JMAP
REGENTS AT RANDOM

NY Algebra II CCSS Regents Exam Questions
from Spring 2015 to August 2017 Sorted at Random

Algebra II Common Core State Standards Regents at Random

1 Which statement regarding the graphs of the functions below is *untrue*?

$$f(x) = 3\sin 2x, \text{ from } -\pi < x < \pi$$

$$g(x) = (x - 0.5)(x + 4)(x - 2)$$

$$h(x) = \log_2 x$$

$$j(x) = -|4x - 2| + 3$$

1) $f(x)$ and $j(x)$ have a maximum y-value of 3.
2) $f(x)$, $h(x)$, and $j(x)$ have one y-intercept.
3) $g(x)$ and $j(x)$ have the same end behavior as $x \to -\infty$.
4) $g(x)$, $h(x)$, and $j(x)$ have rational zeros.

2 Elaina has decided to run the Buffalo half-marathon in May. She researched training plans on the Internet and is looking at two possible plans: Jillian's 12-week plan and Josh's 14-week plan. The number of miles run per week for each plan is plotted below.
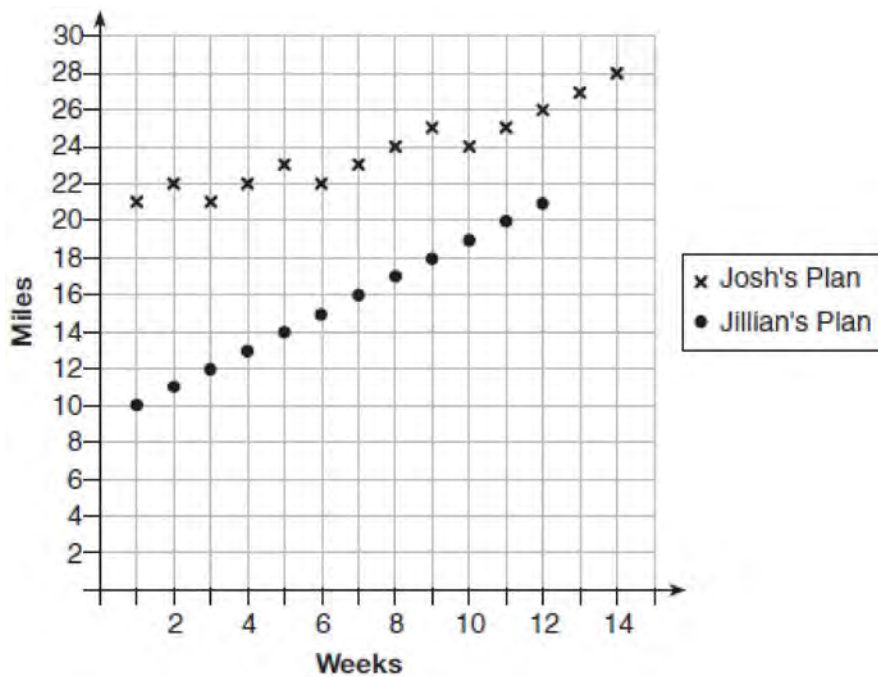
Which one of the plans follows an arithmetic pattern? Explain how you arrived at your answer. Write a recursive definition to represent the number of miles run each week for the duration of the plan you chose. Jillian's plan has an alternative if Elaina wanted to train instead for a full 26-mile marathon. Week one would start at 13 miles and follow the same pattern for the half-marathon, but it would continue for 14 weeks. Write an explicit formula, in *simplest form*, to represent the number of miles run each week for the full-marathon training plan.

3 Gabriel performed an experiment to see if planting 13 tomato plants in black plastic mulch leads to larger tomatoes than if 13 plants are planted without mulch. He observed that the average weight of the tomatoes from tomato plants grown in black plastic mulch was 5 ounces greater than those from the plants planted without mulch. To determine if the observed difference is statistically significant, he rerandomized the tomato groups 100 times to study these random differences in the mean weights. The output of his simulation is summarized in the dotplot below.

Differences in Mean Weight (oz.)
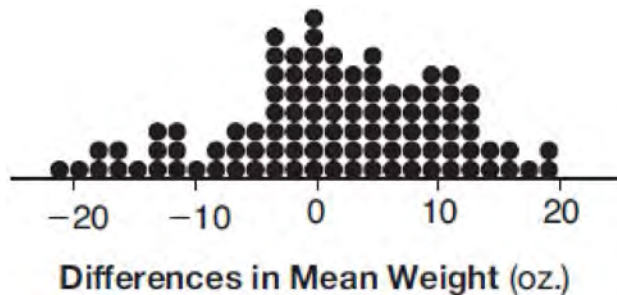
Given these results, what is an appropriate inference that can be drawn?

1) There was no effect observed between the two groups.

2) There was an effect observed that could be due to the random assignment of plants to the groups.

3) There is strong evidence to support the hypothesis that tomatoes from plants planted in black plastic mulch are larger than those planted without mulch.

4) There is strong evidence to support the hypothesis that tomatoes from plants planted without mulch are larger than those planted in black plastic mulch.

4 Titanium-44 is a radioactive isotope such that every 63 years, its mass decreases by half. For a sample of titanium-44 with an initial mass of 100 grams, write a function that will give the mass of the sample remaining after any amount of time. Define all variables. Scientists sometimes use the average yearly decrease in mass for estimation purposes. Use the average yearly decrease in mass of the sample between year 0 and year 10 to predict the amount of the sample remaining after 40 years. Round your answer to the *nearest tenth*. Is the actual mass of the sample or the estimated mass greater after 40 years? Justify your answer.

5 According to a pricing website, Indroid phones lose 58% of their cash value over 1.5 years. Which expression can be used to estimate the value of a $300 Indroid phone in 1.5 years?

1) $300e^{-0.87}$

2) $300e^{-0.63}$

3) $300e^{-0.58}$

4) $300e^{-0.42}$

6 Algebraically determine whether the function $j(x) = x^4 - 3x^2 - 4$ is odd, even, or neither.

2

7 The solution set for the equation
$\sqrt{x+14} - \sqrt{2x+5} = 1$ is
1) $\{-6\}$
2) $\{2\}$
3) $\{18\}$
4) $\{2,22\}$

8 If $\sin^2(32°) + \cos^2(M) = 1$, then M equals
1) $32°$
2) $58°$
3) $68°$
4) $72°$

9 Relative to the graph of $y = 3\sin x$, what is the shift
of the graph of $y = 3\sin\left(x + \dfrac{\pi}{3}\right)$?

1) $\dfrac{\pi}{3}$ right

2) $\dfrac{\pi}{3}$ left

3) $\dfrac{\pi}{3}$ up

4) $\dfrac{\pi}{3}$ down

10 When $g(x) = \dfrac{2}{x+2}$ and $h(x) = \log(x+1) + 3$ are
graphed on the same set of axes, which coordinates
best approximate their point of intersection?
1) $(-0.9, 1.8)$
2) $(-0.9, 1.9)$
3) $(1.4, 3.3)$
4) $(1.4, 3.4)$

11 The expression $\left(\dfrac{m^2}{m^{\frac{1}{3}}}\right)^{-\frac{1}{2}}$ is equivalent to

1) $-\sqrt[6]{m^5}$

2) $\dfrac{1}{\sqrt[6]{m^5}}$

3) $-m\sqrt[5]{m}$

4) $\dfrac{1}{m\sqrt[5]{m}}$

12 Pedro and Bobby each own an ant farm. Pedro
starts with 100 ants and says his farm is growing
exponentially at a rate of 15% per month. Bobby
starts with 350 ants and says his farm is steadily
decreasing by 5 ants per month. Assuming both
boys are accurate in describing the population of
their ant farms, after how many months will they
both have approximately the same number of ants?
1) 7
2) 8
3) 13
4) 36

13 Two versions of a standardized test are given, an
April version and a May version. The statistics for
the April version show a mean score of 480 and a
standard deviation of 24. The statistics for the May
version show a mean score of 510 and a standard
deviation of 20. Assume the scores are normally
distributed. Joanne took the April version and
scored in the interval 510-540. What is the
probability, to the *nearest ten thousandth*, that a
test paper selected at random from the April
version scored in the same interval? Maria took the
May version. In what interval must Maria score to
claim she scored as well as Joanne?

3

14 One of the medical uses of Iodine–131 (I–131), a radioactive isotope of iodine, is to enhance x-ray images. The half-life of I–131 is approximately 8.02 days. A patient is injected with 20 milligrams of I–131. Determine, to the *nearest day*, the amount of time needed before the amount of I–131 in the patient's body is approximately 7 milligrams.

15 A payday loan company makes loans between $100 and $1000 available to customers. Every 14 days, customers are charged 30% interest with compounding. In 2013, Remi took out a $300 payday loan. Which expression can be used to calculate the amount she would owe, in dollars, after one year if she did not make payments?

1) $300(.30)^{\frac{14}{365}}$

2) $300(1.30)^{\frac{14}{365}}$

3) $300(.30)^{\frac{365}{14}}$

4) $300(1.30)^{\frac{365}{14}}$

16 Given $f(x) = 3x^2 + 7x - 20$ and $g(x) = x - 2$, state the quotient and remainder of $\dfrac{f(x)}{g(x)}$, in the form $q(x) + \dfrac{r(x)}{g(x)}$.

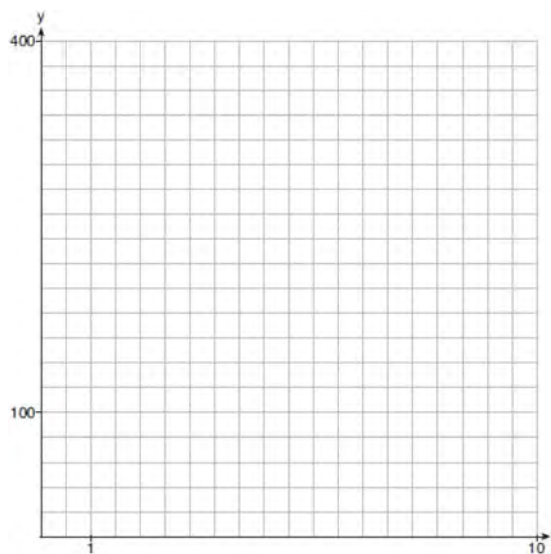17 Algebraically determine the values of x that satisfy the system of equations below.
$$y = -2x + 1$$
$$y = -2x^2 + 3x + 1$$

18 What is the completely factored form of $k^4 - 4k^2 + 8k^3 - 32k + 12k^2 - 48$?

1) $(k-2)(k-2)(k+3)(k+4)$

2) $(k-2)(k-2)(k+6)(k+2)$

3) $(k+2)(k-2)(k+3)(k+4)$

4) $(k+2)(k-2)(k+6)(k+2)$

19 Graph $y = 400(.85)^{2x} - 6$ on the set of axes below.

20 A suburban high school has a population of 1376 students. The number of students who participate in sports is 649. The number of students who participate in music is 433. If the probability that a student participates in either sports or music is $\dfrac{974}{1376}$, what is the probability that a student participates in both sports and music?

21 Express $(1-i)^3$ in $a + bi$ form.

4

22 Drugs break down in the human body at different rates and therefore must be prescribed by doctors carefully to prevent complications, such as overdosing. The breakdown of a drug is represented by the function $N(t) = N_0(e)^{-rt}$, where $N(t)$ is the amount left in the body, N_0 is the initial dosage, r is the decay rate, and t is time in hours. Patient A, $A(t)$, is given 800 milligrams of a drug with a decay rate of 0.347. Patient B, $B(t)$, is given 400 milligrams of another drug with a decay rate of 0.231. Write two functions, $A(t)$ and $B(t)$, to represent the breakdown of the respective drug given to each patient. Graph each function on the set of axes below.
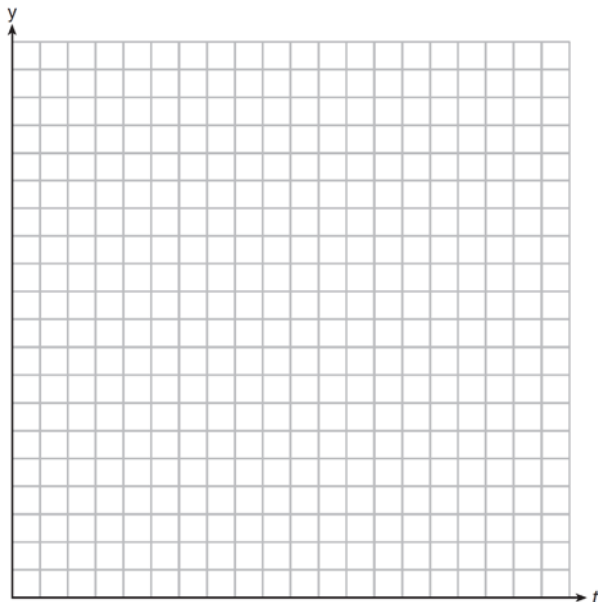
To the *nearest hour*, t, when does the amount of the given drug remaining in patient B begin to exceed the amount of the given drug remaining in patient A? The doctor will allow patient A to take another 800 milligram dose of the drug once only 15% of the original dose is left in the body. Determine, to the *nearest tenth of an hour*, how long patient A will have to wait to take another 800 milligram dose of the drug.

23 To the *nearest tenth*, the value of x that satisfies $2^x = -2x + 11$ is
1) 2.5
2) 2.6
3) 5.8
4) 5.9

24 Describe how a controlled experiment can be created to examine the effect of ingredient X in a toothpaste.

25 The function $p(t) = 110e^{0.03922t}$ models the population of a city, in millions, t years after 2010. As of today, consider the following two statements:
I. The current population is 110 million.
II. The population increases continuously by approximately 3.9% per year.
This model supports
1) I, only
2) II, only
3) both I and II
4) neither I nor II

26 The value of a new car depreciates over time. Greg purchased a new car in June 2011. The value, V, of his car after t years can be modeled by the equation $\log_{0.8}\left(\dfrac{V}{1700}\right) = t$. What is the average decreasing rate of change per year of the value of the car from June 2012 to June 2014, to the *nearest ten dollars per year*?
1) 1960
2) 2180
3) 2450
4) 2770

5

27 The ocean tides near Carter Beach follow a repeating pattern over time, with the amount of time between each low and high tide remaining relatively constant. On a certain day, low tide occurred at 8:30 a.m. and high tide occurred at 3:00 p.m. At high tide, the water level was 12 inches above the average local sea level; at low tide it was 12 inches below the average local sea level. Assume that high tide and low tide are the maximum and minimum water levels each day, respectively. Write a cosine function of the form $f(t) = A\cos(Bt)$, where A and B are real numbers, that models the water level, $f(t)$, in inches above or below the average Carter Beach sea level, as a function of the time measured in t hours since 8:30 a.m. On the grid below, graph one cycle of this function.
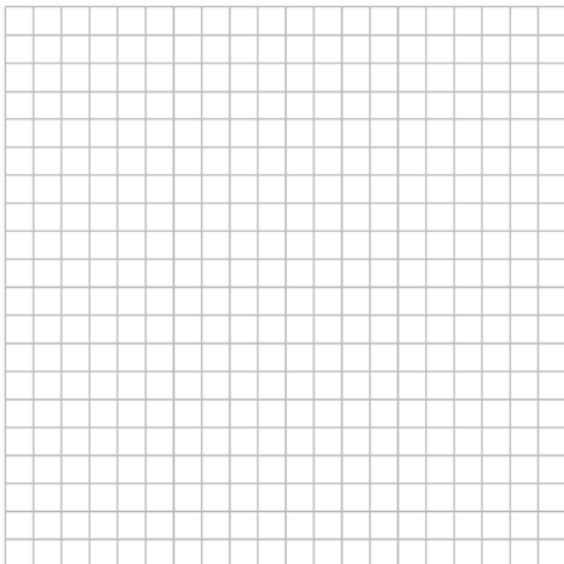
People who fish in Carter Beach know that a certain species of fish is most plentiful when the water level is increasing. Explain whether you would recommend fishing for this species at 7:30 p.m. or 10:30 p.m. using evidence from the given context.

28 Write $\sqrt[3]{x} \cdot \sqrt{x}$ as a single term with a rational exponent.

29 Solve the system of equations shown below algebraically.
$$(x-3)^2 + (y+2)^2 = 16$$
$$2x + 2y = 10$$

30 Monthly mortgage payments can be found using the formula below:

$$M = \frac{P\left(\dfrac{r}{12}\right)\left(1+\dfrac{r}{12}\right)^n}{\left(1+\dfrac{r}{12}\right)^n - 1}$$

M = monthly payment
P = amount borrowed
r = annual interest rate
n = number of monthly payments

The Banks family would like to borrow $120,000 to purchase a home. They qualified for an annual interest rate of 4.8%. Algebraically determine the *fewest* number of whole years the Banks family would need to include in the mortgage agreement in order to have a monthly payment of no more than $720.

31 Rewrite the expression
$\left(4x^2 + 5x\right)^2 - 5\left(4x^2 + 5x\right) - 6$ as a product of four linear factors.

6

32 Graph $y = \log_2(x + 3) - 5$ on the set of axes below. Use an appropriate scale to include *both* intercepts.
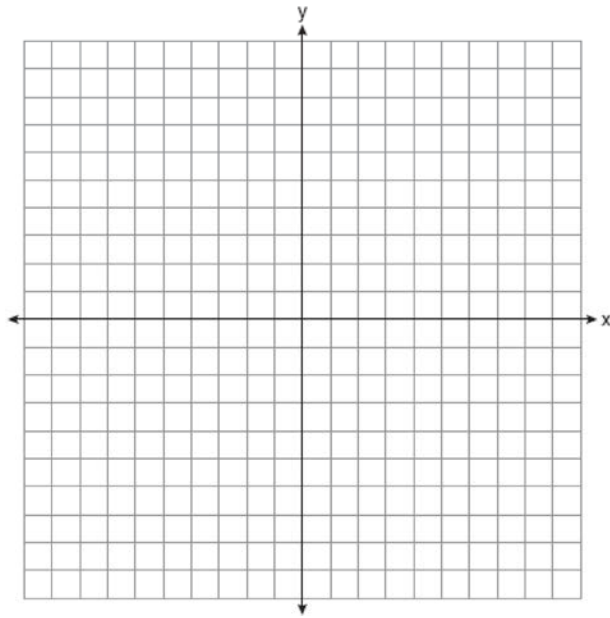
Describe the behavior of the given function as x approaches -3 and as x approaches positive infinity.

33 Verify the following Pythagorean identity for all values of x and y:
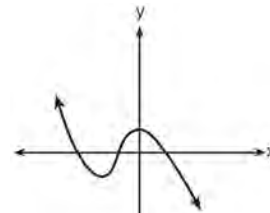$$(x^2 + y^2)^2 = (x^2 - y^2)^2 + (2xy)^2$$

34 Which expression is equivalent to $\dfrac{4x^3 + 9x - 5}{2x - 1}$, where $x \neq \dfrac{1}{2}$?
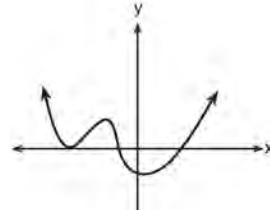
1) $2x^2 + x + 5$

2) $2x^2 + \dfrac{11}{2} + \dfrac{1}{2(2x - 1)}$

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

4) $2x^2 - x + 4 + \dfrac{1}{2x - 1}$
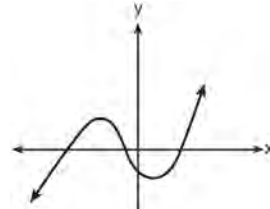
35 Which graph has the following characteristics?
- three real zeros
- as $x \to -\infty$, $f(x) \to -\infty$
- as $x \to \infty$, $f(x) \to \infty$

1)

2)

3)
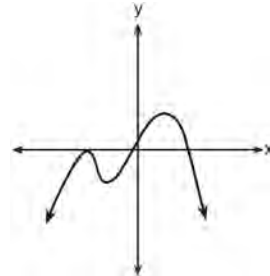
4)

36 For the function $f(x) = (x - 3)^3 + 1$, find $f^{-1}(x)$.

37 Which sinusoid has the greatest amplitude?
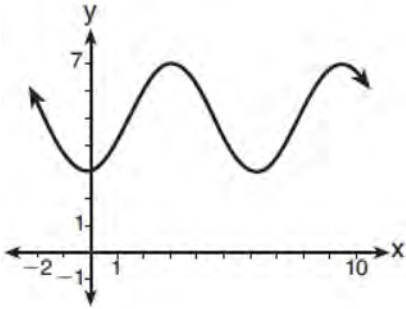
1)

2) $y = 3\sin(\theta - 3) + 5$
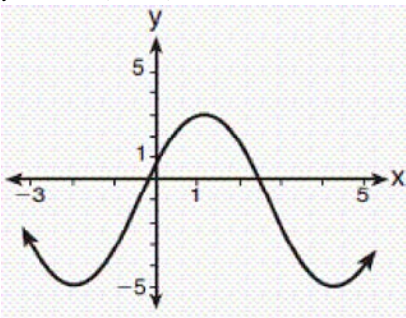
3)

4) $y = -5\sin(\theta - 1) - 3$

38 Which graph represents a cosine function with no horizontal shift, an amplitude of 2, and a period of $\dfrac{2\pi}{3}$?

1)

2)

3)

4)
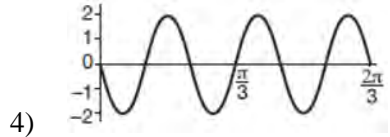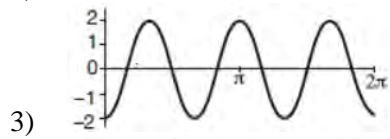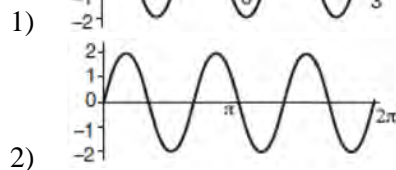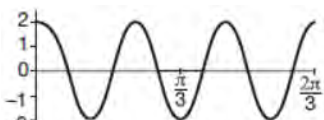
39 Which diagram represents an angle, α, measuring $\dfrac{13\pi}{20}$ radians drawn in standard position, and its reference angle, θ?

1)

2)

3)

4)
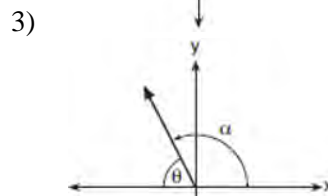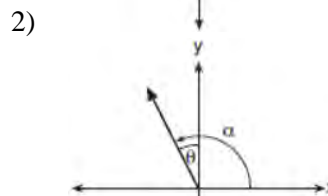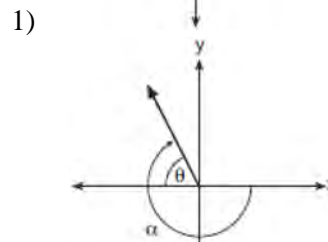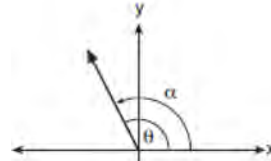
40 Solve the equation $\sqrt{2x-7} + x = 5$ algebraically, and justify the solution set.

8

41 The *x*-value of which function's *x*-intercept is larger, *f* or *h*? Justify your answer.

$$f(x) = \log(x - 4)$$

x	h(x)
−1	6
0	4
1	2
2	0
3	−2

42 Data collected about jogging from students with two older siblings are shown in the table below.

	Neither Sibling Jogs	One Sibling Jogs	Both Siblings Jogs
Student Does Not Jog	1168	1823	1380
Student Jogs	188	416	400

Using these data, determine whether a student with two older siblings is more likely to jog if one sibling jogs or if both siblings jog. Justify your answer.

43 Alexa earns $33,000 in her first year of teaching and earns a 4% increase in each successive year. Write a geometric series formula, S_n, for Alexa's total earnings over *n* years. Use this formula to find Alexa's total earnings for her first 15 years of teaching, to the *nearest cent*.

45 Explain how $\left(3^{\frac{1}{5}}\right)^2$ can be written as the equivalent radical expression $\sqrt[5]{9}$.

44 Which statement about the graph of $c(x) = \log_6 x$ is *false*?
1) The asymptote has equation $y = 0$.
2) The graph has no *y*-intercept.
3) The domain is the set of positive reals.
4) The range is the set of all real numbers.

46 The speed of a tidal wave, *s*, in hundreds of miles per hour, can be modeled by the equation $s = \sqrt{t} - 2t + 6$, where *t* represents the time from its origin in hours. Algebraically determine the time when $s = 0$. How much faster was the tidal wave traveling after 1 hour than 3 hours, to the *nearest mile per hour*? Justify your answer.

47 Which function represents exponential decay?
1) $y = 2^{0.3t}$
2) $y = 1.2^{3t}$
3) $y = \left(\dfrac{1}{2}\right)^{-t}$
4) $y = 5^{-t}$

48 For $x \neq 0$, which expressions are equivalent to one divided by the sixth root of x?

I. $\dfrac{\sqrt[6]{x}}{\sqrt[3]{x}}$ II. $\dfrac{x^{\frac{1}{6}}}{x^{\frac{1}{3}}}$ III. $x^{\frac{-1}{6}}$

1) I and II, only
2) I and III, only
3) II and III, only
4) I, II, and III

49 In 2010, the population of New York State was approximately 19,378,000 with an annual growth rate of 1.5%. Assuming the growth rate is maintained for a large number of years, which equation can be used to predict the population of New York State t years after 2010?
1) $P_t = 19,378,000(1.5)^t$
2) $P_0 = 19,378,000$

$P_t = 19,378,000 + 1.015P_{t-1}$
3) $P_t = 19,378,000(1.015)^{t-1}$
4) $P_0 = 19,378,000$

$P_t = 1.015P_{t-1}$

50 Use an appropriate procedure to show that $x - 4$ is a factor of the function $f(x) = 2x^3 - 5x^2 - 11x - 4$. Explain your answer.

51 A solution of the equation $2x^2 + 3x + 2 = 0$ is
1) $-\dfrac{3}{4} + \dfrac{1}{4}i\sqrt{7}$
2) $-\dfrac{3}{4} + \dfrac{1}{4}i$
3) $-\dfrac{3}{4} + \dfrac{1}{4}\sqrt{7}$
4) $\dfrac{1}{2}$

52 An orange-juice processing plant receives a truckload of oranges. The quality control team randomly chooses three pails of oranges, each containing 50 oranges, from the truckload. Identify the sample and the population in the given scenario. State *one* conclusion that the quality control team could make about the population if 5% of the sample was found to be unsatisfactory.

53 The volume of air in a person's lungs, as the person breathes in and out, can be modeled by a sine graph. A scientist is studying the differences in this volume for people at rest compared to people told to take a deep breath. When examining the graphs, should the scientist focus on the amplitude, period, or midline? Explain your choice.

54 The zeros for $f(x) = x^4 - 4x^3 - 9x^2 + 36x$ are
1) $\{0, \pm 3, 4\}$
2) $\{0, 3, 4\}$
3) $\{0, \pm 3, -4\}$
4) $\{0, 3, -4\}$

55 The distance needed to stop a car after applying the brakes varies directly with the square of the car's speed. The table below shows stopping distances for various speeds.

Speed (mph)	10	20	30	40	50	60	70
Distance (ft)	6.25	25	56.25	100	156.25	225	306.25

Determine the average rate of change in braking distance, in ft/mph, between one car traveling at 50 mph and one traveling at 70 mph. Explain what this rate of change means as it relates to braking distance.

56 Charlie's Automotive Dealership is considering implementing a new check-in procedure for customers who are bringing their vehicles for routine maintenance. The dealership will launch the procedure if 50% or more of the customers give the new procedure a favorable rating when compared to the current procedure. The dealership devises a simulation based on the minimal requirement that 50% of the customers prefer the new procedure. Each dot on the graph below represents the proportion of the customers who preferred the new check-in procedure, each of sample size 40, simulated 100 times.
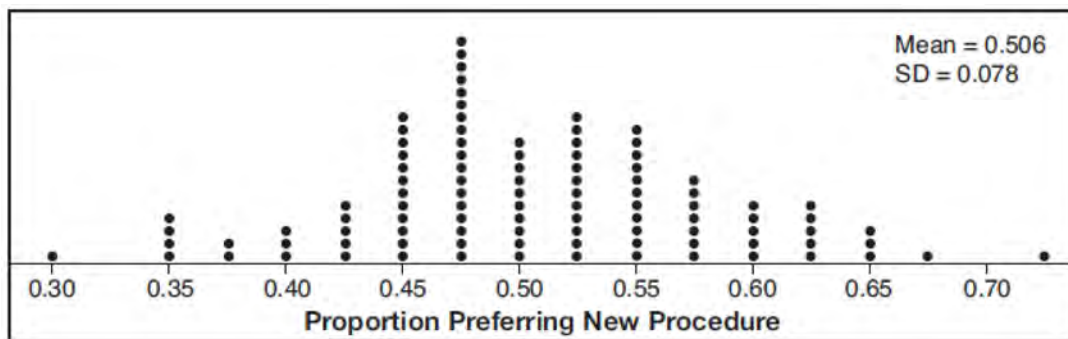
Assume the set of data is approximately normal and the dealership wants to be 95% confident of its results. Determine an interval containing the plausible sample values for which the dealership will launch the new procedure. Round your answer to the *nearest hundredth*. Forty customers are selected randomly to undergo the new check-in procedure and the proportion of customers who prefer the new procedure is 32.5%. The dealership decides *not* to implement the new check-in procedure based on the results of the study. Use statistical evidence to explain this decision.

57 What are the zeros of $P(m) = (m^2 - 4)(m^2 + 1)$?
1) 2 and -2, only
2) $2, -2$, and -4
3) $-4, i$, and $-i$
4) $2, -2, i$, and $-i$

58 Algebraically prove that the difference of the squares of any two consecutive integers is an odd integer.

59 If $p(x) = ab^x$ and $r(x) = cd^x$, then $p(x) \bullet r(x)$ equals

1) $ac(b+d)^x$

2) $ac(b+d)^{2x}$

3) $ac(bd)^x$

4) $ac(bd)^{x^2}$

60 A game spinner is divided into 6 equally sized regions, as shown in the diagram below.

For Miles to win, the spinner must land on the number 6. After spinning the spinner 10 times, and losing all 10 times, Miles complained that the spinner is unfair. At home, his dad ran 100 simulations of spinning the spinner 10 times, assuming the probability of winning each spin is $\frac{1}{6}$.

The output of the simulation is shown in the diagram below.
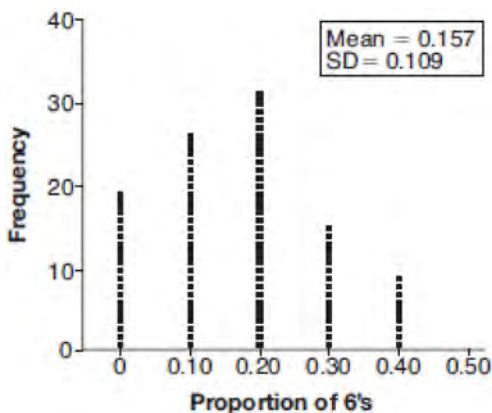
Which explanation is appropriate for Miles and his dad to make?

1) The spinner was likely unfair, since the number 6 failed to occur in about 20% of the simulations.

2) The spinner was likely unfair, since the spinner should have landed on the number 6 by the sixth spin.

3) The spinner was likely not unfair, since the number 6 failed to occur in about 20% of the simulations.

4) The spinner was likely not unfair, since in the output the player wins once or twice in the majority of the simulations.

61 Using the formula below, determine the monthly payment on a 5-year car loan with a monthly percentage rate of 0.625% for a car with an original cost of $21,000 and a $1000 down payment, to the *nearest cent*.

$$P_n = PMT\left(\frac{1-(1+i)^{-n}}{i}\right)$$

P_n = present amount borrowed

n = number of monthly pay periods

PMT = monthly payment

i = interest rate per month

The affordable monthly payment is $300 for the same time period. Determine an appropriate down payment, to the *nearest dollar*.

62 Jasmine decides to put $100 in a savings account each month. The account pays 3% annual interest, compounded monthly. How much money, S, will Jasmine have after one year?

1) $S = 100(1.03)^{12}$

2) $S = \dfrac{100 - 100(1.0025)^{12}}{1 - 1.0025}$

3) $S = 100(1.0025)^{12}$

4) $S = \dfrac{100 - 100(1.03)^{12}}{1 - 1.03}$

63 Using a microscope, a researcher observed and recorded the number of bacteria spores on a large sample of uniformly sized pieces of meat kept at room temperature. A summary of the data she recorded is shown in the table below.

Hours (x)	Average Number of Spores (y)
0	4
0.5	10
1	15
2	60
3	260
4	1130
6	16,380

Using these data, write an exponential regression equation, rounding all values to the *nearest thousandth*. The researcher knows that people are likely to suffer from food-borne illness if the number of spores exceeds 100. Using the exponential regression equation, determine the maximum amount of time, to the *nearest quarter hour*, that the meat can be kept at room temperature safely.

64 A cardboard box manufacturing company is building boxes with length represented by $x + 1$, width by $5 - x$, and height by $x - 1$. The volume of the box is modeled by the function below.
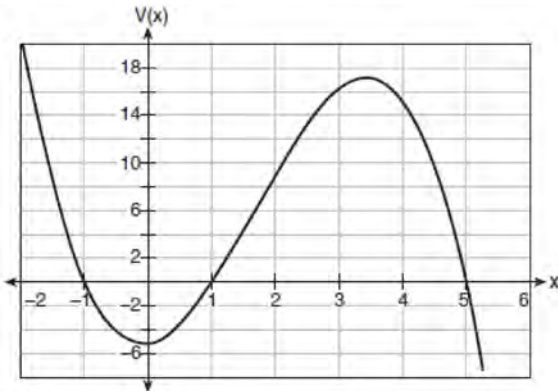
Over which interval is the volume of the box changing at the fastest average rate?
1) [1,2]
2) [1,3.5]
3) [1,5]
4) [0,3.5]

65 On the grid below, sketch a cubic polynomial whose zeros are 1, 3, and -2.
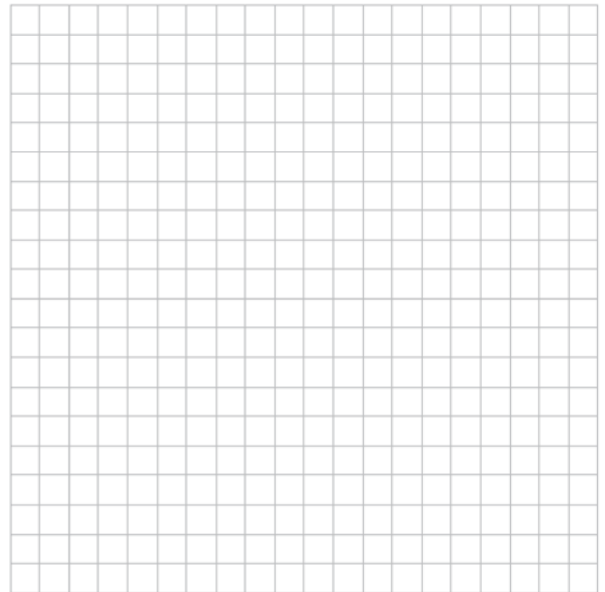
66 The set of data in the table below shows the results of a survey on the number of messages that people of different ages text on their cell phones each month.

Age Group	Text Messages per Month		
	0–10	11–50	Over 50
15–18	4	37	68
19–22	6	25	87
23–60	25	47	157

If a person from this survey is selected at random, what is the probability that the person texts over 50 messages per month given that the person is between the ages of 23 and 60?

1) $\dfrac{157}{229}$

2) $\dfrac{157}{312}$

3) $\dfrac{157}{384}$

4) $\dfrac{157}{456}$

67 The inverse of the function $f(x) = \dfrac{x+1}{x-2}$ is

1) $f^{-1}(x) = \dfrac{x+1}{x+2}$

2) $f^{-1}(x) = \dfrac{2x+1}{x-1}$

3) $f^{-1}(x) = \dfrac{x+1}{x-2}$

4) $f^{-1}(x) = \dfrac{x-1}{x+1}$

68 Solve algebraically for all values of x:
$$\sqrt{x-5} + x = 7$$

69 Which expression has been rewritten correctly to form a true statement?

1) $(x+2)^2 + 2(x+2) - 8 = (x+6)x$

2) $x^4 + 4x^2 + 9x^2y^2 - 36y^2 = (x+3y)^2(x-2)^2$

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

4) $(x^2-4)^2 - 5(x^2-4) - 6 = (x^2-7)(x^2-6)$

70 Functions f, g, and h are given below.

$$f(x) = \sin(2x)$$

$$g(x) = f(x) + 1$$
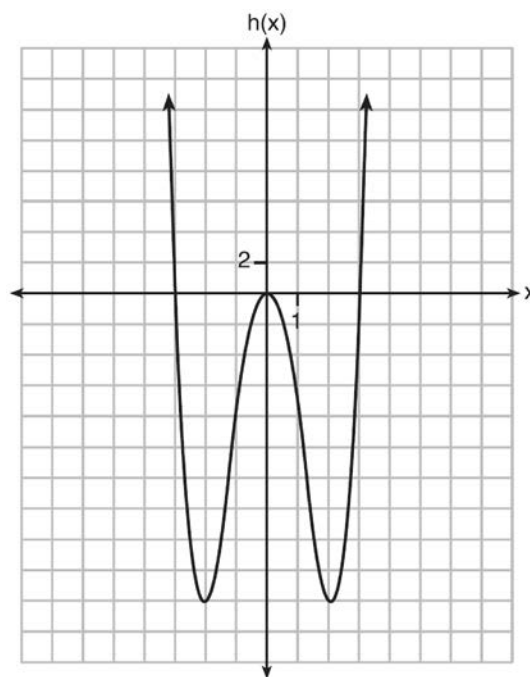
Which statement is true about functions f, g, and h?

1) $f(x)$ and $g(x)$ are odd, $h(x)$ is even.

2) $f(x)$ and $g(x)$ are even, $h(x)$ is odd.

3) $f(x)$ is odd, $g(x)$ is neither, $h(x)$ is even.

4) $f(x)$ is even, $g(x)$ is neither, $h(x)$ is odd.

71 A study of the annual population of the red-winged blackbird in Ft. Mill, South Carolina, shows the population, $B(t)$, can be represented by the function $B(t) = 750(1.16)^t$, where the t represents the number of years since the study began. In terms of the monthly rate of growth, the population of red-winged blackbirds can be best approximated by the function
1) $B(t) = 750(1.012)^t$
2) $B(t) = 750(1.012)^{12t}$
3) $B(t) = 750(1.16)^{12t}$
4) $B(t) = 750(1.16)^{\frac{t}{12}}$

72 As x increases from 0 to $\dfrac{\pi}{2}$, the graph of the equation $y = 2\tan x$ will
1) increase from 0 to 2
2) decrease from 0 to -2
3) increase without limit
4) decrease without limit

73 Jim is looking to buy a vacation home for $172,600 near his favorite southern beach. The formula to compute a mortgage payment, M, is

$$M = P \cdot \frac{r(1+r)^N}{(1+r)^N - 1}$$ where P is the principal

amount of the loan, r is the monthly interest rate, and N is the number of monthly payments. Jim's bank offers a monthly interest rate of 0.305% for a 15-year mortgage. With no down payment, determine Jim's mortgage payment, rounded to the *nearest dollar*. Algebraically determine and state the down payment, rounded to the *nearest dollar*, that Jim needs to make in order for his mortgage payment to be $1100.

74 A parabola has its focus at $(1,2)$ and its directrix is $y = -2$. The equation of this parabola could be
1) $y = 8(x+1)^2$
2) $y = \dfrac{1}{8}(x+1)^2$
3) $y = 8(x-1)^2$
4) $y = \dfrac{1}{8}(x-1)^2$

75 Solve the following system of equations algebraically for all values of x, y, and z:
$$x + 3y + 5z = 45$$
$$6x - 3y + 2z = -10$$
$$-2x + 3y + 8z = 72$$

76 On the axes below, graph *one* cycle of a cosine function with amplitude 3, period $\dfrac{\pi}{2}$, midline $y = -1$, and passing through the point $(0,2)$.
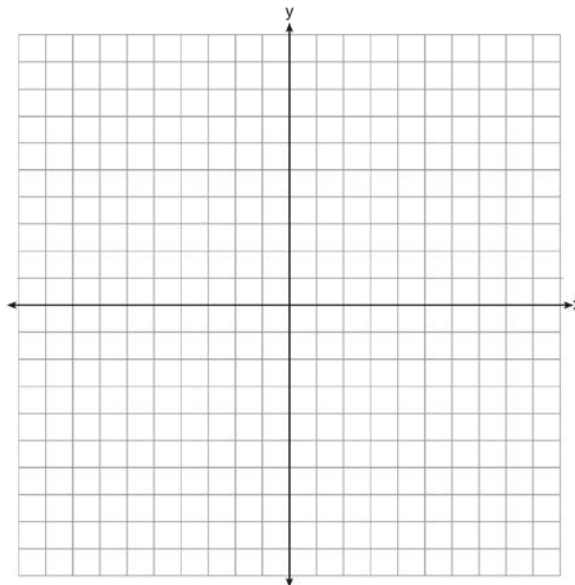
77 The function $M(t)$ represents the mass of radium over time, t, in years.

$$M(t) = 100e^{\frac{\left(\ln\frac{1}{2}\right)t}{1590}}$$

Determine if the function $M(t)$ represents growth or decay. Explain your reasoning.

78 The expression $\dfrac{6x^3 + 17x^2 + 10x + 2}{2x + 3}$ equals

1) $3x^2 + 4x - 1 + \dfrac{5}{2x + 3}$

2) $6x^2 + 8x - 2 + \dfrac{5}{2x + 3}$

3) $6x^2 - x + 13 - \dfrac{37}{2x + 3}$

4) $3x^2 + 13x + \dfrac{49}{2} + \dfrac{151}{2x + 3}$

79 A polynomial equation of degree three, $p(x)$, is used to model the volume of a rectangular box. The graph of $p(x)$ has x intercepts at -2, 10, and 14. Which statements regarding $p(x)$ could be true?
A. The equation of $p(x) = (x - 2)(x + 10)(x + 14)$.
B. The equation of $p(x) = -(x + 2)(x - 10)(x - 14)$.
C. The maximum volume occurs when $x = 10$.
D. The maximum volume of the box is approximately 56.
1) A and C
2) A and D
3) B and C
4) B and D

80 Solve for x: $\dfrac{1}{x} - \dfrac{1}{3} = -\dfrac{1}{3x}$

81 Which equation is represented by the graph shown below?
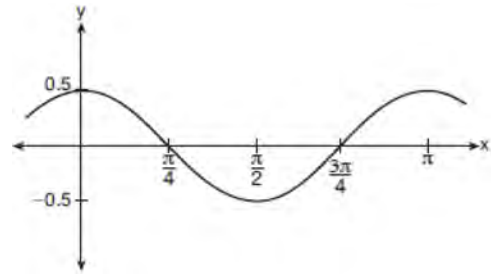
1) $y = \dfrac{1}{2}\cos 2x$

2) $y = \cos x$

3) $y = \dfrac{1}{2}\cos x$

4) $y = 2\cos \dfrac{1}{2}x$

82 Last year, the total revenue for Home Style, a national restaurant chain, increased 5.25% over the previous year. If this trend were to continue, which expression could the company's chief financial officer use to approximate their monthly percent increase in revenue? [Let m represent months.]
1) $(1.0525)^m$
2) $(1.0525)^{\frac{12}{m}}$
3) $(1.00427)^m$
4) $(1.00427)^{\frac{m}{12}}$

16

83 Fifty-five students attending the prom were randomly selected to participate in a survey about the music choice at the prom. Sixty percent responded that a DJ would be preferred over a band. Members of the prom committee thought that the vote would have 50% for the DJ and 50% for the band. A simulation was run 200 times, each of sample size 55, based on the premise that 60% of the students would prefer a DJ. The approximate normal simulation results are shown below.
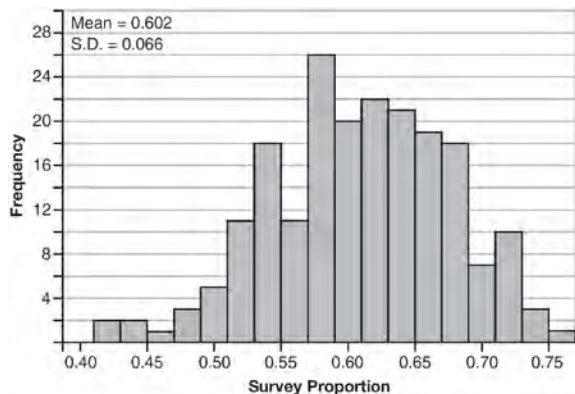
Using the results of the simulation, determine a plausible interval containing the middle 95% of the data. Round all values to the *nearest hundredth*. Members of the prom committee are concerned that a vote of all students attending the prom may produce a 50% − 50% split. Explain what statistical evidence supports this concern.

84 The sequence $a_1 = 6$, $a_n = 3a_{n-1}$ can also be written as
1) $a_n = 6 \cdot 3^n$
2) $a_n = 6 \cdot 3^{n+1}$
3) $a_n = 2 \cdot 3^n$
4) $a_n = 2 \cdot 3^{n+1}$

85 The completely factored form of $2d^4 + 6d^3 - 18d^2 - 54d$ is
1) $2d(d^2 - 9)(d + 3)$
2) $2d(d^2 + 9)(d + 3)$
3) $2d(d + 3)^2(d - 3)$
4) $2d(d - 3)^2(d + 3)$

86 In contract negotiations between a local government agency and its workers, it is estimated that there is a 50% chance that an agreement will be reached on the salaries of the workers. It is estimated that there is a 70% chance that there will be an agreement on the insurance benefits. There is a 20% chance that no agreement will be reached on either issue. Find the probability that an agreement will be reached on *both* issues. Based on this answer, determine whether the agreement on salaries and the agreement on insurance are independent events. Justify your answer.

87 Given the parent function $p(x) = \cos x$, which phrase best describes the transformation used to obtain the graph of $g(x) = \cos(x + a) - b$, if a and b are positive constants?
1) right a units, up b units
2) right a units, down b units
3) left a units, up b units
4) left a units, down b units

88 When $g(x)$ is divided by $x + 4$, the remainder is 0. Given $g(x) = x^4 + 3x^3 - 6x^2 - 6x + 8$, which conclusion about $g(x)$ is true?
1) $g(4) = 0$
2) $g(-4) = 0$
3) $x - 4$ is a factor of $g(x)$.
4) No conclusion can be made regarding $g(x)$.

89 What is the solution to the system of equations $y = 3x - 2$ and $y = g(x)$ where $g(x)$ is defined by the function below?
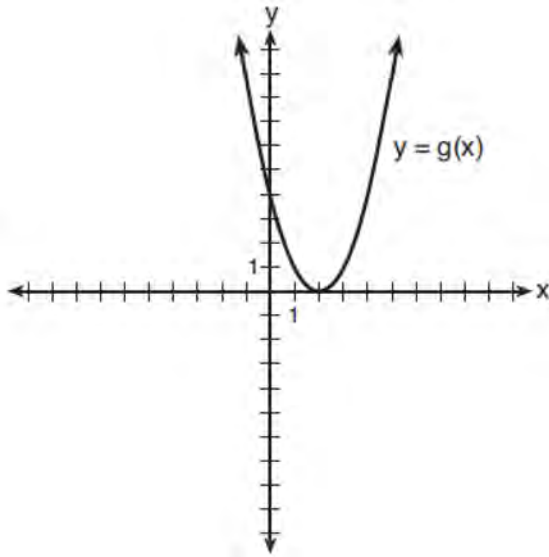
1) $\{(0,-2)\}$
2) $\{(0,-2),(1,6)\}$
3) $\{(1,6)\}$
4) $\{(1,1),(6,16)\}$

90 Sean's team has a baseball game tomorrow. He pitches 50% of the games. There is a 40% chance of rain during the game tomorrow. If the probability that it rains given that Sean pitches is 40%, it can be concluded that these two events are
1) independent
2) dependent
3) mutually exclusive
4) complements

91 Determine if $x - 5$ is a factor of $2x^3 - 4x^2 - 7x - 10$. Explain your answer.

92 Which value, to the *nearest tenth*, is *not* a solution of $p(x) = q(x)$ if $p(x) = x^3 + 3x^2 - 3x - 1$ and $q(x) = 3x + 8$?
1) -3.9
2) -1.1
3) 2.1
4) 4.7

93 The formula below can be used to model which scenario?
$$a_1 = 3000$$
$$a_n = 0.80a_{n-1}$$
1) The first row of a stadium has 3000 seats, and each row thereafter has 80 more seats than the row in front of it.
2) The last row of a stadium has 3000 seats, and each row before it has 80 fewer seats than the row behind it.
3) A bank account starts with a deposit of $3000, and each year it grows by 80%.
4) The initial value of a specialty toy is $3000, and its value each of the following years is 20% less.

94 A sine function increasing through the origin can be used to model light waves. Violet light has a wavelength of 400 nanometers. Over which interval is the height of the wave *decreasing*, only?
1) $(0,200)$
2) $(100,300)$
3) $(200,400)$
4) $(300,400)$

18

95 The graph below represents the height above the ground, h, in inches, of a point on a triathlete's bike wheel during a training ride in terms of time, t, in seconds.
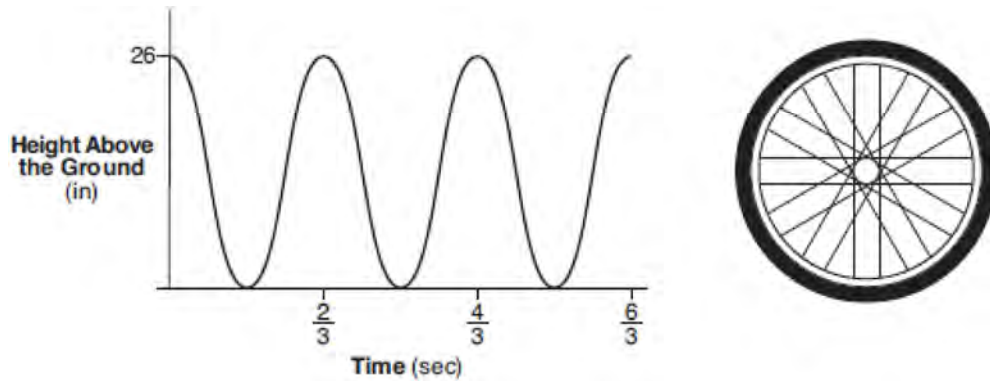
Identify the period of the graph and describe what the period represents in this context.

96 Which equation represents the set of points equidistant from line ℓ and point R shown on the graph below?
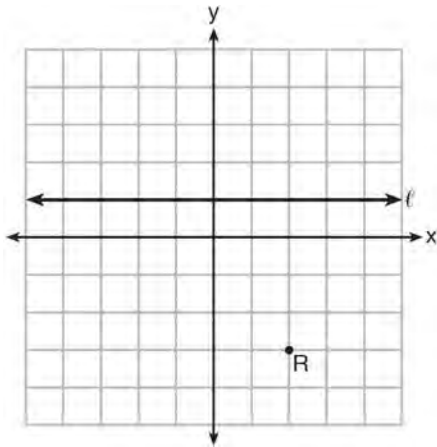
1) $y = -\dfrac{1}{8}(x+2)^2 + 1$

2) $y = -\dfrac{1}{8}(x+2)^2 - 1$

3) $y = -\dfrac{1}{8}(x-2)^2 + 1$

4) $y = -\dfrac{1}{8}(x-2)^2 - 1$

97 The graph of $p(x)$ is shown below.
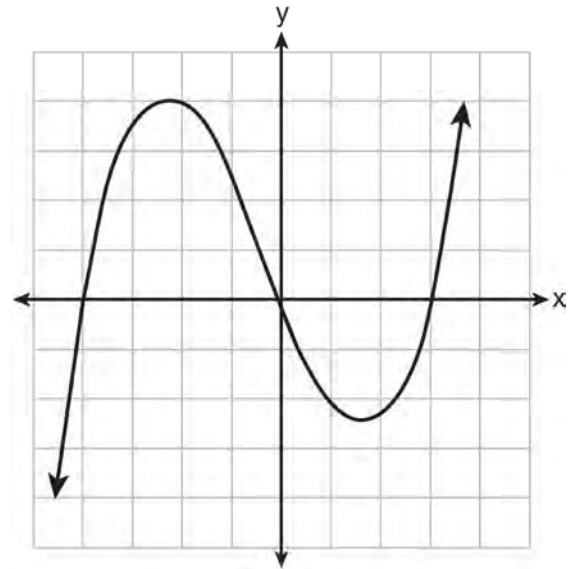
What is the remainder when $p(x)$ is divided by $x+4$?
1) $x-4$
2) -4
3) 0
4) 4

98 a) On the axes below, sketch *at least one* cycle of a sine curve with an amplitude of 2, a midline at $y = -\dfrac{3}{2}$, and a period of 2π.
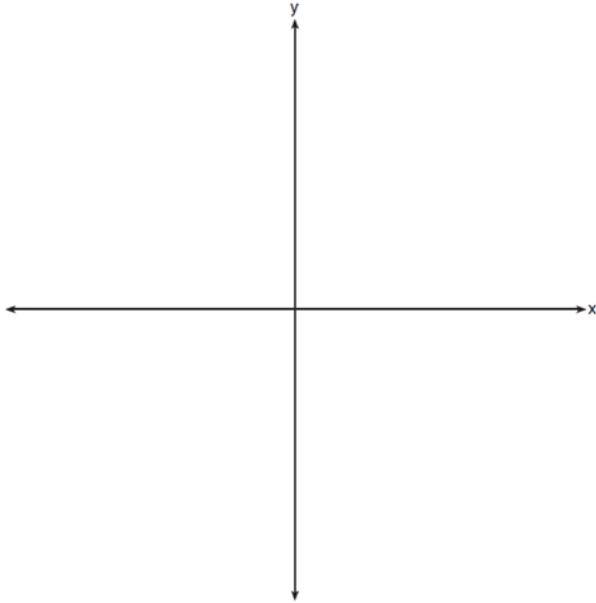
b) Explain any differences between a sketch of $y = 2\sin\left(x - \dfrac{\pi}{3}\right) - \dfrac{3}{2}$ and the sketch from part a.

99 The roots of the equation $x^2 + 2x + 5 = 0$ are
1) -3 and 1
2) -1, only
3) $-1 + 2i$ and $-1 - 2i$
4) $-1 + 4i$ and $-1 - 4i$

100 Given: $h(x) = \dfrac{2}{9}x^3 + \dfrac{8}{9}x^2 - \dfrac{16}{13}x + 2$

$k(x) = -|0.7x| + 5$

State the solutions to the equation $h(x) = k(x)$, rounded to the *nearest hundredth*.

101 The function $f(x) = \dfrac{x - 3}{x^2 + 2x - 8}$ is undefined when x equals
1) 2 or -4
2) 4 or -2
3) 3, only
4) 2, only

102 A candidate for political office commissioned a poll. His staff received responses from 900 likely voters and 55% of them said they would vote for the candidate. The staff then conducted a simulation of 1000 more polls of 900 voters, assuming that 55% of voters would vote for their candidate. The output of the simulation is shown in the diagram below.
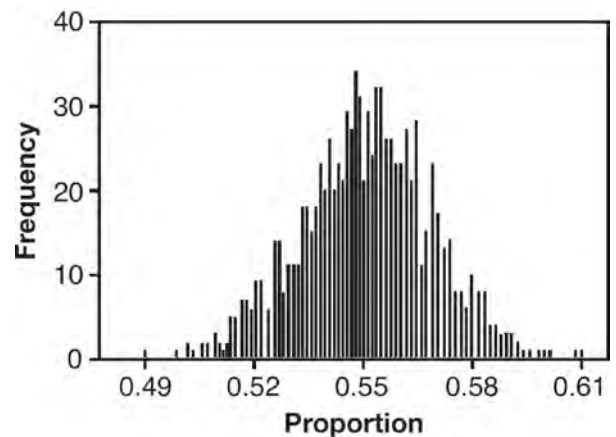
Given this output, and assuming a 95% confidence level, the margin of error for the poll is closest to
1)   0.01
2)   0.03
3)   0.06
4)   0.12

103 Which function shown below has a greater average rate of change on the interval $[-2, 4]$? Justify your answer.

x	f(x)
−4	0.3125
−3	0.625
−2	1.25
−1	2.5
0	5
1	10
2	20
3	40
4	80
5	160
6	320

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

104 Algebraically prove that $\dfrac{x^3 + 9}{x^3 + 8} = 1 + \dfrac{1}{x^3 + 8}$, where $x \neq -2$.

105 A student studying public policy created a model for the population of Detroit, where the population decreased 25% over a decade. He used the model $P = 714(0.75)^d$, where P is the population, in thousands, d decades after 2010. Another student, Suzanne, wants to use a model that would predict the population after y years. Suzanne's model is best represented by

1) $P = 714(0.6500)^y$

2) $P = 714(0.8500)^y$

3) $P = 714(0.9716)^y$

4) $P = 714(0.9750)^y$

106 Solve algebraically for all values of x:
$$\sqrt{x - 4} + x = 6$$

107 The Rickerts decided to set up an account for their daughter to pay for her college education. The day their daughter was born, they deposited $1000 in an account that pays 1.8% compounded annually. Beginning with her first birthday, they deposit an additional $750 into the account on each of her birthdays. Which expression correctly represents the amount of money in the account n years after their daughter was born?

1) $a_n = 1000(1.018)^n + 750$

2) $a_n = 1000(1.018)^n + 750n$

3) $a_0 = 1000$

   $a_n = a_{n-1}(1.018) + 750$

4) $a_0 = 1000$

   $a_n = a_{n-1}(1.018) + 750n$

108 A ball is dropped from a height of 32 feet. It bounces and rebounds 80% of the height from which it was falling. What is the total downward distance, in feet, the ball traveled up to the 12th bounce?
1) 29
2) 58
3) 120
4) 149

109 The focal length, F, of a camera's lens is related to the distance of the object from the lens, J, and the distance to the image area in the camera, W, by the formula below.

$$\frac{1}{J} + \frac{1}{W} = \frac{1}{F}$$

When this equation is solved for J in terms of F and W, J equals
1) $F - W$
2) $\dfrac{FW}{F - W}$
3) $\dfrac{FW}{W - F}$
4) $\dfrac{1}{F} - \dfrac{1}{W}$

110 Which statement is *incorrect* for the graph of the function $y = -3\cos\left[\dfrac{\pi}{3}(x - 4)\right] + 7$?

1) The period is 6.
2) The amplitude is 3.
3) The range is [4,10].
4) The midline is $y = -4$.

111 Factored completely, $m^5 + m^3 - 6m$ is equivalent to
1) $(m + 3)(m - 2)$
2) $(m^2 + 3m)(m^2 - 2)$
3) $m(m^4 + m^2 - 6)$
4) $m(m^2 + 3)(m^2 - 2)$

112 A radioactive substance has a mass of 140 g at 3 p.m. and 100 g at 8 p.m. Write an equation in the form $A = A_0\left(\dfrac{1}{2}\right)^{\frac{t}{h}}$ that models this situation, where h is the constant representing the number of hours in the half-life, A_0 is the initial mass, and A is the mass t hours after 3 p.m. Using this equation, solve for h, to the *nearest ten thousandth*. Determine when the mass of the radioactive substance will be 40 g. Round your answer to the *nearest tenth of an hour*.

113 Use the properties of rational exponents to determine the value of y for the equation:

$$\frac{\sqrt[3]{x^8}}{\left(x^4\right)^{\frac{1}{3}}} = x^y,\ x > 1$$

114 Given i is the imaginary unit, $(2 - yi)^2$ in simplest form is
1) $y^2 - 4yi + 4$
2) $-y^2 - 4yi + 4$
3) $-y^2 + 4$
4) $y^2 + 4$

22

115 Which equation represents a parabola with a focus of $(0,4)$ and a directrix of $y = 2$?

1) $y = x^2 + 3$

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

3) $y = \dfrac{x^2}{2} + 3$

4) $y = \dfrac{x^2}{4} + 3$

116 Kristin wants to increase her running endurance. According to experts, a gradual mileage increase of 10% per week can reduce the risk of injury. If Kristin runs 8 miles in week one, which expression can help her find the total number of miles she will have run over the course of her 6-week training program?

1) $\displaystyle\sum_{n=1}^{6} 8(1.10)^{n-1}$

2) $\displaystyle\sum_{n=1}^{6} 8(1.10)^{n}$

3) $\dfrac{8 - 8(1.10)^6}{0.90}$

4) $\dfrac{8 - 8(0.10)^n}{1.10}$

117 A study was designed to test the effectiveness of a new drug. Half of the volunteers received the drug. The other half received a sugar pill. The probability of a volunteer receiving the drug and getting well was 40%. What is the probability of a volunteer getting well, given that the volunteer received the drug?

118 In New York State, the minimum wage has grown exponentially. In 1966, the minimum wage was $1.25 an hour and in 2015, it was $8.75. Algebraically determine the rate of growth to the *nearest percent*.

119 Find algebraically the zeros for $p(x) = x^3 + x^2 - 4x - 4$. On the set of axes below, graph $y = p(x)$.
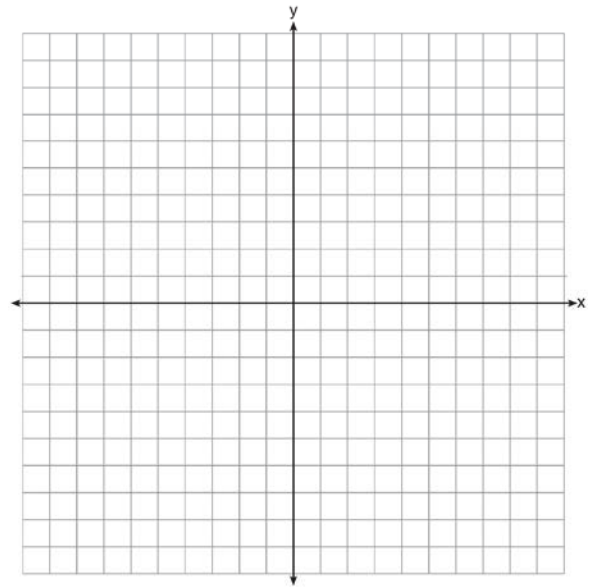
120 Which binomial is a factor of $x^4 - 4x^2 - 4x + 8$?

1) $x - 2$

2) $x + 2$

3) $x - 4$

4) $x + 4$

121 Simon lost his library card and has an overdue library book. When the book was 5 days late, he owed $2.25 to replace his library card and pay the fine for the overdue book. When the book was 21 days late, he owed $6.25 to replace his library card and pay the fine for the overdue book. Suppose the total amount Simon owes when the book is n days late can be determined by an arithmetic sequence. Determine a formula for a_n, the nth term of this sequence. Use the formula to determine the amount of money, in dollars, Simon needs to pay when the book is 60 days late.

122 A public opinion poll was conducted on behalf of Mayor Ortega's reelection campaign shortly before the election. 264 out of 550 likely voters said they would vote for Mayor Ortega; the rest said they would vote for his opponent. Which statement is *least* appropriate to make, according to the results of the poll?
1) There is a 48% chance that Mayor Ortega will win the election.
2) The point estimate ($\hat{p}$) of voters who will vote for Mayor Ortega is 48%.
3) It is most likely that between 44% and 52% of voters will vote for Mayor Ortega.
4) Due to the margin of error, an inference cannot be made regarding whether Mayor Ortega or his opponent is most likely to win the election.

123 If $g(c) = 1 - c^2$ and $m(c) = c + 1$, then which statement is *not* true?
1) $g(c) \cdot m(c) = 1 + c - c^2 - c^3$
2) $g(c) + m(c) = 2 + c - c^2$
3) $m(c) - g(c) = c + c^2$
4) $\dfrac{m(c)}{g(c)} = \dfrac{-1}{1-c}$

124 The value of a certain small passenger car based on its use in years is modeled by $V(t) = 28482.698(0.684)^t$, where $V(t)$ is the value in dollars and t is the time in years. Zach had to take out a loan to purchase the small passenger car. The function $Z(t) = 22151.327(0.778)^t$, where $Z(t)$ is measured in dollars, and t is the time in years, models the unpaid amount of Zach's loan over time. Graph $V(t)$ and $Z(t)$ over the interval $0 \le t \le 5$, on the set of axes below.
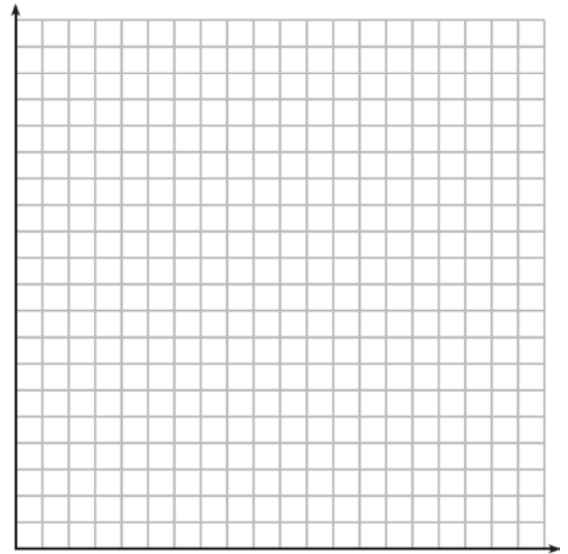
State when $V(t) = Z(t)$, to the *nearest hundredth*, and interpret its meaning in the context of the problem. Zach takes out an insurance policy that requires him to pay a $3000 deductible in case of a collision. Zach will cancel the collision policy when the value of his car equals his deductible. To the *nearest year*, how long will it take Zach to cancel this policy? Justify your answer.

125 Which equation has $1 - i$ as a solution?
1) $x^2 + 2x - 2 = 0$
2) $x^2 + 2x + 2 = 0$
3) $x^2 - 2x - 2 = 0$
4) $x^2 - 2x + 2 = 0$

126 The probability that Gary and Jane have a child with blue eyes is 0.25, and the probability that they have a child with blond hair is 0.5. The probability that they have a child with both blue eyes and blond hair is 0.125. Given this information, the events blue eyes and blond hair are

    I: dependent
    II: independent
    III: mutually exclusive

1) I, only
2) II, only
3) I and III
4) II and III

127 Mallory wants to buy a new window air conditioning unit. The cost for the unit is $329.99. If she plans to run the unit three months out of the year for an annual operating cost of $108.78, which function models the cost per year over the lifetime of the unit, $C(n)$, in terms of the number of years, n, that she owns the air conditioner.
1) $C(n) = 329.99 + 108.78n$
2) $C(n) = 329.99 + 326.34n$
3) $C(n) = \dfrac{329.99 + 108.78n}{n}$
4) $C(n) = \dfrac{329.99 + 326.34n}{n}$

128 The solution to the equation $4x^2 + 98 = 0$ is
1) ± 7
2) $\pm 7i$
3) $\pm\dfrac{7\sqrt{2}}{2}$
4) $\pm\dfrac{7i\sqrt{2}}{2}$

129 A circle centered at the origin has a radius of 10 units. The terminal side of an angle, θ, intercepts the circle in Quadrant II at point C. The y-coordinate of point C is 8. What is the value of $\cos\theta$?
1) $-\dfrac{3}{5}$
2) $-\dfrac{3}{4}$
3) $\dfrac{3}{5}$
4) $\dfrac{4}{5}$

130 The lifespan of a 60-watt lightbulb produced by a company is normally distributed with a mean of 1450 hours and a standard deviation of 8.5 hours. If a 60-watt lightbulb produced by this company is selected at random, what is the probability that its lifespan will be between 1440 and 1465 hours?
1) 0.3803
2) 0.4612
3) 0.8415
4) 0.9612

131 A study conducted in 2004 in New York City found that 212 out of 1334 participants had hypertension. Kim ran a simulation of 100 studies based on these data. The output of the simulation is shown in the diagram below.

Proportion of Successes
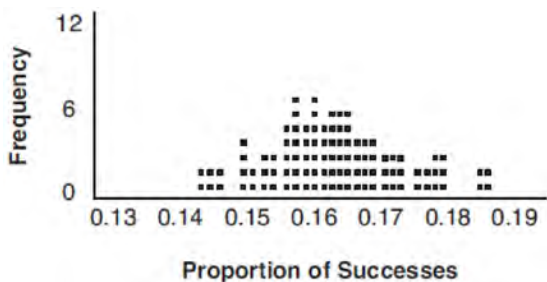
At a 95% confidence level, the proportion of New York City residents with hypertension and the margin of error are closest to
1) proportion $\approx .16$; margin of error $\approx .01$
2) proportion $\approx .16$; margin of error $\approx .02$
3) proportion $\approx .01$; margin of error $\approx .16$
4) proportion $\approx .02$; margin of error $\approx .16$

132 Cheap and Fast gas station is conducting a consumer satisfaction survey. Which method of collecting data would most likely lead to a biased sample?
1) interviewing every 5th customer to come into the station
2) interviewing customers chosen at random by a computer at the checkout
3) interviewing customers who call an 800 number posted on the customers' receipts
4) interviewing every customer who comes into the station on a day of the week chosen at random out of a hat

133 To solve $\dfrac{2x}{x-2} - \dfrac{11}{x} = \dfrac{8}{x^2 - 2x}$, Ren multiplied both sides by the least common denominator. Which statement is true?
1) 2 is an extraneous solution.
2) $\dfrac{7}{2}$ is an extraneous solution.
3) 0 and 2 are extraneous solutions.
4) This equation does not contain any extraneous solutions.

134 The Ferris wheel at the landmark Navy Pier in Chicago takes 7 minutes to make one full rotation. The height, H, in feet, above the ground of one of the six-person cars can be modeled by

$H(t) = 70\sin\left(\dfrac{2\pi}{7}(t - 1.75)\right) + 80$, where t is time,

in minutes. Using $H(t)$ for one full rotation, this car's minimum height, in feet, is
1) 150
2) 70
3) 10
4) 0

135 Given that $\sin^2 \theta + \cos^2 \theta = 1$ and $\sin \theta = -\dfrac{\sqrt{2}}{5}$, what is a possible value of $\cos \theta$?
1) $\dfrac{5 + \sqrt{2}}{5}$
2) $\dfrac{\sqrt{23}}{5}$
3) $\dfrac{3\sqrt{3}}{5}$
4) $\dfrac{\sqrt{35}}{5}$

136 The solutions to the equation $-\frac{1}{2}x^2 = -6x + 20$ are

    1) $\quad -6 \pm 2i$
    2) $\quad -6 \pm 2\sqrt{19}$
    3) $\quad 6 \pm 2i$
    4) $\quad 6 \pm 2\sqrt{19}$

137 Given events A and B, such that $P(A) = 0.6$, $P(B) = 0.5$, and $P(A \cup B) = 0.8$, determine whether A and B are independent or dependent.

138 The graph of the function $p(x)$ is sketched below.
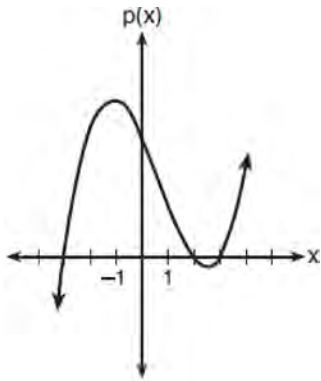
Which equation could represent $p(x)$?

    1) $\quad p(x) = (x^2 - 9)(x - 2)$
    2) $\quad p(x) = x^3 - 2x^2 + 9x + 18$
    3) $\quad p(x) = (x^2 + 9)(x - 2)$
    4) $\quad p(x) = x^3 + 2x^2 - 9x - 18$

139 Solve the following system of equations algebraically for all values of x, y, and z:

$$x + y + z = 1$$
$$2x + 4y + 6z = 2$$
$$-x + 3y - 5z = 11$$

140 The solution set for the equation $\sqrt{56 - x} = x$ is

    1) $\quad \{-8, 7\}$
    2) $\quad \{-7, 8\}$
    3) $\quad \{7\}$
    4) $\quad \{ \}$

141 Using the unit circle below, explain why $\csc \theta = \frac{1}{y}$.
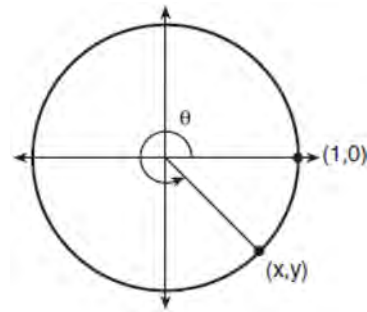
142 Which expression is equivalent to $(3k - 2i)^2$, where i is the imaginary unit?

    1) $\quad 9k^2 - 4$
    2) $\quad 9k^2 + 4$
    3) $\quad 9k^2 - 12ki - 4$
    4) $\quad 9k^2 - 12ki + 4$

143 If a, b, and c are all positive real numbers, which graph could represent the sketch of the graph of $p(x) = -a(x+b)\left(x^2 - 2cx + c^2\right)$?

1)

2)

3)

4)
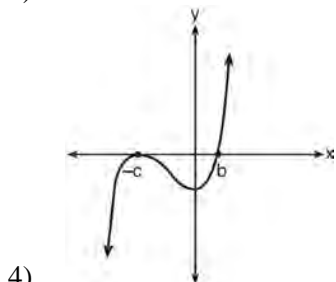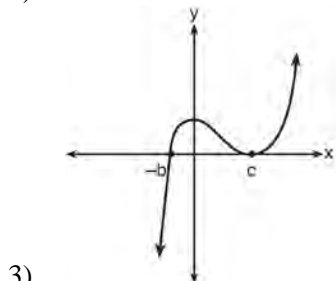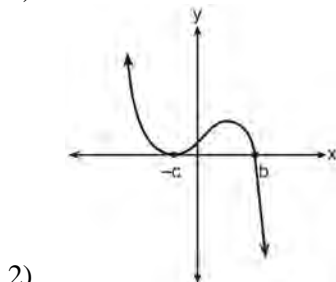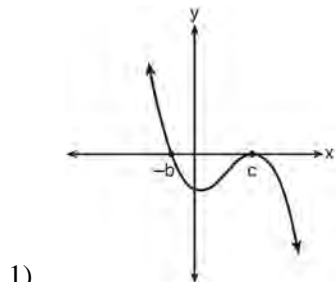
144 Algebraically determine the values of h and k to correctly complete the identity stated below.

$$2x^3 - 10x^2 + 11x - 7 = (x-4)(2x^2 + hx + 3) + k$$

145 The voltage used by most households can be modeled by a sine function. The maximum voltage is 120 volts, and there are 60 cycles *every second*. Which equation best represents the value of the voltage as it flows through the electric wires, where t is time in seconds?
1) $V = 120\sin(t)$
2) $V = 120\sin(60t)$
3) $V = 120\sin(60\pi t)$
4) $V = 120\sin(120\pi t)$

146 Which value is *not* contained in the solution of the system shown below?

$$a + 5b - c = -20$$

$$4a - 5b + 4c = 19$$

$$-a - 5b - 5c = 2$$

1) −2
2) 2
3) 3
4) −3

147 What is the solution, if any, of the equation
$$\frac{2}{x+3} - \frac{3}{4-x} = \frac{2x-2}{x^2-x-12}?$$
1) -1
2) -5
3) all real numbers
4) no real solution

148 Seventy-two students are randomly divided into two equally-sized study groups. Each member of the first group (group 1) is to meet with a tutor after school twice each week for one hour. The second group (group 2), is given an online subscription to a tutorial account that they can access for a maximum of two hours each week. Students in both groups are given the same tests during the year. A summary of the two groups' final grades is shown below:

	Group 1	Group 2
$\bar{x}$	80.16	83.8
S_x	6.9	5.2

Calculate the mean difference in the final grades (group 1 – group 2) and explain its meaning in the context of the problem. A simulation was conducted in which the students' final grades were rerandomized 500 times. The results are shown below.
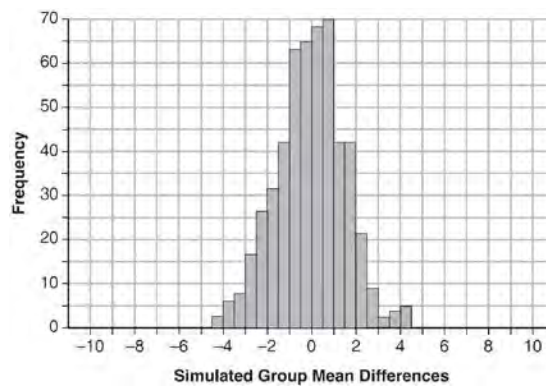
Use the simulation to determine if there is a significant difference in the final grades. Explain your answer.

149 Elizabeth waited for 6 minutes at the drive thru at her favorite fast-food restaurant the last time she visited. She was upset about having to wait that long and notified the manager. The manager assured her that her experience was very unusual and that it would not happen again. A study of customers commissioned by this restaurant found an approximately normal distribution of results. The mean wait time was 226 seconds and the standard deviation was 38 seconds. Given these data, and using a 95% level of confidence, was Elizabeth's wait time unusual? Justify your answer.

150 A house purchased 5 years ago for $100,000 was just sold for $135,000. Assuming exponential growth, approximate the annual growth rate, to the *nearest percent*.

151 If $f(x) = 3|x| - 1$ and $g(x) = 0.03x^3 - x + 1$, an approximate solution for the equation $f(x) = g(x)$ is
1) 1.96
2) 11.29
3) $(-0.99, 1.96)$
4) $(11.29, 32.87)$

152 On the axes below, sketch a possible function $p(x) = (x - a)(x - b)(x + c)$, where a, b, and c are positive, $a > b$, and $p(x)$ has a positive y-intercept of d. Label all intercepts.
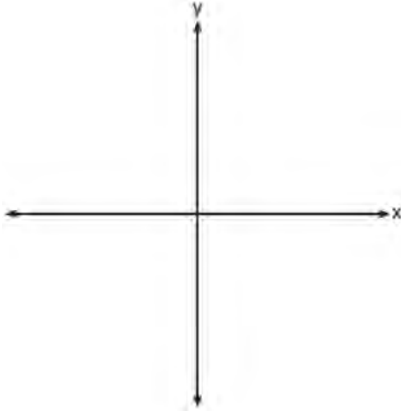
153 Write an explicit formula for a_n, the nth term of the recursively defined sequence below.

$$a_1 = x + 1$$

$$a_n = x(a_{n-1})$$

For what values of x would $a_n = 0$ when $n > 1$?

154 Seth's parents gave him $5000 to invest for his 16th birthday. He is considering two investment options. Option A will pay him 4.5% interest compounded annually. Option B will pay him 4.6% compounded quarterly. Write a function of option A and option B that calculates the value of each account after n years. Seth plans to use the money after he graduates from college in 6 years. Determine how much more money option B will earn than option A to the *nearest cent*. Algebraically determine, to the *nearest tenth of a year*, how long it would take for option B to double Seth's initial investment.

155 Explain how $(-8)^{\frac{4}{3}}$ can be evaluated using properties of rational exponents to result in an integer answer.

156 When $b > 0$ and d is a positive integer, the expression $(3b)^{\frac{2}{d}}$ is equivalent to

1) $\dfrac{1}{\left(\sqrt[d]{3b}\right)^2}$

2) $\left(\sqrt{3b}\right)^d$

3) $\dfrac{1}{\sqrt{3b^d}}$

4) $\left(\sqrt[d]{3b}\right)^2$

157 The weight of a bag of pears at the local market averages 8 pounds with a standard deviation of 0.5 pound. The weights of all the bags of pears at the market closely follow a normal distribution. Determine what percentage of bags, to the *nearest integer*, weighed *less* than 8.25 pounds.

158 Mr. Farison gave his class the three mathematical rules shown below to either prove or disprove. Which rules can be proved for all real numbers?

I $(m + p)^2 = m^2 + 2mp + p^2$

II $(x + y)^3 = x^3 + 3xy + y^3$

III $(a^2 + b^2)^2 = (a^2 - b^2)^2 + (2ab)^2$

1) I, only
2) I and II
3) II and III
4) I and III

159 The loudness of sound is measured in units called decibels (dB). These units are measured by first assigning an intensity I_0 to a very soft sound that is called the threshold sound. The sound to be measured is assigned an intensity, I, and the decibel rating, d, of this sound is found using $d = 10\log\dfrac{I}{I_0}$. The threshold sound audible to the average person is 1.0×10^{-12} W/m² (watts per square meter). Consider the following sound level classifications:

Moderate	45-69 dB
Loud	70-89 dB
Very loud	90-109 dB
Deafening	>110 dB

How would a sound with intensity 6.3×10^{-3} W/m² be classified?
1) moderate
2) loud
3) very loud
4) deafening

160 Which statement about statistical analysis is *false*?
1) Experiments can suggest patterns and relationships in data.
2) Experiments can determine cause and effect relationships.
3) Observational studies can determine cause and effect relationships.
4) Observational studies can suggest patterns and relationships in data.

161 Julie averaged 85 on the first three tests of the semester in her mathematics class. If she scores 93 on each of the remaining tests, her average will be 90. Which equation could be used to determine how many tests, T, are left in the semester?

1) $\dfrac{255 + 93T}{3T} = 90$

2) $\dfrac{255 + 90T}{3T} = 93$

3) $\dfrac{255 + 93T}{T + 3} = 90$

4) $\dfrac{255 + 90T}{T + 3} = 93$

162 Iridium-192 is an isotope of iridium and has a half-life of 73.83 days. If a laboratory experiment begins with 100 grams of Iridium-192, the number of grams, A, of Iridium-192 present after t days would be $A = 100\left(\dfrac{1}{2}\right)^{\frac{t}{73.83}}$. Which equation approximates the amount of Iridium-192 present after t days?

1) $A = 100\left(\dfrac{73.83}{2}\right)^{t}$

2) $A = 100\left(\dfrac{1}{147.66}\right)^{t}$

3) $A = 100(0.990656)^{t}$

4) $A = 100(0.116381)^{t}$

163 Given $z(x) = 6x^3 + bx^2 - 52x + 15$, $z(2) = 35$, and $z(-5) = 0$, algebraically determine all the zeros of $z(x)$.

164 Stephen's Beverage Company is considering whether to produce a new brand of cola. The company will launch the product if at least 25% of cola drinkers will buy the product. Fifty cola drinkers are randomly selected to take a blind taste-test of products *A*, *B*, and the new product. Nine out of fifty participants preferred Stephen's new cola to products *A* and *B*. The company then devised a simulation based on the requirement that 25% of cola drinkers will buy the product. Each dot in the graph shown below represents the proportion of people who preferred Stephen's new product, each of sample size 50, simulated 100 times.

Mean = 0.247
S. D. = 0.062

0.10   0.14   0.18   0.22   0.26   0.30   0.34   0.38   0.42

Proportion Preferring Stephen's Product
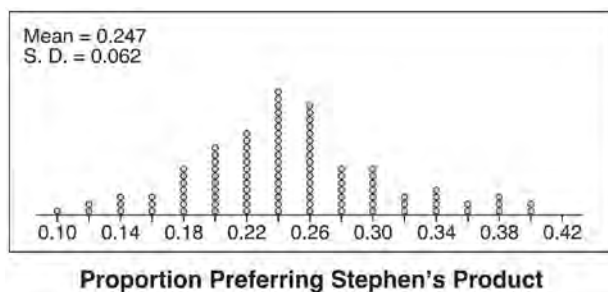
Assume the set of data is approximately normal and the company wants to be 95% confident of its results. Does the sample proportion obtained from the blind taste-test, nine out of fifty, fall within the margin of error developed from the simulation? Justify your answer. The company decides to continue developing the product even though only nine out of fifty participants preferred its brand of cola in the taste-test. Describe how the simulation data could be used to support this decision.

165 Write $(5 + 2yi)(4 - 3i) - (5 - 2yi)(4 - 3i)$ in $a + bi$ form, where *y* is a real number.

166 The heights of women in the United States are normally distributed with a mean of 64 inches and a standard deviation of 2.75 inches. The percent of women whose heights are between 64 and 69.5 inches, to the *nearest whole percent*, is
1) 6
2) 48
3) 68
4) 95

167 Which statement(s) about statistical studies is true?
  I. A survey of all English classes in a high school would be a good sample to determine the number of hours students throughout the school spend studying.
  II. A survey of all ninth graders in a high school would be a good sample to determine the number of student parking spaces needed at that high school.
  III. A survey of all students in one lunch period in a high school would be a good sample to determine the number of hours adults spend on social media websites.
  IV. A survey of all Calculus students in a high school would be a good sample to determine the number of students throughout the school who don't like math.
1) I, only
2) II, only
3) I and III
4) III and IV

168 The equation $4x^2 - 24x + 4y^2 + 72y = 76$ is equivalent to
1) $4(x - 3)^2 + 4(y + 9)^2 = 76$
2) $4(x - 3)^2 + 4(y + 9)^2 = 121$
3) $4(x - 3)^2 + 4(y + 9)^2 = 166$
4) $4(x - 3)^2 + 4(y + 9)^2 = 436$

169 The price of a postage stamp in the years since the end of World War I is shown in the scatterplot below.

Price of a Postage Stamp Since End of World War I
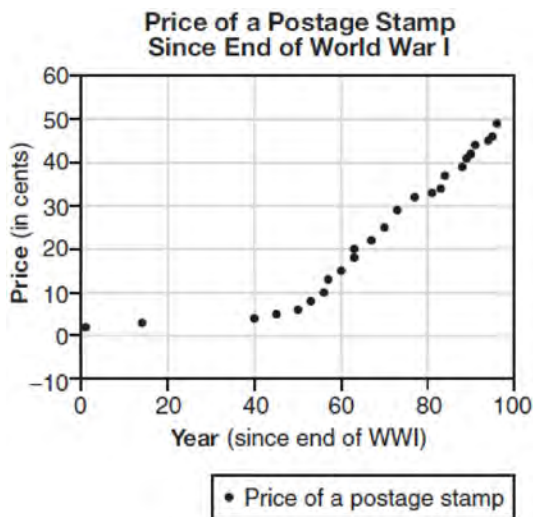
The equation that best models the price, in cents, of a postage stamp based on these data is
1) $y = 0.59x - 14.82$
2) $y = 1.04(1.43)^x$
3) $y = 1.43(1.04)^x$
4) $y = 24\sin(14x) + 25$

170 The function $f(x) = 2^{-0.25x} \bullet \sin\left(\dfrac{\pi}{2}x\right)$ represents a damped sound wave function. What is the average rate of change for this function on the interval $[-7,7]$, to the *nearest hundredth*?
1) -3.66
2) -0.30
3) -0.26
4) 3.36

171 Simplify $xi(i - 7i)^2$, where i is the imaginary unit.

172 Which scenario is best described as an observational study?
1) For a class project, students in Health class ask every tenth student entering the school if they eat breakfast in the morning.
2) A social researcher wants to learn whether or not there is a link between attendance and grades. She gathers data from 15 school districts.
3) A researcher wants to learn whether or not there is a link between children's daily amount of physical activity and their overall energy level. During lunch at the local high school, she distributed a short questionnaire to students in the cafeteria.
4) Sixty seniors taking a course in Advanced Algebra Concepts are randomly divided into two classes. One class uses a graphing calculator all the time, and the other class never uses graphing calculators. A guidance counselor wants to determine whether there is a link between graphing calculator use and students' final exam grades.

173 Which equation represents a parabola with the focus at $(0,-1)$ and the directrix of $y = 1$?
1) $x^2 = -8y$
2) $x^2 = -4y$
3) $x^2 = 8y$
4) $x^2 = 4y$

174 Which equation represents an odd function?
1) $y = \sin x$
2) $y = \cos x$
3) $y = (x + 1)^3$
4) $y = e^{5x}$

175 After sitting out of the refrigerator for a while, a turkey at room temperature (68°F) is placed into an oven at 8 a.m., when the oven temperature is 325°F. Newton's Law of Heating explains that the temperature of the turkey will increase proportionally to the difference between the temperature of the turkey and the temperature of the oven, as given by the formula below:

$$T = T_a + \left(T_0 - T_a\right)e^{-kt}$$

T_a = the temperature surrounding the object

T_0 = the initial temperature of the object

t = the time in hours

T = the temperature of the object after t hours

k = decay constant

The turkey reaches the temperature of approximately 100° F after 2 hours. Find the value of k, to the *nearest thousandth*, and write an equation to determine the temperature of the turkey after t hours. Determine the Fahrenheit temperature of the turkey, to the *nearest degree*, at 3 p.m.

176 The expression $6xi^3(-4xi + 5)$ is equivalent to
1) $2x - 5i$
2) $-24x^2 - 30xi$
3) $-24x^2 + 30x - i$
4) $26x - 24x^2i - 5i$

177 Which factorization is *incorrect*?
1) $4k^2 - 49 = (2k + 7)(2k - 7)$
2) $a^3 - 8b^3 = (a - 2b)(a^2 + 2ab + 4b^2)$
3) $m^3 + 3m^2 - 4m + 12 = (m - 2)^2(m + 3)$
4) $t^3 + 5t^2 + 6t + t^2 + 5t + 6 = (t + 1)(t + 2)(t + 3)$

178 The expression $\dfrac{4x^3 + 5x + 10}{2x + 3}$ is equivalent to
1) $2x^2 + 3x - 7 + \dfrac{31}{2x + 3}$
2) $2x^2 - 3x + 7 - \dfrac{11}{2x + 3}$
3) $2x^2 + 2.5x + 5 + \dfrac{15}{2x + 3}$
4) $2x^2 - 2.5x - 5 - \dfrac{20}{2x + 3}$

179 Solve for all values of p: $\dfrac{3p}{p - 5} - \dfrac{2}{p + 3} = \dfrac{p}{p + 3}$

180 Over the set of integers, factor the expression $4x^3 - x^2 + 16x - 4$ completely.

181 What does $\left(\dfrac{-54x^9}{y^4}\right)^{\frac{2}{3}}$ equal?

1) $\dfrac{9ix^6\sqrt[3]{4}}{y\sqrt[3]{y^2}}$

2) $\dfrac{9ix^6\sqrt[3]{4}}{y^2\sqrt[3]{y^2}}$

3) $\dfrac{9x^6\sqrt[3]{4}}{y\sqrt[3]{y}}$

4) $\dfrac{9x^6\sqrt[3]{4}}{y^2\sqrt[3]{y^2}}$

182 Joelle has a credit card that has a 19.2% annual interest rate compounded monthly. She owes a total balance of B dollars after m months. Assuming she makes no payments on her account, the table below illustrates the balance she owes after m months.

| m	B
0	100.00
10	1172.00
19	1352.00
36	1770.80
60	2591.90
69	2990.00
72	3135.80
73	3186.00

Over which interval of time is her average rate of change for the balance on her credit card account the greatest?
1) month 10 to month 60
2) month 19 to month 69
3) month 36 to month 72
4) month 60 to month 73

183 Sally's high school is planning their spring musical. The revenue, R, generated can be determined by the function $R(t) = -33t^2 + 360t$, where t represents the price of a ticket. The production cost, C, of the musical is represented by the function $C(t) = 700 + 5t$. What is the highest ticket price, to the *nearest dollar*, they can charge in order to *not* lose money on the event?
1) $t = 3$
2) $t = 5$
3) $t = 8$
4) $t = 11$

184 While experimenting with her calculator, Candy creates the sequence 4, 9, 19, 39, 79, ... Write a recursive formula for Candy's sequence. Determine the eighth term in Candy's sequence.

185 The distribution of the diameters of ball bearings made under a given manufacturing process is normally distributed with a mean of 4 cm and a standard deviation of 0.2 cm. What proportion of the ball bearings will have a diameter less than 3.7 cm?
1) 0.0668
2) 0.4332
3) 0.8664
4) 0.9500

186 What is the inverse of the function $y = \log_3 x$?
1) $y = x^3$
2) $y = \log_x 3$
3) $y = 3^x$
4) $x = 3^y$

187 Ayva designed an experiment to determine the effect of a new energy drink on a group of 20 volunteer students. Ten students were randomly selected to form group 1 while the remaining 10 made up group 2. Each student in group 1 drank one energy drink, and each student in group 2 drank one cola drink. Ten minutes later, their times were recorded for reading the same paragraph of a novel. The results of the experiment are shown below.

Group 1 (seconds)	Group 2 (seconds)
17.4	23.3
18.1	18.8
18.2	22.1
19.6	12.7
18.6	16.9
16.2	24.4
16.1	21.2
15.3	21.2
17.8	16.3
19.7	14.5
Mean = 17.7	Mean = 19.1

Ayva thinks drinking energy drinks makes students read faster. Using information from the experimental design or the results, explain why Ayva's hypothesis may be *incorrect*. Using the given results, Ayva randomly mixes the 20 reading times, splits them into two groups of 10, and simulates the difference of the means 232 times.

Simulated Differences

Differences (Group 1 – Group 2)
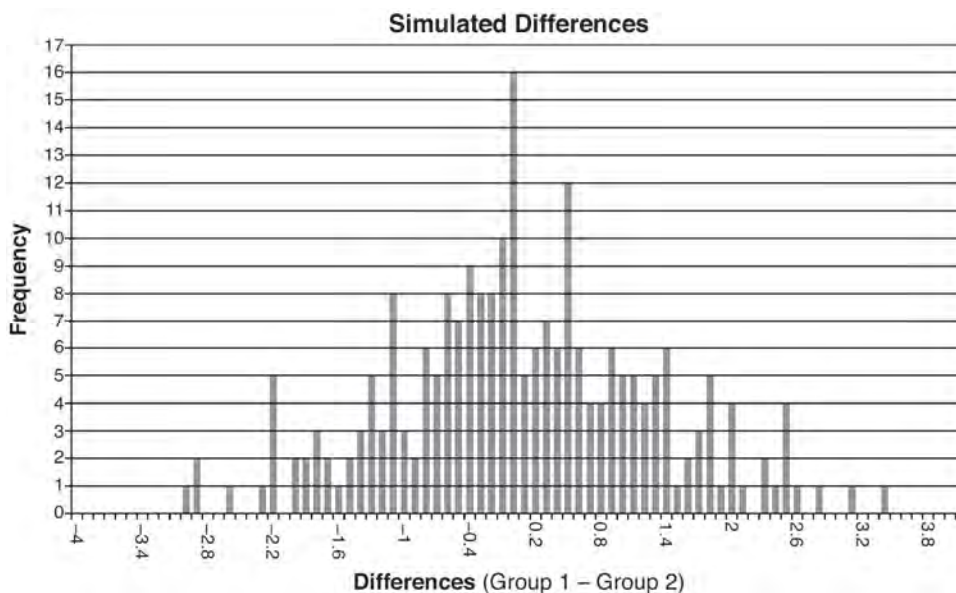
Ayva has decided that the difference in mean reading times is not an unusual occurrence. Support her decision using the results of the simulation. Explain your reasoning.

188 The results of a poll of 200 students are shown in the table below:

	Preferred Music Style		
	Techno	Rap	Country
Female	54	25	27
Male	36	40	18

For this group of students, do these data suggest that gender and preferred music styles are independent of each other? Justify your answer.

189 The population of Jamesburg for the years 2010-2013, respectively, was reported as follows:
250,000 250,937 251,878 252,822
How can this sequence be recursively modeled?

1) $j_n = 250,000(1.00375)^{n-1}$

2) $j_n = 250,000 + 937^{(n-1)}$

3) $j_1 = 250,000$

$j_n = 1.00375 j_{n-1}$

4) $j_1 = 250,000$

$j_n = j_{n-1} + 937$

190 A manufacturing company has developed a cost model, $C(x) = 0.15x^3 + 0.01x^2 + 2x + 120$, where x is the number of items sold, in thousands. The sales price can be modeled by $S(x) = 30 - 0.01x$. Therefore, revenue is modeled by $R(x) = x \bullet S(x)$. The company's profit, $P(x) = R(x) - C(x)$, could be modeled by

1) $0.15x^3 + 0.02x^2 - 28x + 120$
2) $-0.15x^3 - 0.02x^2 + 28x - 120$
3) $-0.15x^3 + 0.01x^2 - 2.01x - 120$
4) $-0.15x^3 + 32x + 120$

191 The directrix of the parabola $12(y + 3) = (x - 4)^2$ has the equation $y = -6$. Find the coordinates of the focus of the parabola.

192 Consider the system shown below.
$$2x - y = 4$$
$$(x + 3)^2 + y^2 = 8$$
The two solutions of the system can be described as
1) both imaginary
2) both irrational
3) both rational
4) one rational and one irrational

193 Which binomial is *not* a factor of the expression $x^3 - 11x^2 + 16x + 84$?
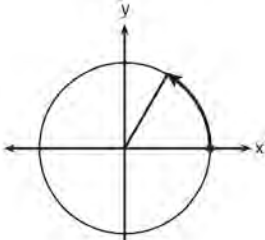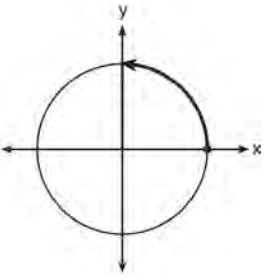1) $x + 2$
2) $x + 4$
3) $x - 6$
4) $x - 7$

194 Using the identity $\sin^2 \theta + \cos^2 \theta = 1$, find the value of $\tan \theta$, to the *nearest hundredth*, if $\cos \theta$ is –0.7 and θ is in Quadrant II.
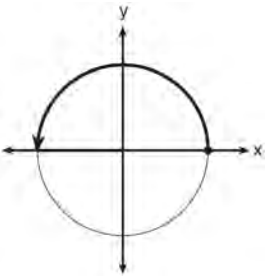
195 Which diagram shows an angle rotation of 1 radian on the unit circle?
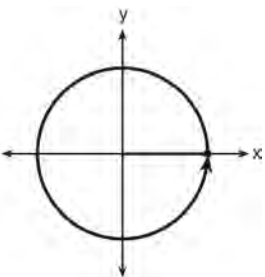

1)

2)

3)

4)

196 What is the solution to $8(2^{x+3}) = 48$?

1) $x = \dfrac{\ln 6}{\ln 2} - 3$

2) $x = 0$

3) $x = \dfrac{\ln 48}{\ln 16} - 3$

4) $x = \ln 4 - 3$

197 In 2013, approximately 1.6 million students took the Critical Reading portion of the SAT exam. The mean score, the modal score, and the standard deviation were calculated to be 496, 430, and 115, respectively. Which interval reflects 95% of the Critical Reading scores?

1) 430 ± 115

2) 430 ± 230

3) 496 ± 115

4) 496 ± 230

198 If the terminal side of angle θ, in standard position, passes through point $(-4,3)$, what is the numerical value of $\sin \theta$?

1) $\dfrac{3}{5}$

2) $\dfrac{4}{5}$

3) $-\dfrac{3}{5}$

4) $-\dfrac{4}{5}$

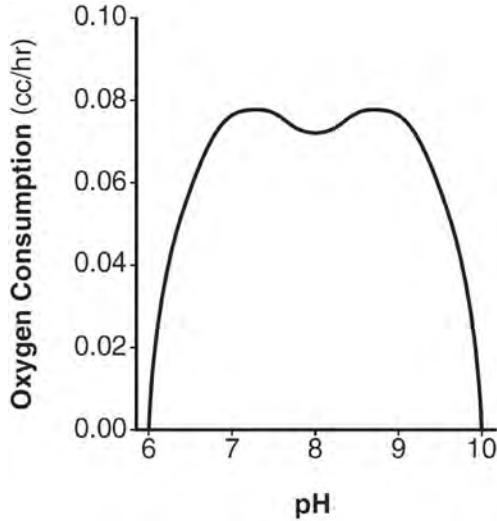199 Given $f^{-1}(x) = -\dfrac{3}{4}x + 2$, which equation represents $f(x)$?

1) $f(x) = \dfrac{4}{3}x - \dfrac{8}{3}$

2) $f(x) = -\dfrac{4}{3}x + \dfrac{8}{3}$

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

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

200 There was a study done on oxygen consumption of snails as a function of pH, and the result was a degree 4 polynomial function whose graph is shown below.

Which statement about this function is *incorrect*?
1) The degree of the polynomial is even.
2) There is a positive leading coefficient.
3) At two pH values, there is a relative maximum value.
4) There are two intervals where the function is decreasing.

201 What is the solution set of the equation $\frac{3x+25}{x+7} - 5 = \frac{3}{x}$?

1) $\left\{ \frac{3}{2}, 7 \right\}$

2) $\left\{ \frac{7}{2}, -3 \right\}$

3) $\left\{ -\frac{3}{2}, 7 \right\}$

4) $\left\{ -\frac{7}{2}, -3 \right\}$

202 Based on climate data that have been collected in Bar Harbor, Maine, the average monthly temperature, in degrees F, can be modeled by the equation $B(x) = 23.914\sin(0.508x - 2.116) + 55.300$. The same governmental agency collected average monthly temperature data for Phoenix, Arizona, and found the temperatures could be modeled by the equation $P(x) = 20.238\sin(0.525x - 2.148) + 86.729$. Which statement can *not* be concluded based on the average monthly temperature models x months after starting data collection?
1) The average monthly temperature variation is more in Bar Harbor than in Phoenix.
2) The midline average monthly temperature for Bar Harbor is lower than the midline temperature for Phoenix.
3) The maximum average monthly temperature for Bar Harbor is 79° F, to the nearest degree.
4) The minimum average monthly temperature for Phoenix is 20° F, to the nearest degree.

203 The guidance department has reported that of the senior class, 2.3% are members of key club, K, 8.6% are enrolled in AP Physics, P, and 1.9% are in both. Determine the probability of P given K, to the *nearest tenth of a percent*. The principal would like a basic interpretation of these results. Write a statement relating your calculated probabilities to student enrollment in the given situation.

204 Given the equal terms $\sqrt[3]{x^5}$ and $y^{\frac{5}{6}}$, determine and state y, in terms of x.

39

205 The solution to the equation $18x^2 - 24x + 87 = 0$ is
1) $-\frac{2}{3} \pm 6i\sqrt{158}$

2) $-\frac{2}{3} \pm \frac{1}{6}i\sqrt{158}$

3) $\frac{2}{3} \pm 6i\sqrt{158}$

4) $\frac{2}{3} \pm \frac{1}{6}i\sqrt{158}$

206 Anne has a coin. She does not know if it is a fair coin. She flipped the coin 100 times and obtained 73 heads and 27 tails. She ran a computer simulation of 200 samples of 100 fair coin flips. The output of the proportion of heads is shown below.

Samples = 200
Mean = 0.497
SD = 0.050
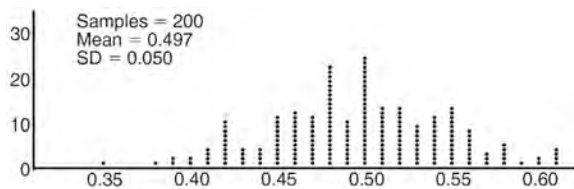
Given the results of her coin flips and of her computer simulation, which statement is most accurate?
1) 73 of the computer's next 100 coin flips will be heads.
2) 50 of her next 100 coin flips will be heads.
3) Her coin is not fair.
4) Her coin is fair.

207 Given $f(9) = -2$, which function can be used to generate the sequence $-8, -7.25, -6.5, -5.75, \ldots$?
1) $f(n) = -8 + 0.75n$
2) $f(n) = -8 - 0.75(n - 1)$
3) $f(n) = -8.75 + 0.75n$
4) $f(n) = -0.75 + 8(n - 1)$

208 The expression $\dfrac{x^3 + 2x^2 + x + 6}{x + 2}$ is equivalent to
1) $x^2 + 3$
2) $x^2 + 1 + \dfrac{4}{x + 2}$
3) $2x^2 + x + 6$
4) $2x^2 + 1 + \dfrac{4}{x + 2}$

209 Given $r(x) = x^3 - 4x^2 + 4x - 6$, find the value of $r(2)$. What does your answer tell you about $x - 2$ as a factor of $r(x)$? Explain.

210 An equation to represent the value of a car after t months of ownership is $v = 32,000(0.81)^{\frac{t}{12}}$. Which statement is *not* correct?
1) The car lost approximately 19% of its value each month.
2) The car maintained approximately 98% of its value each month.
3) The value of the car when it was purchased was $32,000.
4) The value of the car 1 year after it was purchased was $25,920.

211 The eighth and tenth terms of a sequence are 64 and 100. If the sequence is either arithmetic or geometric, the ninth term can *not* be
1) -82
2) -80
3) 80
4) 82

40

212 The results of a survey of the student body at Central High School about television viewing preferences are shown below.

	Comedy Series	Drama Series	Reality Series	Total
Males	95	65	70	230
Females	80	70	110	260
Total	175	135	180	490

Are the events "student is a male" and "student prefers reality series" independent of each other? Justify your answer.

213 The expression $\dfrac{-3x^2 - 5x + 2}{x^3 + 2x^2}$ can be rewritten as

1) $\dfrac{-3x - 3}{x^2 + 2x}$

2) $\dfrac{-3x - 1}{x^2}$

3) $-3x^{-1} + 1$

4) $-3x^{-1} + x^{-2}$

215 Mrs. Jones had hundreds of jelly beans in a bag that contained equal numbers of six different flavors. Her student randomly selected four jelly beans and they were all black licorice. Her student complained and said "What are the odds I got all of that kind?" Mrs. Jones replied, "simulate rolling a die 250 times and tell me if four black licorice jelly beans is unusual." Explain how this simulation could be used to solve the problem.

214 A recursive formula for the sequence $18, 9, 4.5, \ldots$ is

1) $g_1 = 18$

    $g_n = \dfrac{1}{2} g_{n-1}$

2) $g_n = 18\left(\dfrac{1}{2}\right)^{n-1}$

3) $g_1 = 18$

    $g_n = 2g_{n-1}$

4) $g_n = 18(2)^{n-1}$

216 A rabbit population doubles every 4 weeks. There are currently five rabbits in a restricted area. If t represents the time, in weeks, and $P(t)$ is the population of rabbits with respect to time, about how many rabbits will there be in 98 days?

1) 56

2) 152

3) 3688

4) 81,920

Algebra II Common Core State Standards Regents at Random
Answer Section

1 ANS: 2
   $h(x)$ does not have a y-intercept.

   PTS: 2   REF: 011719aii   NAT: F.IF.C.9   TOP: Comparing Functions
2 ANS:
   Jillian's plan, because distance increases by one mile each week. $a_1 = 10$ $a_n = n + 12$

   $$a_n = a_{n-1} + 1$$

   PTS: 4   REF: 011734aii   NAT: F.LE.A.2   TOP: Sequences
3 ANS: 2   PTS: 2   REF: 011709aii   NAT: S.IC.B.5
   TOP: Analysis of Data
4 ANS:

   $A(t) = 100(0.5)^{\frac{t}{63}}$, where t is time in years, and $A(t)$ is the amount of titanium-44 left after t years.
   $\dfrac{A(10) - A(0)}{10 - 0} = \dfrac{89.58132 - 100}{10} = -1.041868$ The estimated mass at $t = 40$ is $100 - 40(-1.041868) \approx 58.3$. The

   actual mass is $A(40) = 100(0.5)^{\frac{40}{63}} \approx 64.3976$. The estimated mass is less than the actual mass.

   PTS: 6   REF: fall1517aii   NAT: F.LE.A.2   TOP: Modeling Exponential Functions
   KEY: AII
5 ANS: 1

   $$\frac{A}{P} = e^{rt}$$

   $$0.42 = e^{rt}$$

   $$\ln 0.42 = \ln e^{rt}$$

   $$-0.87 \approx rt$$

   PTS: 2   REF: 011723aii   NAT: F.BF.A.1   TOP: Modeling Exponential Functions
   KEY: AII
6 ANS:
   $j(-x) = (-x)^4 - 3(-x)^2 - 4 = x^2 - 3x^2 - 4$ Since $j(x) = j(-x)$, the function is even.

   PTS: 2   REF: 081731aii   NAT: F.BF.B.3   TOP: Even and Odd Functions

7   ANS: 2

$$\sqrt{x+14} = \sqrt{2x+5}+1 \qquad\qquad \sqrt{22+14} - \sqrt{2(22)+5} = 1$$

$$x+14 = 2x+5+2\sqrt{2x+5}+1 \qquad\qquad 6-7 \neq 1$$

$$-x+8 = 2\sqrt{2x+5}$$

$$x^2 - 16x + 64 = 8x + 20$$

$$x^2 - 24x + 44 = 0$$

$$(x-22)(x-2) = 0$$

$$x = 2, 22$$

PTS: 2   REF: 081704aii   NAT: A.REI.A.2   TOP: Solving Radicals
KEY: advanced

8   ANS: 1   PTS: 2   REF: 011704aii   NAT: F.TF.C.8
    TOP: Simplifying Trigonometric Expressions

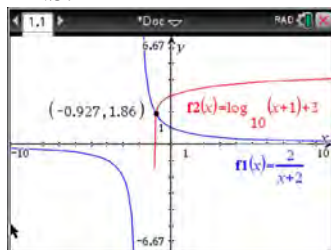9   ANS: 2   PTS: 2   REF: 011701aii   NAT: F.IF.B.4
    TOP: Graphing Trigonometric Functions

10 ANS: 2

PTS: 2   REF: 011712aii   NAT: A.REI.D.11   TOP: Other Systems
KEY: AII

11 ANS: 2

$$\left(m^{\frac{5}{3}} \right)^{-\frac{1}{2}} = m^{-\frac{5}{6}} = \frac{1}{\sqrt[6]{m^5}}$$

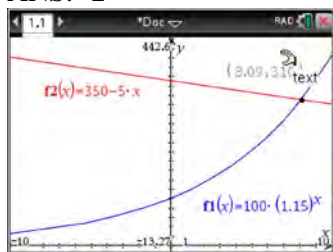PTS: 2   REF: 011707aii   NAT: N.RN.A.2   TOP: Radicals and Rational Exponents
KEY: variables

12 ANS: 2

PTS: 2   REF: 011716aii   NAT: A.REI.D.11   TOP: Other Systems
KEY: AII

13 ANS:

normcdf(510, 540, 480, 24) = 0.0994 $z = \dfrac{510-480}{24} = 1.25$ $1.25 = \dfrac{x-510}{20}$ $2.5 = \dfrac{x-510}{20}$ 535-560

$z = \dfrac{540-480}{24} = 2.5$ $x = 535$ $x = 560$

PTS: 4   REF: fall1516aii   NAT: S.ID.A.4   TOP: Normal Distributions
KEY: probability

14 ANS:

$$7 = 20(0.5)^{\frac{t}{8.02}}$$

$$\log 0.35 = \log 0.5^{\frac{t}{8.02}}$$

$$\log 0.35 = \frac{t\log 0.5}{8.02}$$

$$\frac{8.02\log 0.35}{\log 0.5} = t$$

$$t \approx 12$$

PTS: 4   REF: 081634aii   NAT: F.LE.A.4   TOP: Exponential Decay

15 ANS: 4   PTS: 2   REF: 081622aii   NAT: F.BF.A.1
TOP: Modeling Exponential Functions   KEY: AII

16 ANS:

$$x-2\overline{)3x^2+7x-20}^{\,3x+13}$$ $3x + 13 + \dfrac{6}{x-2}$

$$\underline{3x^2 - 6x}$$

$$13x - 20$$

$$\underline{13x - 26}$$

$$6$$

PTS: 2   REF: 011732aii   NAT: A.APR.D.6   TOP: Rational Expressions

17 ANS:
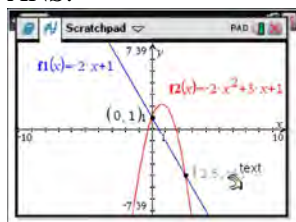
$$-2x + 1 = -2x^2 + 3x + 1$$
$$2x^2 - 5x = 0$$
$$x(2x - 5) = 0$$
$$x = 0, \frac{5}{2}$$

PTS: 2   REF: fall1507aii   NAT: A.REI.C.7   TOP: Quadratic-Linear Systems
KEY: AII

18 ANS: 4

$$k^4 - 4k^2 + 8k^3 - 32k + 12k^2 - 48$$

$$k^2(k^2 - 4) + 8k(k^2 - 4) + 12(k^2 - 4)$$

$$(k^2 - 4)(k^2 + 8k + 12)$$

$$(k + 2)(k - 2)(k + 6)(k + 2)$$

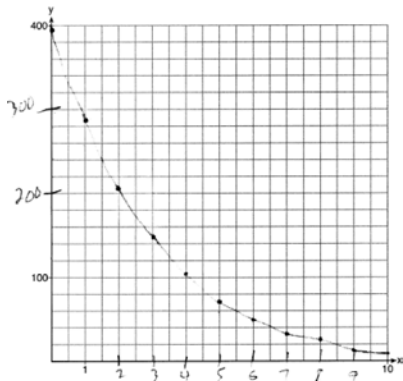PTS: 2   REF: fall1505aii   NAT: A.SSE.A.2   TOP: Factoring Polynomials
KEY: factoring by grouping

19 ANS:

PTS: 2   REF: 061729aii   NAT: F.IF.C.7   TOP: Graphing Exponential Functions
KEY: AII

20 ANS:

$$P(S \cap M) = P(S) + P(M) - P(S \cup M) = \frac{649}{1376} + \frac{433}{1376} - \frac{974}{1376} = \frac{108}{1376}$$

PTS: 2   REF: 061629aii   NAT: S.CP.B.7   TOP: Theoretical Probability

21 ANS:
$(1-i)(1-i)(1-i) = (1-2i+i^2)(1-i) = -2i(1-i) = -2i+2i^2 = -2-2i$

PTS: 2   REF: 011725aii   NAT: N.CN.A.2   TOP: Operations with Complex Numbers

22 ANS:
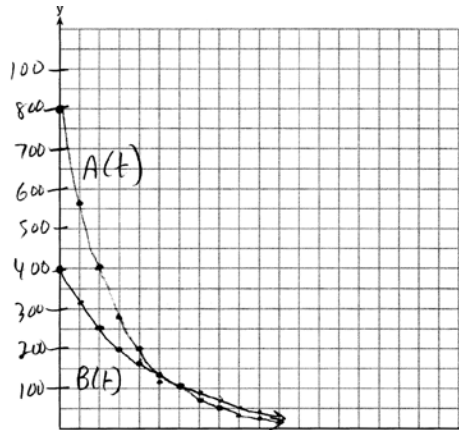
$A(t) = 800e^{-0.347t}$ $800e^{-0.347t} = 400e^{-0.231t}$ $0.15 = e^{-0.347t}$

$B(t) = 400e^{-0.231t}$ $\ln 2e^{-0.347t} = \ln e^{-0.231t}$ $\ln 0.15 = \ln e^{-0.347t}$

$\ln 2 + \ln e^{-0.347t} = \ln e^{-0.231t}$ $\ln 0.15 = -0.347t \cdot \ln e$

$\ln 2 - 0.347t = -0.231t$ $5.5 \approx t$

$\ln 2 = 0.116t$

$6 \approx t$

PTS: 6   REF: 061637aii   NAT: A.REI.D.11   TOP: Other Systems
KEY: AII

23 ANS: 2

PTS: 2   REF: 081603aii   NAT: A.REI.D.11   TOP: Other Systems
KEY: AII

24 ANS:
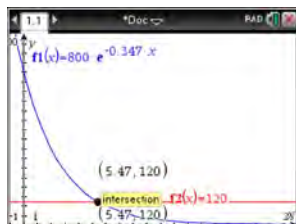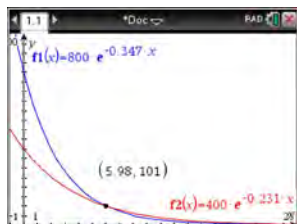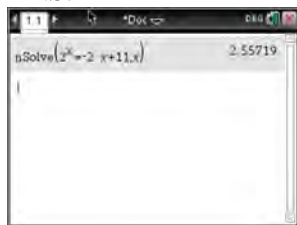Randomly assign participants to two groups. One group uses the toothpaste with ingredient *X* and the other group uses the toothpaste without ingredient *X*.

PTS: 2   REF: 061626aii   NAT: S.IC.B.3   TOP: Analysis of Data
KEY: type

25 ANS: 2
The 2010 population is 110 million.

PTS: 2   REF: 061718aii   NAT: F.LE.B.5   TOP: Modeling Exponential Functions

26 ANS: 3

$$\log_{0.8}\left(\frac{V}{1700}\right) = t \qquad\qquad \frac{17,000(0.8)^3 - 17,000(0.8)^1}{3-1} \approx -2450$$

$$0.8^t = \frac{V}{17000}$$

$$V = 17000(0.8)^t$$

PTS: 2   REF: 081709aii   NAT: F.IF.B.6   TOP: Rate of Change
KEY: AII

27 ANS:
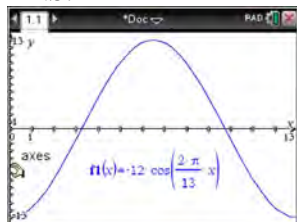
The amplitude, 12, can be interpreted from the situation, since the water level has a minimum of −12 and a maximum of 12. The value of *A* is −12 since at 8:30 it is low tide. The period of the function is 13 hours, and is expressed in the function through the parameter *B*. By experimentation with technology or using the relation $P = \frac{2\pi}{B}$ (where *P* is the period), it is determined that $B = \frac{2\pi}{13}$.
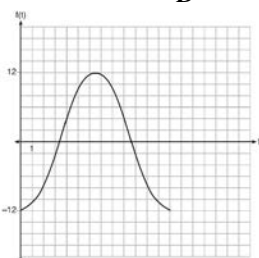
$$f(t) = -12\cos\left(\frac{2\pi}{13}t\right)$$

In order to answer the question about when to fish, the student must interpret the function and determine which choice, 7:30 pm or 10:30 pm, is on an increasing interval. Since the function is increasing from $t = 13$ to $t = 19.5$ (which corresponds to 9:30 pm to 4:00 am), 10:30 is the appropriate choice.

PTS: 6   REF: spr1514aii   NAT: F.IF.C.7   TOP: Graphing Trigonometric Functions
KEY: graph

28 ANS:

$$\sqrt[3]{x} \bullet \sqrt{x} = x^{\frac{1}{3}} \bullet x^{\frac{1}{2}} = x^{\frac{3}{6}} \bullet x^{\frac{3}{6}} = x^{\frac{5}{6}}$$

PTS: 2   REF: 061731aii   NAT: N.RN.A.2   TOP: Operations with Radicals
KEY: with variables, index > 2

29 ANS:
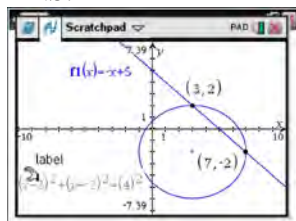
$$y = -x + 5 \quad y = -7 + 5 = -2$$
$$(x - 3)^2 + (-x + 5 + 2)^2 = 16 \quad y = -3 + 5 = 2$$
$$x^2 - 6x + 9 + x^2 - 14x + 49 = 16$$
$$2x^2 - 20x + 42 = 0$$
$$x^2 - 10x + 21 = 0$$
$$(x - 7)(x - 3) = 0$$
$$x = 7, 3$$

PTS: 4   REF: 061633aii   NAT: A.REI.C.7   TOP: Quadratic-Linear Systems
KEY: AII

30 ANS:
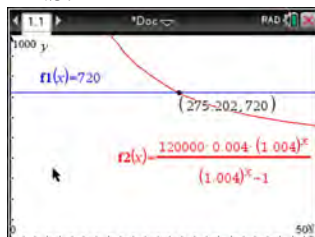
$$720 = \frac{120000\left(\frac{.048}{12}\right)\left(1 + \frac{.048}{12}\right)^n}{\left(1 + \frac{.048}{12}\right)^n - 1} \quad \frac{275.2}{12} \approx 23 \text{ years}$$

$$720(1.004)^n - 720 = 480(1.004)^n$$
$$240(1.004)^n = 720$$
$$1.004^n = 3$$
$$n \log 1.004 = \log 3$$
$$n \approx 275.2 \text{ months}$$

PTS: 4   REF: spr1509aii   NAT: A.CED.A.1   TOP: Exponential Growth

31 ANS:

The expression is of the form $y^2 - 5y - 6$ or $(y - 6)(y + 1)$. Let $y = 4x^2 + 5x$:

$$\left(4x^2 + 5x - 6\right)\left(4x^2 + 5x + 1\right)$$

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

PTS: 2   REF: fall1512aii   NAT: A.SSE.A.2   TOP: Factoring Polynomials
KEY: a>1

32 ANS:
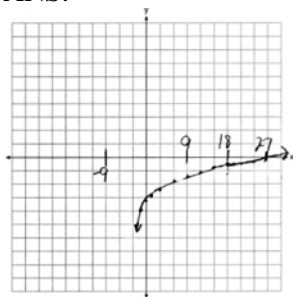
As $x \to -3$, $y \to -\infty$. As $x \to \infty$, $y \to \infty$.

PTS: 4   REF: 061735aii   NAT: F.IF.C.7   TOP: Graphing Logarithmic Functions

33 ANS:

$$(x^2 + y^2)^2 = (x^2 - y^2)^2 + (2xy)^2$$

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

$$x^4 + 2x^2y^2 + y^4 = x^4 + 2x^2y^2 + y^4$$

PTS: 2   REF: 081727aii   NAT: A.APR.C.4   TOP: Polynomial Identities

34 ANS: 1

$$
\begin{array}{r}
2x^2 + x + 5 \\
2x - 1 \overline{\smash{\big)}\, 4x^3 + 0x^2 + 9x - 5} \\
\underline{4x^3 - 2x^2} \\
2x^2 + 9x \\
\underline{2x^2 - x} \\
10x - 5 \\
\underline{10x - 5}
\end{array}
$$

PTS: 2   REF: 081713aii   NAT: A.APR.D.6   TOP: Rational Expressions

35 ANS: 3

The graph shows three real zeros, and has end behavior matching the given end behavior.

PTS: 2   REF: 061604aii   NAT: A.APR.B.3   TOP: Zeros of Polynomials
KEY: AII

36 ANS:

$$x = \left(y - 3 \right)^3 + 1$$

$$x - 1 = \left(y - 3 \right)^3$$

$$\sqrt[3]{x - 1} = y - 3$$

$$\sqrt[3]{x - 1} + 3 = y$$

$$f^{-1}(x) = \sqrt[3]{x - 1} + 3$$

PTS: 2   REF: fall1509aii   NAT: F.BF.B.4   TOP: Inverse of Functions
KEY: equations

37 ANS: 4   PTS: 2   REF: 081718aii   NAT: F.IF.C.7
TOP: Graphing Trigonometric Functions   KEY: amplitude

38 ANS: 3

(3) repeats 3 times over 2π.

PTS: 2   REF: 011722aii   NAT: F.IF.C.7   TOP: Graphing Trigonometric Functions
KEY: recognize

39 ANS: 4   PTS: 2   REF: 081707aii   NAT: F.TF.A.2
TOP: Reference Angles

40 ANS:

$$\left(\sqrt{2x - 7} \right)^2 = (5 - x)^2 \qquad \sqrt{2(4) - 7} + 4 = 5 \quad \sqrt{2(8) - 7} + 8 = 5$$

$$2x - 7 = 25 - 10x + x^2 \qquad \sqrt{1} = 1 \qquad \sqrt{9} \neq -3$$

$$0 = x^2 - 12x + 32$$

$$0 = (x - 8)(x - 4)$$

$$x = 4, 8$$

PTS: 4   REF: 081635aii   NAT: A.REI.A.2   TOP: Solving Radicals
KEY: extraneous solutions

41 ANS:

$0 = \log_{10}(x - 4)$ The x-intercept of h is $(2,0)$. f has the larger value.

$$10^0 = x - 4$$

$$1 = x - 4$$

$$x = 5$$

PTS: 2   REF: 081630aii   NAT: F.IF.C.9   TOP: Comparing Functions
KEY: AII

42 ANS:

A student is more likely to jog if both siblings jog. 1 jogs: $\frac{416}{2239} \approx 0.19$. both jog: $\frac{400}{1780} \approx 0.22$
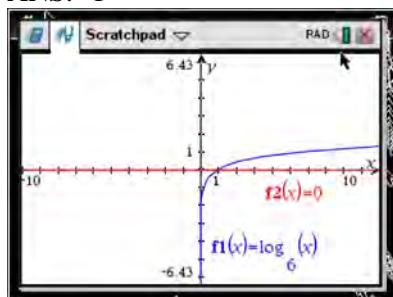
PTS: 2   REF: 061732aii   NAT: S.CP.A.4   TOP: Conditional Probability

43 ANS:

$$S_n = \frac{33000 - 33000(1.04)^n}{1 - 1.04} \quad S_{15} = \frac{33000 - 33000(1.04)^{15}}{1 - 1.04} \approx 660778.39$$

PTS: 4   REF: 061634aii   NAT: A.SSE.B.4   TOP: Series

44 ANS: 1

PTS: 2   REF: 061618aii   NAT: F.IF.C.7   TOP: Graphing Logarithmic Functions

45 ANS:

Applying the commutative property, $\left(3^{\frac{1}{5}}\right)^2$ can be rewritten as $\left(3^2\right)^{\frac{1}{5}}$ or $9^{\frac{1}{5}}$. A fractional exponent can be

rewritten as a radical with the denominator as the index, or $9^{\frac{1}{5}} = \sqrt[5]{9}$.

PTS: 2   REF: 081626aii   NAT: N.RN.A.1   TOP: Radicals and Rational Exponents

46 ANS:

$$0 = \sqrt{t} - 2t + 6 \quad 2\left(\frac{9}{4}\right) - 6 < 0, \text{ so } \frac{9}{4} \text{ is extraneous.}$$
$$2t - 6 = \sqrt{t}$$

$4t^2 - 24t + 36 = t$

$4t^2 - 25t + 36 = 0$

$(4t - 9)(t - 4) = 0$

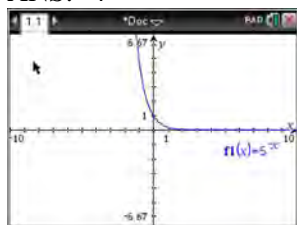$$t = \frac{9}{4}, 4$$

$(\sqrt{1} - 2(1) + 6) - (\sqrt{3} - 2(3) + 6) = 5 - \sqrt{3} \approx 3.268 \quad 327$ mph

PTS: 6   REF: 011737aii   NAT: A.REI.A.2   TOP: Solving Radicals
KEY: context

47 ANS: 4

$$y = 5^{-t} = \left(\frac{1}{5}\right)^{t}$$

PTS: 2   REF: 061615aii   NAT: F.IF.C.8   TOP: Modeling Exponential Functions

48 ANS: 4   PTS: 2   REF: 061716aii   NAT: N.RN.A.2
    TOP: Radicals and Rational Exponents   KEY: variables

49 ANS: 4   PTS: 2   REF: 081624aii   NAT: F.BF.A.2
    TOP: Sequences

50 ANS:

$f(4) = 2(4)^3 - 5(4)^2 - 11(4) - 4 = 128 - 80 - 44 - 4 = 0$ Any method that demonstrates 4 is a zero of $f(x)$ confirms
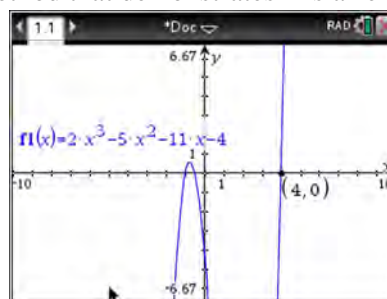
that $x - 4$ is a factor, as suggested by the Remainder Theorem.

PTS: 2   REF: spr1507aii   NAT: A.APR.B.2   TOP: Remainder Theorem

51 ANS: 1
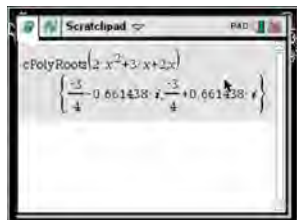
$$x = \frac{-3 \pm \sqrt{3^2 - 4(2)(2)}}{2(2)} = \frac{-3 \pm \sqrt{-7}}{4} = -\frac{3}{4} \pm \frac{i\sqrt{7}}{4}$$

PTS: 2   REF: 061612aii   NAT: A.REI.B.4   TOP: Solving Quadratics
    KEY: complex solutions | quadratic formula

52 ANS:
    sample: pails of oranges; population: truckload of oranges. It is likely that about 5% of all the oranges are
    unsatisfactory.

PTS: 2   REF: 011726aii   NAT: S.IC.A.2   TOP: Analysis of Data

53 ANS:
    Amplitude, because the height of the graph shows the volume of the air.

PTS: 2   REF: 081625aii   NAT: F.IF.C.7   TOP: Graphing Trigonometric Functions
    KEY: mixed

54 ANS: 1

$$x^4 - 4x^3 - 9x^2 + 36x = 0$$

$$x^3(x-4) - 9x(x-4) = 0$$

$$(x^3 - 9x)(x-4) = 0$$

$$x(x^2 - 9)(x-4) = 0$$

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

$$x = 0, \pm 3, 4$$

PTS: 2   REF: 061606aii   NAT: A.APR.B.3   TOP: Zeros of Polynomials
KEY: AII

55 ANS:

$$\frac{156.25 - 56.25}{70 - 50} = \frac{150}{20} = 7.5$$ Between 50-70 mph, each additional mph in speed requires 7.5 more feet to stop.
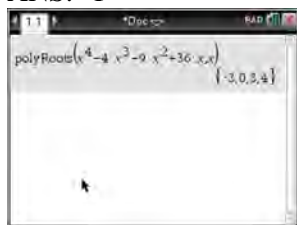
PTS: 2   REF: 081631aii   NAT: F.IF.B.6   TOP: Rate of Change
KEY: AII

56 ANS:
$0.506 \pm 2 \cdot 0.078 = 0.35 - 0.66$. The 32.5% value falls below the 95% confidence level.

PTS: 4   REF: 061736aii   NAT: S.IC.B.5   TOP: Analysis of Data

57 ANS: 4   PTS: 2   REF: 081708aii   NAT: A.APR.B.3
TOP: Zeros of Polynomials   KEY: AII

58 ANS:
Let x equal the first integer and $x + 1$ equal the next. $(x+1)^2 - x^2 = x^2 + 2x + 1 - x^2 = 2x + 1$. $2x + 1$ is an odd integer.

PTS: 2   REF: fall1511aii   NAT: A.APR.C.4   TOP: Polynomial Identities

59 ANS: 3   PTS: 2   REF: 011710aii   NAT: F.BF.A.1
TOP: Operations with Functions

60 ANS: 3   PTS: 2   REF: 061710aii   NAT: S.IC.A.2
TOP: Analysis of Data

61 ANS:

$$20000 = PMT\left(\frac{1-(1+.00625)^{-60}}{0.00625}\right) \quad 21000 - x = 300\left(\frac{1-(1+.00625)^{-60}}{0.00625}\right)$$

$$PMT \approx 400.76 \qquad\qquad x \approx 6028$$

PTS: 4   REF: 011736aii   NAT: A.SSE.B.4   TOP: Series

62 ANS: 2   PTS: 2   REF: 061724aii   NAT: A.SSE.B.4
     TOP: Series

63 ANS:

$y = 4.168(3.981)^x$. $100 = 4.168(3.981)^x$

$$\log \frac{100}{4.168} = \log(3.981)^x$$

$$\log \frac{100}{4.168} = x \log(3.981)$$

$$\frac{\log \frac{100}{4.168}}{\log(3.981)} = x$$

$$x \approx 2.25$$

     PTS: 4   REF: 081736aii   NAT: S.ID.B.6   TOP: Regression
     KEY: exponential AII

64 ANS: 1

(1) $\frac{9-0}{2-1} = 9$ (2) $\frac{17-0}{3.5-1} = 6.8$ (3) $\frac{0-0}{5-1} = 0$ (4) $\frac{17--5}{3.5-1} \approx 6.3$

     PTS: 2   REF: 011724aii   NAT: F.IF.B.6   TOP: Rate of Change
     KEY: AII

65 ANS:
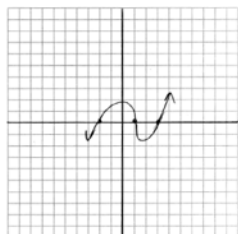
     PTS: 2   REF: 011729aii   NAT: A.APR.B.3   TOP: Zeros of Polynomials

66 ANS: 1

$$\frac{157}{25 + 47 + 157}$$

     PTS: 2   REF: 081607aii   NAT: S.CP.A.4   TOP: Conditional Probability

67 ANS: 2

$$x = \frac{y+1}{y-2}$$

$$xy - 2x = y + 1$$

$$xy - y = 2x + 1$$

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

$$y = \frac{2x+1}{x-1}$$

PTS: 2 REF: 081714aii NAT: F.BF.B.4 TOP: Inverse of Functions
KEY: equations

68 ANS:
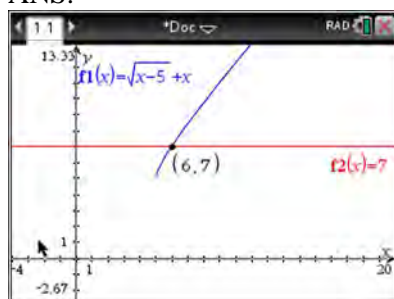
$\sqrt{x-5} = -x + 7$ $\sqrt{x-5} = -9 + 7 = -2$ is extraneous.

$$x - 5 = x^2 - 14x + 49$$

$$0 = x^2 - 15x + 54$$

$$0 = (x-6)(x-9)$$

$$x = 6, 9$$

PTS: 2 REF: spr1508aii NAT: A.REI.A.2 TOP: Solving Radicals
KEY: extraneous solutions

69 ANS: 1

1) let $y = x + 2$, then $y^2 + 2y - 8$

$$(y+4)(y-2)$$

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

$$(x+6)x$$

PTS: 2 REF: 081715aii NAT: A.SSE.A.2 TOP: Factoring Polynomials
KEY: multivariable

70 ANS: 3

$f(x) = -f(x)$, so $f(x)$ is odd. $g(-x) \neq g(x)$, so $g(x)$ is not even. $g(-x) \neq -g(x)$, so $g(x)$ is not odd. $h(-x) = h(x)$, so $h(x)$ is even.

PTS: 2 REF: fall1502aii NAT: F.BF.B.3 TOP: Even and Odd Functions

71 ANS: 2

$$B(t) = 750\left(1.16^{\frac{1}{12}}\right)^{12t} \approx 750(1.012)^{12t} \quad B(t) = 750\left(1 + \frac{0.16}{12}\right)^{12t} \text{ is wrong, because the growth is an annual rate}$$

that is not compounded monthly.

PTS: 2   REF: spr1504aii   NAT: A.SSE.B.3   TOP: Modeling Exponential Functions
KEY: AII

72 ANS: 3   PTS: 2   REF: 081705aii   NAT: F.IF.B.4
TOP: Graphing Trigonometric Functions   KEY: increasing/decreasing

73 ANS:

$$M = 172600 \bullet \frac{0.00305(1 + 0.00305)^{12 \cdot 15}}{(1 + 0.00305)^{12 \cdot 15} - 1} \approx 1247 \quad 1100 = (172600 - x) \bullet \frac{0.00305(1 + 0.00305)^{12 \cdot 15}}{(1 + 0.00305)^{12 \cdot 15} - 1}$$

$$1100 \approx (172600 - x) \bullet (0.007228)$$

$$152193 \approx 172600 - x$$

$$20407 \approx x$$

PTS: 4   REF: 061734aii   NAT: A.SSE.B.4   TOP: Series

74 ANS: 4

The vertex is $(1,0)$ and $p = 2$. $y = \frac{1}{4(2)}(x - 1)^2 + 0$

PTS: 2   REF: 061717aii   NAT: G.GPE.A.2   TOP: Graphing Quadratic Functions

75 ANS:
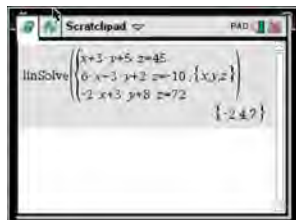
$$6x - 3y + 2z = -10 \quad x + 3y + 5z = 45 \quad 4x + 10z = 62 \quad 4x + 4(7) = 20$$
$$-2x + 3y + 8z = 72 \quad 6x - 3y + 2z = -10 \quad 4x + 4z = 20 \quad 4x = -8$$
$$4x + 10z = 62 \quad 7x + 7z = 35 \quad 6z = 42 \quad x = -2$$
$$4x + 4z = 20 \quad z = 7$$

$$6(-2) - 3y + 2(7) = -10$$
$$-3y = -12$$
$$y = 4$$

PTS: 4   REF: spr1510aii   NAT: A.REI.C.6   TOP: Solving Linear Systems
KEY: three variables

76 ANS:
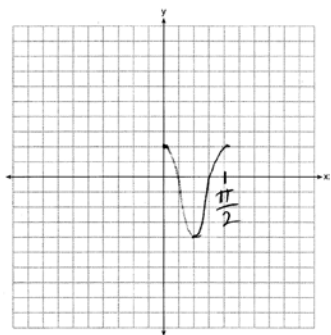
PTS: 2   REF: 061628aii   NAT: F.IF.C.7   TOP: Graphing Trigonometric Functions
KEY: graph

77 ANS:

$$\frac{\left(\ln \frac{1}{2} \right)}{1590}$$ is negative, so $M(t)$ represents decay.

PTS: 2   REF: 011728aii   NAT: F.IF.C.8   TOP: Modeling Exponential Functions

78 ANS: 1

PTS: 2   REF: fall1503aii   NAT: A.APR.D.6   TOP: Rational Expressions

79 ANS: 4

The maximum volume of $p(x) = -(x + 2)(x - 10)(x - 14)$ is about 56, at $x = 12.1$

PTS: 2   REF: 081712aii   NAT: F.IF.B.4   TOP: Graphing Polynomial Functions

80 ANS:
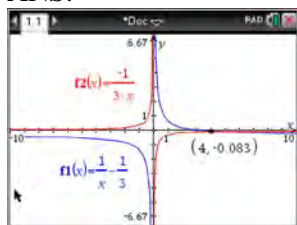
$$\frac{1}{x} - \frac{1}{3} = -\frac{1}{3x}$$

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

$$3 - x = -1$$

$$x = 4$$

PTS: 2   REF: 061625aii   NAT: A.REI.A.2   TOP: Solving Rationals
KEY: rational solutions

81 ANS: 1   PTS: 2   REF: 061708aii   NAT: F.IF.C.7
TOP: Graphing Trigonometric Functions   KEY: identify

82 ANS: 3

$$1.0525^{\frac{1}{12}} \approx 1.00427$$

PTS: 2   REF: 061621aii   NAT: F.BF.A.1   TOP: Modeling Exponential Functions
KEY: AII

83 ANS:
$0.602 \pm 2 \cdot 0.066 = 0.47 - 0.73$. Since 0.50 falls within the 95% interval, this supports the concern there may be an even split.

PTS: 4   REF: 061635aii   NAT: S.IC.B.5   TOP: Analysis of Data

84 ANS: 3   PTS: 2   REF: 081618aii   NAT: F.LE.A.2
TOP: Sequences

85 ANS: 3
$$2d(d^3 + 3d^2 - 9d - 27)$$
$$2d(d^2(d+3) - 9(d+3))$$
$$2d(d^2 - 9)(d+3)$$
$$2d(d+3)(d-3)(d+3)$$
$$2d(d+3)^2(d-3)$$

PTS: 2   REF: 081615aii   NAT: A.SSE.A.2   TOP: Factoring Polynomials
KEY: factoring by grouping

86 ANS:
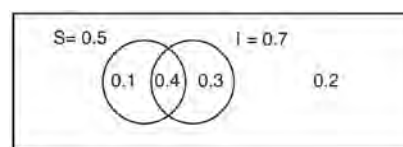
This scenario can be modeled with a Venn Diagram: Since
$P(S \cup I)_c = 0.2$, $P(S \cup I) = 0.8$. Then, $P(S \cap I) = P(S) + P(I) - P(S \cup I)$ If S and I are independent, then the

$$= 0.5 + 0.7 - 0.8$$

$$= 0.4$$

Product Rule must be satisfied. However, $(0.5)(0.7) \neq 0.4$. Therefore, salary and insurance have not been treated independently.

PTS: 4   REF: spr1513aii   NAT: S.CP.A.2   TOP: Theoretical Probability

87 ANS: 4   PTS: 2   REF: 061706aii   NAT: F.IF.B.4
TOP: Graphing Trigonometric Functions

88 ANS: 2   PTS: 2   REF: 011720aii   NAT: A.APR.B.2
TOP: Remainder Theorem

89 ANS: 4

$y = g(x) = (x-2)^2$ $(x-2)^2 = 3x - 2$ $y = 3(6) - 2 = 16$

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

$x^2 - 7x + 6 = 0$

$(x-6)(x-1) = 0$

$x = 6, 1$

PTS: 2   REF: 011705aii   NAT: A.REI.C.7   TOP: Quadratic-Linear Systems
KEY: AII

90 ANS: 1

The probability of rain equals the probability of rain, given that Sean pitches.

PTS: 2   REF: 061611aii   NAT: S.CP.A.3   TOP: Conditional Probability

91 ANS:
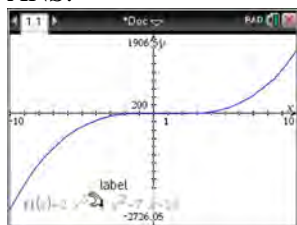
$$2x^2 + 6x + 23$$
$$x - 5 \overline{)\ 2x^3 - 4x^2 - 7x - 10}$$ Since there is a remainder, $x - 5$ is not a factor.

$$\underline{2x^3 - 10x^2}$$

$$6x^2 - 7x$$

$$\underline{6x^2 - 30x}$$

$$23x - 10$$

$$\underline{23x - 115}$$

$$105$$

PTS: 2   REF: 061627aii   NAT: A.APR.B.2   TOP: Remainder Theorem

92 ANS: 4
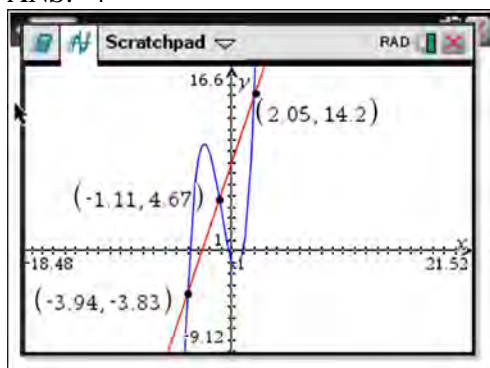
PTS: 2   REF: 061622aii   NAT: A.REI.D.11   TOP: Other Systems
KEY: AII

93 ANS: 4
The scenario represents a decreasing geometric sequence with a common ratio of 0.80.

PTS: 2   REF: 061610aii   NAT: F.BF.A.2   TOP: Sequences

94 ANS: 2   PTS: 2   REF: 081610aii   NAT: F.IF.B.4
TOP: Graphing Trigonometric Functions   KEY: increasing/decreasing

95 ANS:

period is $\frac{2}{3}$. The wheel rotates once every $\frac{2}{3}$ second.

PTS: 2   REF: 061728aii   NAT: F.IF.C.7   TOP: Graphing Trigonometric Functions
KEY: period

96 ANS: 4

The vertex is $(2, -1)$ and $p = 2$. $y = -\dfrac{1}{4(2)}(x - 2)^2 - 1$

PTS: 2   REF: 081619aii   NAT: G.GPE.A.2   TOP: Graphing Quadratic Functions

97 ANS: 3

Since $x + 4$ is a factor of $p(x)$, there is no remainder.

PTS: 2   REF: 081621aii   NAT: A.APR.B.2   TOP: Remainder Theorem

98 ANS:
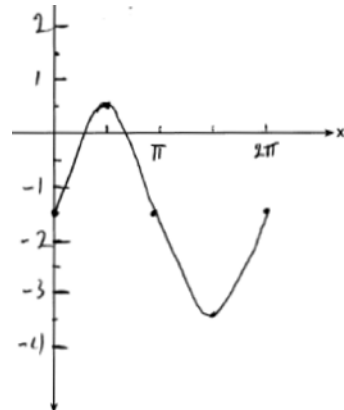
Part a sketch is shifted $\dfrac{\pi}{3}$ units right.

PTS: 4   REF: 081735aii   NAT: F.IF.C.7   TOP: Graphing Trigonometric Functions
KEY: graph

99 ANS: 3

$x^2 + 2x + 1 = -5 + 1$

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

$x + 1 = \pm 2i$

$x = -1 \pm 2i$

PTS: 2   REF: 081703aii   NAT: A.REI.B.4   TOP: Solving Quadratics
KEY: complex solutions | completing the square

100 ANS:
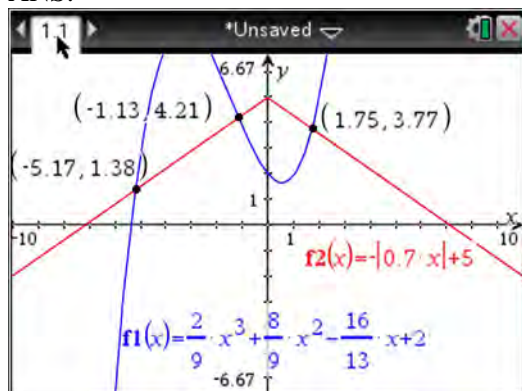
PTS: 2   REF: fall1510aii   NAT: A.REI.D.11   TOP: Other Systems
KEY: AII

101 ANS: 1

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

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

$\qquad x = -4, 2$

PTS: 2   REF: 081701aii   NAT: A.APR.D.6   TOP: Undefined Rationals

102 ANS: 2

$$ME = \left(z\sqrt{\dfrac{p(1-p)}{n}} \right) = \left(1.96\sqrt{\dfrac{(0.55)(0.45)}{900}} \right) \approx 0.03$$

PTS: 2   REF: 081612aii   NAT: S.IC.B.4   TOP: Analysis of Data

103 ANS:

$\dfrac{f(4) - f(-2)}{4 - -2} = \dfrac{80 - 1.25}{6} = 13.125$ $g(x)$ has a greater rate of change

$\dfrac{g(4) - g(-2)}{4 - -2} = \dfrac{179 - -49}{6} = 38$

PTS: 4   REF: 061636aii   NAT: F.IF.B.6   TOP: Rate of Change
KEY: AII

104 ANS:

$\dfrac{x^3 + 9}{x^3 + 8} = \dfrac{x^3 + 8}{x^3 + 8} + \dfrac{1}{x^3 + 8}$

$\dfrac{x^3 + 9}{x^3 + 8} = \dfrac{x^3 + 9}{x^3 + 8}$

PTS: 2   REF: 061631aii   NAT: A.APR.C.4   TOP: Polynomial Identities

105 ANS: 3

$0.75^{\frac{1}{10}} \approx .9716$

PTS: 2 REF: 061713aii NAT: A.SSE.B.3 TOP: Modeling Exponential Functions
KEY: AII

106 ANS:

$\sqrt{x-4} = -x+6$ $\quad\quad \sqrt{x-4} = -8+6 = -2$ is extraneous.

$x - 4 = x^2 - 12x + 36$

$0 = x^2 - 13x + 40$

$0 = (x-8)(x-5)$

$x = 5, 8$

PTS: 2 REF: 061730aii NAT: A.REI.A.2 TOP: Solving Radicals
KEY: extraneous solutions

107 ANS: 3 PTS: 2 REF: 081724aii NAT: F.BF.A.2
TOP: Sequences

108 ANS: 4

$d = 32(.8)^{b-1} \quad S_n = \dfrac{32 - 32(.8)^{12}}{1 - .8} \approx 149$

PTS: 2 REF: 081721aii NAT: A.SSE.B.4 TOP: Series

109 ANS: 3

$\dfrac{1}{J} = \dfrac{1}{F} - \dfrac{1}{W}$

$\dfrac{1}{J} = \dfrac{W-F}{FW}$

$J = \dfrac{FW}{W-F}$

PTS: 2 REF: 081617aii NAT: A.REI.A.2 TOP: Solving Rationals
KEY: rational solutions

110 ANS: 4

As the range is [4,10], the midline is $y = \dfrac{4+10}{2} = 7$.

PTS: 2 REF: fall1506aii NAT: F.IF.C.7 TOP: Graphing Trigonometric Functions
KEY: mixed

111 ANS: 4

$m^5 + m^3 - 6m = m(m^4 + m^2 - 6) = m(m^2 + 3)(m^2 - 2)$
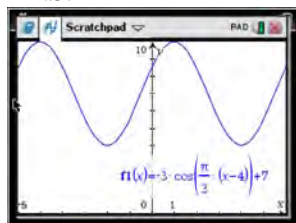
PTS: 2   REF: 011703aii   NAT: A.SSE.A.2   TOP: Factoring Polynomials
KEY: higher power AII

112 ANS:

$$100 = 140 \left(\frac{1}{2}\right)^{\frac{5}{h}} \quad \log\frac{100}{140} = \log\left(\frac{1}{2}\right)^{\frac{5}{h}} \qquad\qquad 40 = 140\left(\frac{1}{2}\right)^{\frac{t}{10.3002}}$$

$$\log\frac{5}{7} = \frac{5}{h}\log\frac{1}{2} \qquad\qquad \log\frac{2}{7} = \log\left(\frac{1}{2}\right)^{\frac{t}{10.3002}}$$

$$h = \frac{5\log\frac{1}{2}}{\log\frac{5}{7}} \approx 10.3002 \qquad \log\frac{2}{7} = \frac{t\log\left(\frac{1}{2}\right)}{10.3002}$$

$$t = \frac{10.3002\log\frac{2}{7}}{\log\frac{1}{2}} \approx 18.6$$

PTS: 6   REF: 061737aii   NAT: F.LE.A.4   TOP: Exponential Decay

113 ANS:

$$\frac{x^{\frac{8}{3}}}{x^{\frac{4}{3}}} = x^y$$

$$x^{\frac{4}{3}} = x^y$$
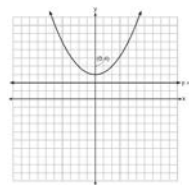
$$\frac{4}{3} = y$$

PTS: 2   REF: spr1505aii   NAT: N.RN.A.2   TOP: Radicals and Rational Exponents
KEY: numbers

114 ANS: 2

$(2 - yi)(2 - yi) = 4 - 4yi + y^2 i^2 = -y^2 - 4yi + 4$

PTS: 2   REF: 061603aii   NAT: N.CN.A.2   TOP: Operations with Complex Numbers

115 ANS: 4

A parabola with a focus of $(0,4)$ and a directrix of $y = 2$ is sketched as follows: By inspection, it is determined that the vertex of the parabola is $(0,3)$. It is also evident that the distance, p, between the vertex and the focus is 1. It is possible to use the formula $(x - h)^2 = 4p(y - k)$ to derive the equation of the parabola as follows: $(x - 0)^2 = 4(1)(y - 3)$

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

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

$$\frac{x^2}{4} + 3 = y$$

or A point (x, y) on the parabola must be the same distance from the focus as it is from the directrix. For any such point (x, y), the distance to the focus is $\sqrt{(x - 0)^2 + (y - 4)^2}$ and the distance to the directrix is $y - 2$. Setting this equal leads to: $x^2 + y^2 - 8y + 16 = y^2 - 4y + 4$

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

$$\frac{x^2}{4} + 3 = y$$

PTS: 2   REF: spr1502aii   NAT: G.GPE.A.2   TOP: Graphing Quadratic Functions

116 ANS: 1   PTS: 2   REF: 081609aii   NAT: F.BF.B.6
TOP: Sigma Notation   KEY: represent

117 ANS:

$$P(W/D) = \frac{P(W \wedge D)}{P(D)} = \frac{.4}{.5} \approx .8$$

PTS: 2   REF: 081726aii   NAT: S.CP.B.6   TOP: Conditional Probability

118 ANS:

$$8.75 = 1.25x^{49} \qquad 4$$

$$7 = x^{49}$$

$$x = \sqrt[49]{7} \approx 1.04$$

PTS: 2   REF: 081730aii   NAT: F.LE.A.4   TOP: Exponential Growth

119 ANS:
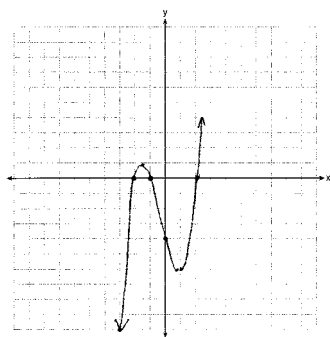
$0 = x^2(x+1) - 4(x+1)$

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

$0 = (x+2)(x-2)(x+1)$

$x = -2, -1, 2$

PTS: 4   REF: 081633aii   NAT: F.IF.C.7   TOP: Graphing Polynomial Functions

120 ANS: 1

```
2 | 1   0  -4  -4   8
  |     2   4   0  -8
  ‾‾‾‾‾‾‾‾‾‾‾‾‾‾‾‾‾‾‾‾
    1   2   0  -4   0
```

Since there is no remainder when the quartic is divided by $x - 2$, this binomial is a factor.

PTS: 2   REF: 061711aii   NAT: A.APR.B.2   TOP: Remainder Theorem

121 ANS:

$\dfrac{6.25 - 2.25}{21 - 5} = \dfrac{4}{16} = \$.25$ fine per day. $2.25 - 5(.25) = \$1$ replacement fee. $a_n = 1.25 + (n-1)(.25)$. $a_{60} = \$16$

PTS: 4   REF: 081734aii   NAT: F.LE.A.2   TOP: Sequences

122 ANS: 1   PTS: 2   REF: 081722aii   NAT: S.IC.B.6
    TOP: Analysis of Data

123 ANS: 4

$\dfrac{m(c)}{g(c)} = \dfrac{c+1}{1-c^2} = \dfrac{c+1}{(1+c)(1-c)} = \dfrac{1}{1-c}$

PTS: 2   REF: 061608aii   NAT: F.BF.A.1   TOP: Operations with Functions

124 ANS:
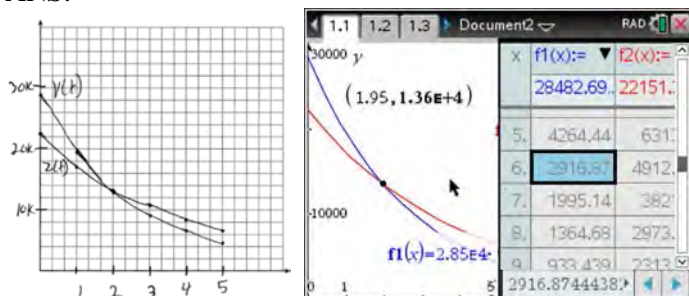
 At 1.95 years, the value of the car equals the loan balance. Zach can cancel the policy after 6 years.

PTS: 4   REF: 081737aii   NAT: A.REI.D.11   TOP: Other Systems
KEY: AII

125 ANS: 4

If $1 - i$ is one solution, the other is $1 + i$. $(x - (1 - i))(x - (1 + i)) = 0$

$$x^2 - x - ix - x + ix + (1 - i^2) = 0$$

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

PTS: 2   REF: 081601aii   NAT: A.REI.B.4   TOP: Complex Conjugate Root Theorem

126 ANS: 2

The events are independent because $P(A \text{ and } B) = P(A) \cdot P(B)$.

$$0.125 = 0.5 \cdot 0.25$$

If $P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B) = 0.25 + 0.5 - .125 = 0.625$, then the events are not mutually exclusive because $P(A \text{ or } B) = P(A) + P(B)$

$$0.625 \neq 0.5 + 0.25$$

PTS: 2   REF: 061714aii   NAT: S.CP.B.7   TOP: Theoretical Probability

127 ANS: 3   PTS: 2   REF: 061722aii   NAT: A.CED.A.1
TOP: Modeling Rationals

128 ANS: 4

$4x^2 = -98$

$$x^2 = -\frac{98}{4}$$

$$x^2 = -\frac{49}{2}$$

$$x = \pm\sqrt{-\frac{49}{2}} = \pm\frac{7i}{\sqrt{2}} \cdot \frac{\sqrt{2}}{\sqrt{2}} = \pm\frac{7i\sqrt{2}}{2}$$

PTS: 2   REF: 061707aii   NAT: A.REI.B.4   TOP: Solving Quadratics
KEY: complex solutions | taking square roots

129 ANS: 1
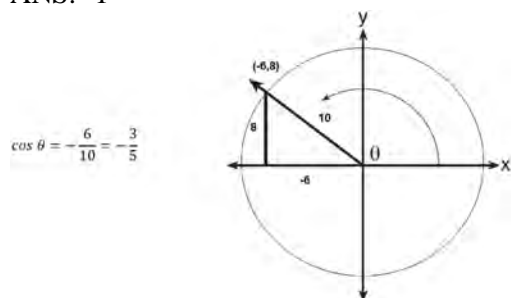
$$\cos \theta = -\frac{6}{10} = -\frac{3}{5}$$

PTS: 2   REF: 061617aii   NAT: F.TF.A.2   TOP: Determining Trigonometric Functions
KEY: extension to reals

130 ANS: 3
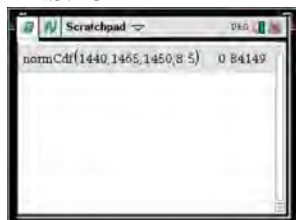
PTS: 2   REF: 081604aii   NAT: S.ID.A.4   TOP: Normal Distributions
KEY: probability

131 ANS: 2

$$ME = \left(z\sqrt{\frac{p(1-p)}{n}} \right) = \left(1.96\sqrt{\frac{(0.16)(0.84)}{1334}} \right) \approx 0.02$$

PTS: 2   REF: 081716aii   NAT: S.IC.B.4   TOP: Analysis of Data

132 ANS: 3
Self selection causes bias.

PTS: 2   REF: 061703aii   NAT: S.IC.B.3   TOP: Analysis of Data
KEY: bias

133 ANS: 1

$$\frac{2x}{x-2}\left(\frac{x}{x}\right) - \frac{11}{x}\left(\frac{x-2}{x-2}\right) = \frac{8}{x^2-2x}$$

$$2x^2 - 11x + 22 = 8$$

$$2x^2 - 11x + 14 = 0$$

$$(2x-7)(x-2) = 0$$

$$x = \frac{7}{2}, 2$$

PTS: 2   REF: 061719aii   NAT: A.REI.A.2   TOP: Solving Rationals

27

134 ANS: 3
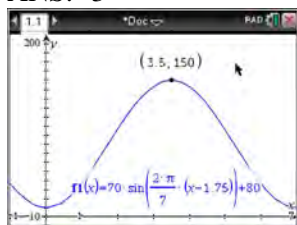
 $H(t)$ is at a minimum at $70(-1) + 80 = 10$

PTS: 2   REF: 061613aii   NAT: F.IF.B.4   TOP: Graphing Trigonometric Functions
KEY: maximum/minimum

135 ANS: 2

$$\cos \theta = \pm \sqrt{1 - \left(\frac{-\sqrt{2}}{5} \right)^2} = \pm \sqrt{\frac{25}{25} - \frac{2}{25}} = \pm \frac{\sqrt{23}}{5}$$

PTS: 2   REF: 061712aii   NAT: F.TF.C.8   TOP: Determining Trigonometric Functions

136 ANS: 3
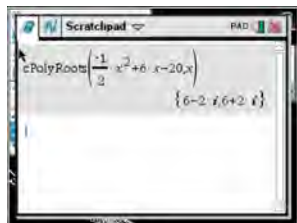
$$-2\left(-\frac{1}{2} x^2 = -6x + 20 \right)$$

$$x^2 - 12x = -40$$

$$x^2 - 12x + 36 = -40 + 36$$

$$(x - 6)^2 = -4$$

$$x - 6 = \pm 2i$$

$$x = 6 \pm 2i$$

PTS: 2   REF: fall1504aii   NAT: A.REI.B.4   TOP: Solving Quadratics
KEY: complex solutions | completing the square

137 ANS:
$P(A \cup B) = P(A) + P(B) - P(A \cap B)$ A and B are independent since $P(A \cap B) = P(A) \cdot P(B)$

$0.8 = 0.6 + 0.5 - P(A \cap B)$ $0.3 = 0.6 \cdot 0.5$

$P(A \cap B) = 0.3$ $0.3 = 0.3$

PTS: 2   REF: 081632aii   NAT: S.CP.A.2   TOP: Theoretical Probability

138 ANS: 1   PTS: 2   REF: 061701aii   NAT: A.APR.B.3
TOP: Zeros of Polynomials   KEY: AII

139 ANS:

$$x + y + z = 1 \qquad 2x + 2y + 2z = 2 \quad -2z - z = 3 \quad y - (-1) = 3 \quad x + 2 - 1 = 1$$

$$\underline{-x + 3y - 5z = 11} \quad \underline{2x + 4y + 6z = 2} \quad -3z = 3 \qquad y = 2 \qquad\qquad x = 0$$

$$4y - 4z = 12 \qquad\quad 2y + 4z = 0 \qquad z = -1$$

$$y - z = 3 \qquad\qquad y + 2z = 0$$

$$y = -2z$$

PTS: 4 REF: 061733aii NAT: A.REI.C.6 TOP: Solving Linear Systems
KEY: three variables

140 ANS: 3
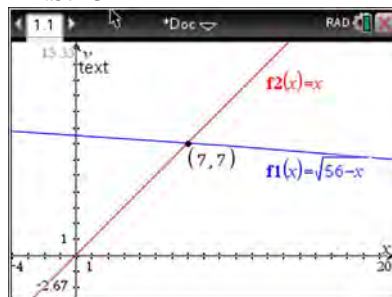
$$\sqrt{56 - x} = x \qquad\qquad -8 \text{ is extraneous.}$$

$$56 - x = x^2$$

$$0 = x^2 + x - 56$$

$$0 = (x + 8)(x - 7)$$

$$x = 7$$

PTS: 2 REF: 061605aii NAT: A.REI.A.2 TOP: Solving Radicals
KEY: extraneous solutions

141 ANS:

$\csc \theta = \dfrac{1}{\sin \theta}$, and $\sin \theta$ on a unit circle represents the y value of a point on the unit circle. Since $y = \sin \theta$,

$\csc \theta = \dfrac{1}{y}$.

PTS: 2 REF: 011727aii NAT: F.TF.A.2 TOP: Reciprocal Trigonometric Relationships

142 ANS: 3

$$(3k - 2i)^2 = 9k^2 - 12ki + 4i^2 = 9k^2 - 12ki - 4$$

PTS: 2 REF: 081702aii NAT: N.CN.A.2 TOP: Operations with Complex Numbers

143 ANS: 1

The zeros of the polynomial are at $-b$, and c. The sketch of a polynomial of degree 3 with a negative leading coefficient should have end behavior showing as x goes to negative infinity, $f(x)$ goes to positive infinity. The multiplicities of the roots are correctly represented in the graph.

PTS: 2 REF: spr1501aii NAT: A.APR.B.3 TOP: Zeros of Polynomials
KEY: AII

144 ANS:

$2x^3 - 10x^2 + 11x - 7 = 2x^3 + hx^2 + 3x - 8x^2 - 4hx - 12 + k \quad h = -2$

$\qquad -2x^2 + 8x + 5 = hx^2 - 4hx + k \qquad\qquad\qquad k = 5$

PTS: 4 REF: 011733aii NAT: A.APR.C.4 TOP: Polynomial Identities

145 ANS: 4

$\text{period} = \dfrac{2\pi}{B}$

$\dfrac{1}{60} = \dfrac{2\pi}{B}$

$B = 120\pi$

PTS: 2 REF: 061624aii NAT: F.TF.B.5 TOP: Modeling Trigonometric Functions

146 ANS: 2

Combining (1) and (3): $-6c = -18$ Combining (1) and (2): $5a + 3c = -1$ Using (3): $-(-2) - 5b - 5(3) = 2$

$\qquad\qquad\qquad c = 3 \qquad\qquad\qquad\qquad 5a + 3(3) = -1 \qquad\qquad\qquad 2 - 5b - 15 = 2$

$\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad 5a = -10 \qquad\qquad\qquad\qquad\qquad b = -3$

$\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad a = -2$

PTS: 2 REF: 081623aii NAT: A.REI.C.6 TOP: Solving Linear Systems
KEY: three variables

147 ANS: 1

$\dfrac{2(x-4)}{(x+3)(x-4)} + \dfrac{3(x+3)}{(x-4)(x+3)} = \dfrac{2x-2}{x^2 - x - 12}$

$\qquad\qquad 2x - 8 + 3x + 9 = 2x - 2$

$\qquad\qquad\qquad\qquad 3x = -3$

$\qquad\qquad\qquad\qquad x = -1$

PTS: 2 REF: 011717aii NAT: A.REI.A.2 TOP: Solving Rationals
KEY: rational solutions

148 ANS:

The mean difference between the students' final grades in group 1 and group 2 is –3.64. This value indicates that students who met with a tutor had a mean final grade of 3.64 points less than students who used an on-line subscription. One can infer whether this difference is due to the differences in intervention or due to which students were assigned to each group by using a simulation to rerandomize the students' final grades many (500) times. If the observed difference –3.64 is the result of the assignment of students to groups alone, then a difference of –3.64 or less should be observed fairly regularly in the simulation output. However, a difference of –3 or less occurs in only about 2% of the rerandomizations. Therefore, it is quite unlikely that the assignment to groups alone accounts for the difference; rather, it is likely that the difference between the interventions themselves accounts for the difference between the two groups' mean final grades.

PTS: 4 REF: fall1514aii NAT: S.IC.B.5 TOP: Analysis of Data

149 ANS:
Using a 95% level of confidence, $x \pm 2$ standard deviations sets the usual wait time as 150-302 seconds. 360 seconds is unusual.

PTS: 2 REF: 081629aii NAT: S.IC.B.6 TOP: Analysis of Data

150 ANS:

$$A = Pe^{rt}$$

$$135000 = 100000e^{5r}$$

$$1.35 = e^{5r}$$

$$\ln 1.35 = \ln e^{5r}$$

$$\ln 1.35 = 5r$$
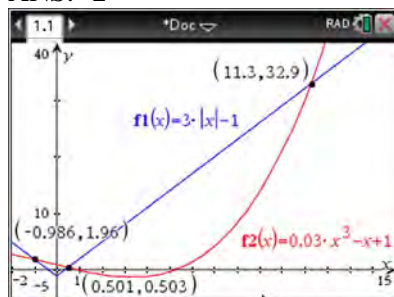
$$.06 \approx r \text{ or } 6\%$$

PTS: 2 REF: 061632aii NAT: F.LE.A.4 TOP: Exponential Growth
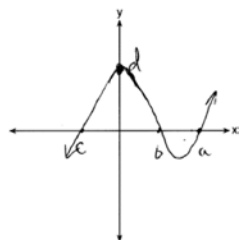
151 ANS: 2

PTS: 2 REF: 061705aii NAT: A.REI.D.11 TOP: Other Systems
KEY: AII

152 ANS:

PTS: 2 REF: 081732aii NAT: A.APR.B.3 TOP: Zeros of Polynomials
KEY: AII

153 ANS:
$a_n = x^{n-1}(x+1)$ $x^{n-1} = 0$ $x+1 = 0$

$$x = 0 \qquad x = -1$$

PTS: 4 REF: spr1511aii NAT: F.BF.A.2 TOP: Sequences

154 ANS:

$A = 5000(1.045)^n$ $5000\left(1 + \dfrac{.046}{4}\right)^{4(6)} - 5000(1.045)^6 \approx 6578.87 - 6511.30 \approx 67.57$ $10000 = 5000\left(1 + \dfrac{.046}{4}\right)^{4n}$

$B = 5000\left(1 + \dfrac{.046}{4}\right)^{4n}$

$2 = 1.0115^{4n}$

$\log 2 = 4n \cdot \log 1.0115$

$n = \dfrac{\log 2}{4 \log 1.0115}$

$n \approx 15.2$

PTS: 6   REF: 081637aii   NAT: A.CED.A.1   TOP: Exponential Growth

155 ANS:

Rewrite $\dfrac{4}{3}$ as $\dfrac{1}{3} \cdot \dfrac{4}{1}$, using the power of a power rule.

PTS: 2   REF: 081725aii   NAT: N.RN.A.1   TOP: Radicals and Rational Exponents

156 ANS: 4   PTS: 2   REF: 061601aii   NAT: N.RN.A.2
TOP: Radicals and Rational Exponents   KEY: variables

157 ANS:

69

PTS: 2   REF: 061726aii   NAT: S.ID.A.4   TOP: Normal Distributions
KEY: percent

158 ANS: 4

$(x + y)^3 = x^3 + 3x^2y + 3xy^2 + y^3 \neq x^3 + 3xy + y^3$

PTS: 2   REF: 081620aii   NAT: A.APR.C.4   TOP: Polynomial Identities

159 ANS: 3

$d = 10 \log \dfrac{6.3 \times 10^{-3}}{1.0 \times 10^{-12}} \approx 98$

PTS: 2   REF: 011715aii   NAT: F.IF.B.4   TOP: Evaluating Logarithmic Expressions

160 ANS: 3   PTS: 2   REF: 011706aii   NAT: S.IC.B.3
TOP: Analysis of Data   KEY: type

161 ANS: 3   PTS: 2   REF: 061602aii   NAT: A.CED.A.1
TOP: Modeling Rationals

162 ANS: 3

$$\left(\frac{1}{2}\right)^{\frac{1}{73.83}} \approx 0.990656$$

PTS: 2   REF: 081710aii   NAT: A.SSE.B.3   TOP: Modeling Exponential Functions
KEY: AII

163 ANS:

$$0 = 6(-5)^3 + b(-5)^2 - 52(-5) + 15 \quad z(x) = 6x^3 + 19x^2 - 52x + 15$$

$$0 = -750 + 25b + 260 + 15$$

$$475 = 25b$$

$$19 = b$$

-5	6	19	-52	15
		-30	55	15
	6	-11	3	0

$$6x^2 - 11x + 3 = 0$$

$$(2x - 3)(3x - 1) = 0$$

$$x = \frac{3}{2}, \frac{1}{3}, -5$$

PTS: 4   REF: fall1515aii   NAT: A.APR.B.2   TOP: Remainder Theorem

164 ANS:

Yes. The margin of error from this simulation indicates that 95% of the observations fall within ± 0.12 of the simulated proportion, 0.25. The margin of error can be estimated by multiplying the standard deviation, shown to be 0.06 in the dotplot, by 2, or applying the estimated standard error formula, $\left(\sqrt{\dfrac{p(1-p)}{n}}\right)$ or $\left(\sqrt{\dfrac{(0.25)(0.75)}{50}}\right)$ and multiplying by 2. The interval 0.25 ± 0.12 includes plausible values for the true proportion of people who prefer Stephen's new product. The company has evidence that the population proportion could be at least 25%. As seen in the dotplot, it can be expected to obtain a sample proportion of 0.18 (9 out of 50) or less several times, even when the population proportion is 0.25, due to sampling variability. Given this information, the results of the survey do not provide enough evidence to suggest that the true proportion is not at least 0.25, so the development of the product should continue at this time.

PTS: 4   REF: spr1512aii   NAT: S.IC.B.4   TOP: Analysis of Data

165 ANS:

$$(4 - 3i)(5 + 2yi - 5 + 2yi)$$

$$(4 - 3i)(4yi)$$

$$16yi - 12yi^2$$

$$12y + 16yi$$

PTS: 2   REF: spr1506aii   NAT: N.CN.A.2   TOP: Operations with Complex Numbers

166 ANS: 2

$\overline{x} + 2\sigma$ represents approximately 48% of the data.

PTS: 2 REF: 061609aii NAT: S.ID.A.4 TOP: Normal Distributions
KEY: percent

167 ANS: 1
II. Ninth graders drive to school less often; III.Students know little about adults; IV. Calculus students love math!

PTS: 2 REF: 081602aii NAT: S.IC.B.3 TOP: Analysis of Data
KEY: bias

168 ANS: 4
$$4(x^2 - 6x + 9) + 4(y^2 + 18y + 81) = 76 + 36 + 324$$
$$4(x - 3)^2 + 4(y + 9)^2 = 436$$

PTS: 2 REF: 061619aii NAT: G.GPE.A.1 TOP: Equations of Circles
KEY: completing the square

169 ANS: 3
The pattern suggests an exponential pattern, not linear or sinusoidal. A 4% growth rate is accurate, while a 43% growth rate is not.

PTS: 2 REF: 011713aii NAT: S.ID.B.6 TOP: Regression
KEY: choose model

170 ANS: 3
$$\frac{f(7) - f(-7)}{7 - -7} = \frac{= 2^{-0.25(7)} \bullet \sin\left(\frac{\pi}{2}(7)\right) - 2^{-0.25(-7)} \bullet \sin\left(\frac{\pi}{2}(-7)\right)}{14} \approx -0.26$$

PTS: 2 REF: 061721aii NAT: F.IF.B.6 TOP: Rate of Change
KEY: AII

171 ANS:
$$xi(-6i)^2 = xi(36i^2) = 36xi^3 = -36xi$$

PTS: 2 REF: 081627aii NAT: N.CN.A.2 TOP: Operations with Complex Numbers

172 ANS: 2 PTS: 2 REF: 081717aii NAT: S.IC.B.3
TOP: Analysis of Data KEY: type

173 ANS: 2
The vertex of the parabola is $(0,0)$. The distance, p, between the vertex and the focus or the vertex and the

directrix is 1. $y = \dfrac{-1}{4p}(x-h)^2 + k$

$$y = \dfrac{-1}{4(1)}(x-0)^2 + 0$$

$$y = -\dfrac{1}{4}x^2$$

PTS: 2   REF: 081706aii   NAT: G.GPE.A.2   TOP: Graphing Quadratic Functions

174 ANS: 1
The graph of $y = \sin x$ is unchanged when rotated 180º about the origin.

PTS: 2   REF: 081614aii   NAT: F.BF.B.3   TOP: Even and Odd Functions

175 ANS:
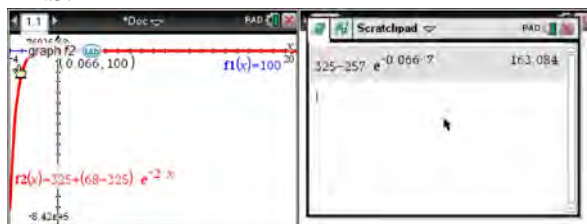
$100 = 325 + (68 - 325)e^{-2k}$ $T = 325 - 257e^{-0.066t}$

$-225 = -257e^{-2k}$ $T = 325 - 257e^{-0.066(7)} \approx 163$

$$k = \dfrac{\ln\left(\dfrac{-225}{-257}\right)}{-2}$$

$$k \approx 0.066$$

PTS: 4   REF: fall1513aii   NAT: F.LE.A.4   TOP: Exponential Growth

176 ANS: 2
$6xi^3(-4xi + 5) = -24x^2 i^4 + 30xi^3 = -24x^2(1) + 30x(-1) = -24x^2 - 30xi$

PTS: 2   REF: 061704aii   NAT: N.CN.A.2   TOP: Operations with Complex Numbers

177 ANS: 3
$(m-2)^2(m+3) = (m^2 - 4m + 4)(m + 3) = m^3 + 3m^2 - 4m^2 - 12m + 4m + 12 = m^3 - m^2 - 8m + 12$

PTS: 2   REF: 081605aii   NAT: A.SSE.A.2   TOP: Factoring Polynomials
KEY: factoring by grouping

178 ANS: 2

$$
2x + 3 \overline{\smash{\big)}\ 4x^3 + 0x^2 + 5x + 10} \quad \overset{2x^2 - 3x + 7}{}
$$

$$
\underline{4x^3 + 6x^2}
$$

$$
-6x^2 + 5x
$$

$$
\underline{-6x^2 - 9x}
$$

$$
14x + 10
$$

$$
\underline{14x + 21}
$$

$$
-11
$$

PTS: 2   REF: 061614aii   NAT: A.APR.D.6   TOP: Rational Expressions

179 ANS:

$$
\frac{3p}{p-5} = \frac{p+2}{p+3}
$$

$$
3p^2 + 9p = p^2 - 3p - 10
$$

$$
2p^2 + 12p + 10 = 0
$$

$$
p^2 + 6p + 5 = 0
$$

$$
(p+5)(p+1) = 0
$$

$$
p = -5, -1
$$

PTS: 4   REF: 081733aii   NAT: A.REI.A.2   TOP: Solving Rationals
KEY: rational solutions

180 ANS:
$$
x^2(4x - 1) + 4(4x - 1) = (x^2 + 4)(4x - 1)
$$

PTS: 2   REF: 061727aii   NAT: A.SSE.A.2   TOP: Factoring Polynomials
KEY: factoring by grouping

181 ANS: 4

$$
\left(\frac{-54x^9}{y^4} \right)^{\frac{2}{3}} = \frac{(2 \cdot -27)^{\frac{2}{3}} x^{\frac{18}{3}}}{y^{\frac{8}{3}}} = \frac{2^{\frac{2}{3}} \cdot 9x^6}{y^2 \cdot y^{\frac{2}{3}}} = \frac{9x^6 \sqrt[3]{4}}{y^2 \sqrt[3]{y^2}}
$$

PTS: 2   REF: 081723aii   NAT: N.RN.A.2   TOP: Radicals and Rational Exponents
KEY: variables

182 ANS: 4

(1) $\dfrac{B(60) - B(10)}{60 - 10} \approx 28\%$ (2) $\dfrac{B(69) - B(19)}{69 - 19} \approx 33\%$ (3) $\dfrac{B(72) - B(36)}{72 - 36} \approx 38\%$ (4) $\dfrac{B(73) - B(60)}{73 - 60} \approx 46\%$

PTS: 2   REF: 011721aii   NAT: F.IF.B.6   TOP: Rate of Change
KEY: AII

183 ANS: 3

$$-33t^2 + 360t = 700 + 5t$$

$$-33t^2 + 355t - 700 = 0$$

$$t = \frac{-355 \pm \sqrt{355^2 - 4(-33)(-700)}}{2(-33)} \approx 3, 8$$

PTS: 2   REF: 081606aii   NAT: A.REI.D.11   TOP: Quadratic-Linear Systems
KEY: AII

184 ANS:

$a_1 = 4$ $a_8 = 639$

$a_n = 2a_{n-1} + 1$

PTS: 2   REF: 081729aii   NAT: F.LE.A.2   TOP: Sequences

185 ANS: 1

PTS: 2   REF: 081711aii   NAT: S.ID.A.4   TOP: Normal Distributions
KEY: percent

186 ANS: 3   PTS: 2   REF: 011708aii   NAT: F.BF.B.4
TOP: Inverse of Functions   KEY: equations

187 ANS:

Some of the students who did not drink energy drinks read faster than those who did drink energy drinks.

$17.7 - 19.1 = -1.4$ Differences of -1.4 and less occur $\dfrac{25}{232}$ or about 10% of the time, so the difference is not unusual.

PTS: 4   REF: 081636aii   NAT: S.IC.B.5   TOP: Analysis of Data

188 ANS:

Based on these data, the two events do not appear to be independent. $P(F) = \dfrac{106}{200} = 0.53$, while

$P(F \mid T) = \dfrac{54}{90} = 0.6$, $P(F \mid R) = \dfrac{25}{65} = 0.39$, and $P(F \mid C) = \dfrac{27}{45} = 0.6$. The probability of being female are not the same as the conditional probabilities. This suggests that the events are not independent.

PTS: 2   REF: fall1508aii   NAT: S.CP.A.4   TOP: Conditional Probability

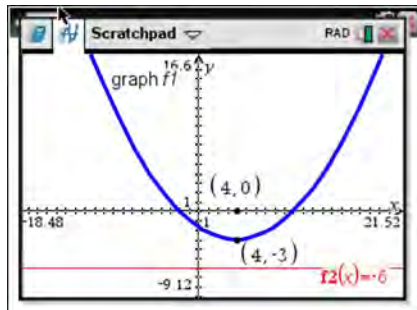189 ANS: 3   PTS: 2   REF: 061623aii   NAT: F.BF.A.2
     TOP: Sequences

190 ANS: 2

$x(30 - 0.01x) - (0.15x^3 + 0.01x^2 + 2x + 120) = 30x - 0.01x^2 - 0.15x^3 - 0.01x^2 - 2x - 120$

$$= -0.15x^3 - 0.02x^2 + 28x - 120$$

PTS: 2   REF: 061709aii   NAT: F.BF.A.1   TOP: Operations with Functions

191 ANS:

 The vertex of the parabola is $(4, -3)$. The x-coordinate of the focus and the vertex is the same. Since the distance from the vertex to the directrix is 3, the distance from the vertex to the focus is 3, so the y-coordinate of the focus is 0. The coordinates of the focus are $(4, 0)$.

PTS: 2   REF: 061630aii   NAT: G.GPE.A.2   TOP: Graphing Quadratic Functions

192 ANS: 1

$\quad\quad (x + 3)^2 + (2x - 4)^2 = 8 \quad\quad b^2 - 4ac$

$x^2 + 6x + 9 + 4x^2 - 16x + 16 = 8 \quad 100 - 4(5)(17) < 0$

$\quad\quad\quad 5x^2 - 10x + 17 = 0$

PTS: 2   REF: 081719aii   NAT: A.REI.C.7   TOP: Quadratic-Linear Systems
     KEY: AII

193 ANS: 2

```
-4 | 1  -11   16    84
   |     -4   60  -304
     1  -15   76
```

Since there is a remainder when the cubic is divided by $x + 4$, this binomial is not a factor.

PTS: 2   REF: 081720aii   NAT: A.APR.B.2   TOP: Remainder Theorem

194 ANS:

$\sin^2\theta + (-0.7)^2 = 1$ Since θ is in Quadrant II, $\sin\theta = \sqrt{.51}$ and $\tan\theta = \dfrac{\sin\theta}{\cos\theta} = \dfrac{\sqrt{.51}}{-0.7} \approx -1.02$

$\quad\quad\quad \sin^2\theta = .51$

$\quad\quad\quad \sin\theta = \pm\sqrt{.51}$

PTS: 2   REF: 081628aii   NAT: F.TF.C.8   TOP: Determining Trigonometric Functions
195 ANS: 1   PTS: 2   REF: 081616aii   NAT: F.TF.A.1
    TOP: Unit Circle
196 ANS: 1

$\quad 8(2^{x+3}) = 48$

$\quad\quad 2^{x+3} = 6$

$(x+3)\ln 2 = \ln 6$

$\quad\quad x+3 = \dfrac{\ln 6}{\ln 2}$

$\quad\quad\quad x = \dfrac{\ln 6}{\ln 2} - 3$

PTS: 2   REF: 061702aii   NAT: F.LE.A.4   TOP: Exponential Equations
KEY: without common base
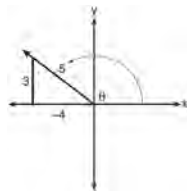197 ANS: 4
$496 \pm 2(115)$

PTS: 2   REF: 011718aii   NAT: S.ID.A.4   TOP: Normal Distributions
KEY: interval
198 ANS: 1
A reference triangle can be sketched using the coordinates $(-4, 3)$ in the second quadrant to find the value of $\sin\theta$.

PTS: 2   REF: spr1503aii   NAT: F.TF.A.2   TOP: Determining Trigonometric Functions
KEY: extension to reals

199 ANS: 2

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

$$-4x = 3y - 8$$

$$-4x + 8 = 3y$$

$$-\frac{4}{3}x + \frac{8}{3} = y$$

PTS: 2   REF: 061616aii   NAT: F.BF.B.4   TOP: Inverse of Functions
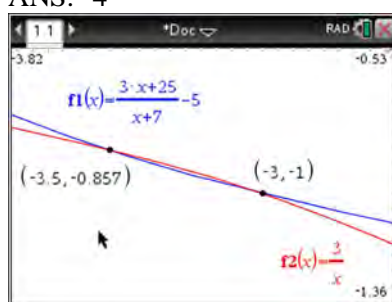KEY: equations

200 ANS: 2   PTS: 2   REF: 061620aii   NAT: F.IF.B.4
TOP: Graphing Polynomial Functions

201 ANS: 4

$$x(x + 7)\left[\frac{3x + 25}{x + 7} - 5 = \frac{3}{x}\right]$$

$$x(3x + 25) - 5x(x + 7) = 3(x + 7)$$

$$3x^2 + 25x - 5x^2 - 35x = 3x + 21$$

$$2x^2 + 13x + 21 = 0$$

$$(2x + 7)(x + 3) = 0$$

$$x = -\frac{7}{2}, -3$$

PTS: 2   REF: fall1501aii   NAT: A.REI.A.2   TOP: Solving Rationals
KEY: rational solutions

202 ANS: 4

	Bar Harbor	**Phoenix**
Minimum	31.386	66.491
Midline	55.3	86.729
Maximum	79.214	106.967
Range	47.828	40.476

PTS: 2   REF: 061715aii   NAT: F.IF.B.4   TOP: Graphing Trigonometric Functions
KEY: maximum/minimum

203 ANS:

$P(P/K) = \dfrac{P(P \wedge K)}{P(K)} = \dfrac{1.9}{2.3} \approx 82.6\%$ A key club member has an 82.6% probability of being enrolled in AP Physics.

PTS: 4   REF: 011735aii   NAT: S.CP.B.6   TOP: Conditional Probability

204 ANS:

$$\left(x^{\frac{5}{3}}\right)^{\frac{6}{5}} = \left(y^{\frac{5}{6}}\right)^{\frac{6}{5}}$$

$$x^2 = y$$

PTS: 2   REF: 011730aii   NAT: N.RN.A.2   TOP: Radicals and Rational Exponents
KEY: variables

205 ANS: 4

$$x = \frac{8 \pm \sqrt{(-8)^2 - 4(6)(29)}}{2(6)} = \frac{8 \pm \sqrt{-632}}{12} = \frac{8 \pm i\sqrt{4}\sqrt{158}}{12} = \frac{2}{3} \pm \frac{1}{6}i\sqrt{158}$$

PTS: 2   REF: 011711aii   NAT: A.REI.B.4   TOP: Solving Quadratics
KEY: complex solutions | quadratic formula

206 ANS: 3   PTS: 2   REF: 061607aii   NAT: S.IC.A.2
TOP: Analysis of Data

207 ANS: 3   PTS: 2   REF: 061720aii   NAT: F.LE.A.2
TOP: Sequences   KEY: AII

208 ANS: 2

$$\begin{array}{r} x^2 + 0x + 1 \\ x+2\overline{)\,x^3 + 2x^2 + x + 6} \\ \underline{x^3 + 2x^2} \\ 0x^2 + x \\ \underline{0x^2 + 0x} \\ x + 6 \\ \underline{x + 2} \\ 4 \end{array}$$

PTS: 2   REF: 081611aii   NAT: A.APR.D.6   TOP: Rational Expressions

209 ANS:
$r(2) = -6$. Since there is a remainder when the cubic is divided by $x - 2$, this binomial is not a factor.

```
2 |  1   -4    4    6
  |      2   -4    0
  ------------------------
     1   -2    0   -6
```

PTS: 2   REF: 061725aii   NAT: A.APR.B.2   TOP: Remainder Theorem

210 ANS: 1
The car lost approximately 19% of its value each year.

PTS: 2   REF: 081613aii   NAT: F.LE.B.5   TOP: Modeling Exponential Functions

211 ANS: 1
$d = 18;\ r = \pm\dfrac{5}{4}$

PTS: 2   REF: 011714aii   NAT: F.IF.A.3   TOP: Sequences
KEY: term

212 ANS:
No, because $P(M / R) \ne P(M)$

$$\frac{70}{180} \ne \frac{230}{490}$$

$$0.38 \ne 0.47$$

PTS: 2   REF: 011731aii   NAT: S.CP.A.4   TOP: Conditional Probability

213 ANS: 4
$$\frac{-3x^2 - 5x + 2}{x^3 + 2x^2} = \frac{(-3x + 1)(x + 2)}{x^2(x + 2)} = \frac{-3x}{x^2} + \frac{1}{x^2} = -3x^{-1} + x^{-2}$$

PTS: 2   REF: 061723aii   NAT: A.APR.D.6   TOP: Expressions with Negative Exponents
KEY: variables

214 ANS: 1
(2) is not recursive

PTS: 2   REF: 081608aii   NAT: F.BF.A.2   TOP: Sequences

215 ANS:
Since there are six flavors, each flavor can be assigned a number, 1-6. Use the simulation to see the number of times the same number is rolled 4 times in a row.

PTS: 2   REF: 081728aii   NAT: S.IC.A.2   TOP: Analysis of Data

216 ANS: 1
$$P(28) = 5(2)^{\frac{98}{28}} \approx 56$$

PTS: 2   REF: 011702aii   NAT: F.LE.A.2   TOP: Modeling Exponential Functions
KEY: AII