



Math Test – Calculator

55 MINUTES, 38 QUESTIONS

Turn to Section 4 of your answer sheet to answer the questions in this section.

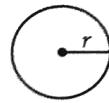
DIRECTIONS

For questions 1–30, solve each problem, choose the best answer from the choices provided, and fill in the corresponding circle on your answer sheet. For questions 31–38, solve the problem and enter your answer in the grid on the answer sheet. Please refer to the directions before question 31 on how to enter your answers in the grid. You may use any available space in your test booklet for scratch work.

NOTES

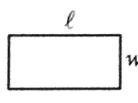
1. The use of a calculator is permitted.
2. All variables and expressions used represent real numbers unless otherwise indicated.
3. Figures provided in this test are drawn to scale unless otherwise indicated.
4. All figures lie in a plane unless otherwise indicated.
5. Unless otherwise indicated, the domain of a given function f is the set of all real numbers x for which $f(x)$ is a real number.

REFERENCE

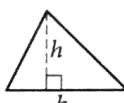


$$A = \pi r^2$$

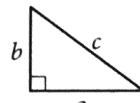
$$C = 2\pi r$$



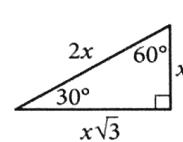
$$A = lw$$



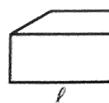
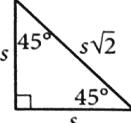
$$A = \frac{1}{2}bh$$



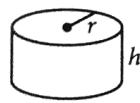
$$c^2 = a^2 + b^2$$



Special Right Triangles



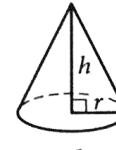
$$V = lwh$$



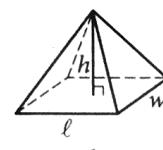
$$V = \pi r^2 h$$



$$V = \frac{4}{3}\pi r^3$$



$$V = \frac{1}{3}\pi r^2 h$$



$$V = \frac{1}{3}lwh$$

The number of degrees of arc in a circle is 360.

The number of radians of arc in a circle is 2π .

The sum of the measures in degrees of the angles of a triangle is 180.



1

The monthly membership fee for an online television and movie service is \$9.80. The cost of viewing television shows online is included in the membership fee, but there is an additional fee of \$1.50 to rent each movie online. For one month, Jill's membership and movie rental fees were \$12.80. How many movies did Jill rent online that month?

- A) 1
- B) 2
- C) 3
- D) 4

$$\begin{array}{r} m + 1.50r = 12.80 \\ \underline{9.80} \\ 1.50r = 3 \end{array}$$

$$r = 2$$

2

One of the requirements for becoming a court reporter is the ability to type 225 words per minute. Donald can currently type 180 words per minute, and believes that with practice he can increase his typing speed by 5 words per minute each month. Which of the following represents the number of words per minute that Donald believes he will be able to type m months from now?

- A) $5 + 180m$
- B) $225 + 5m$
- C) $180 + 5m$
- D) $180 - 5m$

$$180 + 5m$$

3

If a 3-pound pizza is sliced in half and each half is sliced into thirds, what is the weight, in ounces, of each of the slices? (1 pound = 16 ounces)

- A) 4
- B) 6
- C) 8
- D) 16

$$\begin{array}{r} \text{3 pounds} \\ \hline 2 \cdot 3 \\ = 1/2 \cdot 16 \\ = 8 \text{ oz} \end{array}$$

4

Nick surveyed a random sample of the freshman class of his high school to determine whether the Fall Festival should be held in October or November. Of the 90 students surveyed, 25.6% preferred October. Based on this information, about how many students in the entire 225-person class would be expected to prefer having the Fall Festival in October?

- A) 50
- B) 60
- C) 75
- D) 80

$$\begin{array}{r} (0.256) \cdot (225) \\ = 57.6 \end{array}$$



5

The density of an object is equal to the mass of the object divided by the volume of the object. What is the volume, in milliliters, of an object with a mass of 24 grams and a density of 3 grams per milliliter?

- A) 0.125
 (B) 8
 C) 21
 D) 72

$$\frac{24\text{g}}{3\text{mL}} = 8\text{mL}$$

$$V = 8\text{mL}$$

6

Last week Raul worked 11 more hours than Angelica. If they worked a combined total of 59 hours, how many hours did Angelica work last week?

- (A) 24
 B) 35
 C) 40
 D) 48

$$R = A + 11$$

$$R + A = 59$$

$$2A + 11 = 59$$

$$A = 24$$

Movies with Greatest Ticket Sales in 2012

MPAA rating	Type of movie				
	Action	Animated	Comedy	Drama	Total
PG	2	7	0	2	11
PG-13	10	0	4	8	22
R	6	0	5	6	17
Total	18	7	9	16	50

The table above represents the 50 movies that had the greatest ticket sales in 2012, categorized by movie type and Motion Picture Association of America (MPAA) rating. What proportion of the movies are comedies with a PG-13 rating?

- A) $\frac{2}{25}$
 B) $\frac{9}{50}$
 C) $\frac{2}{11}$
 D) $\frac{11}{25}$

$$\frac{4}{50} = \frac{2}{25}$$

8

Line ℓ in the xy -plane contains points from each of Quadrants II, III, and IV, but no points from Quadrant I. Which of the following must be true?

- A) The slope of line ℓ is undefined.
 B) The slope of line ℓ is zero.
 C) The slope of line ℓ is positive.
 D) The slope of line ℓ is negative.





9

Number of Registered Voters
in the United States in 2012, in Thousands

Region	Age, in years					Total
	18 to 24	25 to 44	45 to 64	65 to 74	75 and older	
Northeast	2,713	8,159	10,986	3,342	2,775	27,975
Midwest	3,453	11,237	13,865	4,221	3,350	36,126
South	5,210	18,072	21,346	7,272	4,969	56,869
West	3,390	10,428	11,598	3,785	2,986	32,187
Total	14,766	47,896	57,795	18,620	14,080	153,157

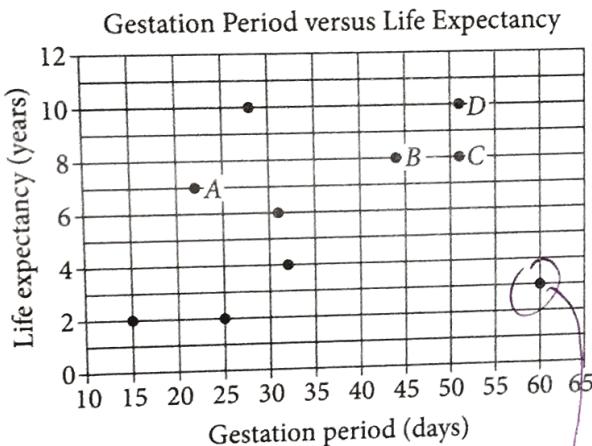
The table above shows the number of registered voters in 2012, in thousands, in four geographic regions and five age groups. Based on the table, if a registered voter who was 18 to 44 years old in 2012 is chosen at random, which of the following is closest to the probability that the registered voter was from the Midwest region?

- A) 0.10
- B) 0.25
- C) 0.40
- D) 0.75

$$\frac{3453}{14766} \approx 0.233$$



Questions 10 and 11 refer to the following information.



A curator at a wildlife society created the scatterplot above to examine the relationship between the gestation period and life expectancy of 10 species of animals.

10

What is the life expectancy, in years, of the animal that has the longest gestation period?

- (A) 3
- (B) 4
- (C) 8
- (D) 10

3

11

Of the labeled points, which represents the animal for which the ratio of life expectancy to gestation period is greatest?

- (A) A
- (B) B
- (C) C
- (D) D

$$\frac{LE}{GP} = \text{slope} = 7A$$

12

In the xy -plane, the graph of function f has x -intercepts at -3 , -1 , and 1 . Which of the following could define f ? roots

- A) $f(x) = (x - 3)(x - 1)(x + 1)$
- B) $f(x) = (x - 3)(x - 1)^2$
- C) $f(x) = (x - 1)(x + 1)(x + 3)$
- D) $f(x) = (x + 1)^2(x + 3)$



13

The population of mosquitoes in a swamp is estimated over the course of twenty weeks, as shown in the table.

Time (weeks)	Population
0	100
5	1,000
10	10,000
15	100,000
20	1,000,000

Which of the following best describes the relationship between time and the estimated population of mosquitoes during the twenty weeks?

- A) Increasing linear
- B) Decreasing linear
- C) Exponential growth
- D) Exponential decay

x10 every 5 weeks

14

$$1,000 \left(1 + \frac{r}{1,200}\right)^{12}$$

The expression above gives the amount of money, in dollars, generated in a year by a \$1,000 deposit in a bank account that pays an annual interest rate of $r\%$, compounded monthly. Which of the following expressions shows how much additional money is generated at an interest rate of 5% than at an interest rate of 3%?

(r = 5%) - (r = 3%)

A) $1,000 \left(1 + \frac{5 - 3}{1,200}\right)^{12}$

B) $1,000 \left(1 + \frac{\frac{5}{12} - \frac{3}{12}}{1,200}\right)^{12}$

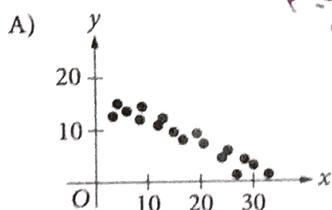
C) $\frac{1,000 \left(1 + \frac{5}{1,200}\right)^{12}}{1,000 \left(1 + \frac{3}{1,200}\right)^{12}}$

D) $1,000 \left(1 + \frac{5}{1,200}\right)^{12} - 1,000 \left(1 + \frac{3}{1,200}\right)^{12}$

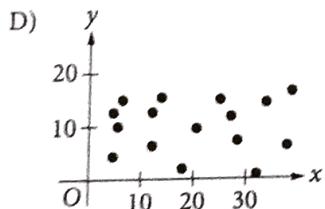
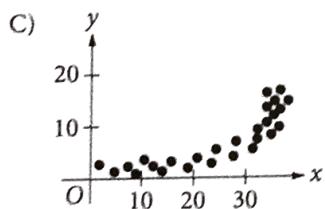
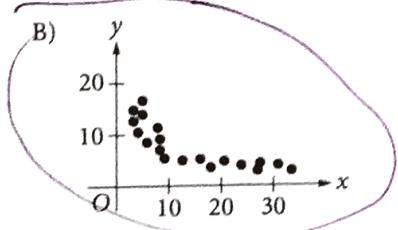


15

Which of the following scatterplots shows a relationship that is appropriately modeled with the equation $y = ax^b$, where a is positive and b is negative?



$$\text{P.G. } y = x^{-2} \\ = \frac{1}{x^2}$$



Questions 16 and 17 refer to the following information.

Mr. Martinson is building a concrete patio in his backyard and deciding where to buy the materials and rent the tools needed for the project. The table below shows the materials' cost and daily rental costs for three different stores.

Store	Materials' Cost, M (dollars)	Rental cost of wheelbarrow, W (dollars per day)	Rental cost of concrete mixer, K (dollars per day)
A	750	15	65
B	600	25	80
C	700	20	70

The total cost, y , for buying the materials and renting the tools in terms of the number of days, x , is given by $y = M + (W + K)x$.

16

For what number of days, x , will the total cost of buying the materials and renting the tools from Store B be less than or equal to the total cost of buying the materials and renting the tools from Store A?

- (A) $x \leq 6$
 (B) $x \geq 6$
 (C) $x \leq 7.3$
 (D) $x \geq 7.3$

$$M_B + (W_B + K_B)x \leq M_A + (W_A + K_A)x$$

$$\Rightarrow 600 + (105)x \leq 750 + 80x$$

$$\Rightarrow 25x \leq 150$$

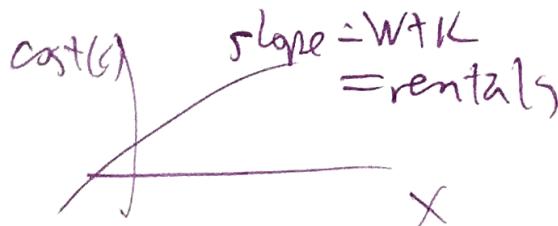
$$x \leq 6$$



17

If the relationship between the total cost, y , of buying the materials and renting the tools at Store C and the number of days, x , for which the tools are rented is graphed in the xy -plane, what does the slope of the line represent?

- A) The total cost of the project
- B) The total cost of the materials
- C) The total daily cost of the project
- D) The total daily rental costs of the tools



18

Jim has identical drinking glasses each in the shape of a right circular cylinder with internal diameter of 3 inches. He pours milk from a gallon jug into each glass until it is full. If the height of milk in each glass is about 6 inches, what is the largest number of full milk glasses that he can pour from one gallon of milk? (Note: There are 231 cubic inches in 1 gallon.)

- A) 2
- B) 4
- C) 5
- D) 6

$$\text{vol} = \pi \cdot (1.5)^2 \cdot 6$$

Want ~~231~~ ~~1.5~~

$$\frac{231}{\pi(1.5)^2 \cdot 6} = 5.4$$

19

If $3p - 2 \geq 1$, what is the least possible value of

$$3p + 2 ?$$

- A) 5
- B) 3
- C) 2
- D) 1

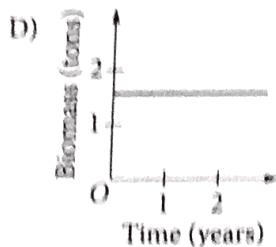
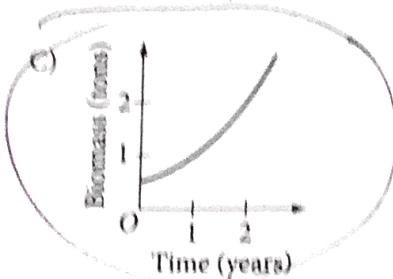
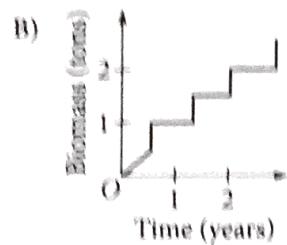
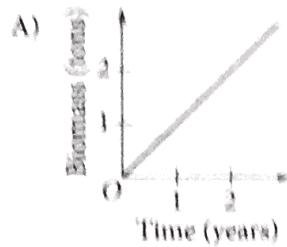
$$3p - 2 \geq 1$$

$$3p + 2 \geq 5$$



20

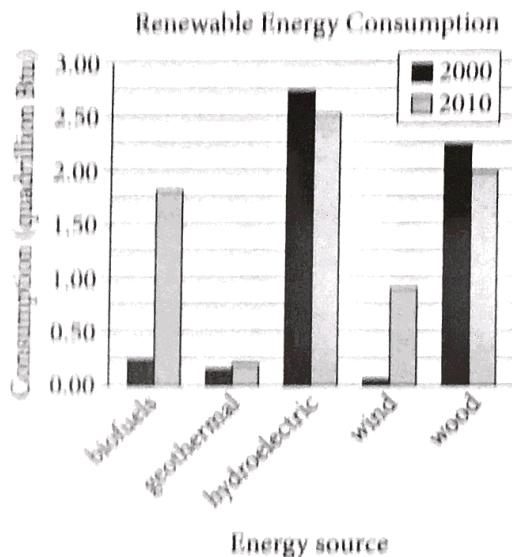
The mass of living organisms in a lake is defined to be the biomass of the lake. If the biomass in a lake doubles each year, which of the following graphs could model the biomass in the lake as a function of time? (Note: In each graph below, O represents $(0, 0)$.)



Exponential

$$b = 2^t$$

Questions 21 and 22 refer to the following information.



The bar graph above shows renewable energy consumption in quadrillions of British thermal units (Btu) in the United States, by energy source, for several energy sources in the years 2000 and 2010.

21

In a scatterplot of this data, where renewable energy consumption in the year 2000 is plotted along the x -axis and renewable energy consumption in the year 2010 is plotted along the y -axis for each of the given energy sources, how many data points would be above the line $y = x$?

- A) 1
- B) 2
- C) 3
- D) 4

2010 > 2000

3 points



22

Of the following, which best approximates the percent decrease in consumption of wood power in the United States from 2000 to 2010?

- A) 6%
- B) 11%**
- C) 21%
- D) 26%

$$2.25 \rightarrow 2$$

$$\frac{0.25}{2.25} = \frac{1}{9} = 11\%$$

23

The tables below give the distribution of high temperatures in degrees Fahrenheit ($^{\circ}\text{F}$) for City A and City B over the same 21 days in March.

City A

Temperature ($^{\circ}\text{F}$)	Frequency
80	3
79	14
78	2
77	1
76	1

City B

Temperature ($^{\circ}\text{F}$)	Frequency
80	6
79	3
78	2
77	4
76	6

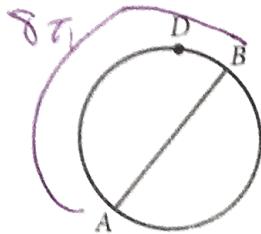
more spread out

Which of the following is true about the data shown for these 21 days?

- A) The standard deviation of temperatures in City A is larger.
- B) The standard deviation of temperatures in City B is larger.**
- C) The standard deviation of temperatures in City A is the same as that of City B.
- D) The standard deviation of temperatures in these cities cannot be calculated with the data provided.



21



In the circle above, segment AB is a diameter. If the length of arc \widehat{ADB} is 8π , what is the length of the radius of the circle?

- A) 2
- B) 4
- C) 8
- D) 16

$$2\pi r = 16\pi$$

$$r = 8$$

25

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

$$\begin{aligned} f(x) &= 2x^3 + 6x^2 + 4x \\ g(x) &= x^2 + 3x + 2 \rightarrow (x+2)(x+1) \end{aligned}$$

The polynomials $f(x)$ and $g(x)$ are defined above. Which of the following polynomials is divisible by

$2x + 3$?

- A) $h(x) = f(x) + g(x)$
- B) $p(x) = f(x) + 3g(x)$
- C) $r(x) = 2f(x) + 3g(x)$
- D) $s(x) = 3f(x) + 2g(x)$

Want $2x+3$ to be a factor

\Rightarrow plugging in $x = -\frac{3}{2}$ gives 0

$$\begin{aligned} f\left(-\frac{3}{2}\right) &= (-3)\left(\frac{1}{2}\right)\left(-\frac{1}{2}\right) = \frac{3}{4} \\ g\left(-\frac{1}{2}\right) &= \left(-\frac{1}{2}\right)\left(\frac{1}{2}\right) = -\frac{1}{4} \rightarrow \textcircled{3g+1} \end{aligned}$$

26

Let x and y be numbers such that $-y < x < y$. Which of the following must be true?

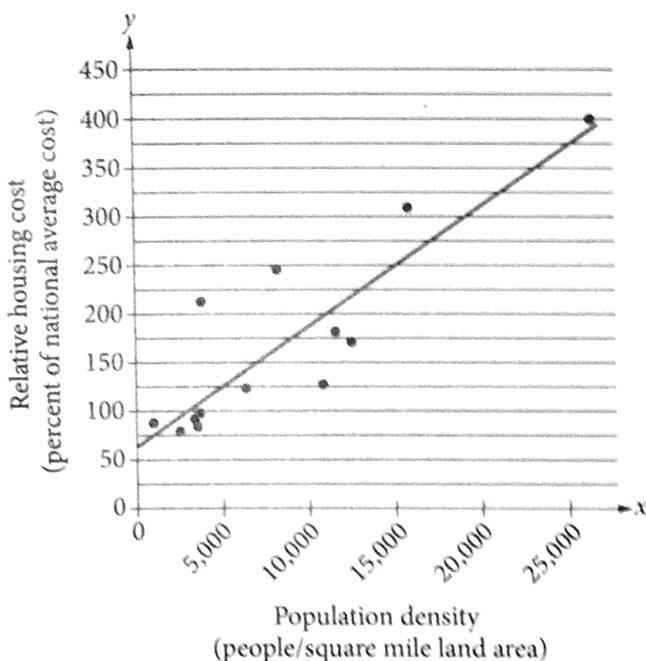
- I. $|x| < y$ ✓
 - II. $x > 0$ ✗
 - III. $y > 0$ ✓
- implies

- A) I only
- B) I and II only
- C) I and III only
- D) I, II, and III



27

The relative housing cost for a US city is defined to be the ratio $\frac{\text{average housing cost for the city}}{\text{national average housing cost}}$, expressed as a percent.



The scatterplot above shows the relative housing cost and the population density for several large US cities in the year 2005. The line of best fit is also shown and has equation $y = 0.0125x + 61$. Which of the following best explains how the number 61 in the equation relates to the scatterplot?

- A) In 2005, the lowest housing cost in the United States was about \$61 per month.
- B) In 2005, the lowest housing cost in the United States was about 61% of the highest housing cost.
- C) In 2005, even in cities with low population densities, housing costs were never below 61% of the national average.
- D) In 2005, even in cities with low population densities, housing costs were likely at least 61% of the national average.



28

$$f(x) = (x + 6)(x - 4)$$

Which of the following is an equivalent form of the function f above in which the minimum value of f appears as a constant or coefficient?

- A) $f(x) = x^2 - 24$
- B) $f(x) = x^2 + 2x - 24$
- C) $f(x) = (x - 1)^2 - 21$
- D) $f(x) = (x + 1)^2 - 25$

$$\begin{aligned} & x^2 + 2x - 24 \\ & -\frac{b}{2a} \geq -1 \\ & \Rightarrow (x+1)^2 - 25 \end{aligned}$$

29

If x is the average (arithmetic mean) of m and 9, y is the average of $2m$ and 15, and z is the average of $3m$ and 18, what is the average of x , y , and z in terms of m ?

- A) $m + 6$
- B) $m + 7$
- C) $2m + 14$
- D) $3m + 21$

$$x = \frac{m+9}{2}$$

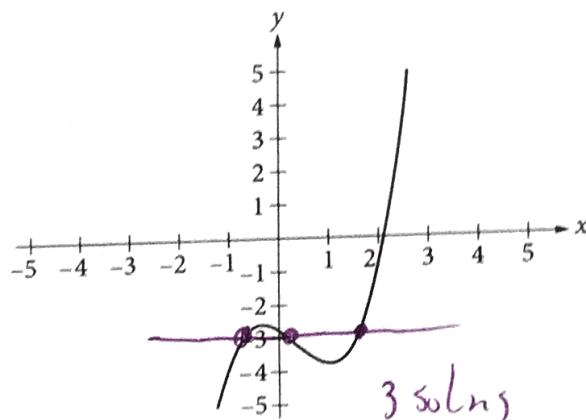
$$y = \frac{2m+15}{2}$$

$$z = \frac{3m+18}{2}$$

$$\frac{x+y+z}{3} = \frac{\frac{1}{2}(6m+42)}{3}$$

$$= m+7$$

30



The function $f(x) = x^3 - x^2 - x - \frac{11}{4}$ is graphed in the xy -plane above. If k is a constant such that the equation $f(x) = k$ has three real solutions, which of the following could be the value of k ?

- A) 2
- B) 0
- C) -2
- D) -3



31

A partially filled pool contains 600 gallons of water. A hose is turned on, and water flows into the pool at the rate of 8 gallons per minute. How many gallons of water will be in the pool after 70 minutes?

$$\begin{aligned} & 600 + 8 \cdot 70 \\ & = 600 + 560 \\ & = \boxed{1160} \end{aligned}$$

32

The normal systolic blood pressure P , in millimeters of mercury, for an adult male x years old can be modeled by the equation $P = \frac{x + 220}{2}$. According to the model, for every increase of 1 year in age, by how many millimeters of mercury will the normal systolic blood pressure for an adult male increase?

$$\begin{aligned} P &= \frac{1}{2}x + 110 \\ \text{slope} &= \boxed{\frac{1}{2}} \end{aligned}$$

33

The *pes*, a Roman measure of length, is approximately equal to 11.65 inches. It is also equivalent to 16 smaller Roman units called digits. Based on these relationships, 75 Roman digits is equivalent to how many feet, to the nearest hundredth? (12 inches = 1 foot)

$$\begin{aligned} 75 \text{ dig} &\cdot \frac{1 \text{ pes}}{16 \text{ dig}} \cdot \frac{11.65 \text{ in.}}{1 \text{ pes}} \cdot \frac{1 \text{ ft}}{12 \text{ in.}} \\ &= \boxed{4.55 \text{ ft}} \end{aligned}$$

34

In a study of bat migration habits, 240 male bats and 160 female bats have been tagged. If 100 more female bats are tagged, how many more male bats must be tagged so that $\frac{3}{5}$ of the total number of bats in the study are male?

$$\begin{aligned} \frac{240+x}{260+240+x} &= \frac{3}{5} \\ 240+x &= \frac{3}{5}(500+x) \\ \frac{2}{5}x &= 60 \\ x &= \boxed{150} \end{aligned}$$



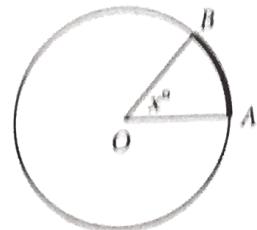
35

$$q = \frac{1}{2} \rho v^2$$

The dynamic pressure q generated by a fluid moving with velocity v can be found using the formula above, where ρ is the constant density of the fluid. An aeronautical engineer uses the formula to find the dynamic pressure of a fluid moving with velocity v and the same fluid moving with velocity $1.5v$. What is the ratio of the dynamic pressure of the faster fluid to the dynamic pressure of the slower fluid?

$$\frac{(1.5v)^2}{v^2} = \boxed{2.25}$$

36



Note: Figure not drawn to scale.

In the figure above, the circle has center O and has radius 10. If the length of arc \widehat{AB} (shown in bold) is between 5 and 6, what is one possible integer value of x ?

$$r=10 \Rightarrow \text{arc } AB = \frac{x}{360} \cdot 2\pi r$$

$$5 < \frac{\pi r}{18} < 6$$

$$\approx \frac{\pi}{18} x$$

$$30 < x < 36$$

$$\boxed{33}$$



Questions 37 and 38 refer to the following information.

The stock price of one share in a certain company is worth \$360 today. A stock analyst believes that the stock will lose 28 percent of its value each week for the next three weeks. The analyst uses the equation $V = 360(r)^t$ to model the value, V , of the stock after t weeks.

37

What value should the analyst use for r ?

$$(-28\%)_0 = \boxed{0.72}$$

38

To the nearest dollar, what does the analyst believe the value of the stock will be at the end of three weeks? (Note: Disregard the \$ sign when gridding your answer.)

$$360(0.72)^3 = \boxed{134}$$

STOP

If you finish before time is called, you may check your work on this section only.

Do not turn to any other section.