n = 25,000 + 1000n$                       (4)  $a_1 = 25,000, a_n = a_{n+1} + 1000$
-



## 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 Elizabeth tried to find the product of  $(2 + 4i)$  and  $(3 - i)$ , and her work is shown below.

$$\begin{aligned}(2 + 4i)(3 - i) \\ &= 6 - 2i + 12i - 4i^2 \\ &= 6 + 10i - 4i^2 \\ &= 6 + 10i - 4(1) \\ &= 6 + 10i - 4 \\ &= 2 + 10i\end{aligned}$$

Identify the error in the process shown and determine the correct product of  $(2 + 4i)$  and  $(3 - i)$ .

**26** A runner is using a nine-week training app to prepare for a “fun run.” The table below represents the amount of the program completed,  $A$ , and the distance covered in a session,  $D$ , in miles.

<b>A</b>	$\frac{4}{9}$	$\frac{5}{9}$	$\frac{6}{9}$	$\frac{8}{9}$	1
<b>D</b>	2	2	2.25	3	3.25

Based on these data, write an exponential regression equation, rounded to the *nearest thousandth*, to model the distance the runner is able to complete in a session as she continues through the nine-week program.

**27** A formula for work problems involving two people is shown below.

$$\frac{1}{t_1} + \frac{1}{t_2} = \frac{1}{t_b}$$

$t_1$  = the time taken by the first person to complete the job

$t_2$  = the time taken by the second person to complete the job

$t_b$  = the time it takes for them working together to complete the job

Fred and Barney are carpenters who build the same model desk. It takes Fred eight hours to build the desk while it only takes Barney six hours. Write an equation that can be used to find the time it would take both carpenters working together to build a desk.

Determine, to the *nearest tenth of an hour*, how long it would take Fred and Barney working together to build a desk.

**28** Completely factor the following expression:

$$x^2 + 3xy + 3x^3 + y$$

**29** Researchers in a local area found that the population of rabbits with an initial population of 20 grew continuously at the rate of 5% per month. The fox population had an initial value of 30 and grew continuously at the rate of 3% per month.

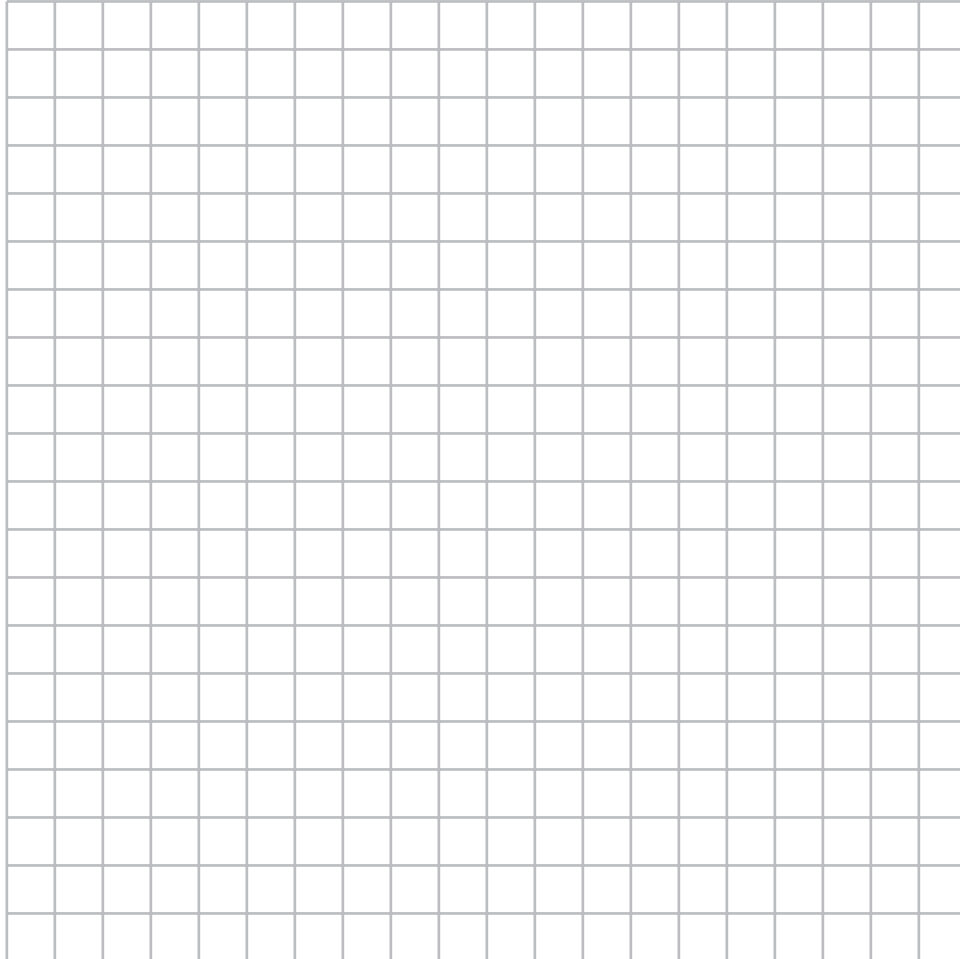
Find, to the *nearest tenth of a month*, how long it takes for these populations to be equal.

**30** Consider the function  $h(x) = 2\sin(3x) + 1$  and the function  $q$  represented in the table below.

$x$	$q(x)$
-2	-8
-1	0
0	0
1	-2
2	0

Determine which function has the *smaller* minimum value for the domain  $[-2,2]$ . Justify your answer.

**31** The zeros of a quartic polynomial function  $h$  are  $-1$ ,  $\pm 2$ , and  $3$ .  
Sketch a graph of  $y = h(x)$  on the grid below.



32 Explain why  $81^{\frac{3}{4}}$  equals 27.

### 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 Given:  $f(x) = 2x^2 + x - 3$  and  $g(x) = x - 1$

Express  $f(x) \cdot g(x) - [f(x) + g(x)]$  as a polynomial in standard form.



**34** A student is chosen at random from the student body at a given high school. The probability that the student selects Math as the favorite subject is  $\frac{1}{4}$ . The probability that the student chosen is a junior is  $\frac{116}{459}$ . If the probability that the student selected is a junior or that the student chooses Math as the favorite subject is  $\frac{47}{108}$ , what is the exact probability that the student selected is a junior whose favorite subject is Math?

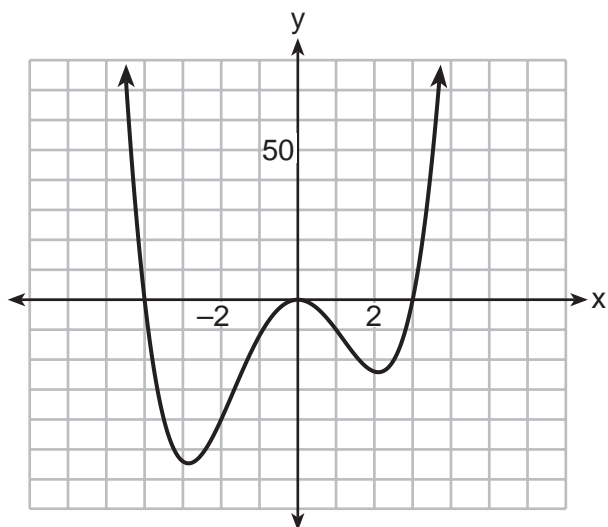
Are the events “the student is a junior” and “the student’s favorite subject is Math” independent of each other? Explain your answer.

**35** In a random sample of 250 men in the United States, age 21 or older, 139 are married. The graph below simulated samples of 250 men, 200 times, assuming that 139 of the men are married.



- a) Based on the simulation, create an interval in which the middle 95% of the number of married men may fall. Round your answer to the *nearest integer*.
  
- b) A study claims “50 percent of men 21 and older in the United States are married.” Do your results from part *a* contradict this claim? Explain.

36 The graph of  $y = f(x)$  is shown below. The function has a leading coefficient of 1.



Write an equation for  $f(x)$ .

The function  $g$  is formed by translating function  $f$  left 2 units. Write an equation for  $g(x)$ .

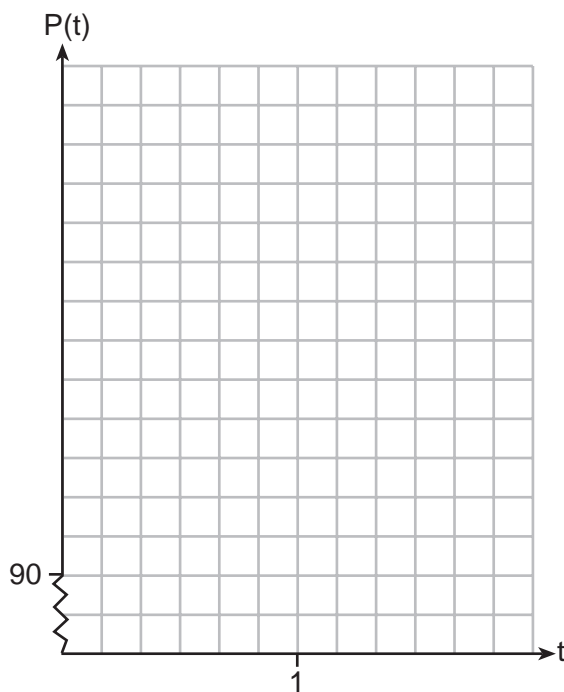
Part IV

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. 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 The resting blood pressure of an adult patient can be modeled by the function  $P$  below, where  $P(t)$  is the pressure in millimeters of mercury after time  $t$  in seconds.

$$P(t) = 24\cos(3\pi t) + 120$$

On the set of axes below, graph  $y = P(t)$  over the domain  $0 \leq t \leq 2$ .



Question 37 is continued on the next page.

**Question 37 continued.**

Determine the period of  $P$ . Explain what this value represents in the given context.

Normal resting blood pressure for an adult is 120 over 80. This means that the blood pressure oscillates between a maximum of 120 and a minimum of 80. Adults with high blood pressure (above 140 over 90) and adults with low blood pressure (below 90 over 60) may be at risk for health disorders. Classify the given patient's blood pressure as low, normal, or high and explain your reasoning.

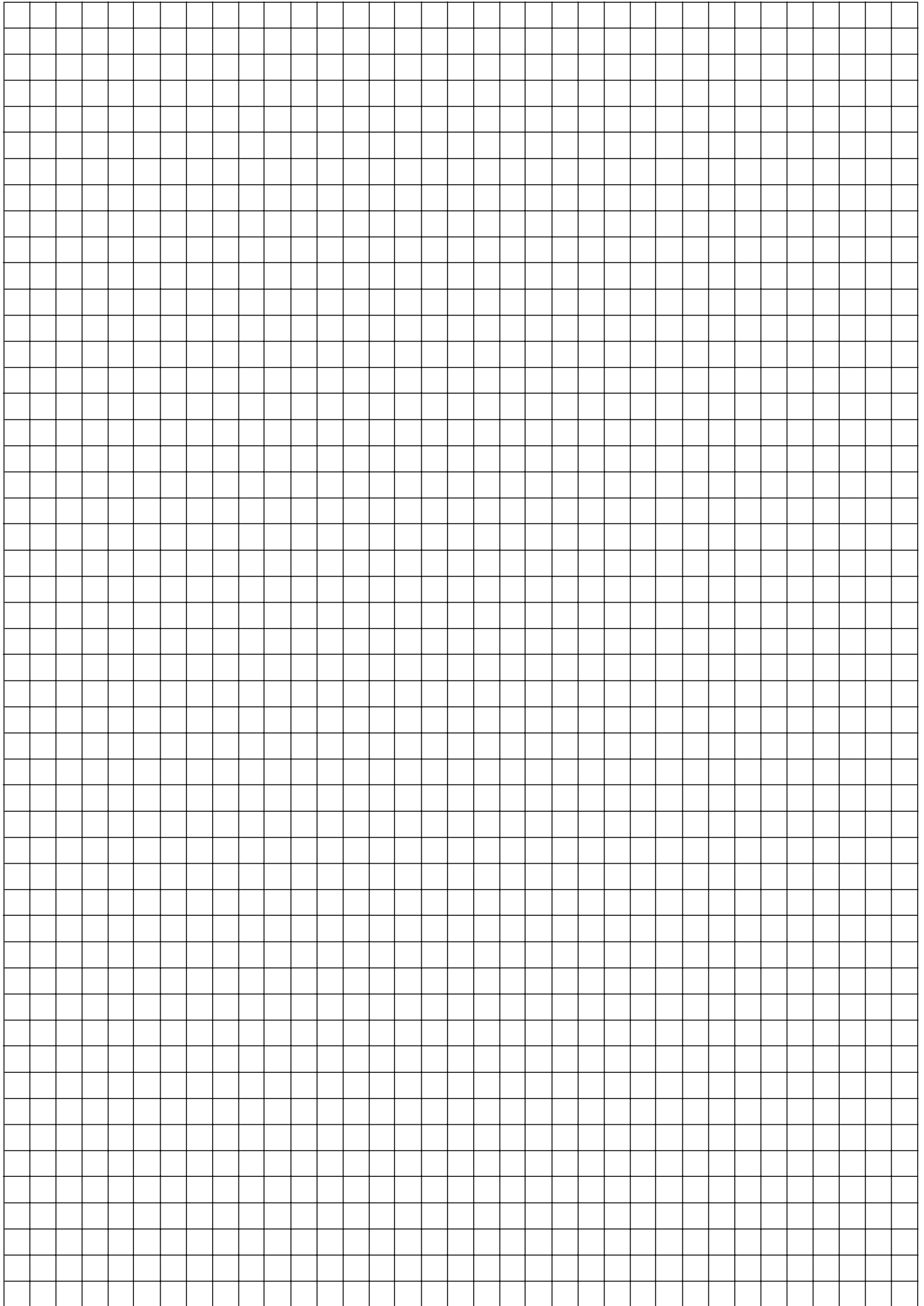








**Scrap Graph Paper — This sheet will *not* be scored.**



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Scrap Graph Paper — This sheet will *not* be scored.



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

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# FOR TEACHERS ONLY

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

## ALGEBRA II

Wednesday, January 24, 2018 — 1:15 to 4:15 p.m., only

### SCORING KEY AND 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 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.**

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 Wednesday, January 24, 2018. 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.

If the student’s responses for the multiple-choice questions are being hand scored prior to being scanned, the scorer must be careful not to make any marks on the answer sheet except to record the scores in the designated score boxes. Marks elsewhere on the answer sheet will interfere with the accuracy of the scanning.

### Part I

Allow a total of 48 credits, 2 credits for each of the following.

(1)..... 4 .....	(9)..... 4 .....	(17)..... 3 .....
(2)..... 3 .....	(10)..... 1 .....	(18)..... 3 .....
(3)..... 4 .....	(11)..... 4 .....	(19)..... 4 .....
(4)..... 2 .....	(12)..... 1 .....	(20)..... 2 .....
(5)..... 4 .....	(13)..... 3 .....	(21)..... 2 .....
(6)..... 2 .....	(14)..... 1 .....	(22)..... 2 .....
(7)..... 3 .....	(15)..... 1 .....	(23)..... 4 .....
(8)..... 4 .....	(16)..... 1 .....	(24)..... 3 .....

Updated information regarding the rating of this examination may be posted on the New York State Education Department’s web site during the rating period. Check this web site at: <http://www.p12.nysed.gov/assessment/> and select the link “Scoring Information” for any recently posted information regarding this examination. This site should be checked before the rating process for this examination begins and several times throughout the Regents Examination period.

The Department is providing supplemental scoring guidance, the “Model Response Set,” for the Regents Examination in Algebra II. This guidance is recommended to be part of the scorer training. Schools are encouraged to incorporate the Model Response Sets into the scorer training or to use them as additional information during scoring. While not reflective of all scenarios, the model responses selected for the Model Response Set illustrate how less common student responses to constructed-response questions may be scored. The Model Response Set will be available on the Department’s web site at <http://www.nysedregents.org/algebratwo/>.

# 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] The error is identified and  $10 + 10i$  or an equivalent expression is written.

[1] One computational error is made.

*or*

[1] One conceptual error is made.

*or*

[1] Either the error is identified or  $10 + 10i$  is written.

[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]  $D = 1.223(2.652)^A$  or equivalent.

[1] One computational or rounding error is made.

*or*

[1] One conceptual error is made.

*or*

[1] The expression  $1.223(2.652)^A$  or equivalent is written.

[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]  $\frac{1}{8} + \frac{1}{6} = \frac{1}{t_b}$ , 3.4, and correct work is shown.
- [1] Appropriate work is shown, but one computational or rounding error is made.
- or**
- [1] Appropriate work is shown, but one conceptual error is made.
- or**
- [1]  $\frac{1}{8} + \frac{1}{6} = \frac{1}{t_b}$  is written, but no further correct work is shown.
- or**
- [1] 3.4, 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.
- (28) [2]  $(x^2 + y)(3x + 1)$  and correct work is shown.
- [1] Appropriate work is shown, but one computational or factoring error is made.
- or**
- [1] Appropriate work is shown, but one conceptual error is made.
- or**
- [1]  $(x^2 + y)(3x + 1)$ , 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.
- (29) [2] 20.3, 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] 20.3, 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]  $q$ , 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]  $q$ , but an incorrect justification is given.  
[0]  $q$ , 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.
- (31) [2] A correct sketch is drawn of a polynomial that has all four zeros represented.  
[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.
- (32) [2] A correct explanation is written.  
[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 explanation is written.  
[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]  $2x^3 - 3x^2 - 6x + 7$ , and correct work is shown.

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

*or*

[3]  $f(x) \cdot g(x) = 2x^3 - x^2 - 4x + 3$  and  $f(x) + g(x) = 2x^2 + 2x - 4$  are found, but no further correct work is shown.

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

*or*

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

*or*

[2] Appropriate work is shown to find either  $f(x) \cdot g(x) = 2x^3 - x^2 - 4x + 3$  or  $f(x) + g(x) = 2x^2 + 2x - 4$ , but no further correct work is shown.

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

*or*

[1]  $2x^3 - 3x^2 - 6x + 7$ , 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.

- (34) [4]  $\frac{31}{459}$  and correct work is shown, no, and a correct reason, such as the  $P(Jr) \times P(\text{favorite subject is Math})$  does not equal  $P(\text{junior and favorite subject is Math})$ , is written.
- [3] Appropriate work is shown, but one computational error is made.
- or**
- [3] Appropriate work is shown, but the explanation is incomplete.
- or**
- [3] Appropriate work is shown, but the answer is expressed as a decimal.
- [2] Appropriate work is shown, but two or more computational errors are made.
- or**
- [2] Appropriate work is shown, but one conceptual error is made.
- or**
- [2] Appropriate work is shown to find  $\frac{31}{459}$ , but no further correct work is shown.
- [1] Appropriate work is shown, but one conceptual error and one computational error are made.
- or**
- [1]  $\frac{31}{459}$ , 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.

- (35) [4] A correct interval is stated such as (123,155), no and a correct explanation is written.
- [3] Appropriate work is shown, but one computational or rounding error is made.
- or***
- [3] Appropriate work is shown, but the explanation is incomplete or incorrect.
- [2] Appropriate work is shown, but two or more computational or rounding errors are made.
- or***
- [2] Appropriate work is shown, but one conceptual error is made.
- or***
- [2] (123, 155), but no further correct work is shown.
- [1] Appropriate work is shown, but one conceptual error and one computational or rounding error are made.
- [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.

(36) [4]  $f(x) = x^2(x + 4)(x - 3)$  or equivalent, and  $g(x) = (x + 2)^2(x + 6)(x - 1)$  is written.

[3] One computational or notation error is made.

**or**

[3]  $f(x) = x^2(x + 4)(x - 3)$  is written, but no further correct work is shown.

[2] Two or more computational errors are made.

**or**

[2] One conceptual error is made.

[1] One conceptual error and one computational error are made.

**or**

[1]  $g(x) = (x + 2)^2(x + 6)(x - 1)$  is written, 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.

---

## 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] A correct graph is drawn,  $\frac{2}{3}$  and a correct explanation is written, and high and a correct explanation is written.
- [5] Appropriate work is shown, but one computational or graphing error is made.
- [4] Appropriate work is shown, but one conceptual error is made.
- or*
- [4] Appropriate work is shown, but two or more computational errors are made.
- or*
- [3] Appropriate work is shown, but one conceptual error and one computational or graphing error are made.
- [2] Appropriate work is shown, but one conceptual error and two or more computational or graphing errors are made.
- or*
- [2] Appropriate work is shown, but two conceptual errors are made.
- or*
- [2] A correct graph is drawn, but no further correct work is shown.
- or*
- [2]  $\frac{2}{3}$  and a correct explanation is written, but no further correct work is shown.
- or*
- [2] High and a correct explanation is written, but no further correct work is shown.
- [1] Appropriate work is shown, but two conceptual errors and one computational or graphing error are made.
- or*
- [1]  $\frac{2}{3}$ , but no further correct work is shown.
- or*
- [1] High, but the explanation is incomplete.
- [0] High, 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 2018**

<b>Question</b>	<b>Type</b>	<b>Credits</b>	<b>Cluster</b>
1	Multiple Choice	2	S-IC.A
2	Multiple Choice	2	A-REI.A
3	Multiple Choice	2	A-REI.C
4	Multiple Choice	2	N-Q.A
5	Multiple Choice	2	F-LE.B
6	Multiple Choice	2	A-APR.C
7	Multiple Choice	2	S-ID.A
8	Multiple Choice	2	A-SSE.B
9	Multiple Choice	2	A-APR.D
10	Multiple Choice	2	A-CED.A
11	Multiple Choice	2	N-RN.A
12	Multiple Choice	2	A-REI.A
13	Multiple Choice	2	F-LE.A
14	Multiple Choice	2	A-REI.D
15	Multiple Choice	2	F-TF.A
16	Multiple Choice	2	G-GPE.A
17	Multiple Choice	2	F-IF.B
18	Multiple Choice	2	A-SSE.A
19	Multiple Choice	2	A-APR.B
20	Multiple Choice	2	S-IC.A



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

**Regents Examination in Algebra II**  
**January 2018**  
**Chart for Converting Total Test Raw Scores to**  
**Final Examination Scores (Scale Scores)**

**The *Chart for Determining the Final Examination Score for the January 2018 Regents Examination in Algebra II* will be posted on the Department's web site at: <http://www.p12.nysed.gov/assessment/> by Wednesday, January 24, 2018. 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

Wednesday, January 24, 2018 — 1:15 to 4:15 p.m., only

## MODEL RESPONSE SET

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**Question 25**

25 Elizabeth tried to find the product of  $(2 + 4i)$  and  $(3 - i)$ , and her work is shown below.

$$\begin{aligned}(2 + 4i)(3 - i) &= 6 - 2i + 12i - 4i^2 \\ &= 6 + 10i - 4i^2 \\ &= 6 + 10i - 4(1) \\ &= 6 + 10i - 4 \\ &= 2 + 10i\end{aligned}$$

Identify the error in the process shown and determine the correct product of  $(2 + 4i)$  and  $(3 - i)$ .

$$\begin{aligned}i^2 &= -1 \\ &\text{not } 1, \\ &= 6 - 2i + 12i - 4i^2 \\ &= 6 + 10i - 4(-1) \\ &= 6 + 10i + 4 \\ &= 10 + 10i\end{aligned}$$

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

---

**Question 25**

---

**25** Elizabeth tried to find the product of  $(2 + 4i)$  and  $(3 - i)$ , and her work is shown below.

$$\begin{aligned}(2 + 4i)(3 - i) &= 6 - 2i + 12i - 4i^2 \\ &= 6 + 10i - 4i^2 \\ &= 6 + 10i - 4(1) \\ &= 6 + 10i - 4 \\ &= 2 + 10i\end{aligned}$$

Identify the error in the process shown and determine the correct product of  $(2 + 4i)$  and  $(3 - i)$ .

ELIZABETH SUBSTITUTED 1 RATHER THAN  $-1$  FOR  $i^2$

$$6 + 10i - 4(-1)$$

$$6 + 10i + 4$$

---

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

---

**Question 25**

---

**25** Elizabeth tried to find the product of  $(2 + 4i)$  and  $(3 - i)$ , and her work is shown below.

$$\begin{aligned}(2 + 4i)(3 - i) \\ &= 6 - 2i + 12i - 4i^2 \\ &= 6 + 10i - 4i^2 \\ &= 6 + 10i - 4\textcircled{1} \\ &= 6 + 10i - 4 \\ &= 2 + 10i\end{aligned}$$

Identify the error in the process shown and determine the correct product of  $(2 + 4i)$  and  $(3 - i)$ .

$$10 + 10i$$

---

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

**Question 25**

**25** Elizabeth tried to find the product of  $(2 + 4i)$  and  $(3 - i)$ , and her work is shown below.

$$\begin{aligned}(2 + 4i)(3 - i) \\ &= 6 - 2i + 12i - 4i^2 \\ &= 6 + 10i - 4i^2 \\ &= 6 + 10i - 4(1) \\ &= 6 + 10i - 4 \\ &= 2 + 10i\end{aligned}$$

Identify the error in the process shown and determine the correct product of  $(2 + 4i)$  and  $(3 - i)$ .

$$4i^2 = 4$$

$$6 + 10i + 4 = 10 + 10i$$

$$\boxed{1 + i}$$

**Score 1:** The student made an error by dividing the complex number by 10.

## Question 25

25 Elizabeth tried to find the product of  $(2 + 4i)$  and  $(3 - i)$ , and her work is shown below.

$$\begin{aligned}(2 + 4i)(3 - i) &= 6 - 2i + 12i - 4i^2 \\ &= 6 + 10i - 4i^2 \\ &= 6 + 10i - 4(1) \\ &= 6 + 10i - 4 \\ &= 2 + 10i\end{aligned}$$

Identify the error in the process shown and determine the correct product of  $(2 + 4i)$  and  $(3 - i)$ .

The error in this process is that  $i^2$  does not equal 1, it equals 0. The correct product is  $6 + 10i$ .

$$\begin{aligned}&= 6 + 10i - 4(0) \\ &= 6 + 10i + 0 \\ &= 6 + 10i\end{aligned}$$

**Score 1:** The student used 0 for  $i^2$ .



---

**Question 25**

---

**25** Elizabeth tried to find the product of  $(2 + 4i)$  and  $(3 - i)$ , and her work is shown below.

$$\begin{aligned}(2 + 4i)(3 - i) & \\ &= 6 - 2i + 12i - 4i^2 \\ &= 6 + 10i - 4i^2 \\ &= 6 + 10i - 4(1) \\ &= 6 + 10i - 4 \\ &= 2 + 10i\end{aligned}$$

Identify the error in the process shown and determine the correct product of  $(2 + 4i)$  and  $(3 - i)$ .

$$\begin{aligned}(4i+2) (-i+3) \\ = 4i^2 + 12i - 2i + 6 \\ = 4i^2 + 10i + 6\end{aligned}$$

**Score 0:** The student did not identify the error or value of  $i^2$ , and did not determine the correct product.

**Question 26**

**26** A runner is using a nine-week training app to prepare for a “fun run”. The table below represents the amount of the program completed,  $A$ , and the distance covered in a session,  $D$ , in miles.

<b>A</b>	$\frac{4}{9}$	$\frac{5}{9}$	$\frac{6}{9}$	$\frac{8}{9}$	1
<b>D</b>	2	2	2.25	3	3.25

Based on these data, write an exponential regression equation, rounded to the *nearest thousandth*, to model the distance the runner is able to complete in a session as she continues through the nine-week program.

$$D = (1.223)(2.652)^A$$

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

**Question 26**

**26** A runner is using a nine-week training app to prepare for a “fun run”. The table below represents the amount of the program completed,  $A$ , and the distance covered in a session,  $D$ , in miles.

<b>A</b>	$\frac{4}{9}$	$\frac{5}{9}$	$\frac{6}{9}$	$\frac{8}{9}$	1
<b>D</b>	2	2	2.25	3	3.25

→ lists + spreadsheets  
↓  
data + statistics

Based on these data, write an exponential regression equation, rounded to the *nearest thousandth*, to model the distance the runner is able to complete in a session as she continues through the nine-week program.

$$y = 1.223(2.652)^x$$

**Score 2:** The student gave a complete and correct response. The variables  $x$  and  $y$  are accepted as the regression equation was not restricted in terms of  $A$  and  $D$ .

**Question 26**

**26** A runner is using a nine-week training app to prepare for a “fun run”. The table below represents the amount of the program completed,  $A$ , and the distance covered in a session,  $D$ , in miles.

<b>A</b>	$\frac{4}{9}$	$\frac{5}{9}$	$\frac{6}{9}$	$\frac{8}{9}$	1
<b>D</b>	2	2	2.25	3	3.25

Based on these data, write an exponential regression equation, rounded to the *nearest thousandth*, to model the distance the runner is able to complete in a session as she continues through the nine-week program.

$$y = ab^x$$

$$a = 1.223034549$$

$$b = 2.652024589$$

$$y = 1.22 * 2.65^x$$

**Score 1:** The student did not round correctly.

**Question 26**

**26** A runner is using a nine-week training app to prepare for a “fun run”. The table below represents the amount of the program completed,  $A$ , and the distance covered in a session,  $D$ , in miles.

<b>A</b>	$\frac{4}{9}$	$\frac{5}{9}$	$\frac{6}{9}$	$\frac{8}{9}$	1
<b>D</b>	2	2	2.25	3	3.25

Based on these data, write an exponential regression equation, rounded to the *nearest thousandth*, to model the distance the runner is able to complete in a session as she continues through the nine-week program.

$$1.223 (2.657)^A$$

**Score 1:** The student wrote an expression, not an equation.

**Question 26**

**26** A runner is using a nine-week training app to prepare for a “fun run”. The table below represents the amount of the program completed,  $A$ , and the distance covered in a session,  $D$ , in miles.

<b>A</b>	$\frac{4}{9}$	$\frac{5}{9}$	$\frac{6}{9}$	$\frac{8}{9}$	1
<b>D</b>	2	2	2.25	3	3.25

Based on these data, write an exponential regression equation, rounded to the *nearest thousandth*, to model the distance the runner is able to complete in a session as she continues through the nine-week program.

$y =$

$$D = 2.991A^2 - 1.866A + 2.188$$

**Score 1:** The student used an incorrect regression model, but rounded correctly.

**Question 26**

**26** A runner is using a nine-week training app to prepare for a “fun run”. The table below represents the amount of the program completed,  $A$ , and the distance covered in a session,  $D$ , in miles.

<b>A</b>	$\frac{4}{9}$	$\frac{5}{9}$	$\frac{6}{9}$	$\frac{8}{9}$	1
<b>D</b>	2	2	2.25	3	3.25

Based on these data, write an exponential regression equation, rounded to the *nearest thousandth*, to model the distance the runner is able to complete in a session as she continues through the nine-week program.

$$A = A_0 e^{k(t-t_0)} + B_0$$
$$A = \frac{4}{9} e^{(9)} + 2$$

**Score 0:** The student gave a completely incorrect response.

**Question 27**

27 A formula for work problems involving two people is shown below.

$$\frac{1}{t_1} + \frac{1}{t_2} = \frac{1}{t_b}$$

$t_1$  = the time taken by the first person to complete the job

$t_2$  = the time taken by the second person to complete the job

$t_b$  = the time it takes for them working together to complete the job

Fred and Barney are carpenters who build the same model desk. It takes Fred eight hours to build the desk while it only takes Barney six hours. Write an equation that can be used to find the time it would take both carpenters working together to build a desk.

$$\left| \frac{1}{8} + \frac{1}{6} = \frac{1}{X} \right|$$

Determine, to the *nearest tenth of an hour*, how long it would take Fred and Barney working together to build a desk.

~~(8)(10)(10)~~ ~~(8)(10)(X)~~ ~~(6)(10)(X)~~

$$\frac{1}{8} + \frac{1}{6} = \frac{1}{X}$$
$$6X + 8X = 48$$
$$14X = 48$$
$$\frac{14X}{14} = \frac{48}{14}$$
$$X = 3.4 \text{ hours}$$

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



**Question 27**

27 A formula for work problems involving two people is shown below.

$$\frac{1}{t_1} + \frac{1}{t_2} = \frac{1}{t_b}$$

$t_1$  = the time taken by the first person to complete the job

$t_2$  = the time taken by the second person to complete the job

$t_b$  = the time it takes for them working together to complete the job

Fred and Barney are carpenters who build the same model desk. It takes Fred eight hours to build the desk while it only takes Barney six hours. Write an equation that can be used to find the time it would take both carpenters working together to build a desk.

$$\frac{1}{8} + \frac{1}{6} = \frac{1}{t_b}$$

Determine, to the *nearest tenth of an hour*, how long it would take Fred and Barney working together to build a desk.

$$\frac{1}{8} + \frac{1}{6} = \frac{7}{24}$$

$$\frac{7}{24} = 0.3 \text{ hours}$$

**Score 1:** The student only stated a correct equation.

**Question 27**

27 A formula for work problems involving two people is shown below.

$$\frac{1}{t_1} + \frac{1}{t_2} = \frac{1}{t_b}$$

$t_1$  = the time taken by the first person to complete the job

$t_2$  = the time taken by the second person to complete the job

$t_b$  = the time it takes for them working together to complete the job

Fred and Barney are carpenters who build the same model desk. It takes Fred eight hours to build the desk while it only takes Barney six hours. Write an equation that can be used to find the time it would take both carpenters working together to build a desk.

$$\frac{1}{6} + \frac{1}{8} = \frac{7}{24}$$

Determine, to the *nearest tenth of an hour*, how long it would take Fred and Barney working together to build a desk.

2.9 hours

**Score 0:** The student did not write a correct equation to solve for  $t_b$  and showed no further correct work.

Question 28

28 Completely factor the following expression:

$$x^2 + 3xy + 3x^3 + y$$

$$\begin{aligned} & x^2 + 3xy + 3x^3 + y \\ & \overbrace{3x^3 + x^2 + 3xy + y} \checkmark \\ & (3x^3 + x^2) + (3xy + y) \\ & x^2(3x + 1) + y(3x + 1) \\ & \boxed{(x^2 + y)(3x + 1)} \end{aligned}$$

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

---

**Question 28**

---

28 Completely factor the following expression:

$$x^2 + 3xy + 3x^3 + y$$

$$\begin{aligned} & 3x^3 + x^2 + 3xy + y \\ & x^2(3x+1) + y(3x+1) \\ & \boxed{x^2 + y(3x+1)} \end{aligned}$$

**Score 1:** The student did not put parentheses around  $x^2 + y$ .

---

**Question 28**

---

28 Completely factor the following expression:

$$\begin{array}{l} x^2 + 3xy \quad \{ \quad 3x^3 + y \\ x^2 + 3x^3 \quad \{ \quad 3xy + y \end{array}$$

$x^2(1+3x) + y(3x+1)$

**Score 1:** The student did not completely factor the expression.

---

**Question 28**

---

28 Completely factor the following expression:

$$x^2 + 3xy + 3x^3 + y$$

$$\begin{aligned} & 3x^3 + x^2 + 3xy + y \\ & x^2(3x+1) + y(3x+1) \\ & (x^2 + y)(3x+1)(3x+1) \end{aligned}$$

**Score 1:** The student did not recognize  $3x + 1$  as the GCF.

Question 28

28 Completely factor the following expression:

$$x^2 + 3xy + 3x^3 + y$$

$$\begin{array}{l} \boxed{x^2 + 3xy + 3x^3 + y} \\ \boxed{x^2 + 3xy^2 + 3x + y} \\ x(x+3)y(x+3) \\ \boxed{(x+y)(x+3)} \end{array} \quad \begin{array}{c} \cancel{3} \\ \cancel{3} \quad \cancel{1} \\ \cancel{1} \end{array}$$

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

**Question 29**

29 Researchers in a local area found that the population of rabbits with an initial population of 20 grew continuously at the rate of 5% per month. The fox population had an initial value of 30 and grew continuously at the rate of 3% per month.

Find, to the *nearest tenth of a month*, how long it takes for these populations to be equal.

$$\frac{20e^{.05t}}{30} = \frac{30e^{.03t}}{30}$$

$$\frac{2}{3} \frac{e^{.05t}}{e^{.05t}} = \frac{e^{.03t}}{e^{.05t}}$$

$$\frac{2}{3} = e^{-.02t}$$

$$\frac{\ln\left(\frac{2}{3}\right)}{-0.02} = \frac{-0.02t}{-0.02}$$

$$20.27325541 = t$$

20.3 months

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



---

**Question 29**

---

**29** Researchers in a local area found that the population of rabbits with an initial population of 20 grew continuously at the rate of 5% per month. The fox population had an initial value of 30 and grew continuously at the rate of 3% per month.

Find, to the *nearest tenth of a month*, how long it takes for these populations to be equal.

$$20 e^{.05t} = 30 e^{.03t}$$

intersection: (20.273..., 55.113...)

20.3 months

---

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

**Question 29**

**29** Researchers in a local area found that the population of rabbits with an initial population of 20 grew continuously at the rate of 5% per month. The fox population had an initial value of 30 and grew continuously at the rate of 3% per month.

Find, to the *nearest tenth of a month*, how long it takes for these populations to be equal.

$$R(m) = 20e^{.5m} \quad F(m) = 30e^{.3m}$$

$$\frac{20e^{.5m}}{30} = \frac{30e^{.3m}}{30}$$

$$\ln \frac{20}{30} = e^{-.2m} \quad | \ln$$

$$-.405465 = \frac{-.2m}{-2}$$

$$m = 2.0273$$

$$m = 2.0$$

**Score 1:** The student used incorrect rates, but rounded correctly.

**Question 29**

29 Researchers in a local area found that the population of rabbits with an initial population of 20 grew continuously at the rate of 5% per month. The fox population had an initial value of 30 and grew continuously at the rate of 3% per month.

Find, to the *nearest tenth of a month*, how long it takes for these populations to be equal.

$$P = 20$$
$$r = 0.05$$

$$P = 30$$
$$r = 0.03$$

$$P(1+r)^t = P(1+r)^t$$
$$20(1+0.05)^t = 30(1+0.03)^t$$
$$20(1.05)^t = 30(1.03)^t$$
$$21^t = 30.9^t$$
$$t \log 21 = \frac{t \log 30.9}{\log 21}$$
$$t = 1.126$$

1 month

**Score 0:** The student made several errors.

**Question 30**

30 Consider the function  $h(x) = 2\sin(3x) + 1$  and the function  $q$  represented in the table below.

$x$	$q(x)$
-2	-8
-1	0
0	0
1	-2
2	0

*min*

Determine which function has the *smaller* minimum value for the domain  $[-2, 2]$ . Justify your answer.

*min of  $h(x)$  is  $-1$*

*$q$  has smaller min*

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

**Question 30**

30 Consider the function  $h(x) = 2\sin(3x) + 1$  and the function  $q$  represented in the table below.

$x$	$q(x)$
-2	-8
-1	0
0	0
1	-2
2	0

Determine which function has the *smaller* minimum value for the domain  $[-2, 2]$ . Justify your answer.

$$h(x) =$$

function  $q(x)$  has a smaller minimum because the min of  $h(x)$  is 0.4 while the min of  $q(x)$  is -8

**Score 1:** The student incorrectly identified the minimum of  $h$ .

---

**Question 30**

---

**30** Consider the function  $h(x) = 2\sin(3x) + 1$  and the function  $q$  represented in the table below.

$x$	$q(x)$
-2	-8
-1	0
0	0
1	-2
2	0

Determine which function has the *smaller* minimum value for the domain  $[-2,2]$ . Justify your answer.

*q* has a smaller minimum value because  
it goes down to -8.

**Score 1:** The student gave an incomplete justification.

**Question 30**

30 Consider the function  $h(x) = 2\sin(3x) + 1$  and the function  $q$  represented in the table below.

$x$	$q(x)$
-2	-8
-1	0
0	0
1	-2
2	0

Determine which function has the *smaller* minimum value for the domain  $[-2, 2]$ . Justify your answer.

~~$q(x)$~~

$$h(x) = 2\sin 3(-2) + 1 = \overline{0.1743} \quad 0.79$$
$$h(x) = 2\sin 3(2) + 1 = 1.209$$

$q(x)$  because  $-8$  is less than  
 ~~$0.79$~~

**Score 1:** The student made an error by using the wrong mode.

**Question 30**

**30** Consider the function  $h(x) = 2\sin(3x) + 1$  and the function  $q$  represented in the table below.

$x$	$q(x)$
-2	-8
-1	0
0	0
1	-2
2	0

$x$	$h(x)$
-2	1.96
-1	.72
0	1
1	1.29
2	.45

Determine which function has the *smaller* minimum value for the domain  $[-2, 2]$ . Justify your answer.

$h(x) = 2\sin 3x + 1$  has the smaller minimum because the amplitude is 2 & it is shifted 1 up so it can never be greater than -2 &  $q(x)$  goes down to -8.

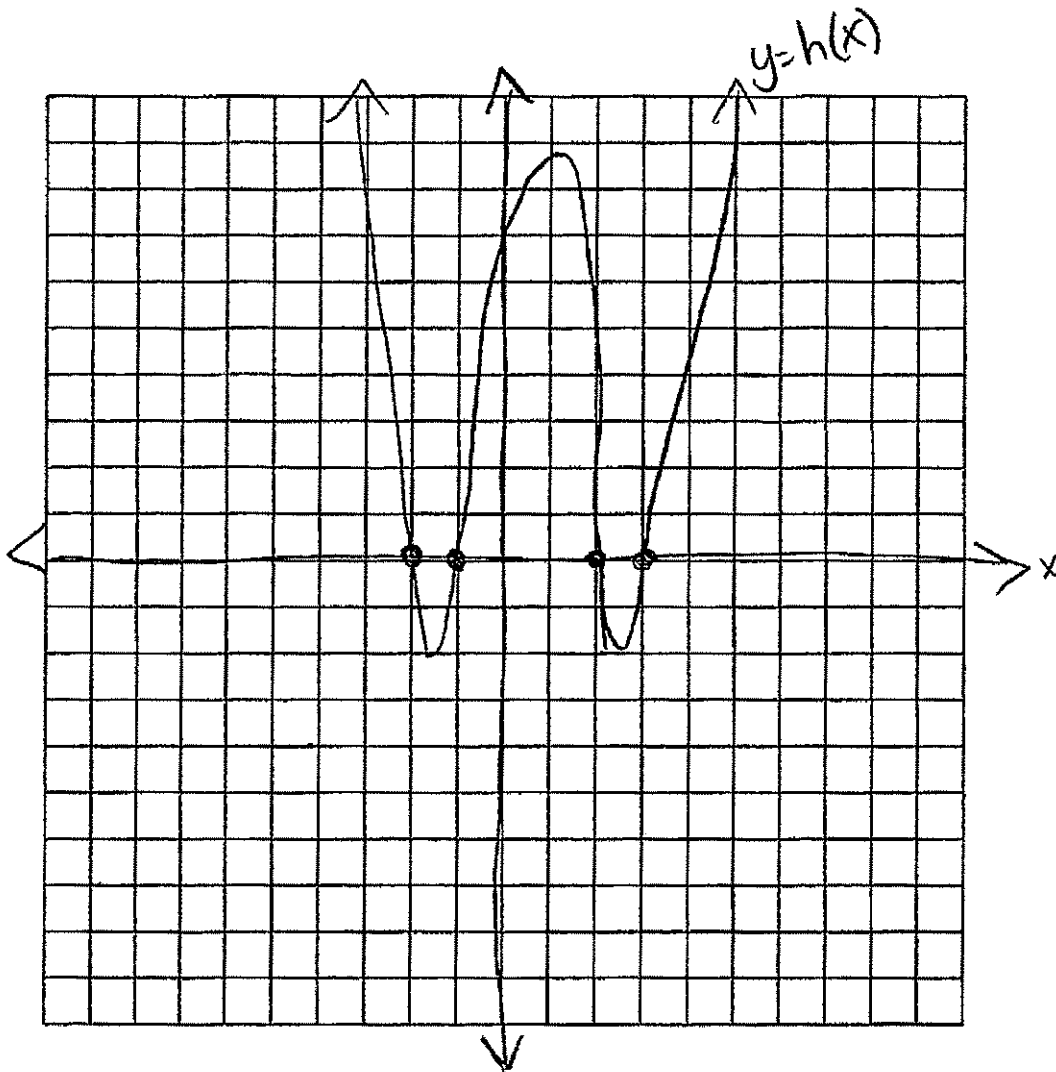
**Score 0:** The student did not show enough correct work to receive any credit.



**Question 31**

**31** The zeros of a quartic polynomial function  $h$  are  $-1, \pm 2,$  and  $3$ .

Sketch a graph of  $y = h(x)$  on the grid below.

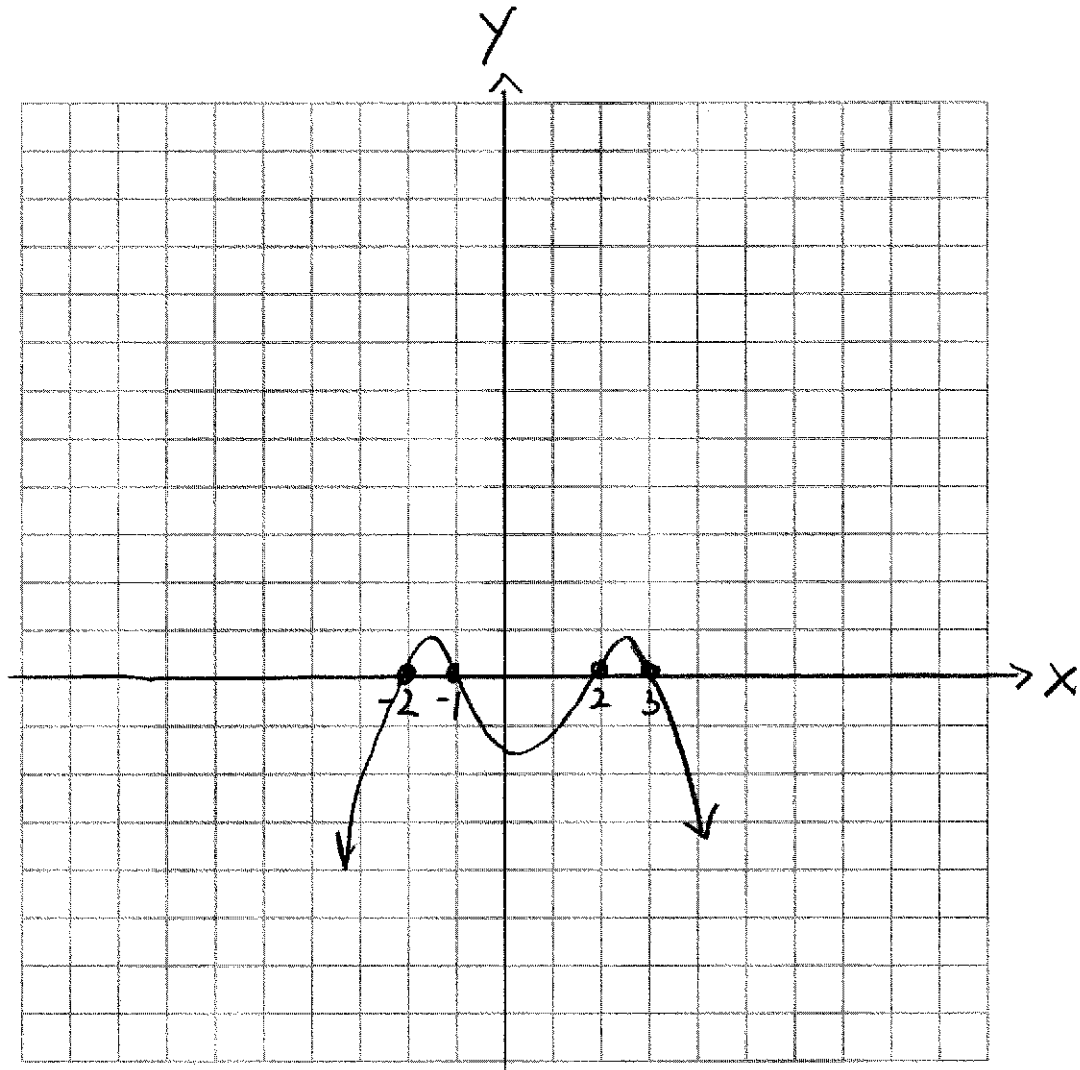


**Score 2:** The student gave a complete and correct response.

**Question 31**

**31** The zeros of a quartic polynomial function  $h$  are  $-1, \pm 2,$  and  $3$ .

Sketch a graph of  $y = h(x)$  on the grid below.

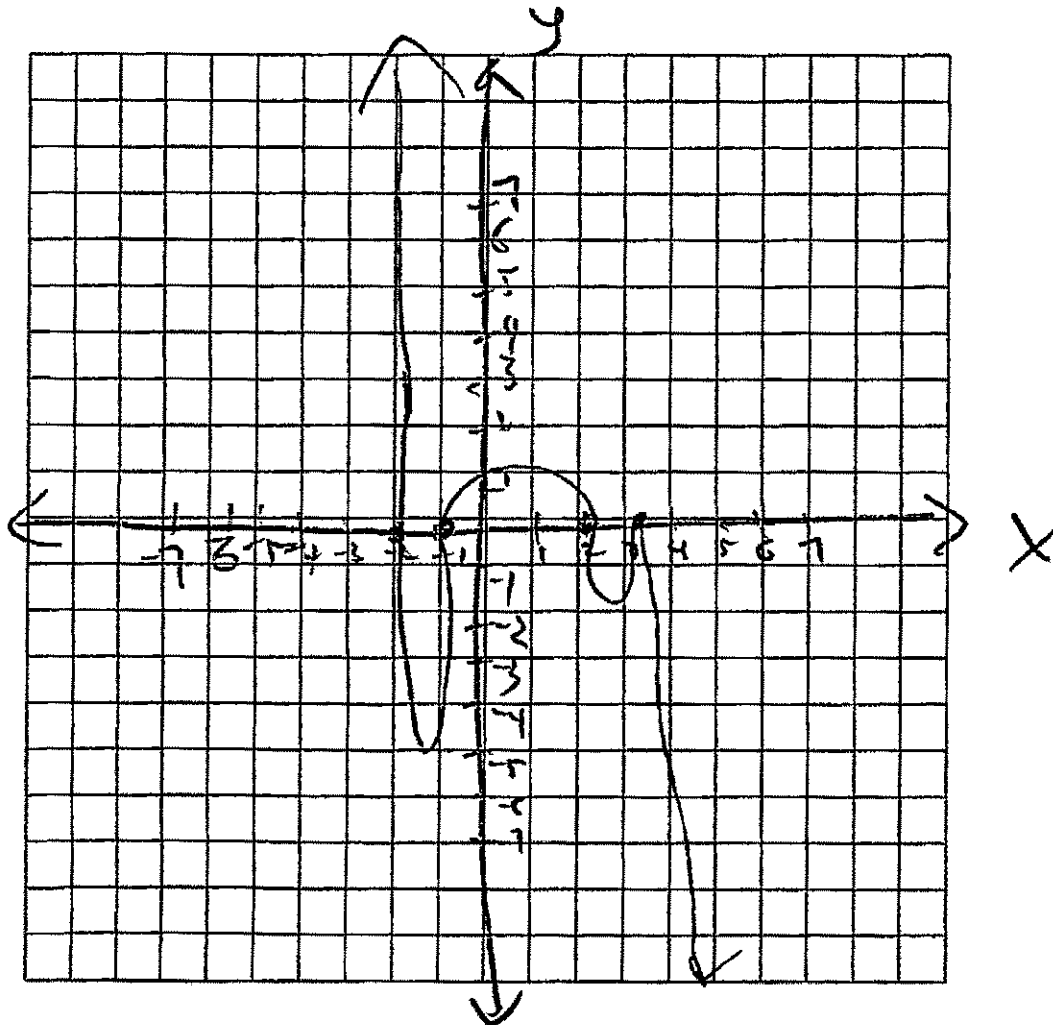


**Score 2:** The student gave a complete and correct response.

**Question 31**

**31** The zeros of a quartic polynomial function  $h$  are  $-1, \pm 2,$  and  $3$ .

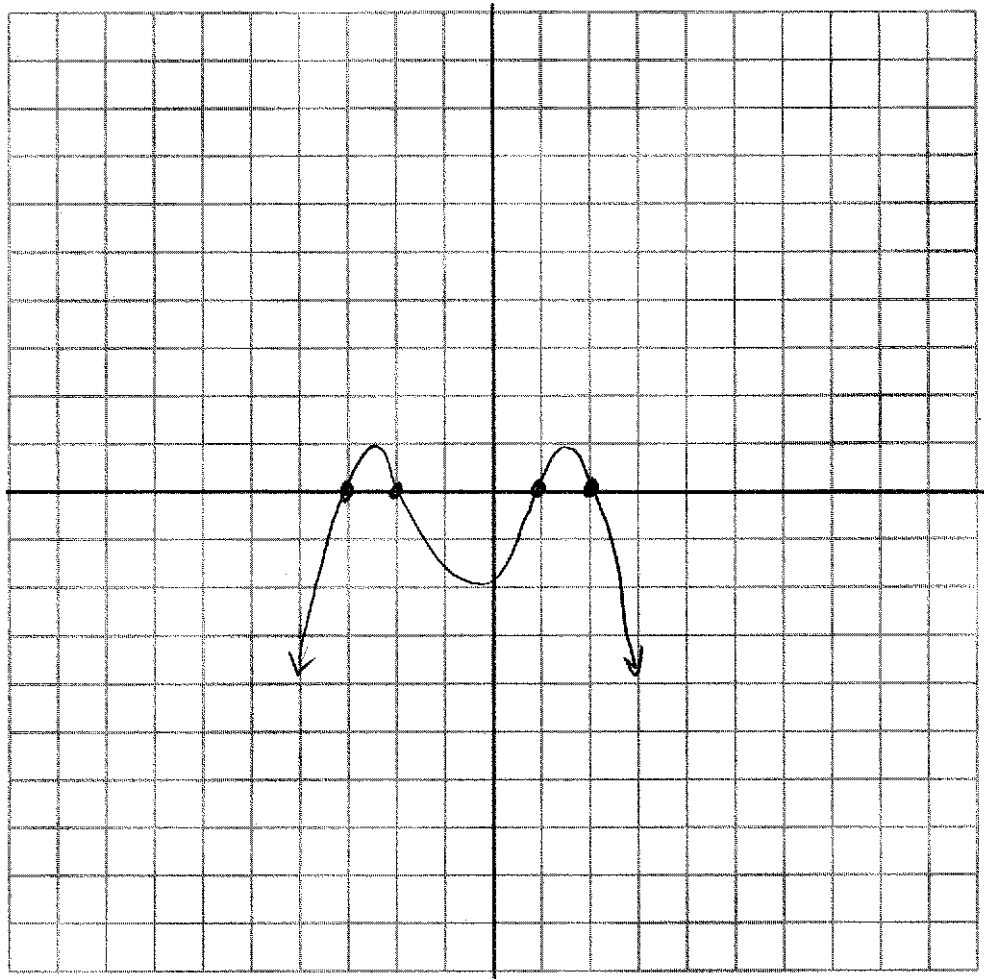
Sketch a graph of  $y = h(x)$  on the grid below.



**Score 1:** The student made one graphing error.

**Question 31**

**31** The zeros of a quartic polynomial function  $h$  are  $-1, \pm 2,$  and  $3$ .  
Sketch a graph of  $y = h(x)$  on the grid below.

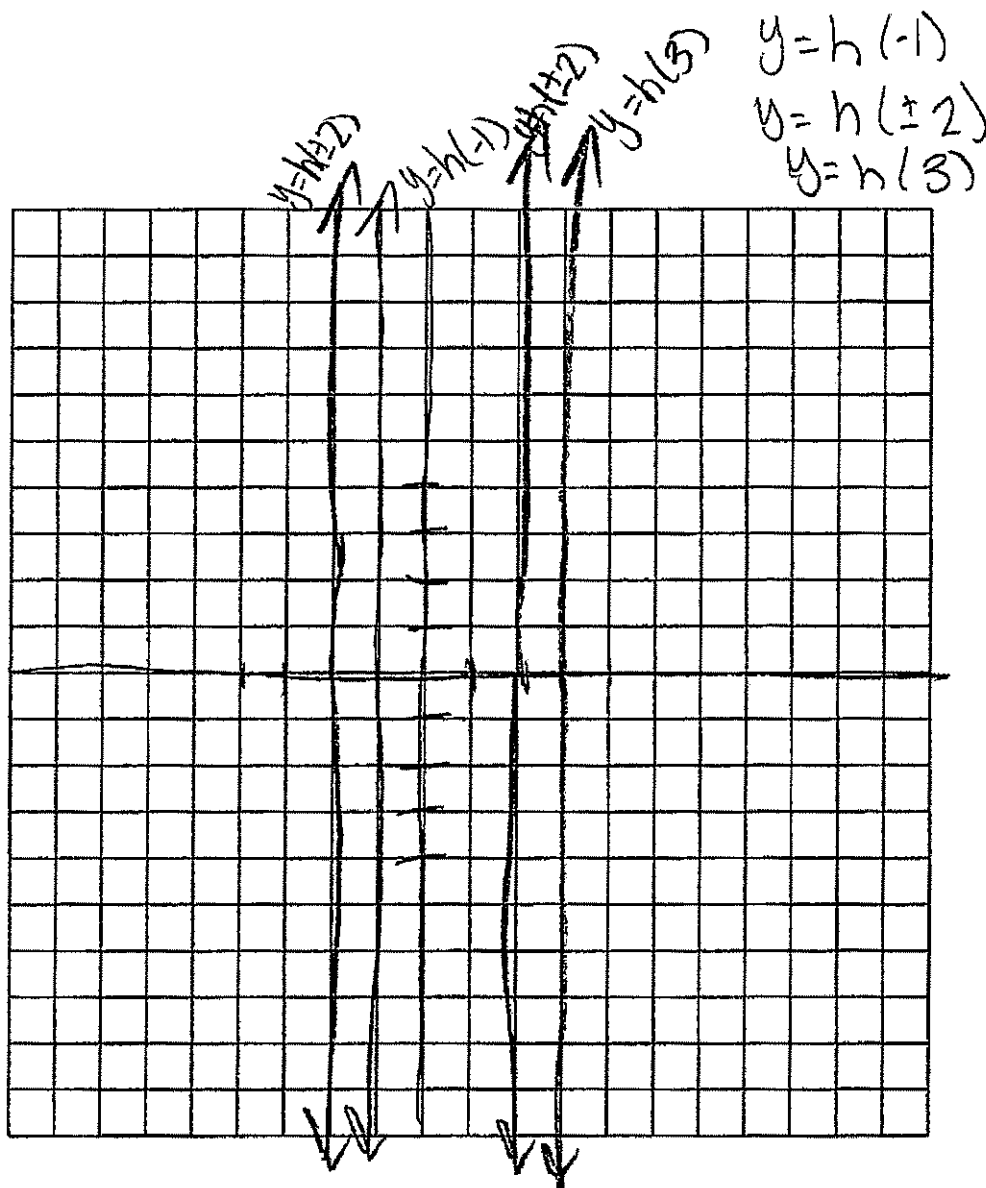


**Score 1:** The student incorrectly interpreted the zeros.

Question 31

31 The zeros of a quartic polynomial function  $h$  are  $-1$ ,  $\pm 2$ , and  $3$ .

Sketch a graph of  $y = h(x)$  on the grid below.



**Score 0:** The student gave a completely incorrect response.

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**Question 32**

---

32 Explain why  $81^{\frac{3}{4}}$  equals 27.

$$\log_{81} 27 = \frac{3}{4}$$

$$\left(\sqrt[4]{81}\right)^3 = 27$$

$81^{\frac{3}{4}}$  equals 27 because 81 with four roots gives you 3 and 3 cubed is 27, therefore  $81^{\frac{3}{4}}$  is 27.

---

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

Question 32

32 Explain why  $81^{\frac{3}{4}}$  equals 27.

because when a number is raised by a fraction, the denominator becomes the index of the root and 81 is inside the root, raised to the power of 3, the numerator.


**Score 1:** The student gave an incomplete explanation because no reference was made to 27.

---

**Question 32**

---

32 Explain why  $81^{\frac{3}{4}}$  equals 27.

$$81^{\frac{3}{4}} = \sqrt[4]{81^3} = \sqrt[4]{531441} = 27$$


**Score 1:** The student gave a justification and did not write an explanation.



---

**Question 32**

---

32 Explain why  $81^{\frac{3}{4}}$  equals 27.

It doesn't, it equals ~~108~~ 108.

---

**Score 0:** The student gave completely incorrect response.

**Question 33**

33 Given  $f(x) = 2x^2 + x - 3$  and  $g(x) = x - 1$

Express  $f(x) \cdot g(x) - [f(x) + g(x)]$  as a polynomial in standard form.

$$\begin{aligned} & (2x^2 + x - 3)(x - 1) - ((2x^2 + x - 3) + (x - 1)) \\ & (2x^3 + x^2 - 3x - 2x^2 - x + 3) - (2x^2 + 2x - 4) \\ & (2x^3 - x^2 - 4x + 3) - (2x^2 + 2x - 4) \\ & 2x^3 - 3x^2 - 6x + 7 \end{aligned}$$

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

**Question 33**

33 Given:  $f(x) = 2x^2 + x - 3$  and  $g(x) = x - 1$

Express  $f(x) \cdot g(x) - [f(x) + g(x)]$  as a polynomial in standard form.

$$\begin{aligned} & (2x^2 + x - 3)(x - 1) \\ & 2x^3 - 2x^2 + x^2 - x - 3x + 3 \\ & (2x^3 - x^2 - 4x + 3) - (2x^2 + 2x + 4) \\ & \underline{2x^3 - 3x^2 - 6x - 1} \end{aligned}$$

$$\begin{aligned} & 2x^2 + x - 3 + x - 1 \\ & 2x^2 + 2x - 4 \end{aligned}$$

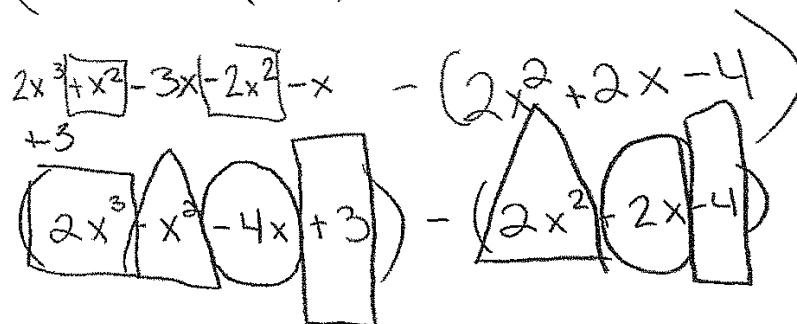
**Score 3:** The student made a transcription error copying the sum.

**Question 33**

33 Given:  $f(x) = 2x^2 + x - 3$  and  $g(x) = x - 1$

Express  $f(x) \cdot g(x) - [f(x) + g(x)]$  as a polynomial in standard form.

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

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


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

**Score 3:** The student correctly found the product and sum, but subtracted incorrectly.

---

**Question 33**

---

**33** Given:  $f(x) = 2x^2 + x - 3$  and  $g(x) = x - 1$

Express  $f(x) \cdot g(x) - [f(x) + g(x)]$  as a polynomial in standard form.

$$\begin{array}{r} 2x^2 + x - 3 \\ + x - 1 \\ \hline 2x^2 + 2x - 4 \end{array}$$

Ans:  $2x^2 + 2x - 4$

---

**Score 2:** The student found the correct sum only.

Question 33

33 Given:  $f(x) = 2x^2 + x - 3$  and  $g(x) = x - 1$

Express  $f(x) \cdot g(x) - [f(x) + g(x)]$  as a polynomial in standard form.

$$g(x) = x - 1$$

$$\begin{aligned} f(x-1) &= 2(x-1)^2 + x - 1 - 3 \\ &= 2x^2 - 4x + 2 + x - 1 - 3 \end{aligned}$$

$$f(g(x)) = 2x^2 - 3x - 2$$

$$2x^2 + x - 3 + x - 1$$

$$f(x) + g(x) = 2x^2 + 2x - 4$$

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

$$\boxed{2x^2} - 3x - 2 - \boxed{2x^2} - 2x + 4$$

$$\boxed{-5x + 2}$$

$$\begin{aligned} (x-1)(x-1) \\ x^2 - x - x + 1 \\ 2(x^2 - 2x + 1) \\ 2x^2 - 4x + 2 \end{aligned}$$

**Score 2:** The student made a conceptual error by performing a composition.

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**Question 33**

---

**33** Given:  $f(x) = 2x^2 + x - 3$  and  $g(x) = x - 1$

Express  $f(x) \cdot g(x) - [f(x) + g(x)]$  as a polynomial in standard form.

$$\begin{array}{r} 2x^2 + x - 3 \\ + \quad \quad x - 1 \\ \hline 2x^2 + 2x - 2 \end{array}$$

**Score 1:** The student made an error computing the sum.

---

**Question 33**

---

**33** Given:  $f(x) = 2x^2 + x - 3$  and  $g(x) = x - 1$

Express  $f(x) \cdot g(x) - [f(x) + g(x)]$  as a polynomial in standard form.

$$\begin{aligned} & 2x^2 + x - 3 - 1 \\ & 2x^2 - 2x - 7 - 2x^2 + x - 3 + x - 1 \\ & -2x - 2 - 2x^2 \end{aligned}$$

---

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



Question 34

34 A student is chosen at random from the student body at a given high school. The probability that the student selects Math as the favorite subject is  $\frac{1}{4}$ . The probability that the student chosen is a junior is  $\frac{116}{459}$ . If the probability that the student selected is a junior or that the student chooses Math as the favorite subject is  $\frac{47}{108}$ , what is the exact probability that the student selected is a junior whose favorite subject is Math?

$M = \text{Math as favorite subject}$

$$P(M) = \frac{1}{4}$$

$$P(M \text{ or } J) = \frac{47}{108}$$

$J = \text{Junior}$

$$P(J) = \frac{116}{459}$$

$$P(M \text{ AND } J) = P(M) + P(J) - P(M \text{ or } J)$$

$$= \frac{1}{4} + \frac{116}{459} - \frac{47}{108} = \boxed{\frac{31}{459}}$$

Are the events “the student is a junior” and “the student’s favorite subject is Math” independent of each other? Explain your answer.

$$P(M) = \frac{1}{4} = .25$$

If Independent:

$$P(A \text{ AND } B) = P(A) P(B)$$

$$P(J) = \frac{116}{459} = .2527$$

$$P(M \text{ AND } J) = \frac{31}{459} = 0.0675$$

$$P(M) \cdot P(J) = \frac{1}{4} \cdot \frac{116}{459} = \frac{29}{459} = 0.0631$$

No,  $P(M)$  and  $P(J)$  are not independent of each other because  $P(M \text{ AND } J) \neq P(M) \cdot P(J)$

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

**Question 34**

34 A student is chosen at random from the student body at a given high school. The probability that the student selects Math as the favorite subject is  $\frac{1}{4}$ . The probability that the student chosen is a junior is  $\frac{116}{459}$ . If the probability that the student selected is a junior or that the student chooses Math as the favorite subject is  $\frac{47}{108}$ , what is the exact probability that the student selected is a junior whose favorite subject is Math?

$$\frac{47}{108} = \frac{1}{4} + \frac{116}{459} - x$$

$$\frac{799}{1836} = \frac{459}{1836} + \frac{464}{1836} - x$$

$$x = \frac{124}{1836} = \frac{31}{459}$$

Are the events “the student is a junior” and “the student’s favorite subject is Math” independent of each other? Explain your answer.

$$P(j \text{ and } m) = P(j)P(m)$$

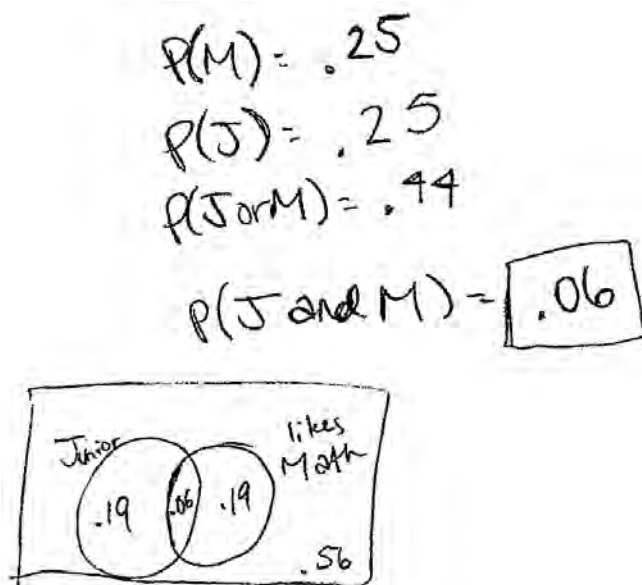
$$\frac{31}{459} = \frac{116}{459} \cdot \frac{1}{4}$$

$$\frac{31}{459} \neq \frac{116}{1836}$$

**Score 3:** The student did not provide an explanation.

**Question 34**

34 A student is chosen at random from the student body at a given high school. The probability that the student selects Math as the favorite subject is  $\frac{1}{4}$ . The probability that the student chosen is a junior is  $\frac{116}{459}$ . If the probability that the student selected is a junior or that the student chooses Math as the favorite subject is  $\frac{47}{108}$ , what is the exact probability that the student selected is a junior whose favorite subject is Math?



Are the events “the student is a junior” and “the student’s favorite subject is Math” independent of each other? Explain your answer.

$$P(J) \stackrel{?}{=} P(J|M)$$
$$.25 \stackrel{?}{=} \frac{.06}{.25}$$
$$.25 \neq .27$$

NOT INDEPENDENT

**Score 2:** The student did not find the exact probability and did not provide an explanation.

---

**Question 34**

---

**34** A student is chosen at random from the student body at a given high school. The probability that the student selects Math as the favorite subject is  $\frac{1}{4}$ . The probability that the student chosen is a junior is  $\frac{116}{459}$ . If the probability that the student selected is a junior or that the student chooses Math as the favorite subject is  $\frac{47}{108}$ , what is the exact probability that the student selected is a junior whose favorite subject is Math?

$$\frac{1}{4} + \frac{106}{459} - \frac{47}{108} = \frac{7}{153}$$

Are the events “the student is a junior” and “the student’s favorite subject is Math” independent of each other? Explain your answer.

---

**Score 1:** The student made one transcription error and did not write an explanation.

**Question 34**

34 A student is chosen at random from the student body at a given high school. The probability that the student selects Math as the favorite subject is  $\frac{1}{4}$ . The probability that the student chosen is a junior is  $\frac{116}{459}$ . If the probability that the student selected is a junior or that the student chooses Math as the favorite subject is  $\frac{47}{108}$ , what is the exact probability that the student selected is a junior whose favorite subject is Math?

$$\frac{1}{4} \times \frac{\overset{29}{\cancel{116}}}{459} \times \frac{47}{\cancel{108} 27} = \frac{1363}{99572}$$

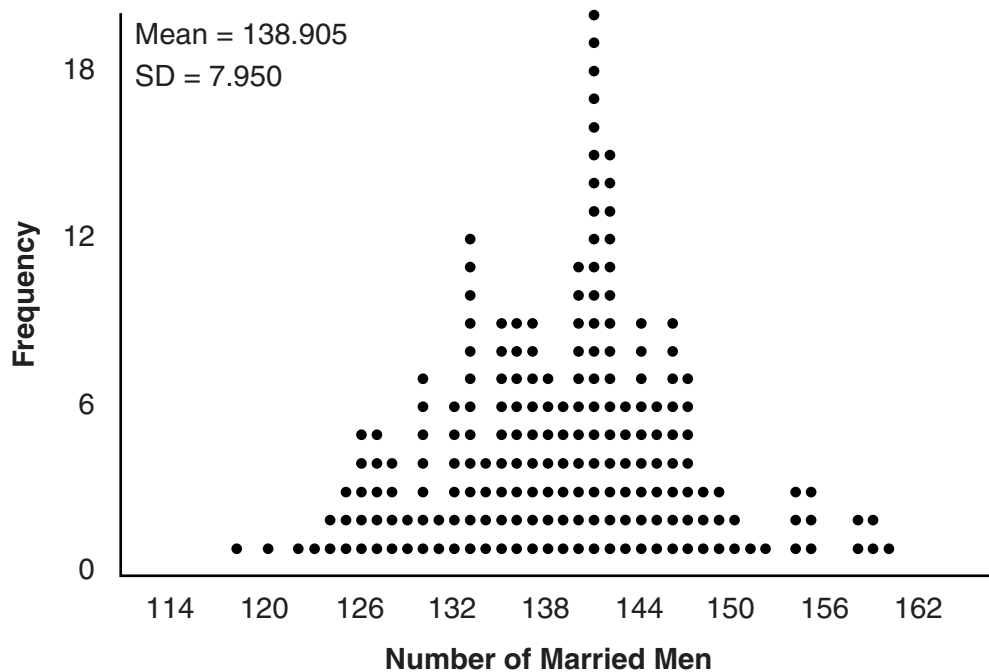
Are the events “the student is a junior” and “the student’s favorite subject is Math” independent of each other? Explain your answer.

They are independent of each other because you don't have to be a junior to like math or like math to be a junior.

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

**Question 35**

**35** In a random sample of 250 men in the United States, age 21 or older, 139 are married. The graph below simulated samples of 250 men, 200 times, assuming that 139 of the men are married.



- a) Based on the simulation, create an interval in which the middle 95% of the number of married men may fall. Round your answer to the *nearest integer*.

$$\begin{aligned} \bar{x} &= 138.905 & \bar{x} - 2(\sigma) & & \bar{x} & & \bar{x} + 2(\sigma) \\ \sigma &= 7.950 & 138.905 - 2(7.950) & \text{---} & 138.905 + 2(7.950) & & \\ & & \boxed{123 \text{ --- } 155} & & & & \end{aligned}$$

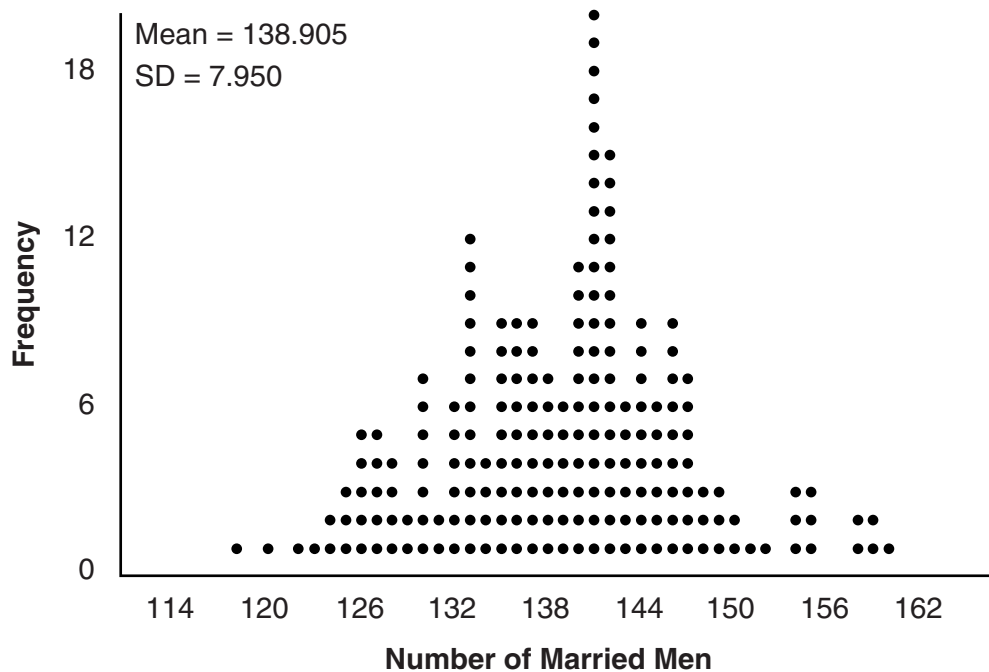
- b) A study claims “50 percent of men 21 and older in the United States are married.” Do your results from part *a* contradict this claim? Explain.

My results from part a do not contradict this claim because half of 250 is 125. My result was between 123 and 155.

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

**Question 35**

**35** In a random sample of 250 men in the United States, age 21 or older, 139 are married. The graph below simulated samples of 250 men, 200 times, assuming that 139 of the men are married.



- a) Based on the simulation, create an interval in which the middle 95% of the number of married men may fall. Round your answer to the *nearest integer*.

$$138.905 - 2(7.95) = 123.005$$

$$138.905 + 2(7.95) = 154.805$$

123 to 155

- b) A study claims “50 percent of men 21 and older in the United States are married.” Do your results from part *a* contradict this claim? Explain.

$\frac{123}{250} = .492$  No, since .5 falls within the 95% interval of .492 to .50 it is not a rare event

$\frac{155}{250} = .62$  therefore this proportion could happen

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

**Question 35**

**35** In a random sample of 250 men in the United States, age 21 or older, 139 are married. The graph below simulated samples of 250 men, 200 times, assuming that 139 of the men are married.



- a) Based on the simulation, create an interval in which the middle 95% of the number of married men may fall. Round your answer to the *nearest integer*.

$$2(7.950) = 15.9$$

$$138.905 \pm 15.9$$

$$(123.005, 154.805)$$

- b) A study claims “50 percent of men 21 and older in the United States are married.” Do your results from part *a* contradict this claim? Explain.

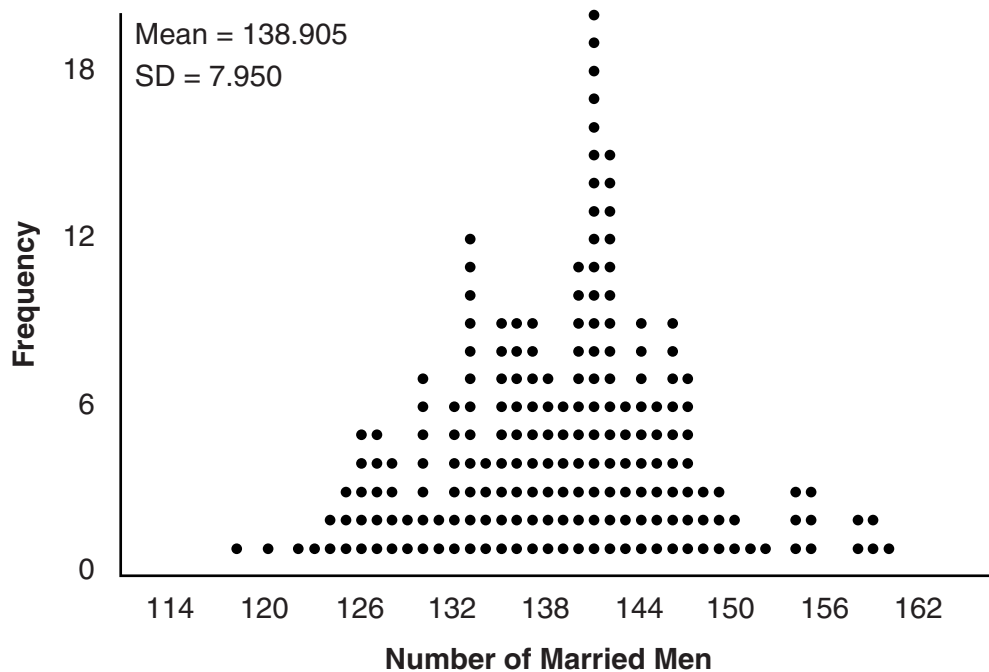
No because  $250(.5) = 125$ . Even though it is not likely, 125 is in the interval which makes it plausible

**Score 3:** The student made a rounding error creating the interval.



**Question 35**

**35** In a random sample of 250 men in the United States, age 21 or older, 139 are married. The graph below simulated samples of 250 men, 200 times, assuming that 139 of the men are married.



- a) Based on the simulation, create an interval in which the middle 95% of the number of married men may fall. Round your answer to the *nearest integer*.

$$139 - 143$$

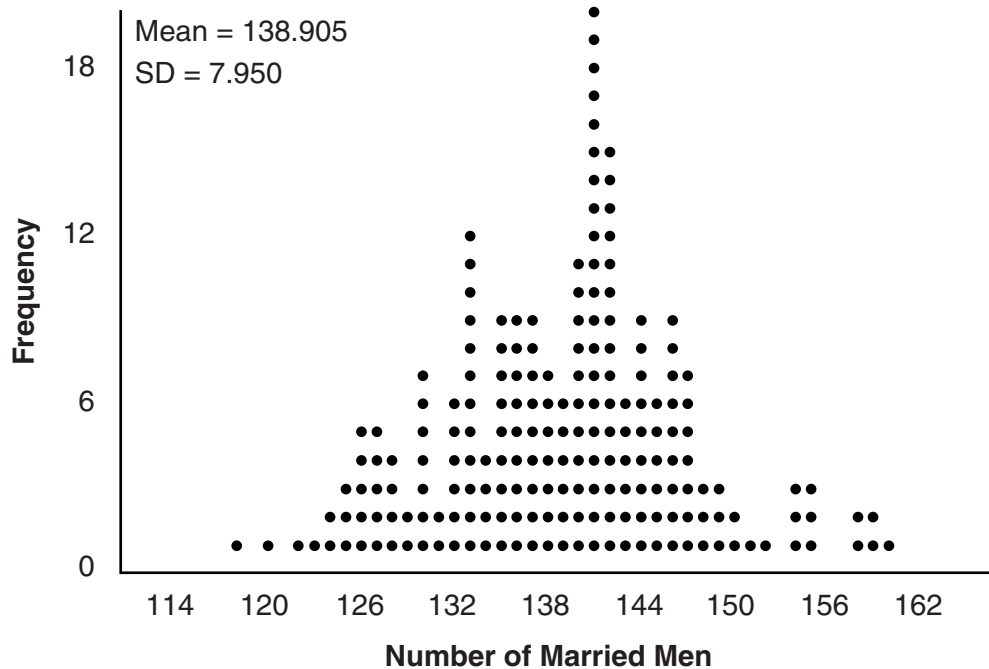
- b) A study claims “50 percent of men 21 and older in the United States are married.” Do your results from part *a* contradict this claim? Explain.

Yes because 50% of 250 is 125, which doesn't fit into the interval.

**Score 2:** The student stated an incorrect interval, but gave a complete explanation based on the interval.

**Question 35**

**35** In a random sample of 250 men in the United States, age 21 or older, 139 are married. The graph below simulated samples of 250 men, 200 times, assuming that 139 of the men are married.



- a) Based on the simulation, create an interval in which the middle 95% of the number of married men may fall. Round your answer to the *nearest integer*.

$$138.905 + 2(7.95) = 154.805$$

$$138.905 - 2(7.95) = 123.005$$

$$123 < x < 155$$

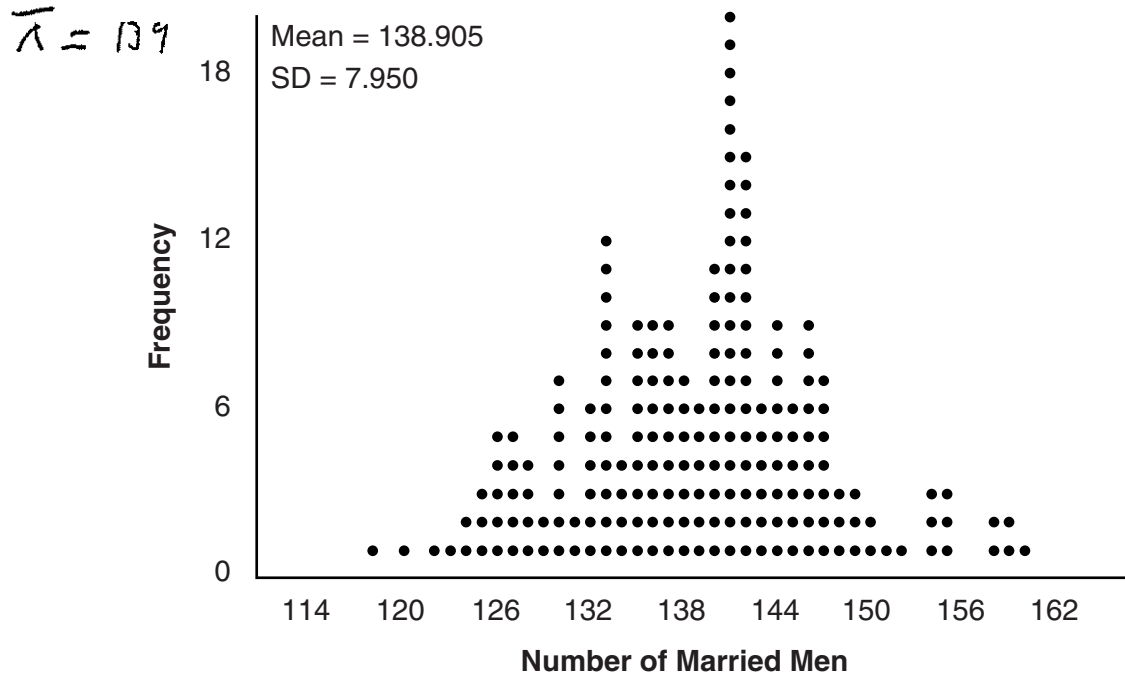
- b) A study claims “50 percent of men 21 and older in the United States are married.” Do your results from part *a* contradict this claim? Explain.

It is possible, but not highly likely, that 125 men out of 250 are married.

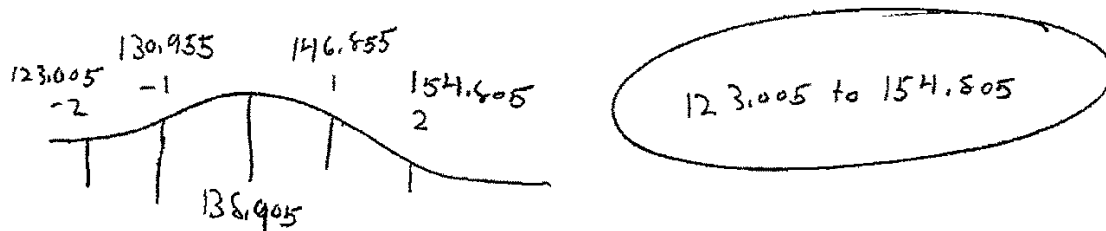
**Score 2:** The student only received credit for the correct interval.

**Question 35**

**35** In a random sample of 250 men in the United States, age 21 or older, 139 are married. The graph below simulated samples of 250 men, 200 times, assuming that 139 of the men are married.



- a) Based on the simulation, create an interval in which the middle 95% of the number of married men may fall. Round your answer to the *nearest integer*.

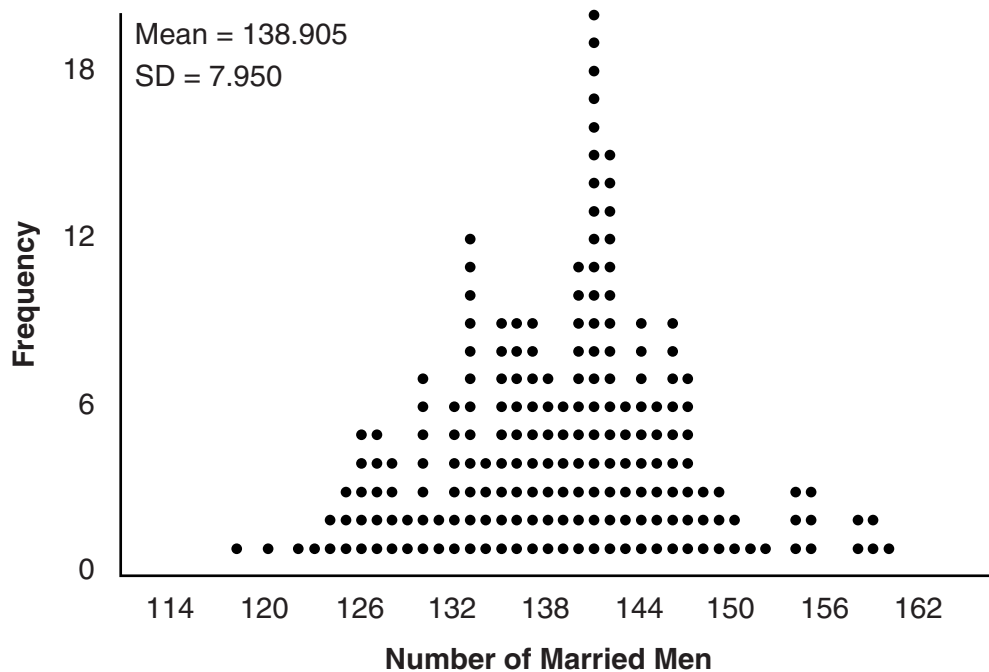


- b) A study claims “50 percent of men 21 and older in the United States are married.” Do your results from part *a* contradict this claim? Explain.

**Score 1:** The student made a rounding error creating the interval and did not provide an explanation.

**Question 35**

**35** In a random sample of 250 men in the United States, age 21 or older, 139 are married. The graph below simulated samples of 250 men, 200 times, assuming that 139 of the men are married.



- a) Based on the simulation, create an interval in which the middle 95% of the number of married men may fall. Round your answer to the *nearest integer*.

$$ME = 2 \left( \frac{7.95}{\sqrt{200}} \right) = 1.0056 = 1$$

$$137.905 \leq \mu \leq 139.905$$

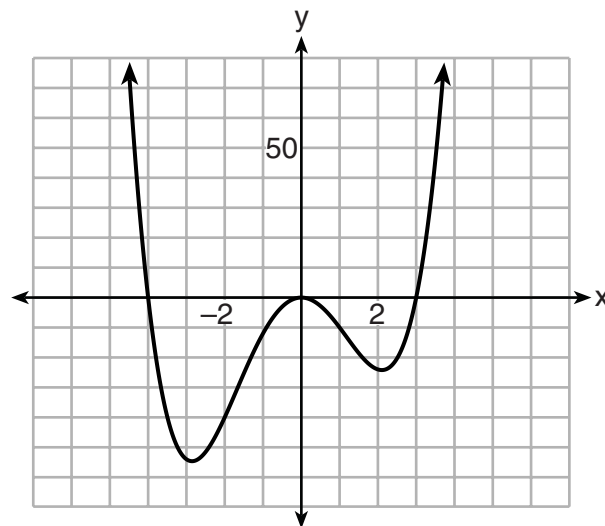
- b) A study claims “50 percent of men 21 and older in the United States are married.” Do your results from part *a* contradict this claim? Explain.

No they don't. We don't know the age of the men.

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

**Question 36**

36 The graph of  $y = f(x)$  is shown below. The function has a leading coefficient of 1.



Write an equation for  $f(x)$ .

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

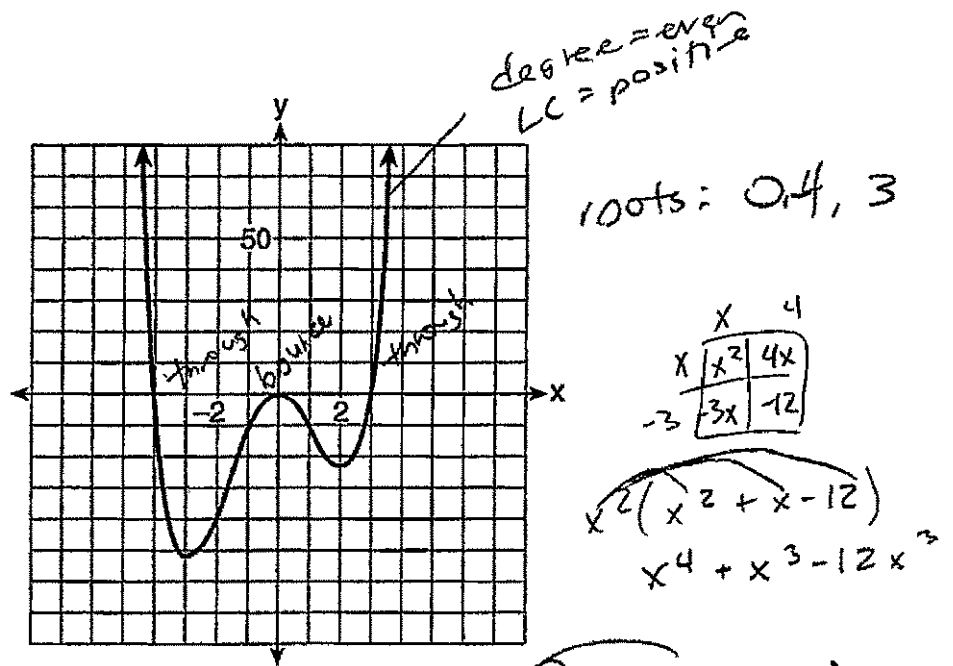
The function  $g$  is formed by translating function  $f$  left 2 units. Write an equation for  $g(x)$ .

$$g(x) = (x-1)(x+2)^2(x+6)$$

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

Question 36

36 The graph of  $y = f(x)$  is shown below. The function has a leading coefficient of 1.



Write an equation for  $f(x)$ .

$$y = x^4 + x^3 - 12x^2$$

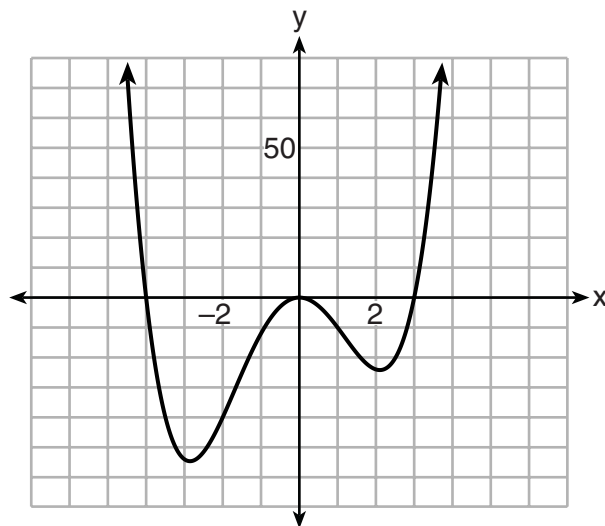
The function  $g$  is formed by translating function  $f$  left 2 units. Write an equation for  $g(x)$ .

$$g(x) = (x+2)^4 + (x+2)^3 - 12(x+2)^2$$

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

**Question 36**

36 The graph of  $y = f(x)$  is shown below. The function has a leading coefficient of 1.



Write an equation for  $f(x)$ .

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

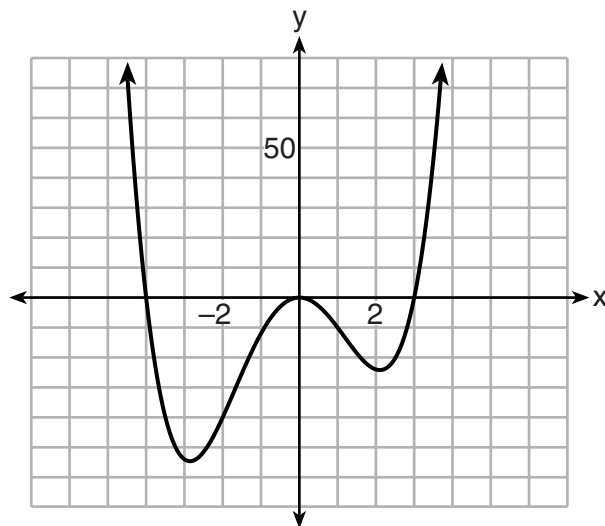
The function  $g$  is formed by translating function  $f$  left 2 units. Write an equation for  $g(x)$ .

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

**Score 3:** The student made a notation error by mislabeling  $g(x)$ .

**Question 36**

36 The graph of  $y = f(x)$  is shown below. The function has a leading coefficient of 1.



Write an equation for  $f(x)$ .

$$\begin{aligned} & (x^4 - 4x^3 + 4x^2 - 16x^2) \\ & (x^2 + 4x)(x^2 - 4x) \\ & (x + 4)(x + 0)(x + 0)(x - 4) \\ & f(x) = x^4 - 16x^2 \end{aligned}$$

The function  $g$  is formed by translating function  $f$  left 2 units. Write an equation for  $g(x)$ .

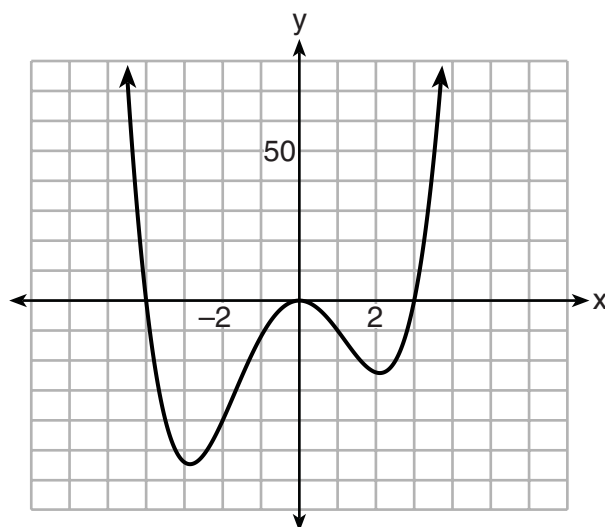
$$g(x) = (x + 2)^4 - 16(x + 2)^2$$

**Score 3:** The student used  $x - 4$  instead of  $x - 3$ .



**Question 36**

36 The graph of  $y = f(x)$  is shown below. The function has a leading coefficient of 1.



Write an equation for  $f(x)$ .

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

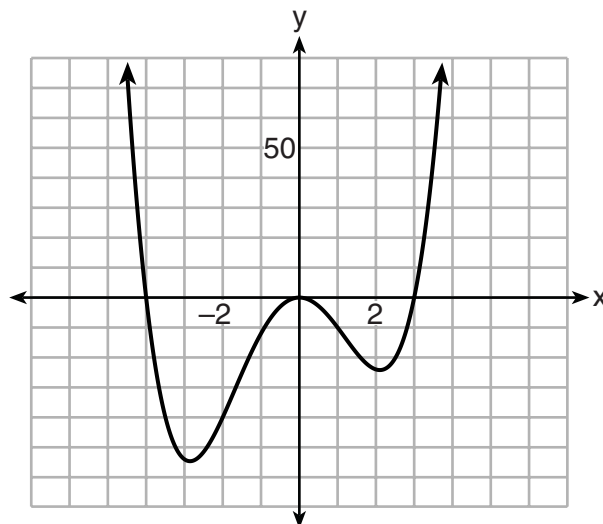
The function  $g$  is formed by translating function  $f$  left 2 units. Write an equation for  $g(x)$ .

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

**Score 2:** The student made two errors writing the equation for  $f(x)$ .

Question 36

36 The graph of  $y = f(x)$  is shown below. The function has a leading coefficient of 1.



Write an equation for  $f(x)$ .

$$f(x) = (x-3)(x-0)(x+4)$$

$$f(x) = (x^2 - 3x)(x+4) \quad x^3 + 4x^2 - 3x^2 - 12x = \boxed{x^3 + x^2 - 12x}$$

The function  $g$  is formed by translating function  $f$  left 2 units. Write an equation for  $g(x)$ .

$$g(x) = (x-1)(x+2)(x+6)$$

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

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

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

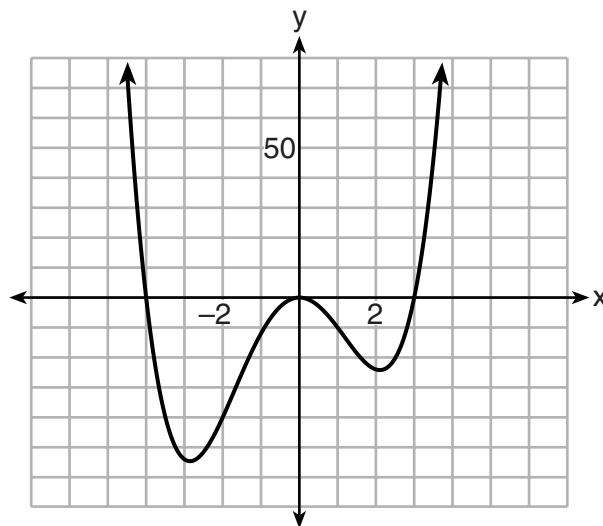
$$x^3 + 6x^2 + x^2 + 6x - 2x - 12$$

$$\boxed{x^3 + 7x^2 + 4x - 12}$$

**Score 2:** The student made a conceptual error not realizing  $x = 0$  was a double root.

**Question 36**

**36** The graph of  $y = f(x)$  is shown below. The function has a leading coefficient of 1.



Write an equation for  $f(x)$ .

$$f(x) = x^2$$

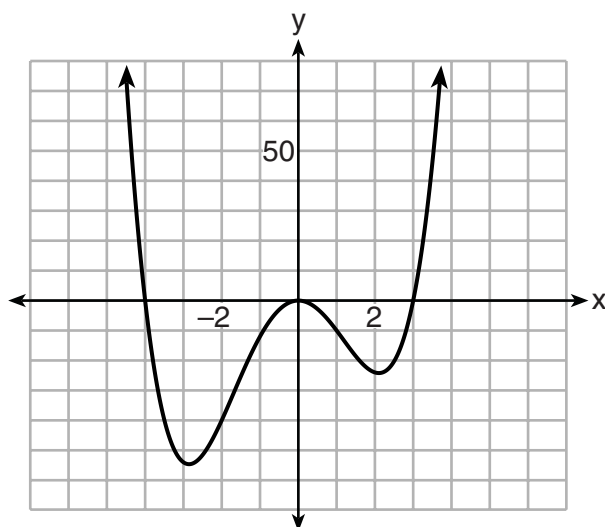
The function  $g$  is formed by translating function  $f$  left 2 units. Write an equation for  $g(x)$ .

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

**Score 1:** The student only received credit for  $g(x)$ .

**Question 36**

36 The graph of  $y = f(x)$  is shown below.



$$\begin{aligned} & (x^2 + 4x) (x - 3) \\ & + 3 - 3x^2 + 4x^2 - 12x \\ & x^3 + x^2 - 12x (x + 2) \\ & x^4 + x^3 - 12x^2 \\ & 2x^3 + 2x^2 - 14x \end{aligned}$$

Write an equation for  $f(x)$ .

$$\begin{aligned} f(x) &= (x + 4)(x - 3)(x) \\ f(x) &= x^3 + x^2 - 12x \end{aligned}$$

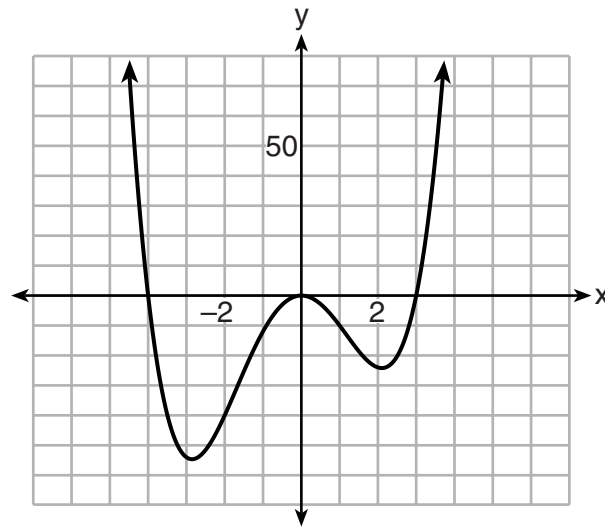
The function  $g$  is formed by translating function  $f$  left 2 units. Write an equation for  $g(x)$ .

$$g(x) = x^4 + 3x^3 - 10x^2 - 14x$$

**Score 1:** The student made a conceptual error not realizing  $x = 0$  was a double root and incorrectly determined  $g(x)$ .

Question 36

36 The graph of  $y = f(x)$  is shown below. The function has a leading coefficient of 1.



Write an equation for  $f(x)$ .

$$(x+4)(x+0)(x-3) \quad x^3 + 4x^2 - 3x^2 + 4x - 3x - 12 = x^3 + x^2 + x - 12$$

The function  $g$  is formed by translating function  $f$  left 2 units. Write an equation for  $g(x)$ .

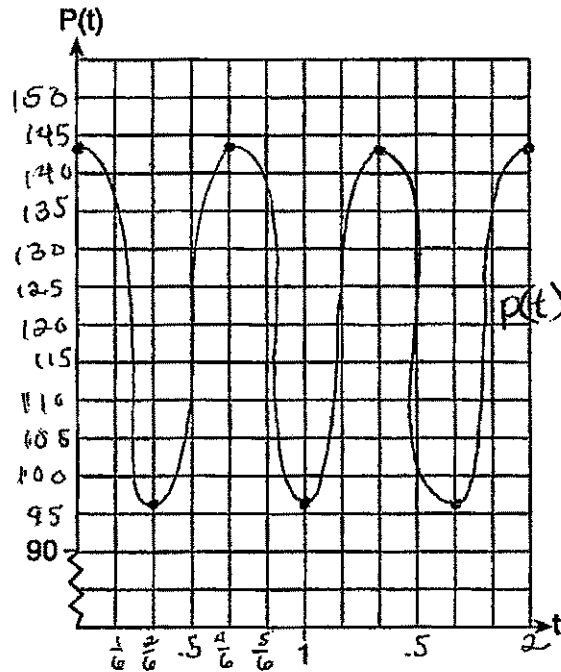
**Score 0:** The student did not show enough correct work to receive any credit.

**Question 37**

37 The resting blood pressure of an adult patient can be modeled by the function  $P$  below, where  $P(t)$  is the pressure in millimeters of mercury after time  $t$  in seconds.

$$P(t) = 24\cos(3\pi t) + 120$$

On the set of axes below, graph  $y = P(t)$  over the domain  $0 \leq t \leq 2$ .



$$120 - 24 = 96 \text{ min}$$

$$120 + 24 = 144 \text{ max}$$

$$\frac{2\pi}{3\pi} = \frac{2}{3} = P$$

$$f = \frac{2\pi}{P}$$

$$f = \frac{2\pi}{\frac{2}{3}} = 3$$

$$f = 3$$

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

---

**Question 37 continued.**

---

Determine the period of  $P$ . Explain what this value represents in the given context.

$$p = \frac{211}{311} \rightarrow \boxed{\frac{2}{3}} \text{ every 2 seconds, the blood pressure oscillates 3 times}$$

Normal resting blood pressure for an adult is 120 over 80. This means that the blood pressure oscillates between a maximum of 120 and a minimum of 80. Adults with high blood pressure (above 140 over 90) and adults with low blood pressure (below 90 over 60) may be at risk for health disorders. Classify the given patient's blood pressure as low, normal, or high and explain your reasoning.

$$\frac{144}{96} \quad \text{The given patient has high blood pressure. The values 144 and 96 are above 140 and over 90.}$$

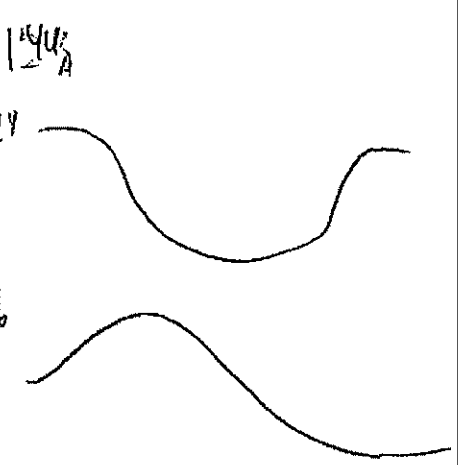
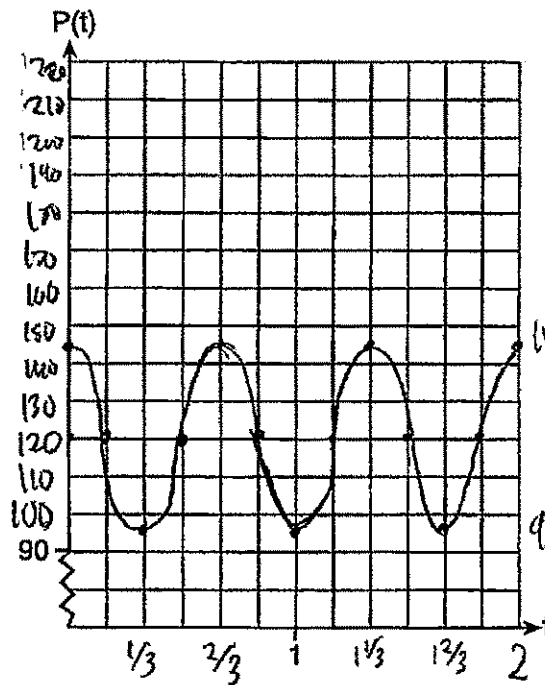
**Question 37**

37 The resting blood pressure of an adult patient can be modeled by the function  $P$  below, where  $P(t)$  is the pressure in millimeters of mercury after time  $t$  in seconds.

$$P(t) = 24\cos(3\pi t) + 120$$

On the set of axes below, graph  $y = P(t)$  over the domain  $0 \leq t \leq 2$ .

~~Ampl = 24~~  
~~freq = 3\pi~~  
~~per = 2/3~~  
 $\frac{2\pi}{3\pi}$



**Score 5:** The student provided an incomplete explanation of period in the given contest.



---

**Question 37 continued.**

---

Determine the period of  $P$ . Explain what this value represents in the given context.

$2/3$  : Entire length of each oscillation

Normal resting blood pressure for an adult is 120 over 80. This means that the blood pressure oscillates between a maximum of 120 and a minimum of 80. Adults with high blood pressure (above 140 over 90) and adults with low blood pressure (below 90 over 60) may be at risk for health disorders. Classify the given patient's blood pressure as low, normal, or high and explain your reasoning.

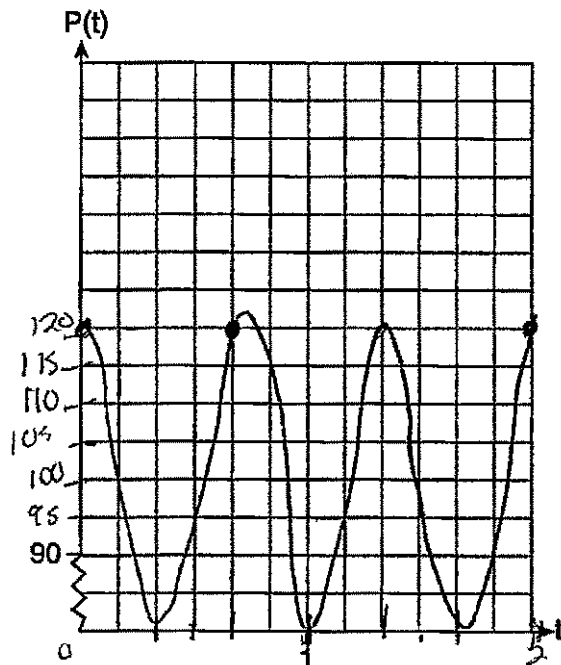
high, because it went as high as 144 and as low as 96 — mostly in the "high" range.

**Question 37**

37 The resting blood pressure of an adult patient can be modeled by the function  $P$  below, where  $P(t)$  is the pressure in millimeters of mercury after time  $t$  in seconds.

$$P(t) = 24\cos(3\pi t) + 120$$

On the set of axes below, graph  $y = P(t)$  over the domain  $0 \leq t \leq 2$ .



$$24\cos(3\pi x) + 120$$

$$A = 24$$

$$F = 3\pi$$

$$P = \frac{24}{3\pi} = \frac{2}{3}$$

$$C.P = \frac{2}{3} \cdot 4 = \frac{8}{3}$$

$$P(t) = 24\cos(3\pi t) + 120$$

**Score 4:** The student made an error graphing the range and incorrectly interpreted the graph.

---

**Question 37 continued.**

---

Determine the period of  $P$ . Explain what this value represents in the given context.

Period =  $\frac{2}{3}$  This is how long it takes for blood pressure to oscillate to its maximum.

Normal resting blood pressure for an adult is 120 over 80. This means that the blood pressure oscillates between a maximum of 120 and a minimum of 80. Adults with high blood pressure (above 140 over 90) and adults with low blood pressure (below 90 over 60) may be at risk for health disorders. Classify the given patient's blood pressure as low, normal, or high and explain your reasoning.

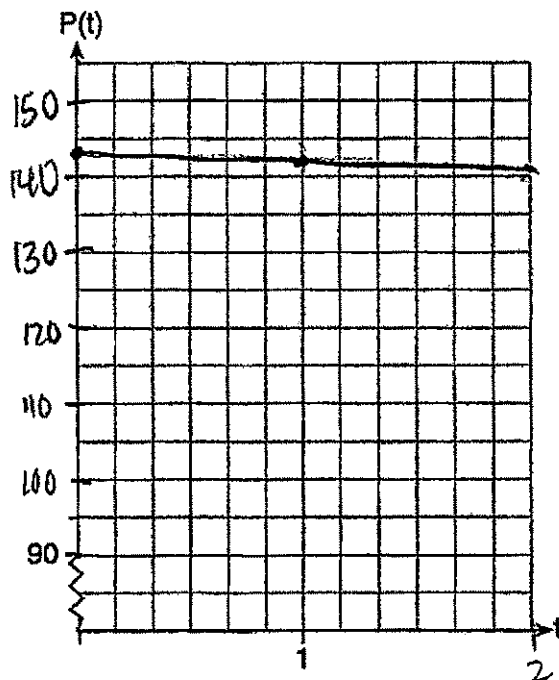
The patient is normal because the maximum is 120 and the minimum is 90.

### Question 37

37 The resting blood pressure of an adult patient can be modeled by the function  $P$  below, where  $P(t)$  is the pressure in millimeters of mercury after time  $t$  in seconds.

$$P(t) = 24\cos(3\pi t) + 120$$

On the set of axes below, graph  $y = P(t)$  over the domain  $0 \leq t \leq 2$ .



$$P(0) = 24 \cos(3\pi \cdot 0) + 120$$

$$(0, 144)$$

$$(1, 143.18)$$

$$(2, 142.78)$$

**Score 3:** The student correctly identified the period and, based on the graph, correctly classified and explained the patient's blood pressure.

---

**Question 37 continued.**

---

Determine the period of  $P$ . Explain what this value represents in the given context.

$\frac{1}{3}$ , the normal curve for blood pressure.  
(Shows min and max)

Normal resting blood pressure for an adult is 120 over 80. This means that the blood pressure oscillates between a maximum of 120 and a minimum of 80. Adults with high blood pressure (above 140 over 90) and adults with low blood pressure (below 90 over 60) may be at risk for health disorders. Classify the given patient's blood pressure as low, normal, or high and explain your reasoning.

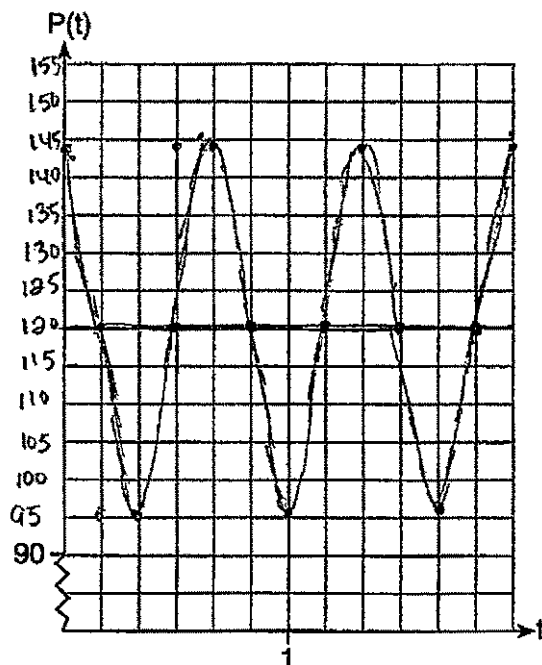
high b/c above 140

**Question 37**

37 The resting blood pressure of an adult patient can be modeled by the function  $P$  below, where  $P(t)$  is the pressure in millimeters of mercury after time  $t$  in seconds.

$$P(t) = 24\cos(3\pi t) + 120$$

On the set of axes below, graph  $y = P(t)$  over the domain  $0 \leq t \leq 2$ .



**Score 2:** The student received credit for a correct graph only.

---

**Question 37 continued.**

---

Determine the period of  $P$ . Explain what this value represents in the given context.

$$P = 2\pi / B \quad \textcircled{\pi/6}$$

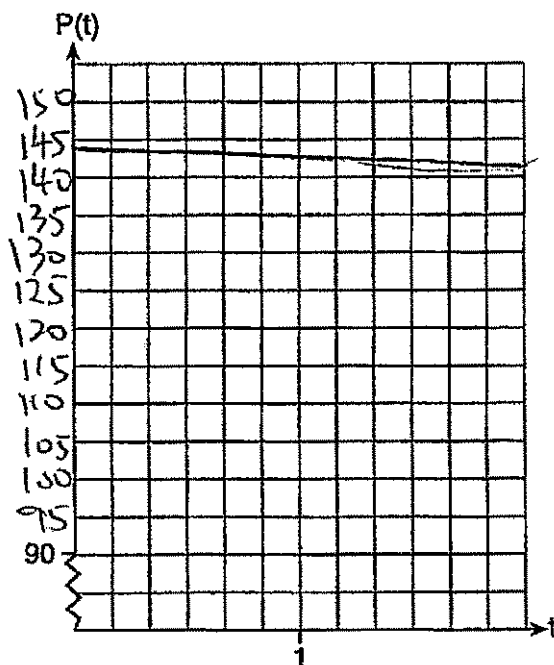
Normal resting blood pressure for an adult is 120 over 80. This means that the blood pressure oscillates between a maximum of 120 and a minimum of 80. Adults with high blood pressure (above 140 over 90) and adults with low blood pressure (below 90 over 60) may be at risk for health disorders. Classify the given patient's blood pressure as low, normal, or high and explain your reasoning.

### Question 37

37 The resting blood pressure of an adult patient can be modeled by the function  $P$  below, where  $P(t)$  is the pressure in millimeters of mercury after time  $t$  in seconds.

$$P(t) = 24\cos(3\pi t) + 120$$

On the set of axes below, graph  $y = P(t)$  over the domain  $0 \leq t \leq 2$ .



**Score 2:** The student correctly classified and explained the patient's blood pressure based on the graph.



---

**Question 37 continued.**

---

Determine the period of  $P$ . Explain what this value represents in the given context.

Normal resting blood pressure for an adult is 120 over 80. This means that the blood pressure oscillates between a maximum of 120 and a minimum of 80. Adults with high blood pressure (above 140 over 90) and adults with low blood pressure (below 90 over 60) may be at risk for health disorders. Classify the given patient's blood pressure as low, normal, or high and explain your reasoning.

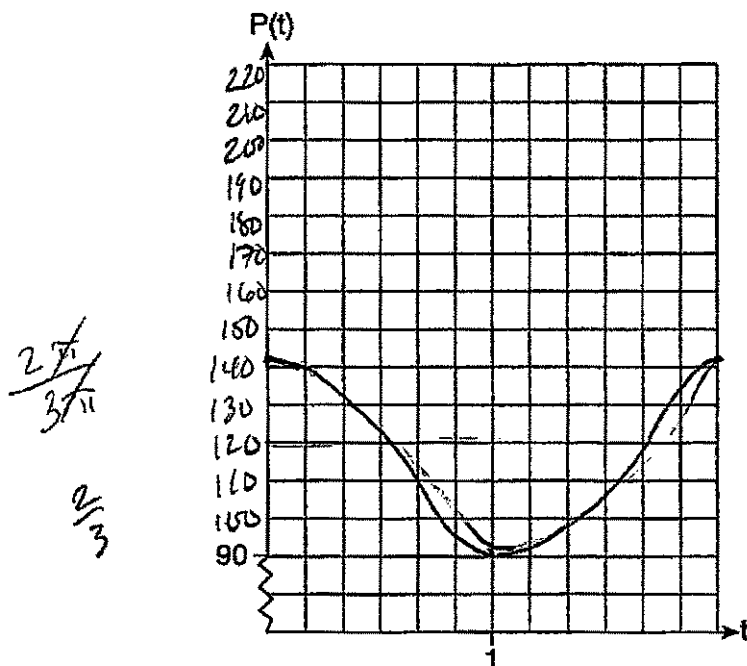
This patient's pressure is high because his average blood pressure is above 140.

**Question 37**

37 The resting blood pressure of an adult patient can be modeled by the function  $P$  below, where  $P(t)$  is the pressure in millimeters of mercury after time  $t$  in seconds.

$$P(t) = 24\cos(3\pi t) + 120$$

On the set of axes below, graph  $y = P(t)$  over the domain  $0 \leq t \leq 2$ .



**Score 1:** The student correctly stated the period.

---

**Question 37 continued.**

---

Determine the period of  $P$ . Explain what this value represents in the given context.

$$\frac{2\pi}{\text{freq}} = \frac{2\pi}{3\pi} = \left(\frac{2}{3}\right) \text{ THIS VALUE REPRESENTS THE}$$

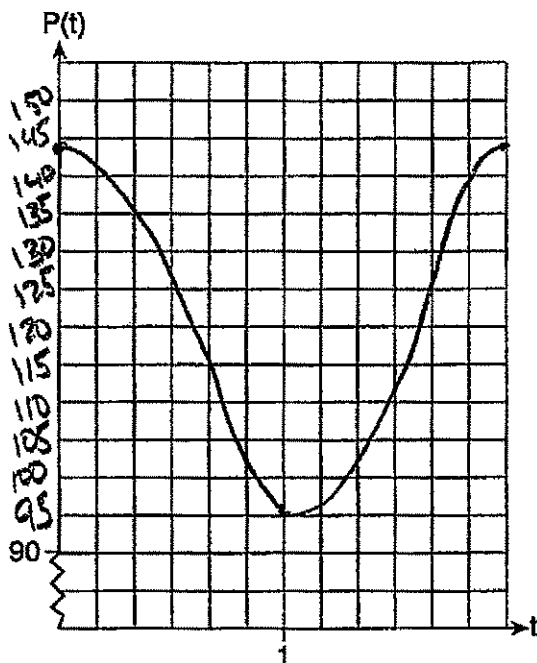
Normal resting blood pressure for an adult is 120 over 80. This means that the blood pressure oscillates between a maximum of 120 and a minimum of 80. Adults with high blood pressure (above 140 over 90) and adults with low blood pressure (below 90 over 60) may be at risk for health disorders. Classify the given patient's blood pressure as low, normal, or high and explain your reasoning.

**Question 37**

37 The resting blood pressure of an adult patient can be modeled by the function  $P$  below, where  $P(t)$  is the pressure in millimeters of mercury after time  $t$  in seconds.

$$P(t) = 24\cos(3\pi t) + 120$$

On the set of axes below, graph  $y = P(t)$  over the domain  $0 \leq t \leq 2$ .



**Score 1:** The student made one graphing error relating to the period.

Question 37 continued.

Determine the period of  $P$ . Explain what this value represents in the given context.

2, because one full wavelength occurs in the domain of  $0 \leq t \leq 2$ .

Normal resting blood pressure for an adult is 120 over 80. This means that the blood pressure oscillates between a maximum of 120 and a minimum of 80. Adults with high blood pressure (above 140 over 90) and adults with low blood pressure (below 90 over 60) may be at risk for health disorders. Classify the given patient's blood pressure as low, normal, or high and explain your reasoning.

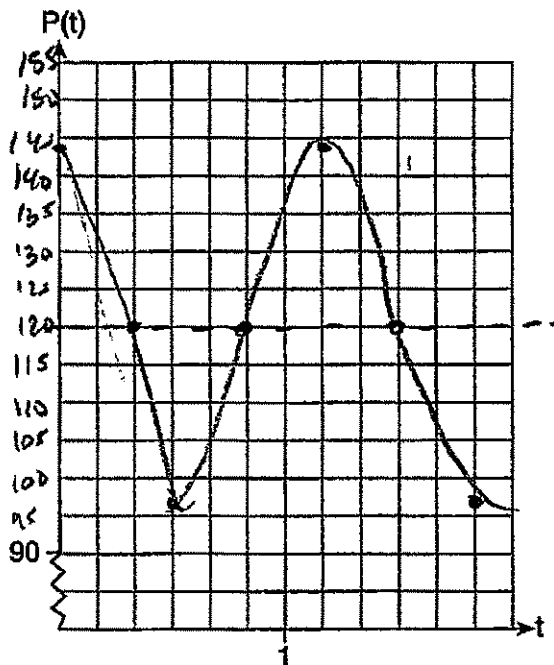
High blood pressure means that the blood pressure oscillates very high and low blood pressure means that it oscillates too low. Both are unhealthy and patients are at risk if not treated to be in the healthy range, 120 over 80.

**Question 37**

37 The resting blood pressure of an adult patient can be modeled by the function  $P$  below, where  $P(t)$  is the pressure in millimeters of mercury after time  $t$  in seconds.

$$P(t) = 24\cos(3\pi t) + 120$$

On the set of axes below, graph  $y = P(t)$  over the domain  $0 \leq t \leq 2$ .



**Score 0:** The student made multiple graphing errors and showed no further work.

---

**Question 37 continued.**

---

Determine the period of  $P$ . Explain what this value represents in the given context.

Normal resting blood pressure for an adult is 120 over 80. This means that the blood pressure oscillates between a maximum of 120 and a minimum of 80. Adults with high blood pressure (above 140 over 90) and adults with low blood pressure (below 90 over 60) may be at risk for health disorders. Classify the given patient's blood pressure as low, normal, or high and explain your reasoning.

## Regents Examination in Algebra II – January 2018

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

(Use for the January 2018 exam only.)

Raw Score	Scale Score	Performance Level	Raw Score	Scale Score	Performance Level	Raw Score	Scale Score	Performance Level
86	100	5	57	82	4	28	67	3
85	99	5	56	82	4	27	66	3
84	98	5	55	81	4	26	65	3
83	97	5	54	81	4	25	64	2
82	96	5	53	80	4	24	62	2
81	95	5	52	80	4	23	61	2
80	94	5	51	80	4	22	60	2
79	93	5	50	79	4	21	58	2
78	92	5	49	79	4	20	55	2
77	92	5	48	79	4	19	54	1
76	91	5	47	78	4	18	53	1
75	90	5	46	78	4	17	51	1
74	90	5	45	77	3	16	49	1
73	89	5	44	77	3	15	47	1
72	89	5	43	77	3	14	45	1
71	88	5	42	76	3	13	43	1
70	88	5	41	76	3	12	40	1
69	87	5	40	75	3	11	38	1
68	87	5	39	75	3	10	35	1
67	86	5	38	74	3	9	32	1
66	86	5	37	74	3	8	29	1
65	86	5	36	73	3	7	26	1
64	85	5	35	73	3	6	23	1
63	84	4	34	72	3	5	20	1
62	84	4	33	71	3	4	16	1
61	83	4	32	70	3	3	13	1
60	83	4	31	70	3	2	9	1
59	83	4	30	69	3	1	4	1
58	82	4	29	68	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.