

Related Technical Math Test

Instructions: Please place your contestant number at the top of this page and on the first page of the test. Do all necessary work on the test sheets and place the answers on the Answer Sheet. Remember to attach the correct units.

You may use any type calculator and the given formula sheet. Use the calculator value for π . Round your answers to the nearest tenth or cent unless other directions are given. Place the answers on the answer sheet.

Should there be a tie, the judges will determine the winner by the reasoning and writing question plus the quality of the work shown.

You will have two hours to complete the test.

Date _____

Number _____

Answer Sheet

SkillsUSA Related Technical Math

Show all necessary work on these sheets and record your answers on this sheet

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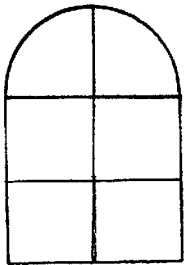
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1. Lance Armstrong won his fourth straight Tour de France bike race in 2002. He is able to travel at 32 miles per hour for an hour without resting. At this rate, how many feet per second he would be traveling?
2. Doug Mientkewicz, the Minnesota Twins Gold Glove first baseman, received \$285,000 for the 2002 season. By going to arbitration his 2003 salary was raised to \$1.75 million. Find the percent of increase.
3. Find the perimeter of a window that is shaped as a square on the bottom and a half circle on the top as shown in the figure. The side of the square is 36 inches.



4. The cumulative coaching record of St. John's University's football coach John Gagliardi is 400 wins and 119 losses. If the Johnnies win their next 9 games, determine Coach Gagliardi's winning percentage.

5. During the first four days of Jack's new job, he had to wake up at 5:30, 5:30, 7:10, and 7:30 AM. On average, at what time did he have to wake up each morning?

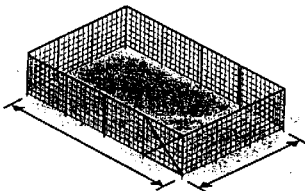
6. Two tractors are pulling a tree stump. If two forces A and B pull at right angles (90 degrees) to each other, the size of the resulting force R is given by the formula $R = \sqrt{A^2 + B^2}$. If tractor A is exerting 600 pounds of force and the resulting force is 850 pounds, find how much force tractor B is exerting.



7. A circular plastic wading pool contains 100 gallons of water when it is 18 inches deep. On a hot day, children splashing reduces the depth of the water to 13 inches. To the nearest gallon, how much water is in the pool when the depth is 13 inches?

8. The amount of P pollution varies directly with the population N of people. Kansas City has a population of 442,000 and produced 260,000 tons of pollutants. How many tons of pollutants would St. Louis produce if we know its population is 348,000. Round to the nearest ton.

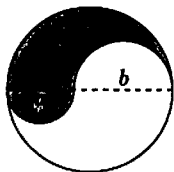
9. Medora's rectangular dog pen for her black lab must have an area of 875 square feet. Also, the length must be 10 feet longer than the width. Find the dimensions of the pen.



10. A prop jet can travel 750 miles in the same length of time that it takes a private plane to travel 300 miles. The speed of the prop jet is 60 miles per hour more than twice the speed of the private plane. What is the speed of the prop jet?

11. After a hernia operation, a patient was instructed to take one 500-milligram hyracoidean tablet every 4 hours. If the patient used this medication for 5 days, how many grams of hyracoidean were consumed?

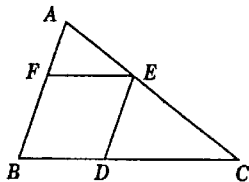
12. The figure shown is the union of a circle and two semicircles of diameter a and b whose centers are collinear. Compute the ratio of the area of the shaded region to the area of the unshaded region.



13. John and Brian leave Williston at the same time. John drives north and Brian drives east. John's average speed is 10 miles per hour slower than Brian's. At the end of one hour they are 50 miles apart. Find Brian's average speed.

14. Alex draws 300 circles with a diameter of 1 unit, Cormac draws 400 squares with 1 unit sides, and Ella draws 500 equilateral triangles with 1 unit sides. If they all draw with the same type pen, who uses the most ink?

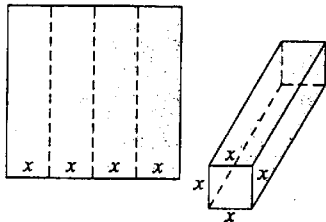
15. Quadrilateral BDEF is a rhombus with vertices on triangle ABC. Given $AB = 10$ and $BC = 15$, find DE.



16. How many blocks are there in a pile if there are 19 blocks in the first layer, 17 in the next layer, 15 in the third layer, and so on, with only 1 block on the top layer.

17. Angella averaged 60 miles per hour driving from home to The Lodge, and her husband, Andy, averaged 55 miles per hour. Angella arrived 10 minutes before Andy. What is the distance from their home to The Lodge if they both drove the same route?

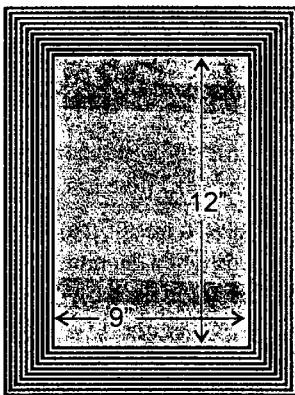
18. A rectangular box with open ends is to be built from a piece of cardboard with parallel and equally spaced creases. If the perimeter, of the cardboard is 20 feet, find the approximate maximum volume of the container.



19. The difference between the squares of two consecutive odd numbers is 128. What is the product of the two integers?

20. Each flower has a specific price. One tulip, one daisy, and two mums cost \$4.20. One tulip, two daisies and one mum cost \$3.80. Two tulips and two mums cost \$4.80. How much does one tulip, three daisies and two mums cost?

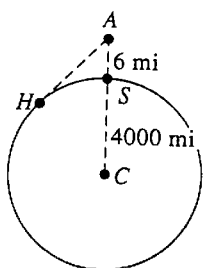
21. A picture 9 inches wide and 12 inches long is surrounded by a matte of uniform width. The area of the matte is 162 square inches, find the width of the matte.



22. A dozen ping-pong balls are numbered 1 to 12. Ryan separated the balls into two groups and noticed that the sum of the numbers on the balls in the first group equaled the sum of the numbers on the balls in the second group. What is the common sum?

23. The safe load, L , of a wooden beam supported at both ends varies jointly as the width, w , and the square of the depth, d , and inversely as the length, l . A wooden beam 2 inches wide, 8 inches deep, and 14 feet long holds up 2400 pounds. What load would a beam 3 inches wide by 6 inches deep and 15 feet long, of the same material, support?

24. An airplane at A is flying at a height of 6 miles above the Earth's surface at S as shown. Find the distance AH .



25. In the United States, the percent of women using the Internet is increasing faster than the percent of men. For the years 1996-2001, the function $y = 7x + 18.7$ can be used to estimate the percent of females using the Internet while the function $y = 6x + 27.7$ can be used to estimate the percent of males. For both functions, x is the number of years since 1996. If this trend continues, predict the year in which the percent of females is equal to the percent of males.

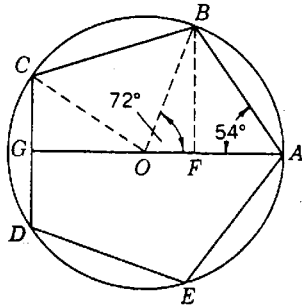
26. A box contained 31 chocolates. The first day, Susan ate $\frac{3}{4}$ of the number Jacqueline ate. The second day, Susan ate $\frac{2}{3}$ of the number that Jacqueline ate that day, and the chocolates were all gone. How many chocolates did Susan eat?

Problem 27 has been deleted at the request of the Technical committee.

28. A nonsmoker in excellent physical condition, using deep inhalation and forced exhalation, could exhale 250 cubic inches. (Some air must remain or the lungs will collapse). What radius balloon could a healthy person inflate in two exhalations? Round to the nearest tenth of an inch.

29. Find the percent increase in the area of a circular pizza if the diameter is increased from 10 inches to 12 inches.

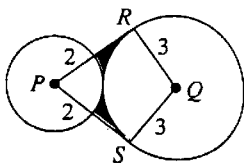
30. In order to locate the holes that are to be drilled in a regular pentagonal project, the piece is clamped to the table of a milling machine. The radius is 1 inch. Find the length of EA. Round to the nearest thousandth.



31. The yearly cost of tuition and required fees for attending a public two-year college full time can be estimated by the linear equation $y = 68.3x + 1372$ where x is the number of years after 1996 and y is the total cost in dollars. Use this equation, to approximate the yearly cost of attending a two-year college in 2004.

32. Bernie, a modern farmer, plants corn, wheat, and soybeans and rotates the planting each year on his 500- acre farm. In one year, the profits were: \$120 per acre for corn, \$100 per acre for wheat, and \$80 per acre for soybeans. He planted twice as many acres with corn as with soybeans. How many acres did he plant with each crop the year he made a profit of \$51,800?

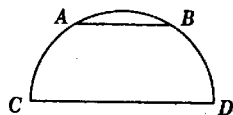
33. Two circles with radii 2 and 3 and centers P and Q , respectively, are externally tangent. From P , tangents PR and PS are drawn to the larger circle. Find the area of the quadrilateral $PRQS$.



34. Find the equation in $y = mx + b$ form for the line parallel to the line $3x + 2y = -4$ and passing through the point $(4, -4)$.

35. Kay Cobb goes up a ski lift at a speed of 4 miles per hour and down the slope at a speed of 24 miles per hour. If the ski slope is the same length as the ski lift and if we ignore any time spent at the top of the hill, what is her average speed for the round trip?

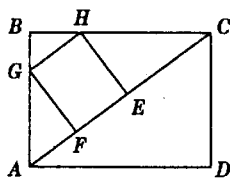
36. The semicircle below has a radius of 2 cm, and chord AB is parallel to the diameter CD . If AB is half as long as the diameter of the semicircle, how far is it from the diameter?



37. Suppose that a lake is stocked with 500 fish, and biologists predict that the population of these fish will grow approximately by the function. $P(t) = 500 \ln(2t + e)$ where t is measured in years. What will the population be in 5 years?

38. The complex number $13 + i$ can be factored into the product of $1 + 2i$ and what other complex number?

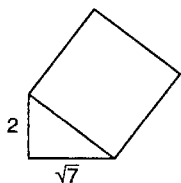
39. In the figure, ABCD is a rectangle, $AG = 15$, $BG = 6$, and $AD = 28$. Find the area of rectangle EFGH.



40. The world population is currently growing at a rate of 1.3% annually. In 2001, the midyear population of the world was 6137 million people. Predict the midyear population in 2012. Use $y = 6137(2.7)^{0.013t}$, where y is the world population in millions and t is the number of years after 2001. Round to the nearest million.

41. The Beefreeze Company has learned that by pricing a newly released Frisbee at \$6, sales will reach 2000 per day. Raising the price to \$8 will cause the sales to fall to 1500 per day. Assume that the ratio of change in price to change in daily sales is constant, and let x be the price of the frisbee and y be the number of sales. Use this information to predict the daily sales of frisbees if the price is set at \$7.50.

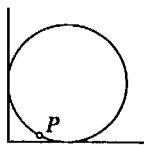
42. A square is constructed on the hypotenuse of a right triangle whose legs have lengths 2 and $\sqrt{7}$, forming a pentagon. What is the area of the pentagon?



43. How long does it take an investment of \$2000 to double if it is invested at 5% interest compounded quarterly? Given the formula $A = p\left(1 + \frac{r}{n}\right)^{nt}$ where A is the accrued amount, p is the principal invested, r is the annual rate of interest, n is the number of compounding periods per year, and t is the number of years.

44. In Canada, eastbound and westbound trains travel along the same track, with sidings to pull onto to avoid accidents. Two trains are now 150 miles apart, with the westbound train traveling twice as fast as the eastbound train. A warning must be issued to pull one train onto a siding or else the trains will crash in 1.25 hours. Find the speed of the east bound train.

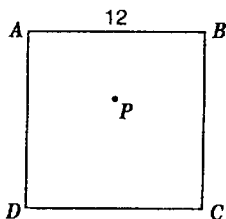
45. A circular table in the diagram is pushed against two perpendicular walls. The point P on the circumference of the table is a distance 2 inches from one wall and a distance 9 inches from the other wall. What is the radius of the table?



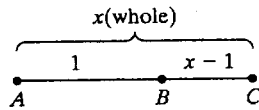
46. Dirt Cheap, a car rental agency, rents 200 cars per day at a rate of \$30 per day. For each \$1 increase in rate, five fewer cars are rented. What daily rate would give total receipts of \$6125 for one day?

47. The Taylor's Falls Climbing Club planned a climbing expedition. The total cost was \$900, which was to be divided equally among the members going on the expedition. While practicing, three members fell and were unable to go. If the cost per person increased by \$15, how many members went on the expedition?

48. ABCD is a square with $AB = 12$. Point P is an interior point whose distances to A, B, and to the side CD are equal. Find that distance.

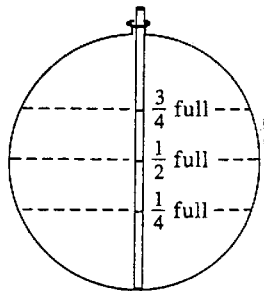


49. If a point B divides a line segment such that the smaller portion is to the larger portion as the larger is to the whole, the whole is the length of the *golden ratio*. The *golden ratio* was thought by the Greeks to be the most pleasing to the eye, and many of their buildings contained numerous examples of the *golden ratio*. The value of the *golden ratio* is the positive solution of the following equation. Find the value of x, to the nearest thousandth.



$$\begin{array}{l} \text{(smaller)} \\ \text{(larger)} \end{array} \frac{x-1}{1} = \frac{1}{x} \begin{array}{l} \text{(larger)} \\ \text{(whole)} \end{array}$$

50. The diagram shows an end view of a cylindrical gasoline tank with a radius of 1 meter. Through a hole in the top, a vertical rod is lowered to touch the bottom of the tank. When the rod is removed the gasoline level in the tank can be read from the gasoline mark on the rod. Where on the rod should the mark be to show that the tank is $\frac{3}{4}$ full?



2003 Reasoning and Writing Question

Today is your first day driving a city bus. When you leave downtown, you have twenty-three passengers. At the first stop, three people exit and five people get on the bus. At the second stop, eleven people exit and eight people get on the bus. At the third stop, five people exit and ten people get on. How old is the bus driver?

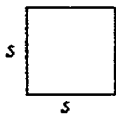
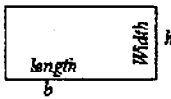
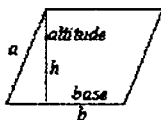
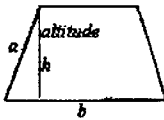
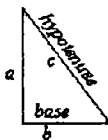
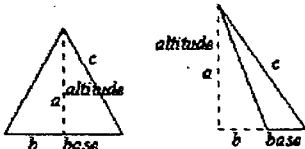
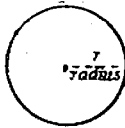
Comments and explanation

Plane Figures

p = perimeter (distance around a plane figure)

C = length of the circumference of a circle

A = area of a plane figure

Square		All sides equal and parallel and all angles right angles	$p = 4s$ $A = s^2$
Rectangle		Opposite sides parallel and all angles right angles.	$p = 2h + 2b$ $A = bh$
Parallelogram		Opposite side parallel	$p = 2a + 2b$ $A = bh$
Trapezoid		Two sides parallel	$p = b_1 + b_2 + a + c$ $A = \frac{(b_1 + b_2)h}{2}$
Right Triangle		Three-sided figure with one right angle.	$p = a + b + c$ $A = \frac{ab}{2}$ $c^2 = a^2 + b^2$ $c = \sqrt{a^2 + b^2}$
Scalene Triangle		Three-sided figure with no right angles.	$p = a + b + c$ $A = \frac{bh}{2}$
Circle		All points on perimeter equidistant from center.	$C = \pi d$ $r = \frac{d}{2}$ $A = \pi r^2$ $\pi = 3.1416$ (approximately)

Solids

Lateral area

prism or pyramid
cylinder or cone

The sum of the areas of all faces other than the base or bases
Area of the curved surface

Total surface area

The sum of the lateral area and the area of the base (or bases).

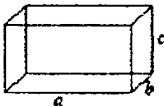
The following abbreviations are used:

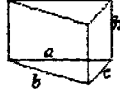

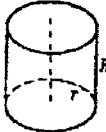
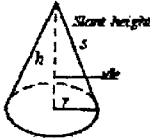
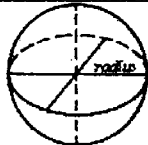
L = lateral area

S = total surface area

V = volume

B = area of the base

Parallelepiped		All faces are rectangles	$S = 2ab + 2ac + 2bc$ $V = abc$
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Right Prism		Bases in parallel planes, other faces rectangles	$L = (a + b + c)h$ $S = L + B$ $V = Bh$
Regular Pyramid		All faces congruent triangles	$L = \frac{Ps}{2}$ $S = L + B$ $V = \frac{Bh}{3}$
Right Circular Cylinder		Bases are circles in parallel planes	$L = 2\pi r h$ $V = \pi r^2 h$ $S = 2\pi r (h + r)$
Right Circular Cone		Base is a circle and lines joining vertex to center of base is perpendicular to base.	$L = \pi r s$ $S = \pi (rs + r^2)$ $V = \frac{(\pi r^2 h)}{3}$
Sphere		All points equidistant from center.	$V = \frac{4\pi r^3}{3}$ $S = 4\pi r^2$

English-Metric Summary Sheet

Length Units	
1 foot (ft) = 12 inches (in)	1 kilometer (km) = 1,000 meters
1 yard (yd) = 3 ft	1 hectometer (hm) = 100 meters
1 mile (mi) = 5,280 ft or 1,760 yds	1 dekameter (dam) = 10 meters
1 meter = 39.37 inches	1 meter (m) = 1 meter
1 inch = 2.54 centimeters	1 decimeter (dm) = 0.1 meter
1 kilometer = 0.6214 miles	1 centimeter (cm) = 0.01 meter
1 mile = 1.609 kilometers	1 millimeter (mm) = 0.001 meter
Weight (Mass) Units	
1 pound (lb) = 16 ounces (oz)	1 pint (pt) = 16 ounces (oz)
1 ton (T) = 2,000 pounds	1 quart (qt) = 2 pints
1 oz = 28.35 grams (g)	1 gallon (gal) = 4 quarts
1 kilogram = 2.205 lb	1 liter (l) = 1.057 quarts
1 metric ton (MT) = 1,000 kilograms	1 gallon = 3.785 liters
1 milligram (mg) = $\frac{1}{1,000}$ gram	1 milliliter (ml) = $\frac{1}{1,000}$ liter
	1 cubic ft = 7.48 gallons
	1 gallon = 231 cubic inches
Time Units	
1 minute (min) = 60 seconds (sec)	
1 hour (hr) = 60 minutes	
1 hour = 3,600 seconds	
Temperature Conversions	
	$C = \frac{5F - 160}{9}$ $F = \frac{9C}{5} + 32$