Grade 12 Mathematics
Sample Questions

This booklet contains sample Grade 12 Mathematics items from the National Assessment of Educational Progress (NAEP). Additional items can be accessed at www.nces.ed.gov/nationsreportcard/itmrls.

SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics (NCES), National Assessment of Educational Progress (NAEP).

This Grade 12 Mathematics Sample Questions Booklet and the corresponding answer booklet are posted at http://www.fldoe.org/asp/naep/naep-pt.asp.

NAEP GRADE 12 MATHEMATICS
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NAEP GRADE 12 MATHEMATICS CONTENTS, continued

Introduction

The sample items included in this document are taken from previously administered, publicly released Grade 12 National Assessment of Educational Progress (NAEP) Mathematics assessments. The answers to the sample items are included in a companion document. For the multiple-choice questions, the correct answers (indicated by an asterisk) and the distracters; the percentage of the Florida's or the nation's responses to each of the possible answers; and the Description, Difficulty, and Mathematics Practice of each item are provided. Score descriptors are shown for short- and extended-constructed response items. Grade 12 Mathematics state-level results are only available for 2009, but will also be available for 2013. All released NAEP items and sample responses can be found in the NAEP Questions Tool (NQT) at http://nces.ed.gov/nationsreportcard/itmrlsx/default.aspx.

The NQT is an interactive tool containing over 2,000 released questions from NAEP assessments in all NAEP subject areas. The questions are an example of what NAEP asks students on the assessments and can be used as a supplement to classroom instruction. Also available are the scoring rubrics; sample student responses; and scoring results by subject, grade, item type, difficulty, content classification, framework, year, and key words.

For more information about NAEP results, go to the NAEP Data Explorer (NDE) at http://nces.ed.gov/nationsreportcard/naepdata/. The NDE is an interactive tool that provides access to a wide variety of data about what students know and can do, as well as demographic and contextual factors that may affect their performance. The NDE produces charts, customized tables, and graphics based on NAEP results by year and jurisdiction; significance between jurisdictions, within variables, and across years; and gap analyses between jurisdictions or across years and between groups, between years, and between groups and years.

Additional information about the knowledge and skills the mathematics assessment is designed to measure can be found in the 2011 Mathematics Framework, http://www.nagb.org/publications/frameworks/math-2011-framework.pdf. The current NAEP Mathematics Framework guided the development of all Mathematics assessments since 2005. The previous NAEP Mathematics Framework guided the development of the mathematics assessments between 1990 and 2003.

NAEP GRADE 12 NUMBER PROPERTIES AND OPERATIONS

Question 1, Multiply a 3-digit number by a decimal number

360 X 0.3

    a. 10.8
    b. 108
    c. 120
    d. 980
    e. 1,080

Question 2, Estimate amount of time for problem in context

The manager of a company has to order new engines for its delivery trucks after the trucks have been driven 150,000 miles. One of the delivery trucks currently has 119,866 miles on it. This truck has the same delivery route each week and is driven an average of 40,000 miles each year. At this rate, the manager should expect this truck to reach 150,000 miles in approximately how many months?

    a. Less than 4 months
    b. Between 4 and 6 months
    c. Between 6 and 8 months
    d. Between 8 and 10 months
    e. More than 10 months

Question 3, Find the cost of mailing a letter, based on its weight

The cost to mail a first-class letter is 43 cents for the first ounce. Each additional ounce costs 22 cents. (Fractions of an ounce are rounded up to the next whole ounce.)

How much would it cost to mail a letter that weighs 2.7 ounces?

    a. 65 cents
    b. 76 cents
    c. 87 cents
    d. 98 cents
    e. 1 dollar and 9 cents

Question 4, Calculate an expected value, given a percentage

Vanessa's Vans finds that about 40% of the time, a person who makes an advance reservation for transportation does not keep the reservation. Therefore, for each of their 10-passenger vans, Vanessa's Vans schedules 13 persons on the basis of advance reservations.

Based on the information above, about how many riders out of the 13 scheduled would <u>not</u> keep their reservation?

    a. 1
    b. 3
    c. 5
    d. 7
    e. 9

Question 5, Given the scale, determine the length of a side

If you were to redraw the diagram below using a scale of ¾ inch = 10 feet, what would be the length of the side that is 48 feet?
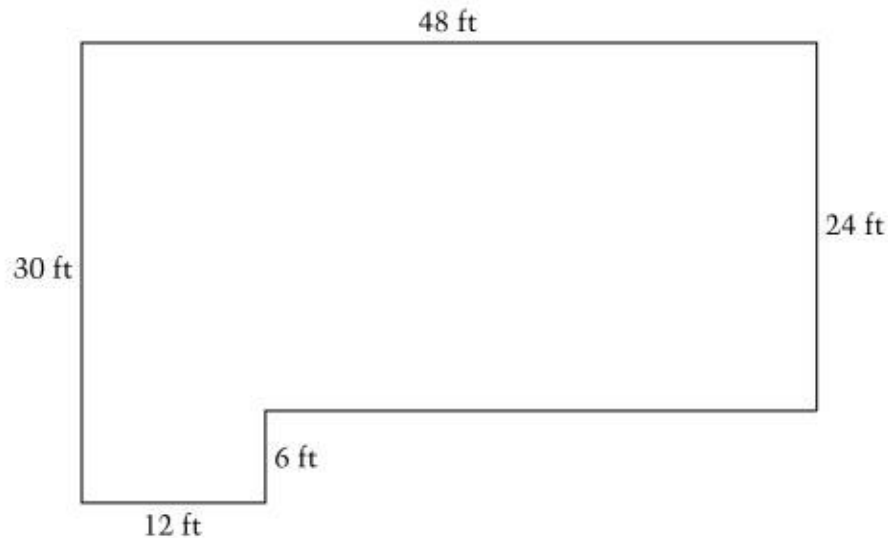
    a. 3.0 in
    b. 3.6 in
    c. 5.6 in
    d. 7.5 in
    e. 12.0 in

Question 6, Identify effect of changing certain digits on a number's value

If the digit in the tens place of 37,241 is increased by one and the digit in the thousands place is decreased by one, how has the number been changed?

   a.   The number has been decreased by 990
   b.   The number has been decreased by 1,000
   c.   The number has been decreased by 1,010
   d.   The number has been increased by 10
   e.   The number has been increased by 1,010

Question 7, Estimate property value, given tax rate and amount

The town of Mayville taxes property at a rate of $42 for each $1000 of estimated value. What is the estimated value of a property on which the owner owes $5,250 in property tax?

   a. $42,000
   b. $47,250
   c. $125,500
   d. $220,500
   e. $5,250,000

Question 8, Determine the remainder in an algebraic setting

The remainder when a number n is divided by 7 is 2. Which of the following is the remainder when $2n + 1$ is divided by 7?

   a.   1
   b.   2
   c.   3
   d.   4
   e.   5

Question 9, Determine a weight of a letter given mailing cost

The cost to mail a first-class letter is 43 cents for the first ounce. Each additional ounce costs 22 cents. (Fractions of an ounce are rounded up to the next whole ounce.)

What is a possible weight for a first-class letter that costs $1.31 to mail? Show your work.

Question 10, Solve a problem involving fractions

In a certain restaurant a whole pie has been sliced into 8 equal pieces. Only 2 slices of the pie remain. Three people would each like an equal portion from the remaining slices of pie. What fraction of the original pie should each person receive?

Answer: _____

Question 11, Determine proportional enlargement of photograph

Roxanne plans to enlarge her photograph, which is 4 inches x 6 inches. Which of the following enlargements maintains the same proportions as the original photograph? Justify your answer.

     5 inches x 7 inches   5 inches by 7 ½ inches

Answer: _____

NAEP GRADE 12 ALGEBRA

Question 1, Determine a nonequivalent expression

Which of the following expressions is NOT equivalent to (a + b)(x + y) ?

    a. (a + b)x + (a + b)y
    b. a(x + y) + b(x + y)
    c. (b + a)(y + x)
    d. ax + by
    e. ax + bx + ay + by

Question 2, Solve problem involving numerical sequence

The first four terms in a sequence are shown below.

40, 8, 24, 16

Each term after the first two items is found by taking one-half of the sum of the two preceding terms. Which term is the first odd number in this sequence?

    a. The 5th term
    b. The 6th term
    c. The 7th term
    d. The 8th term
    e. The 9th term

Question 3, Subtract rational expressions

Which of the following expressions is equal to $\dfrac{1}{x+2} - \dfrac{2}{x+1}$?

    a. $\dfrac{-1}{2x+3}$

    b. $\dfrac{-x-3}{x^2+2}$

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

    d. $\dfrac{-x+5}{x^2+3x+2}$

Question 4, Solve a system of linear equations

What is the solution to the system of equations $\begin{cases} 3x - 2y = -7 \\ x + y = 11 \end{cases}$?

Answer: x = _____   y = _____

Question 5, Find annual rate of population growth

The population *P* of a certain town is given by the equation $P = 50,000(1 + r)^t$, where *r* is the annual rate of population increase and *t* is the number of years since 1990.
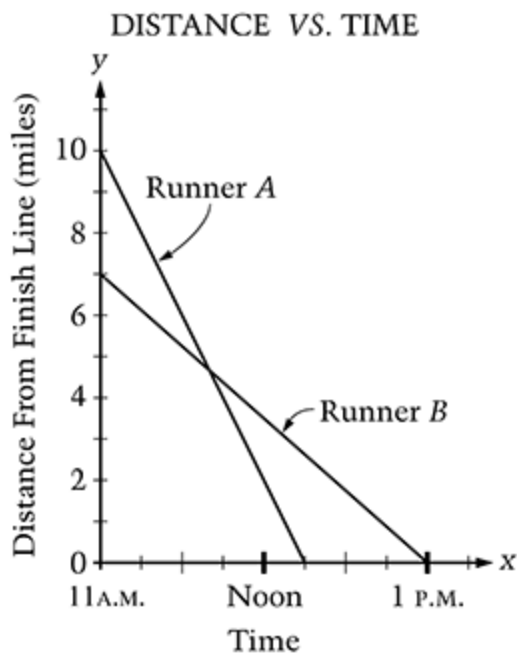
   a. What was the population in 1990?

            Answer: _____

   b. In 2001 the population was 100,000. What was the annual rate of population increase?

            Answer: _____

Question 6, Interpret characteristics of graph in a context

DISTANCE *VS.* TIME

The graph above shows distance *versus* time for a race between runners *A* and *B*. The race is already in progress, and the graph shows only the portion of the race that occurred after 11 A.M.

The table on the next page lists several characteristics of the graph. Interpret these characteristics in terms of what happened during this portion of the race. Include times and distances to support your interpretation. (A sample interpretation of the *y*-intercepts is given in the table.)

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Characteristic of Graph	Interpretation in Terms of the Race
y-intercepts	At 11 A.M. Runner A is 10 miles from the finish line and Runner B is 7 miles from the finish line.
Slopes	
Point of intersection	
x-intercepts	

Question 1, Compare units of volume

Which of the following containers has the greatest liquid capacity?
(1 gallon = 4 quarts = 8 pints = 128 ounces)

    a.   A 64-ounce orange juice container
    b.   A 16-pint water jug
    c.   A 5-quart punch bowl
    d.   A 2-quart cola bottle
   e.   A 1-gallon milk bottle

Question 2, Solve problem involving area in context

John is going to cover an attic floor with insulation. The floor measures 25 feet by 35 feet. If one roll of insulation will cover 64 square feet, how many rolls of insulation does John need?

    a. 1
    b. 2
    c. 8
    d. 14
    e. 110

Question 3, Calculate the measure of an angle in a triangle

In Δ ABC shown below, what is the measure of $\angle B$?
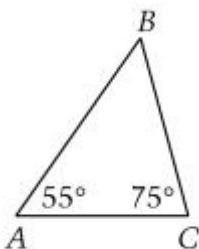
Question 4, Find actual dimensions of room drawn to scale

A scale drawing of a rectangular room is 5 inches by 3 inches. If 1 inch on this scale drawing represents 3 feet, what area the dimensions of the room?

      a. 5 feet by 3 feet
      b. 5 feet by 9 feet
      c. 15 feet by 3 feet
      d. 15 feet by 5 feet
      e. 15 feet by 9 feet

Question 5, Identify a 90-degree angle in a figure

Each of the 12 sides of the figure below has the same length.
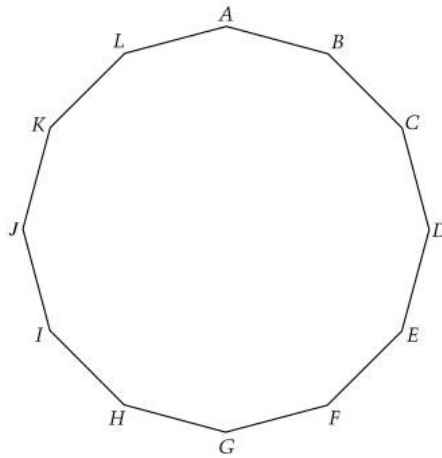
Which of the following angles has a measure of 90˚?

      a. Angle *ABI*
      b. Angle *ACG*
      c. Angle *ADF*
      d. Angle *ADJ*
      e. Angle *AEH*

Question 6, Find the length of the sides of a square

If a 2 by 18 rectangle has the same area as a square, what is the length of a side of the square?

    a. 4
    b. 6
    c. 8
    d. 10
    e. 12

Question 7, Solve a problem using trigonometry

A cat lies crouched on level ground 50 feet away from the base of a tree. The cat can see a bird's nest directly above the base of the tree. The angle of elevation from the cat to the bird's next is 40˚. To the nearest foot, how far above the base of the tree is the bird's nest?

    a. 32
    b. 38
    c. 42
    d. 60
    e. 65

Question 8, Find range for area given precision of linear measurements

Carlene told Octavio that a rectangular room measured 16 feet by 12 feet, to the nearest foot. This means that the length could measure between 15.5 feet and 16.5 feet and the width could measure between 11.5 feet and 12.5 feet.

Octavio performed the following calculations.

Dimensions (feet)	Area (square feet)
15 by 11	165
15.5 by 11.5	178.25
16 by 12	192
16.5 by 12.5	206.25
17 by 13	221

Of the following intervals, which is the smallest interval that contains all possible values of the area of the room?

    a. Between 191.5 and 192.5 square feet
    b. Between 191 and 193 square feet
    c. Between 176 and 206 square feet
    d. Between 178 and 207 square feet
    e. Between 165 and 221 square feet

Question 9, Use trigonometry to find height of object

On level ground from a distance of 200 feet, the angle of elevation to the top of a building is 21˚, as shown in the figure below. What is the height of the building, to the nearest foot?
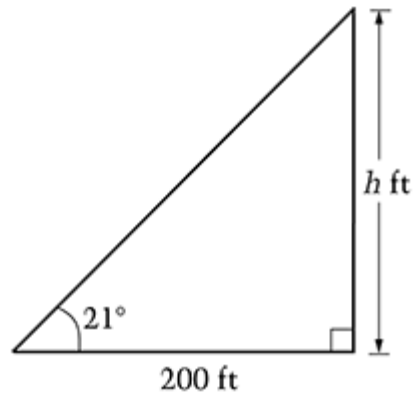
Note: Figure not drawn to scale.

a. 72
b. 77
c. 187
d. 201
e. 521

Question 10, Solve a multi-step problem with a rectangle and sphere

A rectangle is twice as long as it is wide.

(a) If x represents the width of the rectangle, what represents the length?

Answer: _____

(b) What is the area of the rectangle in terms of *x*?

Answer: _____

(c) The radius of a sphere is 2 inches. What is the surface area of this sphere, in square inches? Round your answer to the nearest tenth. (Surface area of sphere$= 4\pi r^2$.)
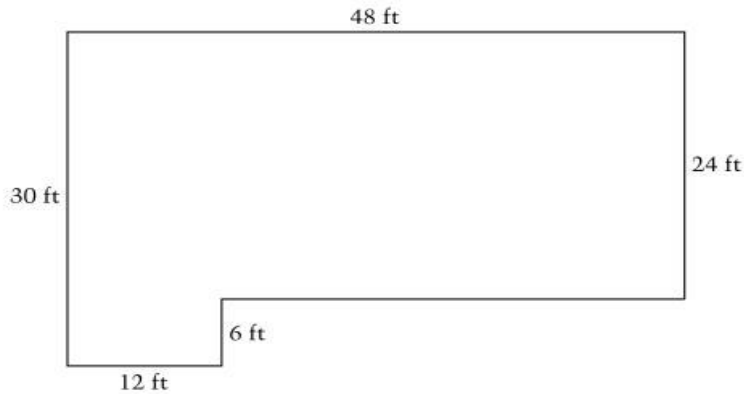
Answer: _____

(d) If the area of the rectangle from part (b) is equal to the sphere from part (c), what would be the dimensions of the rectangle? Round your answers to the nearest inch.

Answer: _____

Question 1, Find the missing dimension of a room

The diagram below is part of a scale drawing of a house.

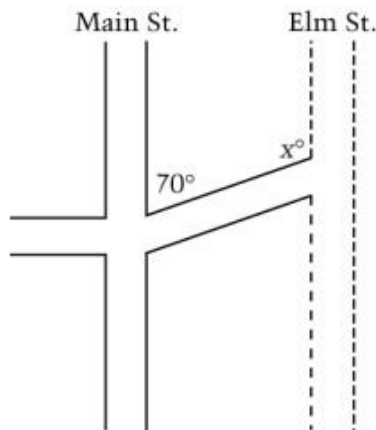

What is the length, in feet, of the side whose dimension is not given in the diagram?

   a. 12
   b. 24
   c. 30
   d. 36
   e. 40

Question 2, Find the measure of angle between streets
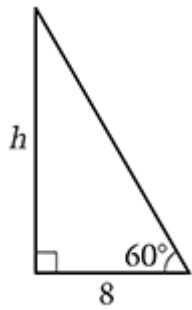
In the figure below, Elm Street is to be constructed parallel to Main Street. What is the value of x?

   a. 70
   b. 110
   c. 120
   d. 130
   e. 140

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Question 3, Find length of side in a 30-60-90 triangle

What is the value of h in the figure below?

h

$60°$

8

a. $4\sqrt{3}$

b. $8\sqrt{2}$

c. $8\sqrt{3}$

d. $12\sqrt{2}$

e. $12\sqrt{3}$

## Question 4, Analyze properties of quadrilateral inscribed in circle

Quadrilateral *ABCD* is inscribed in circle *O*, and $\angle C$ is a right angle, as shown below. Segment *AB* is <u>not</u> parallel to segment *DC*. Which of the following statements must be true?

a. $\angle A \cong \angle B$

b. $\angle B \cong \angle D$

c. $\angle B$ is a right angle

d. $\overline{AC}$ is a diameter of circle O

e. $\overline{BD}$ is a diameter of circle O
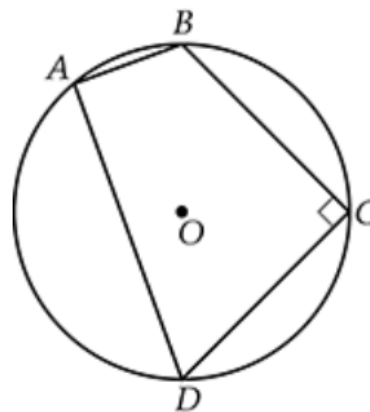
Question 5, Determine which triangle is not a 30-60-90 right angle

Which of the right triangles below could NOT be a 30° - 60° - 90° triangle?

a.

b.

c.

d.

e.
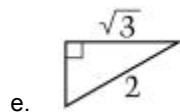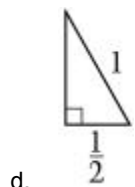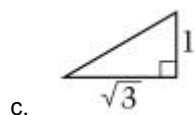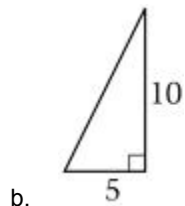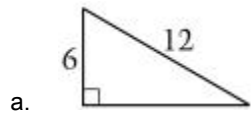
Question 6, Identify the 3-D figure resulting from folding paper

The figure below is folded on the dotted lines so that all the points labeled *P* touch each other, what three-dimensional figure will result?
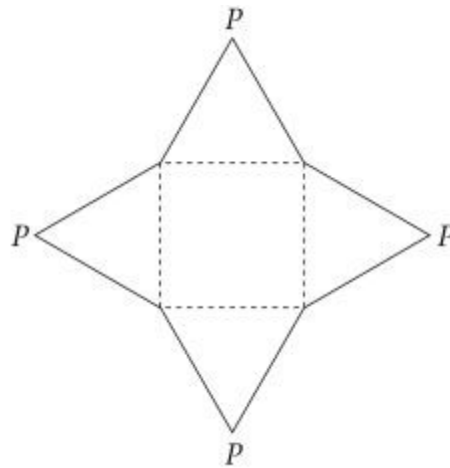
Answer:_____

Question 7, Prove that given figure is a parallelogram

In the figure below, the vertices of *ABCD* are A(−4, −4), **B**(−2,2) **C**(8, 4) and **D**(6, −2).

Give a mathematical justification that *ABCD* is a parallelogram.

Question 8, Perform multiple transformations of segment in *xy*-plane
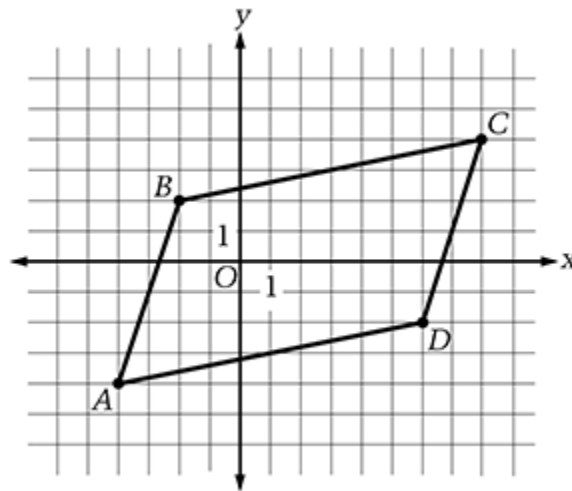
Perform the following two transformations on the graph below. After each transformation, draw the resulting image of segment *PQ*.

1. Rotate the segment 90° counterclockwise $\left(\curvearrowleft\right)$ about point *P*. Label the resulting segment with a 1.
2. Reflect the segment you drew in part (1) across the *x* – axis. Label the resulting segment with a 2.

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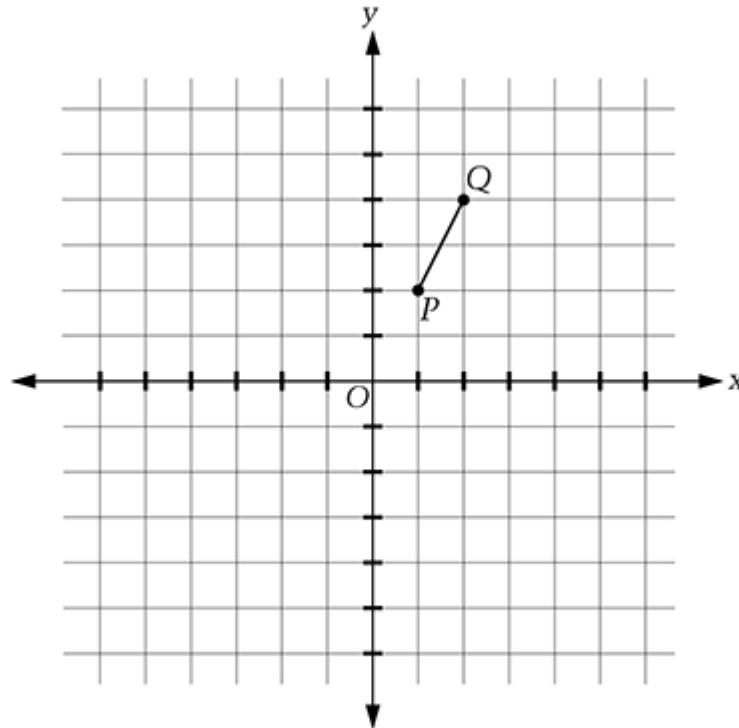
NAEP GRADE 12 DATA ANALYSIS and PROBABILITY

Question 1, Solve problem using data in table

The table below shows the high and low temperatures on October 1st for five cities. Which city had the greatest temperature range?

TEMPERATURES ON OCTOBER 1ST
FOR FIVE CITIES (in °F)

	High	Low
City A	72	50
City B	90	75
City C	83	72
City D	50	37
City E	92	72

a. City A
b. City B
c. City C
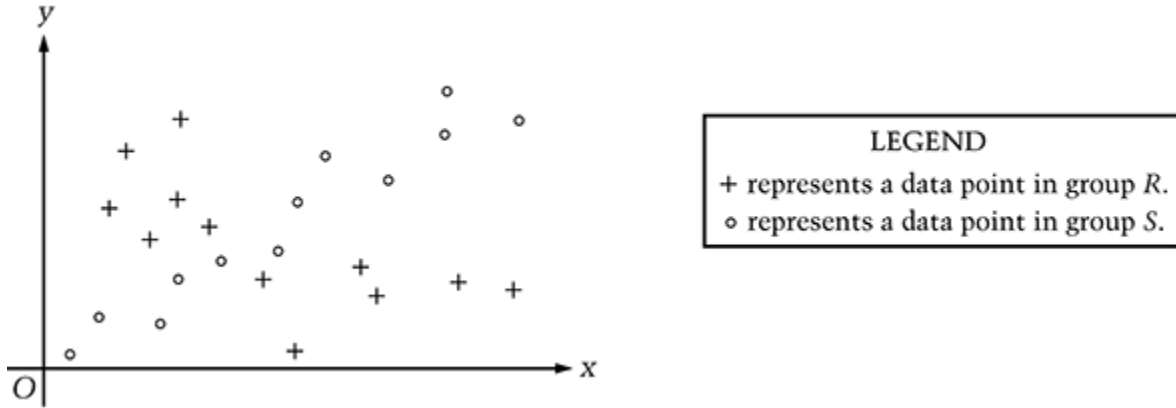d. City D
e. City E

Question 2, Analyze correlations of two data sets in a scatterplot

The scatterplot below shows data for groups *R* and *S*. Which of the following statements is true about the correlation between the *x* and *y* values of group *R* and the correlation between the *x* and *y* value of group *S*?

a. The *x* and *y* values appear to be negatively correlated in both *R* and *S*.
b. The *x* and *y* values appear to be positively correlated in both *R* and *S*.
c. The *x* and *y* values appear to be negatively correlated in *R*, but positively correlated in *S*.
d. The *x* and *y* values appear to be positively correlated in *R*, but negatively correlated in *S*.
e. The *x* and *y* values appear to be more highly correlated in *R* than is *S*.

Question 3, Identify linear equation that best fits data in a scatterplot

A random sample of graduates from a particular college program reported their ages and incomes in response to a survey.   Each point on the scatterplot below represents the age and income of a different graduate.
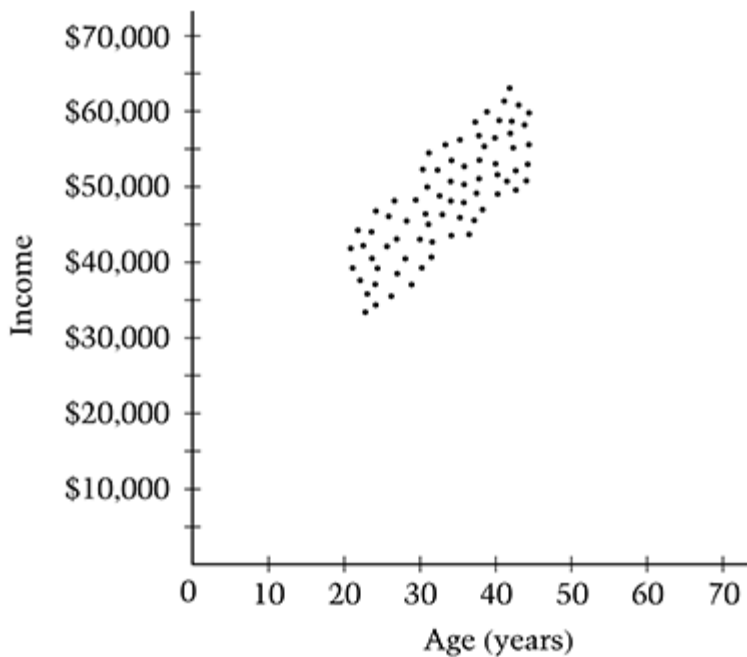
Of the following equations, which best fits the data above?

a. $y = -1,000x + 15,000$

b. $y = 1,000x$

c. $y = 1,000x + 15,000$

d. $y = 10,000x$

e. $y = 10,000x + 15,000$

Question 4, Identify appropriate method for selecting random sample

The principal of a high school would like to determine why there has been a large decline during the year in the number of students who purchase food in the school's cafeteria. To do this, 25 students from the school will be surveyed. Which method would be the most appropriate for selecting the 25 students to participate in the survey?

    a.   Randomly select 25 students from the senior class
    b.   Randomly select 25 students from those taking physics
    c.   Randomly select 25 students from a list of all students at the school
    d.   Randomly select 25 students from a list of students who eat in the cafeteria
    e.   Give the survey to the first 25 students to arrive at school in the morning

Question 5, Make a prediction based on data in a scatterplot

A random sample of graduates from a particular college program reported their ages and incomes in response to a survey. Each point on the scatterplot above represents the age and income of a different graduate.
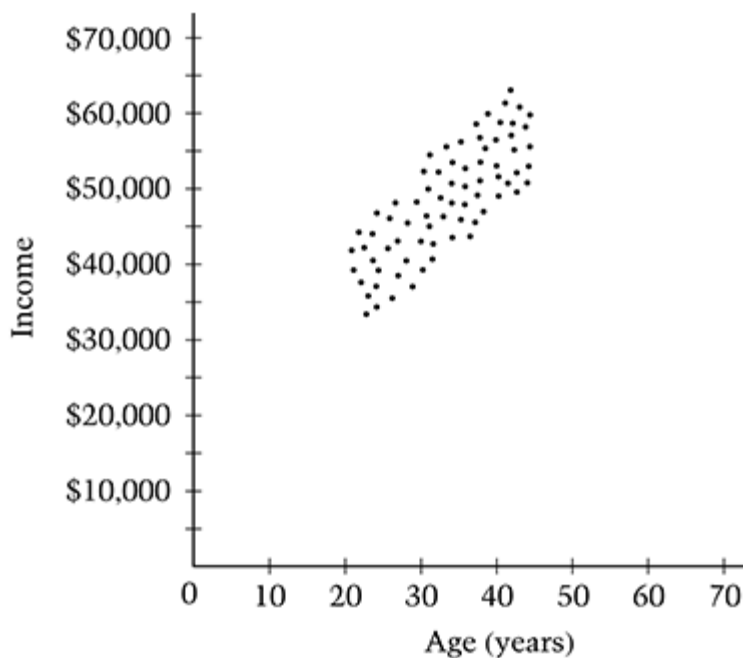
Based on the data in the above scatterplot, predictions can be made about the income of a 35-year-old and the income of a 55-year-old. For which group is the prediction more likely to be accurate?

_____ 35-year-olds   _____ 55-year-olds

Question 6, Calculate probability of independent events

Marissa is going on a trip. She will be taking a taxi, a flight, and then a train. Marissa chose the following three companies based on their claims.

- Tammy's Taxi Service claims that it is on time 95% of the time
- Friendly Flyer Airlines claims that it is on time 93% of the time
- Rapid Railways claims that it is on time 98% of the time

Based on the three companies' claims, what is the approximate probability that all three parts of Marissa's trip will be on time, assuming that all three probabilities are independent?

Answer: _____

Question 7, Determine the type of graph to best represent a situation

An election involving four candidates for mayor has been held. Of the following, which is the best way to present the percentage of votes each candidate received?

- a. Circle graph
- b. Line graph
- c. Box plot
- d. Scatterplot
- e. Histogram

Question 8, Determine conditional probability from two-way table

The table below shows the gender and color of 7 puppies. If a puppy is selected at random from the group is brown, what is the probability it is a male?

	Male	Female
Black	1	2
Brown	1	3

a. $\dfrac{1}{4}$

b. $\dfrac{2}{7}$

c. $\dfrac{1}{3}$

d. $\dfrac{1}{2}$

e. $\dfrac{2}{3}$

Question 9, Solve a data-related problem and justify the answer

Vanessa's Vans finds that about 40% of the time a person who makes an advance reservation for transportation does not keep the reservation. Therefore, for each of their 10-passenger vans, Veronica's Vans schedules 13 persons on the basis of advance reservations.

On any given day, how many persons who made and kept their advance reservations would not have a seat in the van on that day? Justify your answer.

Question 10, Use survey results to make an inference

The pulse rate per minute of a group of 100 adults is displayed in the histogram below. For example, 5 adults have a pulse rate from 40-49 inclusive. Based on these data, how many individuals from a comparable group of 40 adults would be expected to have a pulse rate of 80 or above?

RESULTS OF PULSE RATE SURVEY
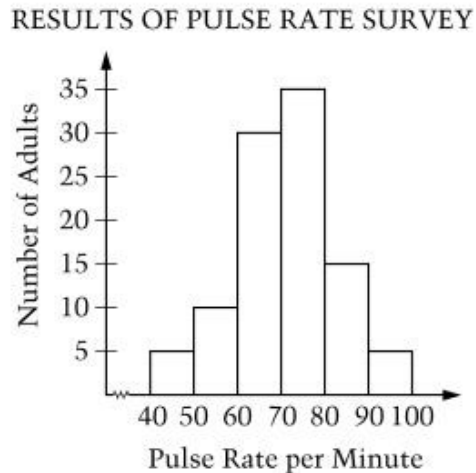
Answer: _____

Question 11, Solve a problem involving color patterns

Suppose that square lunchroom trays are assembled using 4 smaller square pieces. Each piece is a single color. If the smaller pieces are available in red and green only, how many different colored patterns of trays can be made? (Patterns of colors that result from rotating the tray such as

and are not considered different.)

Illustrate below the different patterns corresponding to your answers.