JMAP
REGENTS BY COMMON CORE STATE STANDARD: TOPIC

NY Algebra II Regents Exam Questions
from Spring 2015 to January 2017 sorted by CCSS: Topic

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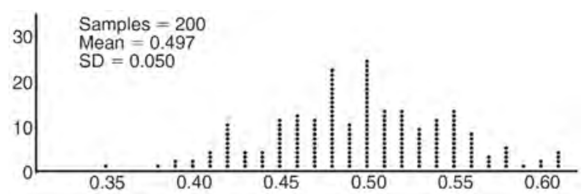
Algebra II Regents Exam Questions by Common Core State Standard: Topic

GRAPHS AND STATISTICS

S.IC.A.2, S.IC.B.3-6: ANALYSIS OF DATA

1 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.



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.

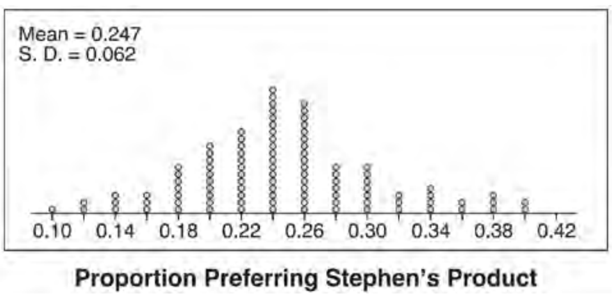
2 An orange-juice processing plant receives a truckload of oranges. The quality control team randomly chooses three pails of oranges, each containing 50 oranges, from the truckload. Identify the sample and the population in the given scenario. State *one* conclusion that the quality control team could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

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

4 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

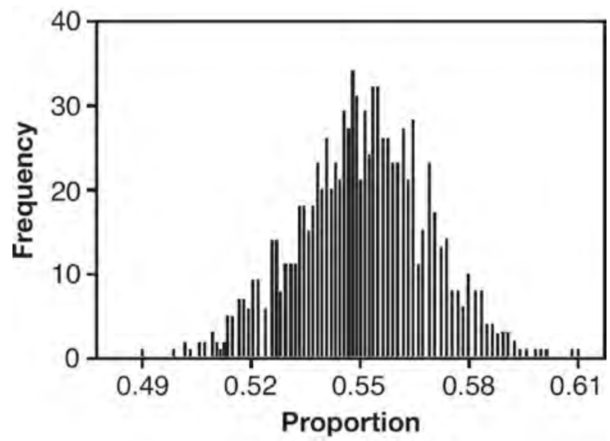
5 Which statement about statistical analysis is *false*?
1 Experiments can suggest patterns and relationships in data.
2 Experiments can determine cause and effect relationships.
3 Observational studies can determine cause and effect relationships.
4 Observational studies can suggest patterns and relationships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

6 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.



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.

7 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.

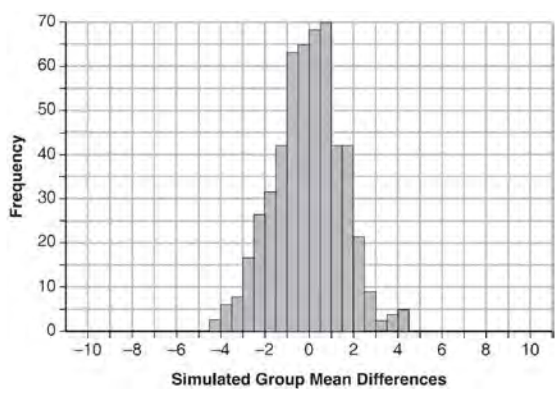


Given this output, and assuming a 95% confidence level, the margin of error for the poll is closest to
1 0.01
2 0.03
3 0.06
4 0.12

8 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:

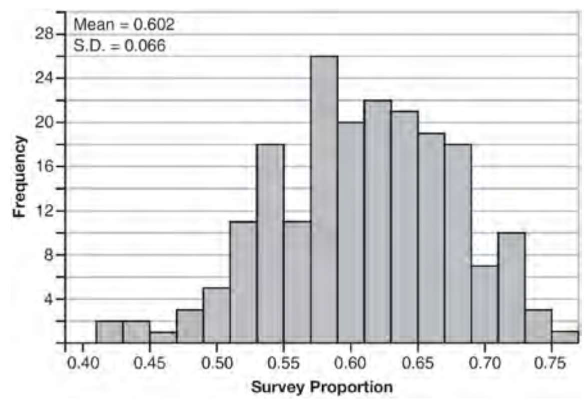
	Group 1	Group 2
$\bar{x}$	80.16	83.8
S_x	6.9	5.2

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.

9 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.

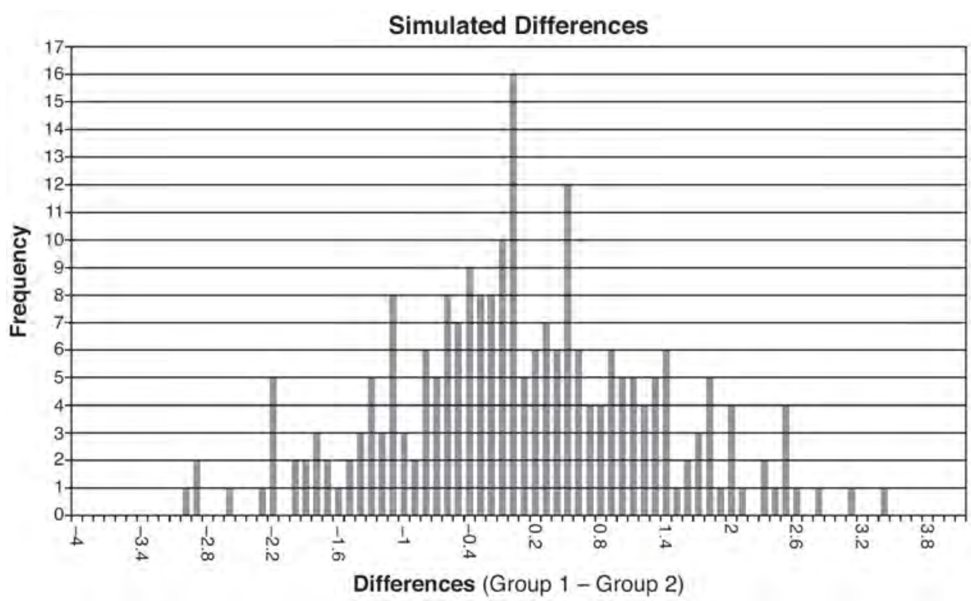


Using the results of the simulation, determine a plausible interval containing the middle 95% of the data. Round all values to the *nearest hundredth*. Members of the prom committee are concerned that a vote of all students attending the prom may produce a 50% – 50% split. Explain what statistical evidence supports this concern.

10 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.

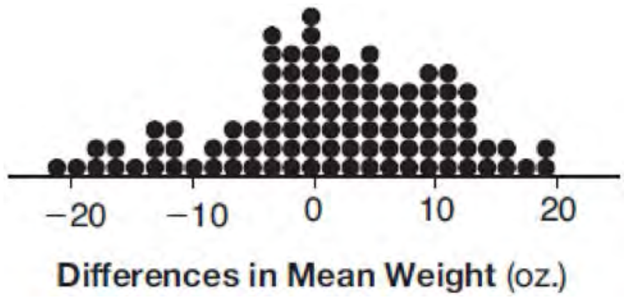
Group 1 (seconds)	**Group 2** (seconds)
17.4	23.3
18.1	18.8
18.2	22.1
19.6	12.7
18.6	16.9
16.2	24.4
16.1	21.2
15.3	21.2
17.8	16.3
19.7	14.5
Mean = 17.7	Mean = 19.1

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.



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.

11 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.



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.

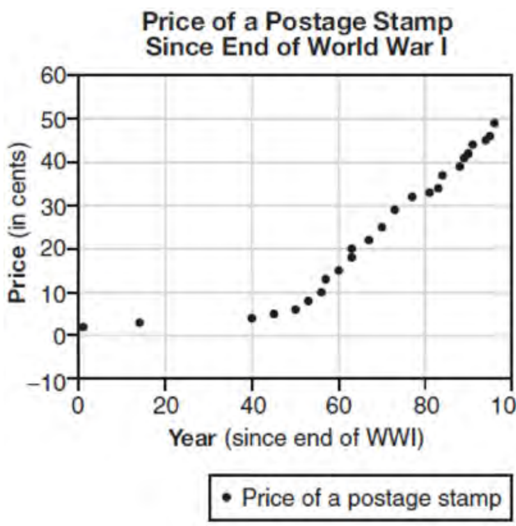
3 There is strong evidence to support the hypothesis that tomatoes from plants planted in black plastic mulch are larger than those planted without mulch.

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.

12 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.

S.ID.B.6: REGRESSION

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



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 $y = 24\sin(14x) + 25$

S.ID.A.4: NORMAL DISTRIBUTIONS

14 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?

15 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

16 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

17 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

PROBABILITY

S.CP.A.2, S.CP.B.7: THEORETICAL PROBABILITY

18 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.

19 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.

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 $\frac{974}{1376}$, what is the probability that a student participates in both sports and music?

S.CP.A.3-4, S.CP.B.6: CONDITIONAL PROBABILITY

21 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

22 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.

23 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 $\dfrac{157}{456}$

24 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.

25 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.

RATE

F.IF.B.6: RATE OF CHANGE

26 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

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

27 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

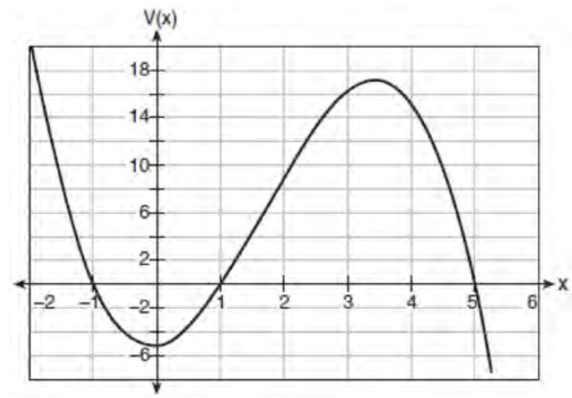
Determine the average rate of change in braking distance, in ft/mph, between one car traveling at 50 mph and one traveling at 70 mph. Explain what this rate of change means as it relates to braking distance.

28 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	1000.00
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

29 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 $[0,3.5]$

QUADRATICS
A.REI.B.4: SOLVING QUADRATICS

30 The solutions to the equation $-\frac{1}{2}x^2 = -6x+20$ are
1 $-6 \pm 2i$
2 $-6 \pm 2\sqrt{19}$
3 $6 \pm 2i$
4 $6 \pm 2\sqrt{19}$

31 A solution of the equation $2x^2 + 3x + 2 = 0$ is

1 $-\frac{3}{4} + \frac{1}{4}i\sqrt{7}$

2 $-\frac{3}{4} + \frac{1}{4}i$

3 $-\frac{3}{4} + \frac{1}{4}\sqrt{7}$

4 $\frac{1}{2}$

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

A.REI.B.4: COMPLEX CONJUGATE ROOT THEOREM

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

G.GPE.A.2: GRAPHING QUADRATIC FUNCTIONS

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

1 $y = x^2 + 3$

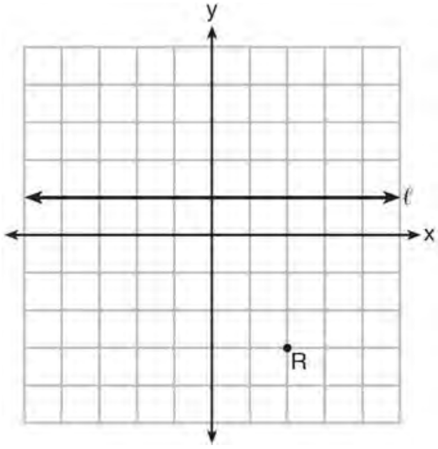
2 $y = -x^2 + 1$

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

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

35 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.

36 Which equation represents the set of points equidistant from line ℓ and point R shown on the graph below?



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

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

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

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

SYSTEMS

A.REI.C.6: SOLVING LINEAR SYSTEMS

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

$$x + 3y + 5z = 45$$
$$6x - 3y + 2z = -10$$
$$-2x + 3y + 8z = 72$$

38 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

A.REI.7, 11: QUADRATIC-LINEAR SYSTEMS

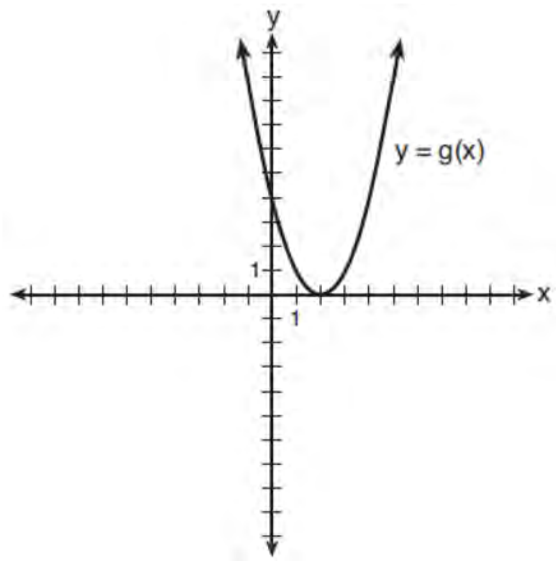
39 Algebraically determine the values of x that satisfy the system of equations below.

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

40 Solve the system of equations shown below algebraically.

$$(x-3)^2 + (y+2)^2 = 16$$
$$2x + 2y = 10$$

41 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 $\{(1,1),(6,16)\}$

42 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 $t = 11$

A.REI.D.11: OTHER SYSTEMS

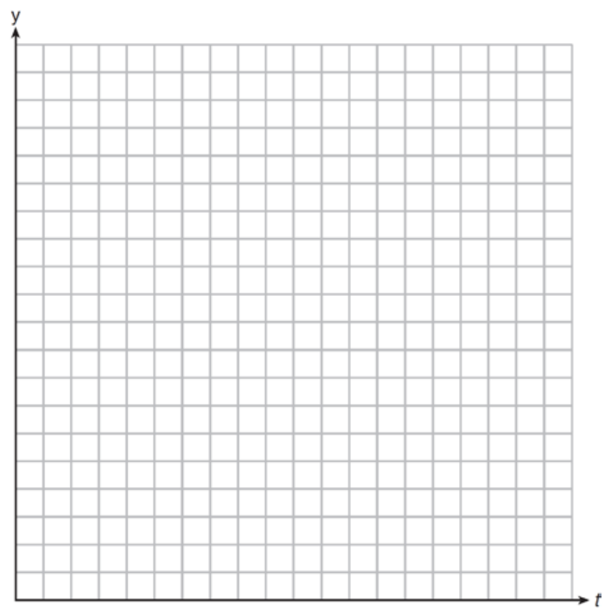
43 Given: $h(x) = \frac{2}{9}x^3 + \frac{8}{9}x^2 - \frac{16}{13}x + 2$

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

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

44 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

45 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.

46 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

47 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 $(1.4, 3.4)$

48 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

POWERS
A.SSE.B.3, F.BF.A.1, F.IF.C.8, F.LE.A.2, F.LE.A.5: MODELING EXPONENTIAL FUNCTIONS

49 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 $B(t) = 750(1.16)^{\frac{t}{12}}$

50 Which function represents exponential decay?

1 $y = 2^{0.3t}$
2 $y = 1.2^{3t}$
3 $y = \left(\frac{1}{2}\right)^{-t}$
4 $y = 5^{-t}$

51 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.

52 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 $(1.00427)^{\frac{m}{12}}$

53 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 $300(1.30)^{\frac{365}{14}}$

54 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 $300e^{-0.42}$

55 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.

56 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

57 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.

F.IF.B.4: EVALUATING LOGARITHMIC EXPRESSIONS

58 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 $d = 10\log\frac{I}{I_0}$. The threshold sound audible to the average person is 1.0×10^{-12} W/m^2 (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/m^2 be classified?
1 moderate
2 loud
3 very loud
4 deafening

F.IF.C.7: GRAPHING EXPONENTIAL AND LOGARITHMIC FUNCTIONS

59 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.

A.CED.A.1, F.LE.A.4: EXPONENTIAL EQUATIONS

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

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

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.

61 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.

62 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.

63 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*.

64 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.

POLYNOMIALS

A.SSE.A.2: FACTORING POLYNOMIALS

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

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

67 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 $t^3 + 5t^2 + 6t + t^2 + 5t + 6 = (t+1)(t+2)(t+3)$

68 The completely factored form of $2d^4 + 6d^3 - 18d^2 - 54d$ is

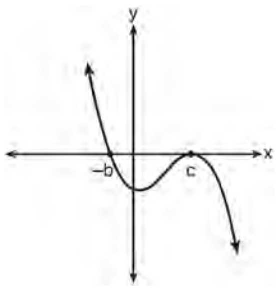
1 $2d(d^2-9)(d+3)$
2 $2d(d^2+9)(d+3)$
3 $2d(d+3)^2(d-3)$
4 $2d(d-3)^2(d+3)$

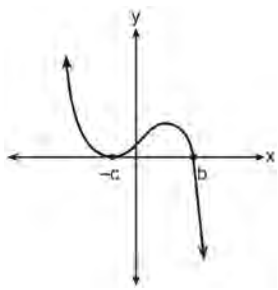
69 Factored completely, $m^5 + m^3 - 6m$ is equivalent to

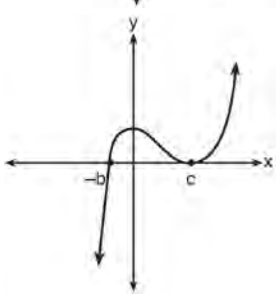
1 $(m+3)(m-2)$
2 $(m^2+3m)(m^2-2)$
3 $m(m^4+m^2-6)$
4 $m(m^2+3)(m^2-2)$

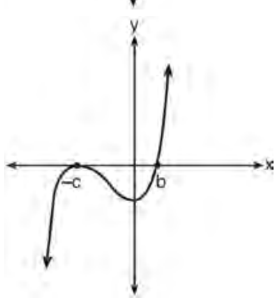
A.APR.B.3: ZEROS OF POLYNOMIALS

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

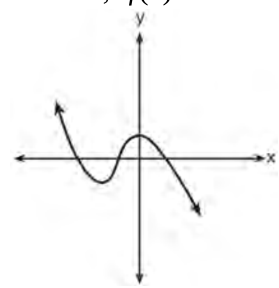
1 

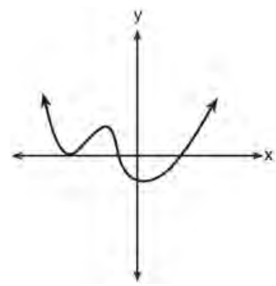
2 

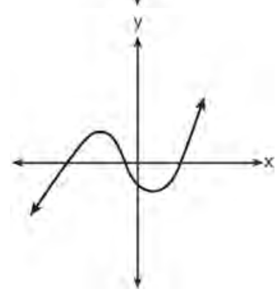
3 

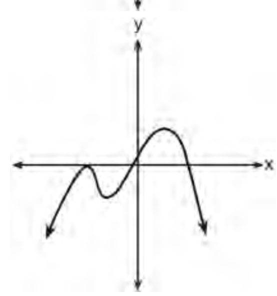
4 

71 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 

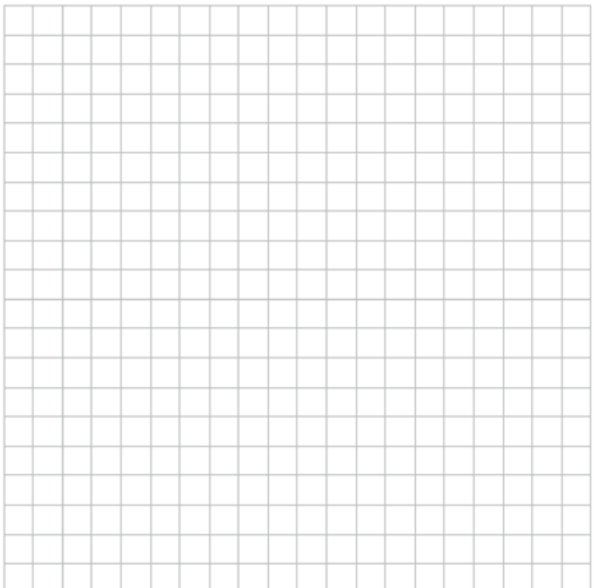
2 

3 

4 

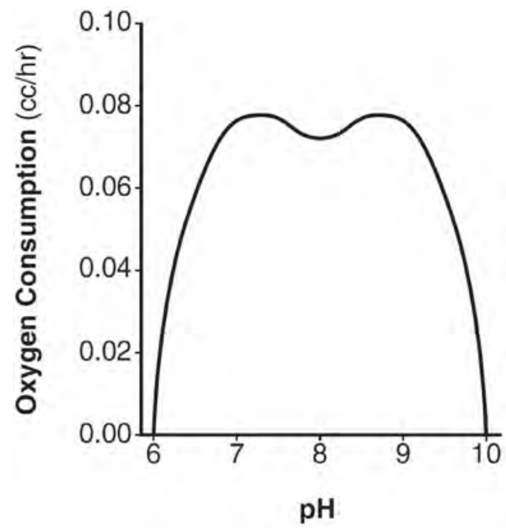
72 The zeros for $f(x) = x^4 - 4x^3 - 9x^2 + 36x$ are
1 $\{0, \pm 3, 4\}$
2 $\{0, 3, 4\}$
3 $\{0, \pm 3, -4\}$
4 $\{0, 3, -4\}$

73 On the grid below, sketch a cubic polynomial whose zeros are 1, 3, and -2.



F.IF.B.4, F.IF.C.7: GRAPHING POLYNOMIAL FUNCTIONS

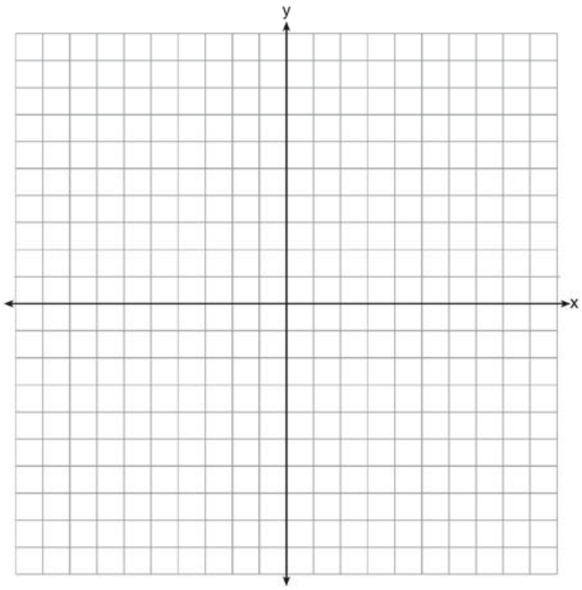
74 There was a study done on oxygen consumption of snails as a function of pH, and the result was a degree 4 polynomial function whose graph is shown below.



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.

75 Find algebraically the zeros for $p(x) = x^3 + x^2 - 4x - 4$. On the set of axes below, graph $y = p(x)$.



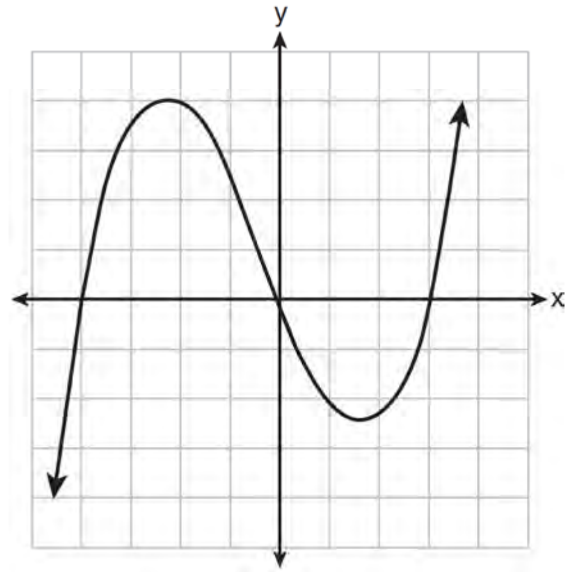
A.APR.B.2: REMAINDER THEOREM

76 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.

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

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

79 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

80 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 $g(x)$.

A.APR.C.4: POLYNOMIAL IDENTITIES

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

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

83 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

84 Algebraically determine the values of h and k to correctly complete the identity stated below.

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

RADICALS

A.REI.A.2: SOLVING RADICALS

85 Solve algebraically for all values of x:

$\sqrt{x-5} + x = 7$

86 The solution set for the equation $\sqrt{56-x} = x$ is
1 $\{-8,7\}$
2 $\{-7,8\}$
3 $\{7\}$
4 $\{\ \}$

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

88 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.

N.RN.A.1-2: RADICALS AND RATIONAL EXPONENTS

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

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

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

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

92 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 $\dfrac{1}{m\sqrt[5]{m}}$

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

N.CN.A.2: OPERATIONS WITH COMPLEX NUMBERS

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

95 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

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

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

RATIONALS

A.APR.D.6: RATIONAL EXPRESSIONS

98 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 $3x^2+13x+\dfrac{49}{2}+\dfrac{151}{2x+3}$

99 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 $2x^2-2.5x-5-\dfrac{20}{2x+3}$

100 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 $2x^2+1+\dfrac{4}{x+2}$

101 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 $q(x)+\dfrac{r(x)}{g(x)}$.

A.CED.A.1: MODELING RATIONALS

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

A.REI.A.2: SOLVING RATIONALS

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

1 $\left\{\dfrac{3}{2},7\right\}$

2 $\left\{\dfrac{7}{2},-3\right\}$

3 $\left\{-\dfrac{3}{2},7\right\}$

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

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

105 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 $\dfrac{1}{F}-\dfrac{1}{W}$

106 What is the solution, if any, of the equation $\dfrac{2}{x+3}-\dfrac{3}{4-x}=\dfrac{2x-2}{x^2-x-12}$?

1 -1

2 -5

3 all real numbers

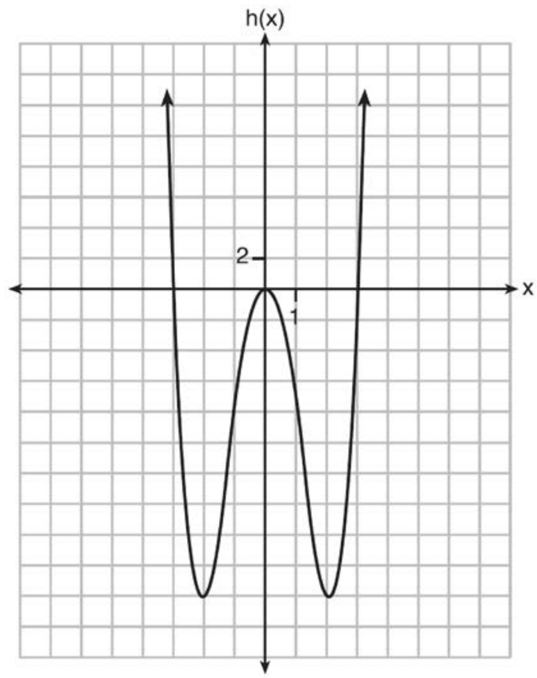
4 no real solution

FUNCTIONS

F.BF.B.3: EVEN AND ODD FUNCTIONS

107 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.

108 Which equation represents an odd function?

1 $y=\sin x$

2 $y=\cos x$

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

4 $y=e^{5x}$

F.BF.A.1: OPERATIONS WITH FUNCTIONS

109 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 $\dfrac{m(c)}{g(c)} = \dfrac{-1}{1-c}$

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

F.IF.B.4: PROPERTIES OF GRAPHS OF FUNCTIONS

111 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.

F.IF.C.9: COMPARING FUNCTIONS

112 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

F.BF.B.4: INVERSE OF FUNCTIONS

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

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

115 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 $x = 3^y$

SEQUENCES AND SERIES

F.LE.A.2, F.IF.A.3, F.BF.A.2, A.SSE.B.4: SEQUENCES

116 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 $n > 1$?

117 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 $j_1 = 250,000$
$j_n = j_{n-1} + 937$

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

1 $g_1 = 18$
$g_n = \frac{1}{2} g_{n-1}$
2 $g_n = 18\left(\frac{1}{2}\right)^{n-1}$
3 $g_1 = 18$
$g_n = 2g_{n-1}$
4 $g_n = 18(2)^{n-1}$

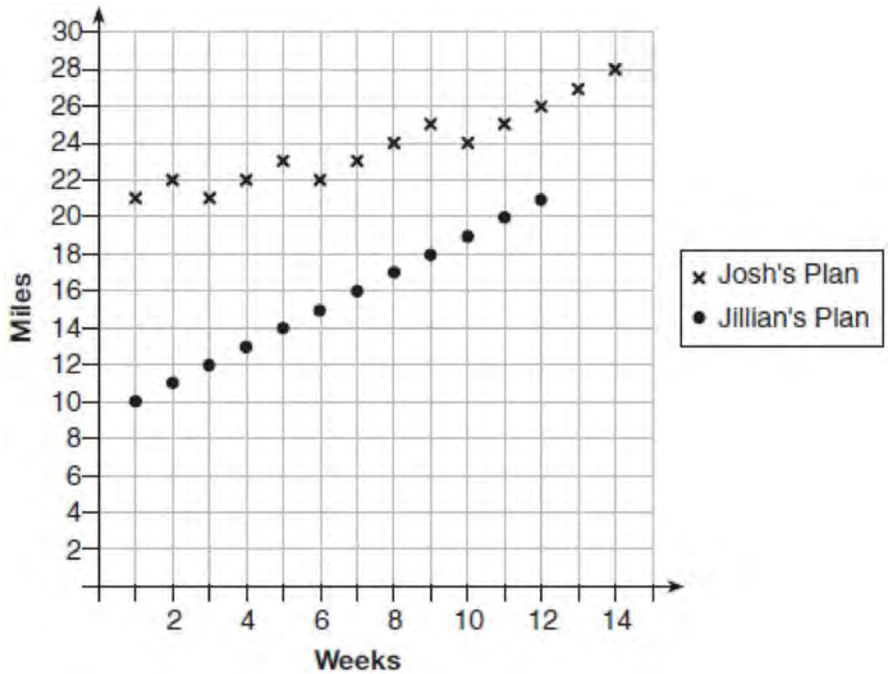
119 The sequence $a_1 = 6$, $a_n = 3a_{n-1}$ can also be written as

1 $a_n = 6 \cdot 3^n$
2 $a_n = 6 \cdot 3^{n+1}$
3 $a_n = 2 \cdot 3^n$
4 $a_n = 2 \cdot 3^{n+1}$

120 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 $P_0 = 19,378,000$
$P_t = 1.015P_{t-1}$

121 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.

122 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

123 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.

A.SSE.B.4: SERIES

124 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*.

125 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 $\sum\limits_{n=1}^{6} 8(1.10)^{n-1}$
2 $\sum\limits_{n=1}^{6} 8(1.10)^{n}$
3 $\dfrac{8-8(1.10)^6}{0.90}$
4 $\dfrac{8-8(0.10)^n}{1.10}$

126 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*.

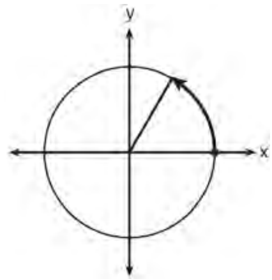
$$P_n = PMT\left(\frac{1-(1+i)^{-n}}{i}\right)$$

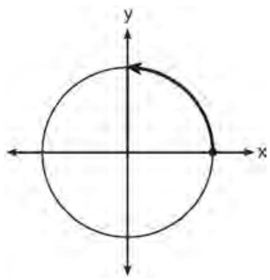
P_n = present amount borrowed
n = number of monthly pay periods
PMT = monthly payment
i = interest rate per month
The affordable monthly payment is $300 for the same time period. Determine an appropriate down payment, to the *nearest dollar*.

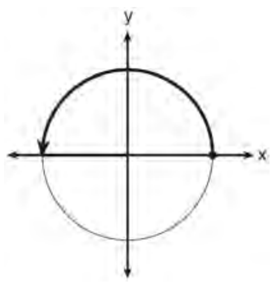
TRIGONOMETRY

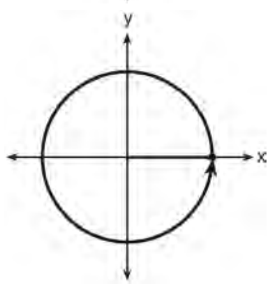
F.TF.A.1-2: UNIT CIRCLE

127 Which diagram shows an angle rotation of 1 radian on the unit circle?

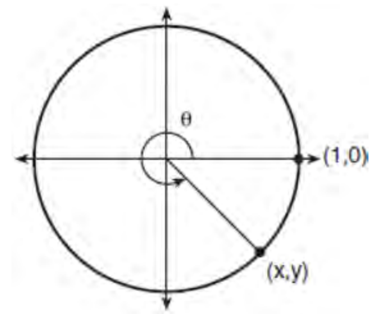
1 

2 

3 

4 

128 Using the unit circle below, explain why $\csc\theta = \frac{1}{y}$.



F.TF.A.2, F.TF.C.8: DETERMINING TRIGONOMETRIC FUNCTIONS

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

1 $\frac{3}{5}$

2 $\frac{4}{5}$

3 $-\frac{3}{5}$

4 $-\frac{4}{5}$

130 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 $-\frac{3}{5}$
2 $-\frac{3}{4}$
3 $\frac{3}{5}$
4 $\frac{4}{5}$

131 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.

F.TF.C.8: PROVING TRIGONOMETRIC IDENTITIES

132 If $\sin^2(32°) + \cos^2(M) = 1$, then M equals

1 32°
2 58°
3 68°
4 72°

F.TF.B.5: MODELING TRIGONOMETRIC FUNCTIONS

133 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 $V = 120\sin(120\pi t)$

F.IF.B.4, F.IF.C.7: GRAPHING TRIGONOMETRIC FUNCTIONS

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 $H(t) = 70\sin\left(\frac{2\pi}{7}(t - 1.75)\right) + 80$, 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 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 $(300, 400)$

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

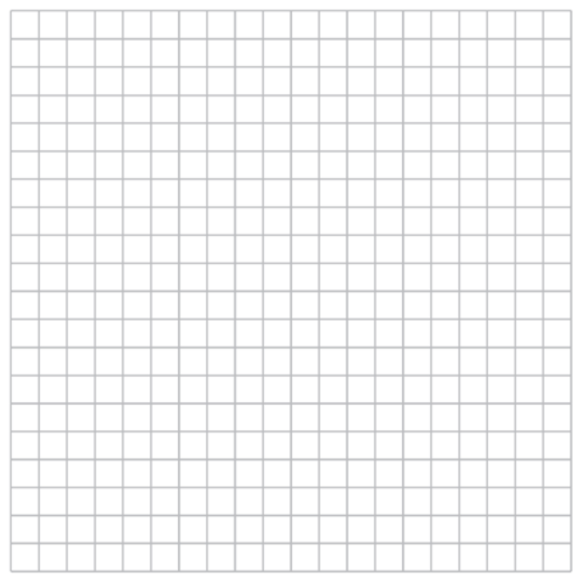
1 $\frac{\pi}{3}$ right

2 $\frac{\pi}{3}$ left

3 $\frac{\pi}{3}$ up

4 $\frac{\pi}{3}$ down

137 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.

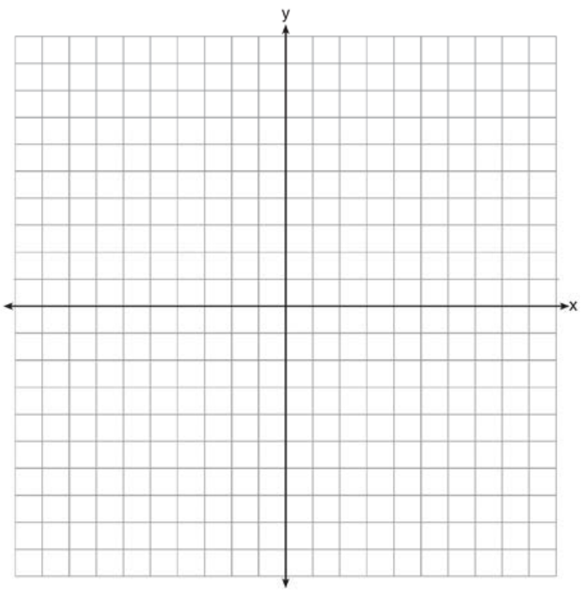


People who fish in Carter Beach know that a certain species of fish is most plentiful when the water level is increasing. Explain whether you would recommend fishing for this species at 7:30 p.m. or 10:30 p.m. using evidence from the given context.

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

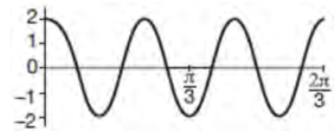
1 The period is 6.
2 The amplitude is 3.
3 The range is [4,10].
4 The midline is $y = -4$.

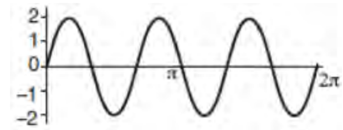
139 On the axes below, graph *one* cycle of a cosine function with amplitude 3, period $\frac{\pi}{2}$, midline $y = -1$, and passing through the point $(0,2)$.

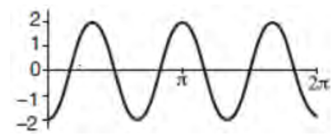


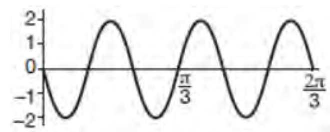
140 The volume of air in a person's lungs, as the person breathes in and out, can be modeled by a sine graph. A scientist is studying the differences in this volume for people at rest compared to people told to take a deep breath. When examining the graphs, should the scientist focus on the amplitude,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

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

1 

2 

3 

4 

CONICS

A.SSE.A.2: EQUATIONS OF CONICS

142 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 $4(x-3)^2 + 4(y+9)^2 = 436$

Algebra II Regents Exam Questions by Common Core State Standard: Topic
Answer Section

1 ANS: 3 PTS: 2 REF: 061607aii NAT: S.IC.A.2
TOP: Analysis of Data

2 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

3 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

4 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

5 ANS: 3 PTS: 2 REF: 011706aii NAT: S.IC.B.3
TOP: Analysis of Data KEY: type

6 ANS:
Yes. The margin of error from this simulation indicates that 95% of the observations fall within $\pm$ 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

7 ANS: 2

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

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

8 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

9 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

10 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 $\frac{25}{232}$ 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

11 ANS: 2 PTS: 2 REF: 011709aii NAT: S.IC.B.5
TOP: Analysis of Data

12 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

13 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

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

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

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

15 ANS: 2

$\bar{x} + 2\sigma$ represents approximately 48% of the data.

PTS: 2 REF: 061609aii NAT: S.ID.A.4 TOP: Normal Distributions
KEY: percent

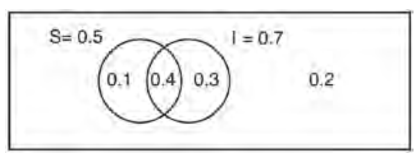
16 ANS: 3

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

17 ANS: 4
$496 \pm 2(115)$

PTS: 2 REF: 011718aii NAT: S.ID.A.4 TOP: Normal Distributions
KEY: interval

18 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, $P(S \cap I) = P(S) + P(I) - P(S \cup I)$

$$= 0.5 + 0.7 - 0.8$$

$$= 0.4$$

If S and I are independent, then the 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

19 ANS:

$P(A \cup B) = P(A) + P(B) - P(A \cap B)$

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

$P(A \cap B) = 0.3$

A and B are independent since $P(A \cap B) = P(A) \cdot P(B)$

$0.3 = 0.6 \cdot 0.5$

$0.3 = 0.3$

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

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

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

22 ANS:

Based on these data, the two events do not appear to be independent. $P(F) = \frac{106}{200} = 0.53$, while $P(F|T) = \frac{54}{90} = 0.6$, $P(F|R) = \frac{25}{65} = 0.39$, and $P(F|C) = \frac{27}{45} = 0.6$. 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

23 ANS: 1

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

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

24 ANS:

No, because $P(M/R) \neq P(M)$

$$\frac{70}{180} \neq \frac{230}{490}$$

$$0.38 \neq 0.47$$

PTS: 2 REF: 011731aii NAT: S.CP.A.4 TOP: Conditional Probability

25 ANS:

$P(P/K) = \frac{P(P \wedge K)}{P(K)} = \frac{1.9}{2.3} \approx 82.6\%$ 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

26 ANS:

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

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

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

KEY: AII

27 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.

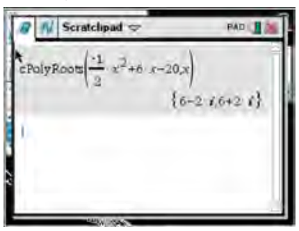
PTS: 2 REF: 081631aii NAT: F.IF.B.6 TOP: Rate of Change
KEY: AII

28 ANS: 4
(1) $\frac{B(60)-B(10)}{60-10}\approx 28\%$ (2) $\frac{B(69)-B(19)}{69-19}\approx 33\%$ (3) $\frac{B(72)-B(36)}{72-36}\approx 38\%$ (4) $\frac{B(73)-B(60)}{73-60}\approx 46\%$

PTS: 2 REF: 011721aii NAT: F.IF.B.6 TOP: Rate of Change
KEY: AII

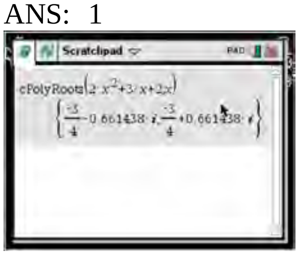
29 ANS: 1
(1) $\frac{9-0}{2-1}=9$ (2) $\frac{17-0}{3.5-1}=6.8$ (3) $\frac{0-0}{5-1}=0$ (4) $\frac{17--5}{3.5-1}\approx 6.3$

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

30 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

31 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

32 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

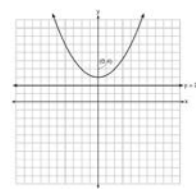
33 ANS: 4

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

34 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: $(x-0)^2 = 4(1)(y-3)$

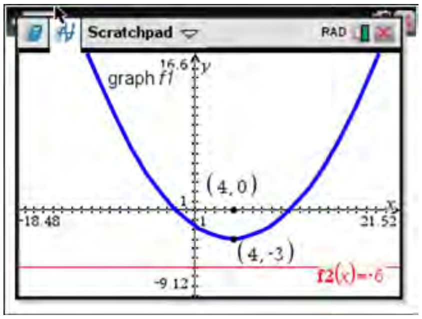
$$x^2 = 4y - 12$$
$$x^2 + 12 = 4y$$
$$\frac{x^2}{4} + 3 = y$$

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

35 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 $(4,0)$.

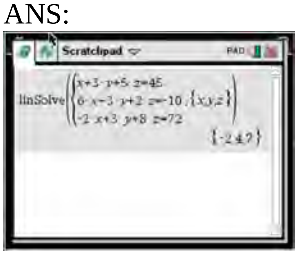
PTS: 2 REF: 061630aii NAT: G.GPE.A.2 TOP: Graphing Quadratic Functions

36 ANS: 4

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

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

37 ANS:



$$\begin{array}{rrrr} 6x-3y+2z=-10 & x+3y+5z=45 & 4x+10z=62 & 4x+4(7)=20 \\ -2x+3y+8z=72 & 6x-3y+2z=-10 & 4x+4z=20 & 4x=-8 \\ 4x+10z=62 & 7x+7z=35 & 6z=42 & x=-2 \\ & 4x+4z=20 & z=7 & \end{array}$$

$$\begin{aligned} 6(-2)-3y+2(7)&=-10 \\ -3y&=-12 \\ y&=4 \end{aligned}$$

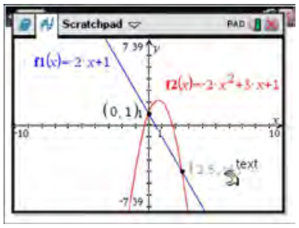
PTS: 4 REF: spr1510aii NAT: A.REI.C.6 TOP: Solving Linear Systems
KEY: three variables

38 ANS: 2

Combining (1) and (3): $\begin{aligned} -6c&=-18 \\ c&=3 \end{aligned}$ Combining (1) and (2): $\begin{aligned} 5a+3c&=-1 \\ 5a+3(3)&=-1 \\ 5a&=-10 \\ a&=-2 \end{aligned}$ Using (3): $\begin{aligned} -(-2)-5b-5(3)&=2 \\ 2-5b-15&=2 \\ b&=-3 \end{aligned}$

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

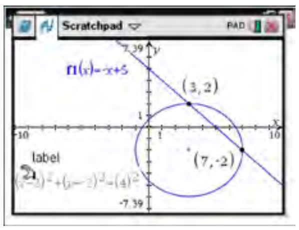
39 ANS:



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

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

40 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

41 ANS: 4

$$y=g(x)=(x-2)^2 \qquad (x-2)^2=3x-2 \quad y=3(6)-2=16$$
$$x^2-4x+4=3x-2 \quad y=3(1)-2=1$$
$$x^2-7x+6=0$$
$$(x-6)(x-1)=0$$
$$x=6,1$$

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

42 ANS: 3

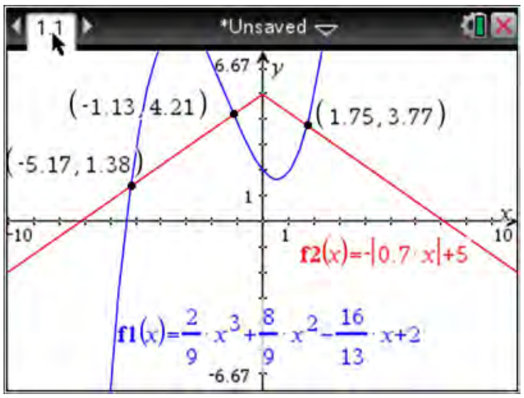
$$-33t^2 + 360t = 700 + 5t$$

$$-33t^2 + 355t - 700 = 0$$

$$t = \frac{-355 \pm \sqrt{355^2 - 4(-33)(-700)}}{2(-33)} \approx 3,8$$

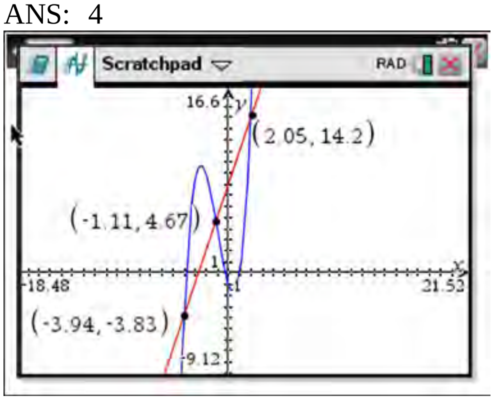
PTS: 2 REF: 081606aii NAT: A.REI.D.11 TOP: Quadratic-Linear Systems
KEY: AII

43 ANS:



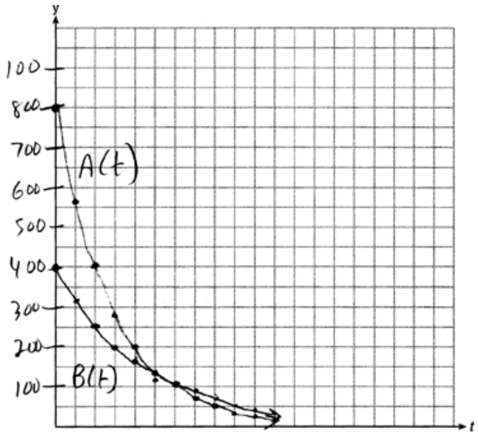
PTS: 2 REF: fall1510aii NAT: A.REI.D.11 TOP: Other Systems
KEY: AII

44 ANS: 4



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

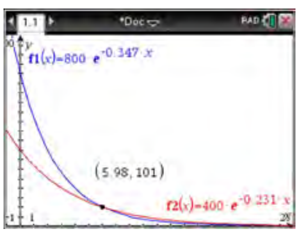
45 ANS:

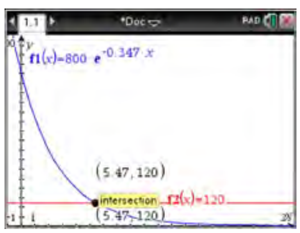


$$A(t) = 800e^{-0.347t}$$
$$B(t) = 400e^{-0.231t}$$

$$\begin{aligned} 800e^{-0.347t} &= 400e^{-0.231t} \\ \ln 2e^{-0.347t} &= \ln e^{-0.231t} \\ \ln 2 + \ln e^{-0.347t} &= \ln e^{-0.231t} \\ \ln 2 - 0.347t &= -0.231t \\ \ln 2 &= 0.116t \\ 6 &\approx t \end{aligned}$$

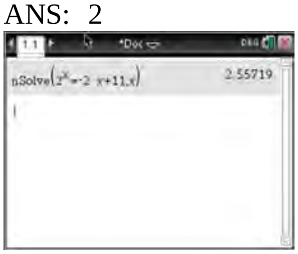
$$\begin{aligned} 0.15 &= e^{-0.347t} \\ \ln 0.15 &= \ln e^{-0.347t} \\ \ln 0.15 &= -0.347t \cdot \ln e \\ 5.5 &\approx t \end{aligned}$$





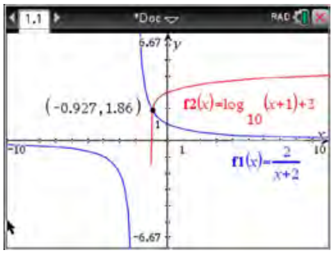
PTS: 6 REF: 061637aii NAT: A.REI.D.11 TOP: Other Systems
KEY: AII

46 ANS: 2



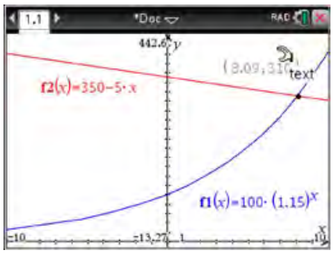
PTS: 2 REF: 081603aii NAT: A.REI.D.11 TOP: Other Systems
KEY: AII

47 ANS: 2



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

48 ANS: 2



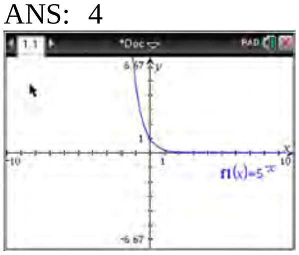
PTS: 2 REF: 011716aii NAT: A.REI.D.11 TOP: Other Systems
KEY: AII

49 ANS: 2

$B(t)=750\left(1.16^{\frac{1}{12}}\right)^{12t} \approx 750(1.012)^{12t}$ $B(t)=750\left(1+\frac{0.16}{12}\right)^{12t}$ 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

50 ANS: 4



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

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

51 ANS:

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

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

52 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

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

54 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

55 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

56 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

57 ANS: 1
The car lost approximately 19% of its value each year.

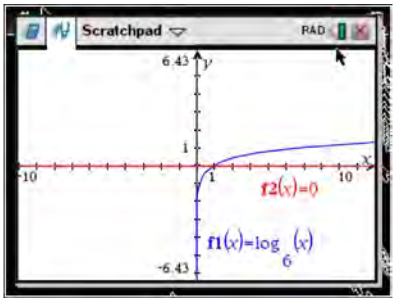
PTS: 2 REF: 081613aii NAT: F.LE.B.5 TOP: Modeling Exponential Functions

58 ANS: 3

$d = 10\log\dfrac{6.3 \times 10^{-3}}{1.0 \times 10^{-12}} \approx 98$

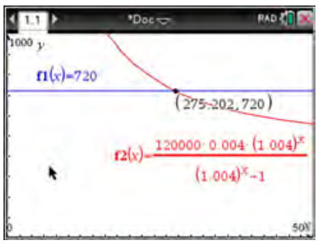
PTS: 2 REF: 011715aii NAT: F.IF.B.4 TOP: Evaluating Logarithmic Expressions

59 ANS: 1



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

60 ANS:



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

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

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

61 ANS:

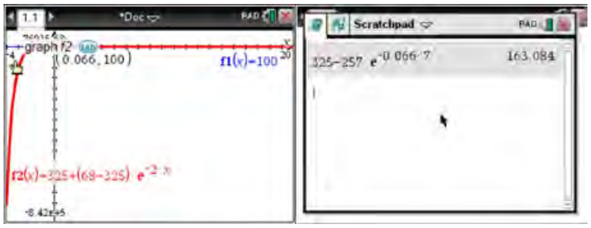
$$A = 5000(1.045)^n \qquad 5000\left(1+\frac{.046}{4}\right)^{4(6)} - 5000(1.045)^6 \approx 6578.87 - 6511.30 \approx 67.57 \qquad 10000 = 5000\left(1+\frac{.046}{4}\right)^{4n}$$

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

$$\begin{aligned} 2 &= 1.0115^{4n} \\ \log 2 &= 4n \cdot \log 1.0115 \\ n &= \frac{\log 2}{4 \log 1.0115} \\ n &\approx 15.2 \end{aligned}$$

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

62 ANS:



$$100 = 325 + (68 - 325)e^{-2k} \qquad T = 325 - 257e^{-0.066t}$$

$$-225 = -257e^{-2k} \qquad T = 325 - 257e^{-0.066(7)} \approx 163$$

$$k = \frac{\ln\left(\frac{-225}{-257}\right)}{-2}$$

$$k \approx 0.066$$

PTS: 4 REF: fall1513aii NAT: F.LE.A.4 TOP: Exponential Growth

63 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

64 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

65 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

66 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

67 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

68 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

69 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

70 ANS: 1

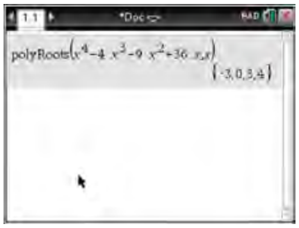
The zeros of the polynomial are at $-b$, and c. The sketch of a polynomial of degree 3 with a negative leading coefficient should have end behavior showing as x goes to negative infinity, $f(x)$ goes to positive infinity. The multiplicities of the roots are correctly represented in the graph.

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

71 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

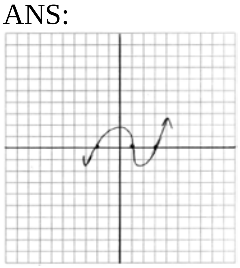
72 ANS: 1



$$x^4-4x^3-9x^2+36x=0$$
$$x^3(x-4)-9x(x-4)=0$$
$$(x^3-9x)(x-4)=0$$
$$x(x^2-9)(x-4)=0$$
$$x(x+3)(x-3)(x-4)=0$$
$$x=0,\pm3,4$$

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

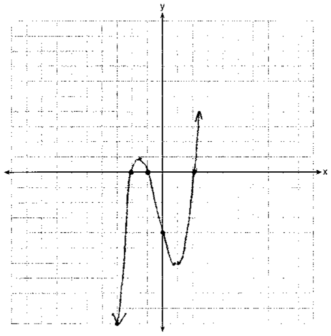
73 ANS:



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

74 ANS: 2 PTS: 2 REF: 061620aii NAT: F.IF.B.4
TOP: Graphing Polynomial Functions

75 ANS:



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

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

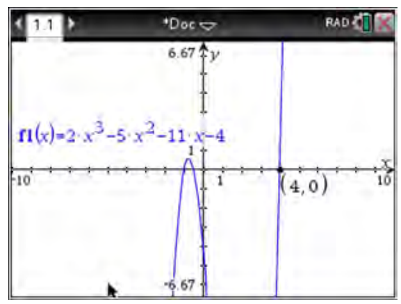
$0 = (x + 2)(x - 2)(x + 1)$

$x = -2, -1, 2$

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

76 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

77 ANS:

$0 = 6(-5)^3 + b(-5)^2 - 52(-5) + 15$ $z(x) = 6x^3 + 19x^2 - 52x + 15$

$0 = -750 + 25b + 260 + 15$

$475 = 25b$

$19 = b$

$$\begin{array}{r|rrrr} -5 & 6 & 19 & -52 & 15 \\ & & -30 & 55 & 15 \\ \hline & 6 & -11 & 3 & 0 \end{array}$$

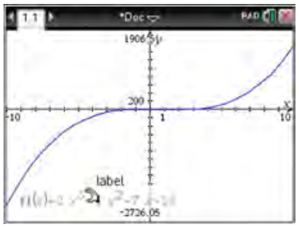
$6x^2 - 11x + 3 = 0$

$(2x - 3)(3x - 1) = 0$

$x = \frac{3}{2}, \frac{1}{3}, -5$

PTS: 4 REF: fall1515aii NAT: A.APR.B.2 TOP: Remainder Theorem

78 ANS:



$$
\begin{array}{r}
2x^2 + 6x + 23 \\
x-5 \overline{\big) 2x^3 - 4x^2 - 7x - 10} \\
\underline{2x^3 - 10x^2} \qquad\qquad \\
6x^2 - 7x \qquad \\
\underline{6x^2 - 30x} \qquad \\
23x - 10 \\
\underline{23x - 115} \\
105
\end{array}
$$

Since there is a remainder, $x - 5$ is not a factor.

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

79 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

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

81 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

82 ANS:

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

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

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

83 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

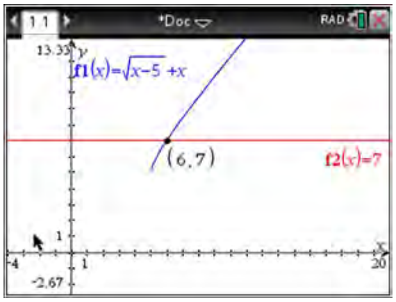
84 ANS:

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

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

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

85 ANS:



$$\sqrt{x-5} = -x + 7 \qquad \sqrt{x-5} = -9 + 7 = -2 \text{ is extraneous.}$$

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

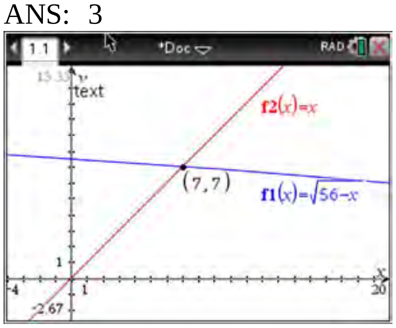
$$0 = x^2 - 15x + 54$$

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

$$x = 6, 9$$

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

86 ANS: 3



$$\sqrt{56-x} = x \qquad -8 \text{ is extraneous.}$$

$$56 - x = x^2$$

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

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

$$x = 7$$

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

87 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

88 ANS:

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

$$2t-6 = \sqrt{t}$$

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

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

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

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

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

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

89 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

90 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

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

92 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

93 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

94 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

95 ANS: 2

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

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

96 ANS:

$$xi(-6i)^2 = xi(36i^2) = 36xi^3 = -36xi$$

PTS: 2 REF: 081627aii NAT: N.CN.A.2 TOP: Operations with Complex Numbers

97 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

98 ANS: 1

$$\begin{array}{r} 3x^2+4x-1 \\ 2x+3\overline{\smash{\big)}\,6x^3+17x^2+10x+2} \\ \underline{6x^3+9x^2} \qquad\qquad \\ 8x^2+10x \qquad \\ \underline{8x^2+12x} \qquad \\ -2x+2 \\ \underline{-2x-3} \\ 5 \end{array}$$

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

99 ANS: 2

$$\begin{array}{r} 2x^2-3x+7 \\ 2x+3\overline{\smash{\big)}\,4x^3+0x^2+5x+10} \\ \underline{4x^3+6x^2} \qquad\qquad \\ -6x^2+5x \qquad \\ \underline{-6x^2-9x} \qquad \\ 14x+10 \\ \underline{14x+21} \\ -11 \end{array}$$

PTS: 2 REF: 061614aii NAT: A.APR.D.6 TOP: Rational Expressions
KEY: remainder

100 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
KEY: remainder

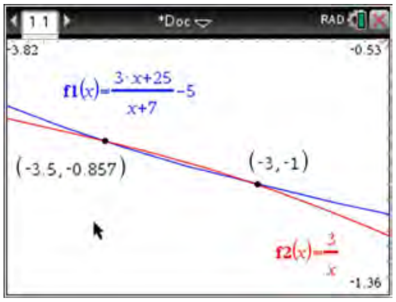
101 ANS:

$$
\begin{array}{r}
3x+13 \\
x-2\overline{)\,3x^2+7x-20} \\
\underline{3x^2-6x\quad\;\;} \\
13x-20 \\
\underline{13x-26} \\
6
\end{array}
\quad 3x+13+\frac{6}{x-2}
$$

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

102 ANS: 3 PTS: 2 REF: 061602aii NAT: A.CED.A.1
TOP: Modeling Rationals

103 ANS: 4



$$x(x+7)\left[\frac{3x+25}{x+7}-5=\frac{3}{x}\right]$$

$$x(3x+25)-5x(x+7)=3(x+7)$$

$$3x^2+25x-5x^2-35x=3x+21$$

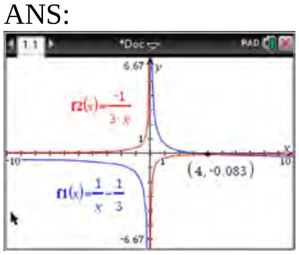
$$2x^2+13x+21=0$$

$$(2x+7)(x+3)=0$$

$$x=-\frac{7}{2},-3$$

PTS: 2 REF: fall1501aii NAT: A.REI.A.2 TOP: Solving Rationals
KEY: rational solutions

104 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

105 ANS: 3

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

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

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

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

106 ANS: 1

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

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

$$3x=-3$$

$$x=-1$$

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

107 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

108 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

109 ANS: 4

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

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

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

111 ANS: 2

$h(x)$ does not have a y-intercept.

PTS: 2 REF: 011719aii NAT: F.IF.B.4 TOP: Properties of Graphs of Functions

112 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

113 ANS:

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

$$x - 1 = (y-3)^3$$

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

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

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

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

114 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

115 ANS: 3 PTS: 2 REF: 011708aii NAT: F.BF.B.4
TOP: Inverse of Functions KEY: equations

116 ANS:

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

$x = 0$ $x = -1$

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

117 ANS: 3 PTS: 2 REF: 061623aii NAT: F.LE.A.2
TOP: Sequences

118 ANS: 1

(2) is not recursive

PTS: 2 REF: 081608aii NAT: F.LE.A.2 TOP: Sequences

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

120 ANS: 4 PTS: 2 REF: 081624aii NAT: F.LE.A.2
TOP: Sequences

121 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

122 ANS: 1

$d = 18;\ r = \pm\frac{5}{4}$

PTS: 2 REF: 011714aii NAT: F.IF.A.3 TOP: Sequences
KEY: term

123 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

124 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

125 ANS: 1 PTS: 2 REF: 081609aii NAT: A.SSE.B.4
TOP: Series KEY: sigma notation

126 ANS:

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

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

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

127 ANS: 1 PTS: 2 REF: 081616aii NAT: F.TF.A.1
TOP: Unit Circle

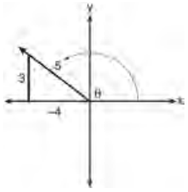
128 ANS:

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

PTS: 2 REF: 011727aii NAT: F.TF.A.2 TOP: Unit Circle

129 ANS: 1

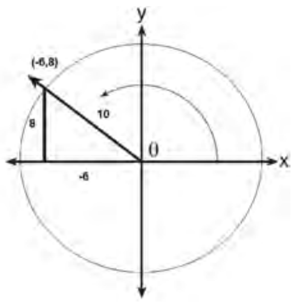
A reference triangle can be sketched using the coordinates $(-4,3)$ in the second quadrant to find the value of $\sin\theta$.



PTS: 2 REF: spr1503aii NAT: F.TF.A.2 TOP: Determining Trigonometric Functions

130 ANS: 1

$\cos\theta = -\frac{6}{10} = -\frac{3}{5}$



PTS: 2 REF: 061617aii NAT: F.TF.A.2 TOP: Determining Trigonometric Functions

131 ANS:

$$\sin^2\theta + (-0.7)^2 = 1$$
$$\sin^2\theta = .51$$
$$\sin\theta = \pm\sqrt{.51}$$

Since θ is in Quadrant II, $\sin\theta = \sqrt{.51}$ and $\tan\theta = \frac{\sin\theta}{\cos\theta} = \frac{\sqrt{.51}}{-0.7} \approx -1.02$

PTS: 2 REF: 081628aii NAT: F.TF.C.8 TOP: Determining Trigonometric Functions

132 ANS: 1 PTS: 2 REF: 011704aii NAT: F.TF.C.8

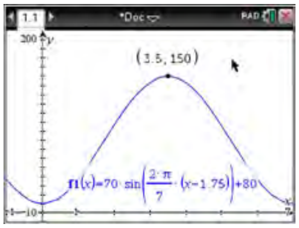
TOP: Proving Trigonometric Identities

133 ANS: 4

$$\text{period} = \frac{2\pi}{B}$$
$$\frac{1}{60} = \frac{2\pi}{B}$$
$$B = 120\pi$$

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

134 ANS: 3



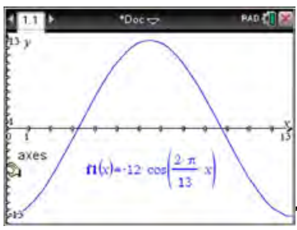
$H(t)$ is at a minimum at $70(-1)+80=10$

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

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

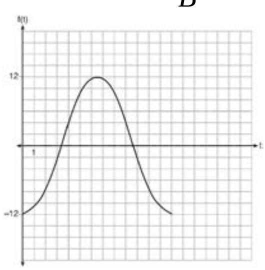
136 ANS: 2 PTS: 2 REF: 011701aii NAT: F.IF.B.4
TOP: Graphing Trigonometric Functions

137 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 $P=\dfrac{2\pi}{B}$ (where P is the period), it is determined that $B=\dfrac{2\pi}{13}$.

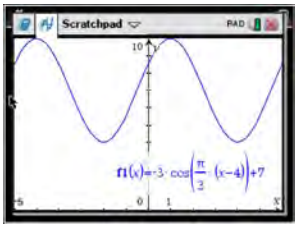
$f(t)=-12\cos\left(\dfrac{2\pi}{13}t\right)$



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

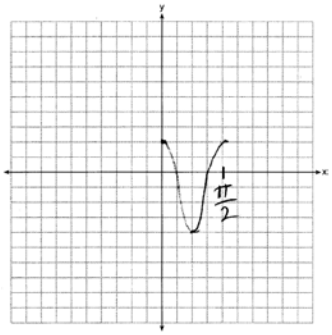
138 ANS: 4



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

139 ANS:



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

140 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

141 ANS: 3
(3) repeats 3 times over 2π.

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

142 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: A.SSE.A.2 TOP: Equations of Conics