

SkillsUSA

2015 Contest Projects

Related Technical Math

Click the “Print this Section” button above to automatically print the specifications for this contest. Make sure your printer is turned on before pressing the button.

Contestant Number _____

2015 SkillsUSA

Related Technical Math Test

INSTRUCTIONS

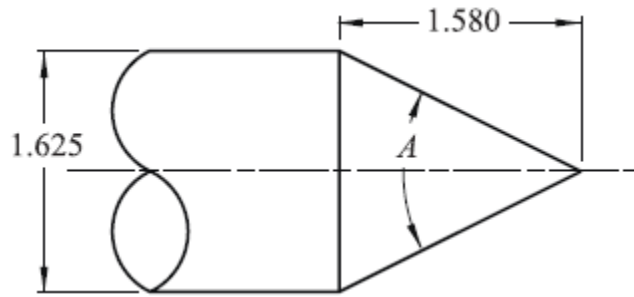
Please place your contestant number at the top of this page and on the first page of the test.
Do all necessary work on the test sheets and place the answers on the answer sheet.
Remember to include the correct units on your answers.

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

In the event of a tie: The judges will determine the winner by the reasoning and overall quality
of the work shown to solve the problems.

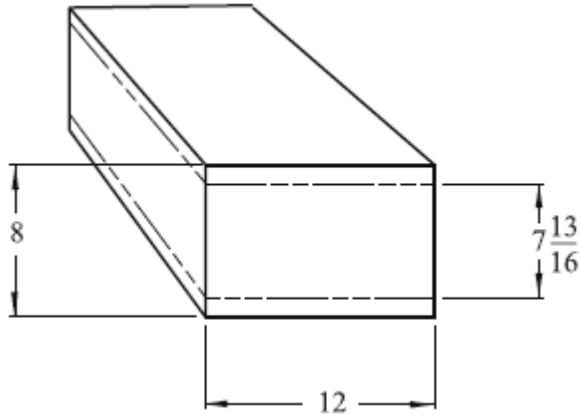
You will have two hours to complete the test.

- 1) Determine angle A . The dimensions shown are in inches.



- 2) Suppose that the mean starting salary of welders in a specific region is \$37,480 with a standard deviation of \$1,400 and that salaries follow a normal distribution. Approximately what percentage of the salaries will be between \$34,680 and \$40,280?

- 3) A millwright must use a rough wooden timber measuring 8 by 12 inches. If a timber that is $7\frac{13}{16}$ inches thick is required, and equal thickness are cut from each rough side, how thick are the pieces cut off each side?



- 4) A lever has a 140-pound weight on one end and a 160-pound weight on the other end. The lever is balanced, and the 140-pound weight is exactly one foot farther from the fulcrum than the 160-pound weight. How far from the fulcrum is the 160-pound weight?

- 5) Floor tiles measure 8 inches square. How many will be required to tile an office floor containing 1600 square yards?

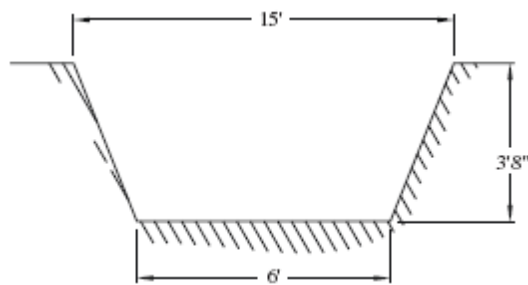
6) Solve for x : $\sqrt{x+3} - 2 = 6$

- 7) A contractor estimates that 10,032 cement blocks are needed for a job. How many additional blocks must be ordered to provide for 12% scrap and damage?

- 8) To test the flow of coolant through a radiator with a 2 inch diameter passage, a flow of 5 gallons was recorded in 4 minutes. Find the velocity in feet per second of the flow through the radiator.
- 9) A local pizza parlor is offering a half-price deal on any pizza with one topping. There are eight toppings from which to choose. In addition, there are three different choices for the size of the pizza, and two choices for the type of crust. In how many ways can a pizza be ordered?
- 10) The local hardware store sells custom-colored paint. A certain orange color needed to match the color on a piece of machinery consists of 1.5 parts red paint and 2 parts yellow paint. How many gallons of red and how many gallons of yellow paint are needed to make 28 gallons of orange paint?

- 11) Let E be the event that a new car requires engine work under warranty and let T be the event that the car requires transmission work under warranty. Suppose that $P(E) = 0.10$, $P(T) = 0.02$, and $P(E \text{ and } T) = 0.01$. Find the probability that the car needs work on either the engine, the transmission, or both.

- 12) Calculate the cross-sectional area of the storm drain shown below. Give answer in square feet.



13) A lumber yard has 100 hardwood boards, $1\frac{1}{4}$ inches thick by 8 inches wide and 8 feet long in stock. How many board feet is this?

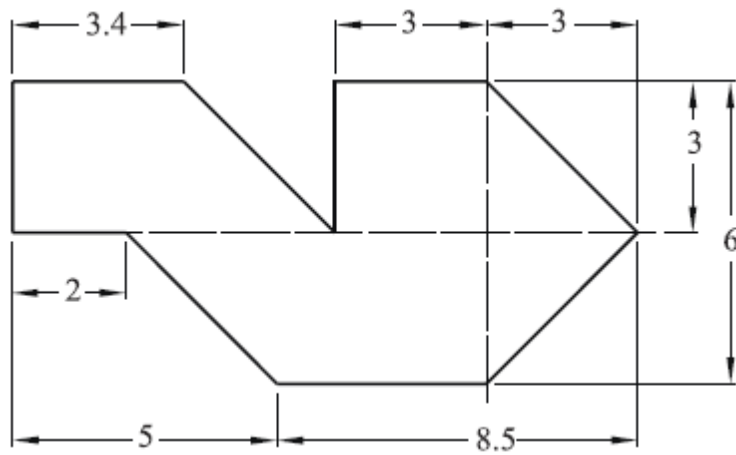
14) The walls of a house are to be covered with insulation board. The actual area is 2604 square feet. How many 8 foot by 4 foot insulation boards must be ordered to allow for 7% waste?

15) Find the number whose log is 0.25.

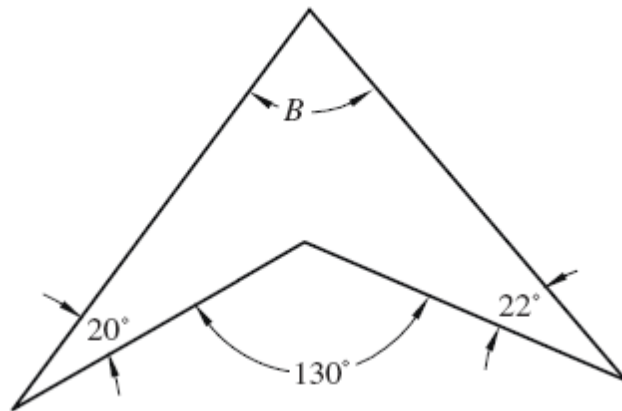
16) A news story reported the number of calories in hamburgers from six fast-food restaurants as 250, 290, 230, 310, 310, and 350. Find the mean number of calories.

17) A sphere is cut from a cube 20 inches on an edge. What is the minimum amount of waste in cubic inches?

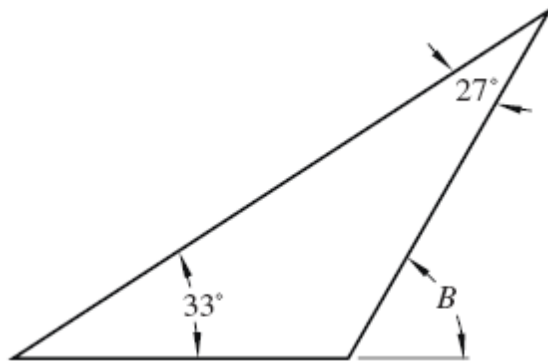
18) What is the perimeter of the blank shown below? Dimensions are in inches.



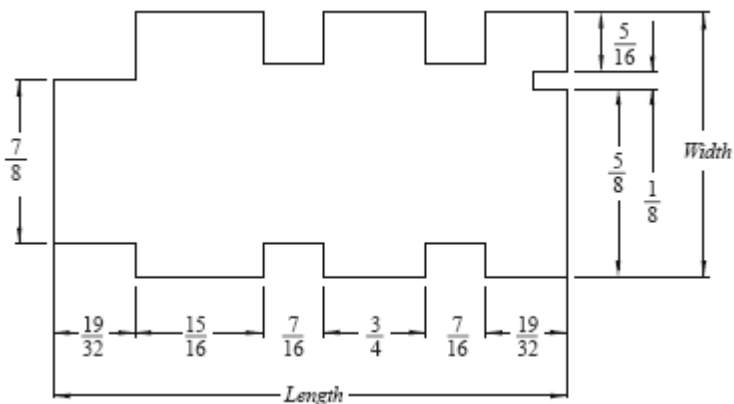
19) Solve for angle B in the polygon shown below.



20) In the oblique triangle shown below, solve for $\angle B$.

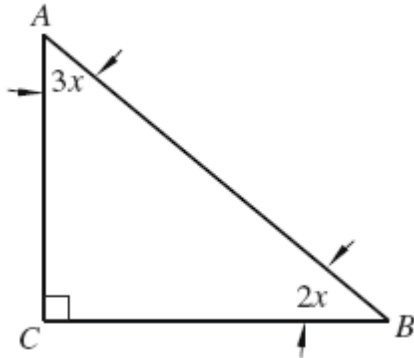


21) The dimensions of the detail shown below are given in inches. Determine the indicated length and width.

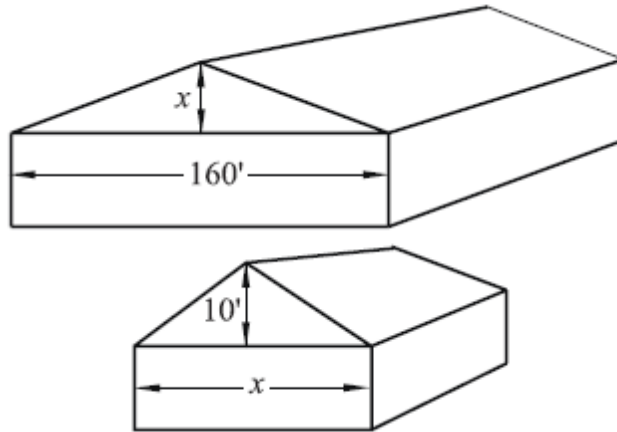


- 22) The lifting capacity of a cable is proportional to the area of its cross section. If a cable 1.5 inches in diameter will lift 10,000 pounds, what will a cable 6.25 inches in diameter lift?

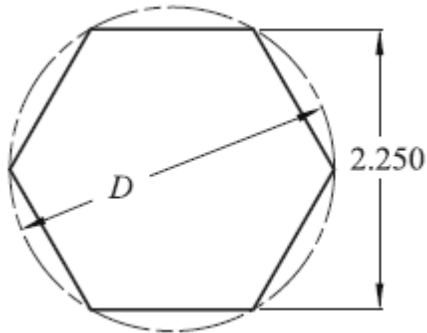
- 23) In triangle ABC shown below, the sizes of the acute angles are given as $\angle CAB = 3x$ and $\angle CBA = 2x$. Solve for the two angles in degrees.



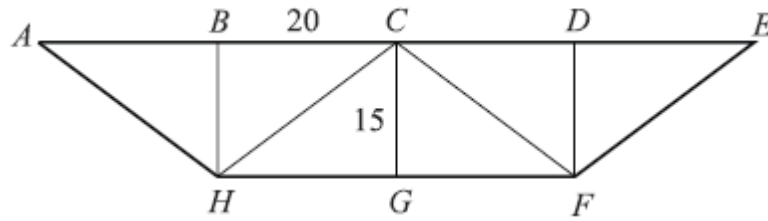
- 24) An equally pitched roof has both sides at the same angle with the horizontal. Two buildings have equally pitched roofs as shown below. The span of the first roof is 160 ft and the vertical height of the second roof is 10 ft. What is the span of the second roof if its span equals the vertical height of the first roof?



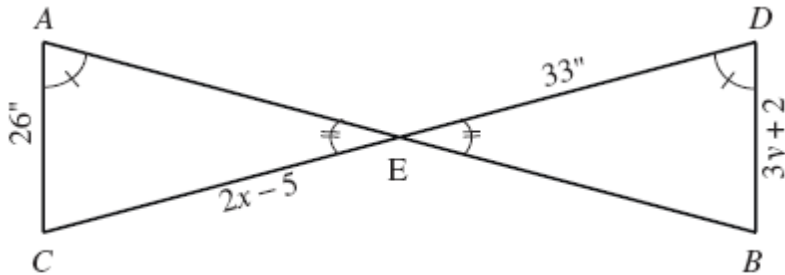
- 25) Determine the diameter of the circle circumscribed around the hexagon shown below. Dimensions are in centimeters. Round to the thousandths place.



- 26) The principal dimensions of a truss are provided in the figure below. Calculate $\angle CHG$ and the length of HC. All dimensions are in feet.

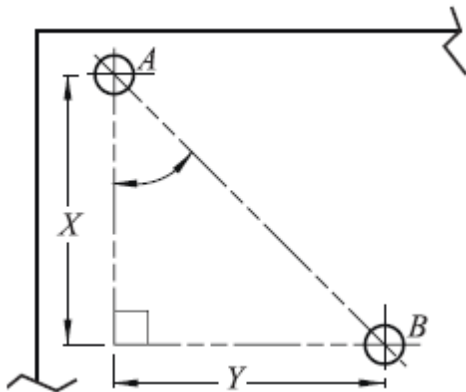


- 27) In the figure below, $\angle CAE \cong \angle DBE$, $AE = EB$, and angle $\angle AEC \cong \angle DEB$. CE is given as $2x - 5$ and BD as $3y + 2$. Using geometric principles and algebra, solve for x and y .

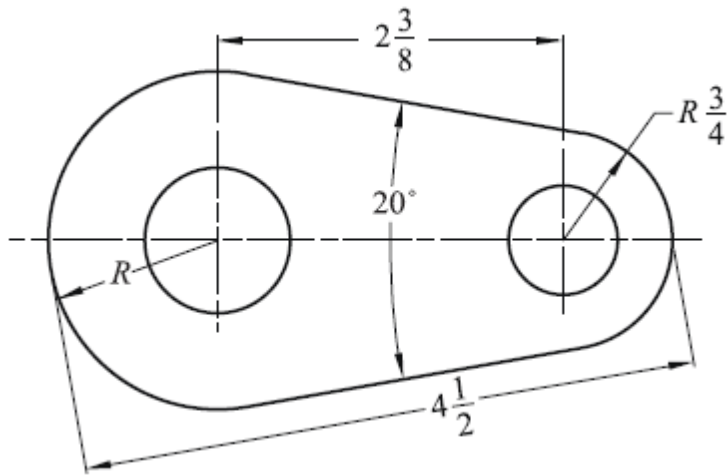


- 28) Flow Q in gallons per minute (gpm) through a pipe with inside diameter d in inches and flow velocity V in feet per second is given by the formula $Q = 2.44d^2V$. How many gpm of water are discharged from a 1.5-inch inside diameter pipe if the flow velocity is 10 feet per second? Round to the tenths place.

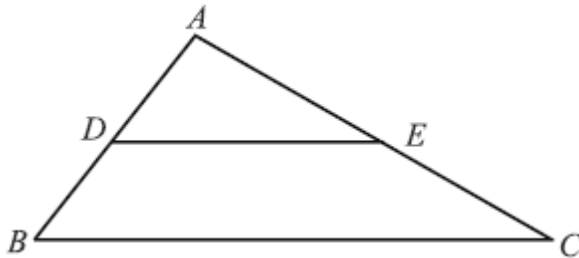
- 29) The plate shown below is to have two holes bored using a boring machine. After hole A is bored, the table of the machine is moved in two directions, X and Y , to locate hole B. Find the distances X and Y when line AB and $\angle A$ have the following measurements: $AB = 8.75$ inches, $\angle A = 45^\circ$. Round to the thousandths place.



30) Determine the length of radius R in the figure below. Dimensions are in inches.



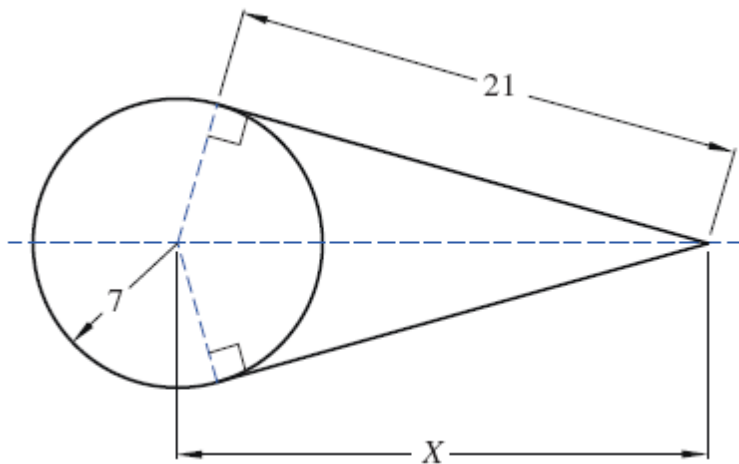
31) In triangle ABC shown in Figure 18.8, segments DE and BC are parallel, $DA = 4$ inches, $AB = 8$ inches, $DE = 10$ inches. Solve for length of side BC .



- 32) The weather in Plain City is dry most of the time, but it can be quite rainy in the spring. The rainiest month of the year is April. The table below shows the annual rainfall in Plain City, in inches, for each April from 1982 to 1992. Find the median for the data.

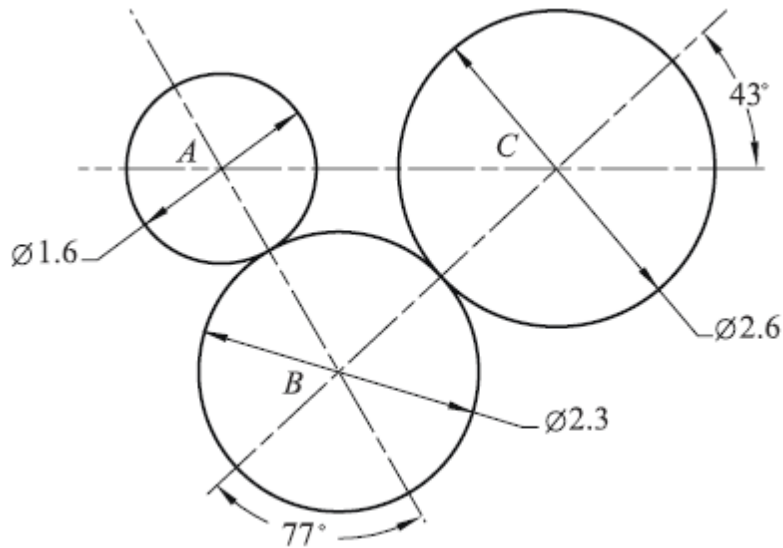
YEAR	RAINFALL
1982	0.7
1983	4.37
1984	5.21
1985	1.23
1986	3.21
1987	2.56
1988	1.89
1989	3.36
1990	5.01
1991	0.56
1992	2.31

- 33) In the figure below solve for X. Dimensions are in feet.



- 34) The elongation of a guy wire varies directly with small loads. What is the elongation of the guy wire when the load is 2500 N if a load of 400 N causes an elongation of 8 mm?

- 35) Three gears mesh as shown below. Find the distance between points A and C. Dimensions are in centimeters.



36) Calculate the weighted mean for the grade sheet shown below.

	HOMEWORK	QUZZES	TESTS	FINAL
GRADE	90	72	80	95
WEIGHT	0.2	0.15	0.3	0.35

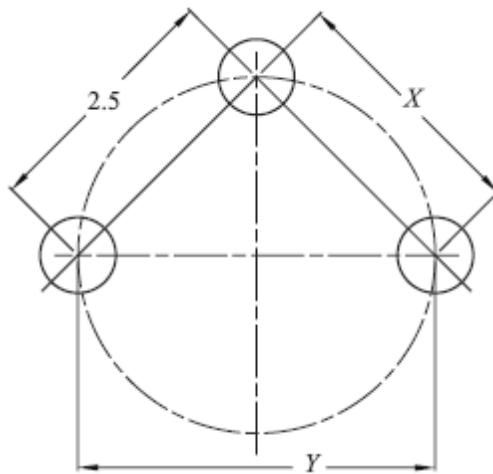
37) A fair coin is tossed 3 times. What is the probability that all three tosses will land tail side up?

38) If the radius of a circle is doubled, by what factor is the area multiplied?

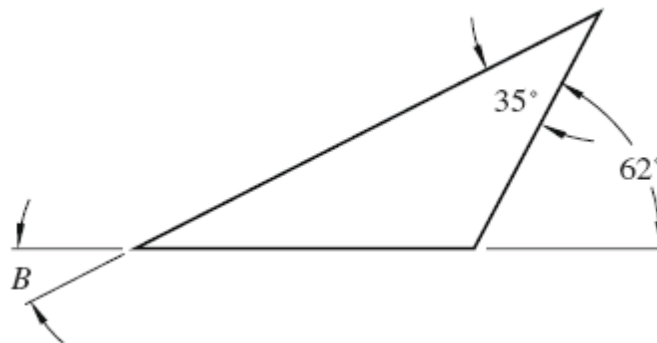
39) A special laminated wooden beam is made up of two pieces of planking, each $1\frac{5}{8}$ inch thick, and three pieces of lumber, each $\frac{13}{16}$ inch thick. What is the thickness of the beam?

40) The formula for the sum of the separate resistances in a parallel circuit containing 3 resistors is: $\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$. What size resistor is needed for R_3 if $R_1 = 2$ ohms, $R_2 = 6$ ohms, and the total circuit resistance is 1.33 ohms? Round answer to the tenths place.

- 41) In the figure shown below, solve for dimension X , a chord of the circle, and Y , the circle's diameter. Dimensions are in centimeters.



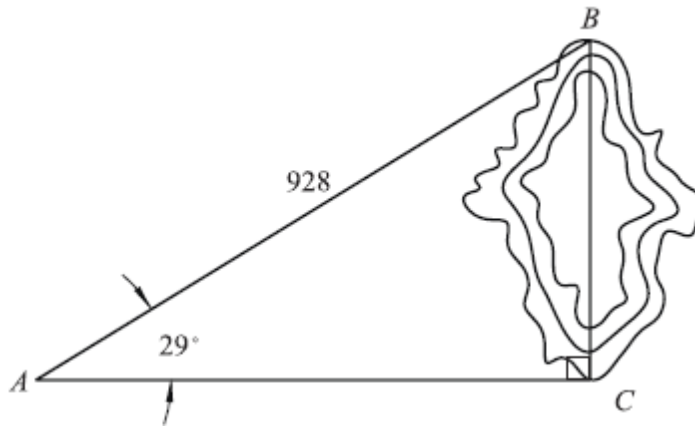
- 42) Determine $\angle B$ in the figure shown below.



43) Five taper reams cost \$12. How much would 1 dozen taper reams cost?

44) Solve for x in the expression: $3(x + 2y) = 2(5x - y)$.

- 45) A builder wishes to measure a pond. Right triangle ACB is constructed as shown in the figure below. If $AB = 928$ feet and $\angle A$ is 29° , find the distance between point B and C.



- 46) Solve the roots of the quadratic equation: $x^2 - 4x + 2 = 0$.

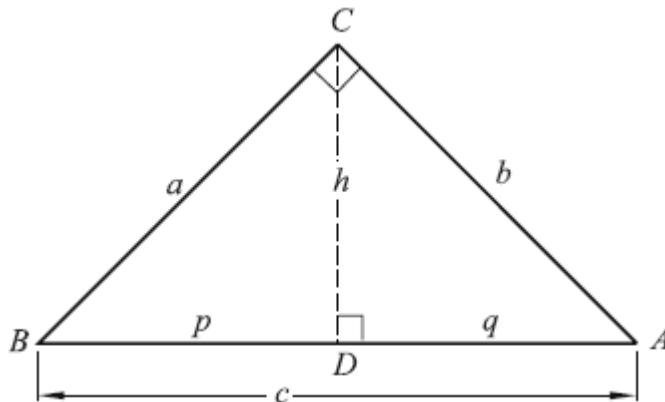
- 47) A population of 600 transistors contains transistors from three lots. The transistors are categorized by lot and by whether they pass an electrical test, with the results shown in the table below. If a transistor is chosen at random from the population, what is the probability that the transistor is from Lot A and passes the electrical test?

LOT	PASS	FAIL
A	88	12
B	165	35
C	260	40

- 48) Find the equation of the line passing through the points $(-3,4)$ and $(-1,-6)$.

- 49) A person standing 120 feet from the base of a smokestack finds that the angle of elevation (the angle a line from the eye to the object makes with the horizontal) is 50° . If the person's eye is 5 feet 8 inches from the ground, what is the height of the stack? Round to the thousandths place.

- 50) In the figure shown below, solve for a and h when $p = 2$ and $q = 6$.



Date _____

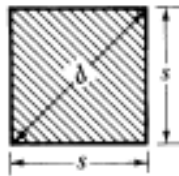
Contestant Number _____

Answer sheet for 2015 SkillsUSA Related Technical Math Test

- | | |
|-----------|-----------|
| 1. _____ | 26. _____ |
| 2. _____ | 27. _____ |
| 3. _____ | 28. _____ |
| 4. _____ | 29. _____ |
| 5. _____ | 30. _____ |
| 6. _____ | 31. _____ |
| 7. _____ | 32. _____ |
| 8. _____ | 33. _____ |
| 9. _____ | 34. _____ |
| 10. _____ | 35. _____ |
| 11. _____ | 36. _____ |
| 12. _____ | 37. _____ |
| 13. _____ | 38. _____ |
| 14. _____ | 39. _____ |
| 15. _____ | 40. _____ |
| 16. _____ | 41. _____ |
| 17. _____ | 42. _____ |
| 18. _____ | 43. _____ |
| 19. _____ | 44. _____ |
| 20. _____ | 45. _____ |
| 21. _____ | 46. _____ |
| 22. _____ | 47. _____ |
| 23. _____ | 48. _____ |
| 24. _____ | 49. _____ |
| 25. _____ | 50. _____ |

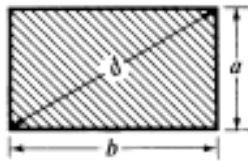
Plane Figures

Square:



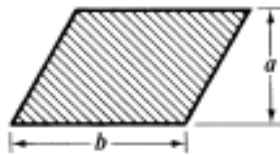
$$\begin{aligned}\text{Area} = A &= s^2 = \frac{1}{2}d^2 \\ s &= 0.7071d = \sqrt{A} \\ d &= 1.414s = 1.414\sqrt{A}\end{aligned}$$

Rectangle:



$$\begin{aligned}\text{Area} = A &= ab = a\sqrt{d^2 - a^2} = b\sqrt{d^2 - b^2} \\ d &= \sqrt{a^2 + b^2} \\ a &= \sqrt{d^2 - b^2} = A + b \\ b &= \sqrt{d^2 - a^2} = A + a\end{aligned}$$

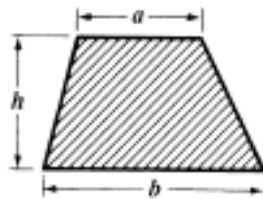
Parallelogram:



$$\begin{aligned}\text{Area} = A &= ab \\ a &= A + b \\ b &= A + a\end{aligned}$$

Note: The dimension a is measured at right angles to line b .

Trapezoid:



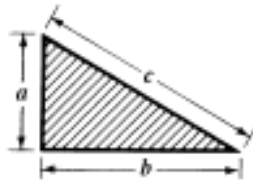
$$\text{Area} = A = \frac{(a+b)h}{2}$$

Note: In Britain, this figure is called a *trapezium* and the one below it is known as a *trapezoid*, the terms being reversed.

Example: Side $a = 23$ meters, side $b = 32$ meters, and height $h = 12$ meters. Find the area.

$$A = \frac{(a+b)h}{2} = \frac{(23+32)12}{2} = \frac{55 \times 12}{2} = 330 \text{ square meters}$$

Right-Angled Triangle:

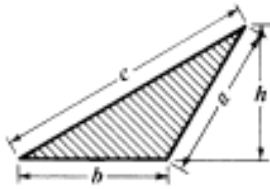


$$\begin{aligned}\text{Area} = A &= \frac{ab}{2} \\ c &= \sqrt{a^2 + b^2} \\ a &= \sqrt{c^2 - b^2} \\ b &= \sqrt{c^2 - a^2}\end{aligned}$$

Acute-Angled Triangle:



$$\begin{aligned}\text{Area} = A &= \frac{bh}{2} = \frac{b}{2} \sqrt{a^2 - \left(\frac{a^2 + b^2 - c^2}{2b}\right)^2} \\ \text{If } S &= \frac{1}{2}(a+b+c), \text{ then} \\ A &= \sqrt{S(S-a)(S-b)(S-c)}\end{aligned}$$

Obtuse-Angled Triangle:

$$\text{Area} = A = \frac{bh}{2} = \frac{b}{2} \sqrt{a^2 - \left(\frac{c^2 - a^2 - b^2}{2b}\right)^2}$$

If $S = \frac{1}{2}(a + b + c)$, then

$$A = \sqrt{S(S-a)(S-b)(S-c)}$$

Circle:

$$\text{Area} = A = \pi r^2 = 3.1416 r^2 = 0.7854 d^2$$

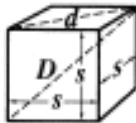
$$\text{Circumference} = C = 2\pi r = 6.2832 r = 3.1416 d$$

$$r = \frac{C}{6.2832} = \sqrt{\frac{A}{3.1416}} = 0.564 \sqrt{A}$$

$$d = \frac{C}{3.1416} = \sqrt{\frac{A}{0.7854}} = 1.128 \sqrt{A}$$

$$\text{Length of arc for center angle of } 1^\circ = 0.008727 d$$

$$\text{Length of arc for center angle of } n^\circ = 0.008727 n d$$

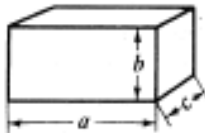
Solids*Cube:*

$$\text{Diagonal of cube face} = d = s\sqrt{2}$$

$$\text{Diagonal of cube} = D = \sqrt{\frac{3d^2}{2}} = s\sqrt{3} = 1.732s$$

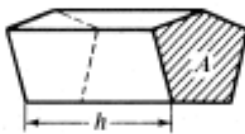
$$\text{Volume} = V = s^3$$

$$s = \sqrt[3]{V}$$

Square Prism:

$$\text{Volume} = V = abc$$

$$a = \frac{V}{bc} \quad b = \frac{V}{ac} \quad c = \frac{V}{ab}$$

Prism:

V = volume

A = area of end surface

$$V = h \times A$$

The area A of the end surface is found by the formulas for areas of plane figures on the preceding pages. Height h must be measured perpendicular to the end surface.

Pyramid:

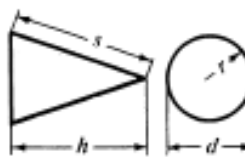
$$\text{Volume} = V = \frac{1}{3} h \times \text{area of base}$$

If the base is a regular polygon with n sides, and s = length of side, r = radius of inscribed circle, and R = radius of circumscribed circle, then:

$$V = \frac{nsrh}{6} = \frac{ns}{6} \sqrt{R^2 - \frac{s^2}{4}}$$

Cylinder:

$$\begin{aligned}\text{Volume} &= V = 3.1416r^2h = 0.7854d^2h \\ \text{Area of cylindrical surface} &= S = 6.2832rh = 3.1416dh \\ \text{Total area } A \text{ of cylindrical surface and end surfaces:} \\ A &= 6.2832r(r+h) = 3.1416d(\tfrac{1}{2}d+h)\end{aligned}$$

Cone:

$$\begin{aligned}\text{Volume} &= V = \frac{3.1416r^2h}{3} = 1.0472r^2h = 0.2618d^2h \\ \text{Conical surface area} &= A = 3.1416r\sqrt{r^2+h^2} = 3.1416rs \\ &= 1.5708ds \\ s &= \sqrt{r^2+h^2} = \sqrt{\frac{d^2}{4}+h^2}\end{aligned}$$

Sphere:

$$\begin{aligned}\text{Volume} &= V = \frac{4\pi r^3}{3} = \frac{\pi d^3}{6} = 4.1888r^3 = 0.5236d^3 \\ \text{Surface area} &= A = 4\pi r^2 = \pi d^2 = 12.5664r^2 = 3.1416d^2 \\ r &= \sqrt[3]{\frac{3V}{4\pi}} = 0.6204\sqrt[3]{V}\end{aligned}$$

U.S. Liquid Measure*1 U.S. gallon =*

0.13368 cubic foot
 231 cubic inches
 128 U.S. fluid ounces
 4 U.S. quarts
 8 U.S. pints
 0.8327 British Imperial gallon
 3.785411784 liters

1 quart =

2 U.S. pints
 8 U.S. gills
 32 U.S. fluid ounces
 57.75 cubic inches
 0.9463529 liters

1 pint =

4 U.S. gills
 16 U.S. fluid ounces
 28.875 cubic inches
 473.176 milliliters

1 gill =

1/2 cup = 4 U.S. fluid ounces
 7.21875 cubic inches
 118.29 milliliters

1 board foot = 1 ft x 1 ft x 1 in

Quadratic formula: $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$