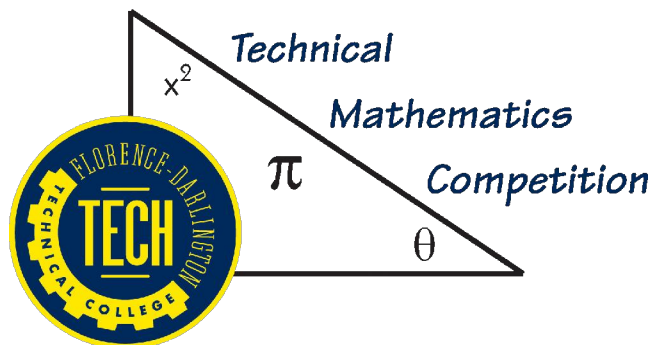


# Florence-Darlington Technical College Technical Mathematics Contest Sample Problems

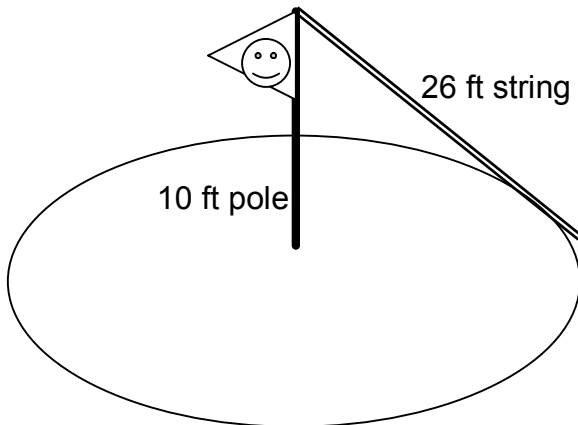
## Problem Set 3



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Enclosed are suggested problems for review for participation in the 2006 math contest. The problems are similar to problems used in previous contests. All problems use concepts and skills from arithmetic, geometry, algebra, and trigonometry. Students will be allowed to use calculators on all problems. Florence-Darlington Technical College requires either a TI-83 or TI-84 series calculator for all mathematics courses.

(All answers must include correct units and where necessary be rounded as requested. All problems should be completed by rounding only the final answer.)

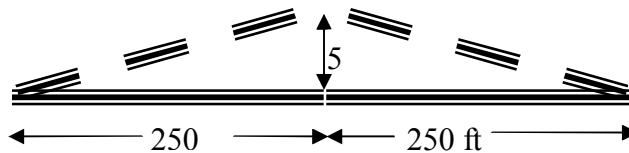


41. A flagpole is placed in the sand with the top of the pole standing 10 feet above the ground. A 26-foot string is attached to the top of the flag pole. Holding the string to the ground, what is the area of the largest circle that can be drawn in the sand with the end of the string? Use your calculator button for  $\pi$ . Round your answer to the nearest tenth of a square foot. - *Suggested Time Limit: 3 minutes*

$$r = \sqrt{26^2 - 10^2} \text{ ft.} = 24 \text{ ft.}$$

$$A = \pi(24 \text{ ft.})^2 = 1,809.6 \text{ ft.}^2$$

42. A flat steel bridge is built from two rigid 250 foot long beams joined at the middle. On a hot day, the beams expand equally causing the joint to rise 5 feet. By how many **inches** did one of the beams expand? Express your answer to the nearest hundredth of an inch. - *Suggested Time Limit: 3 minutes*



Let  $x$  equal the amount of linear expansion of one beam.

$$(x + 250)^2 = 5^2 + 250^2$$

$$x^2 + 500x + 62,500 = 25 + 62,500$$

$$x^2 + 500x - 25 = 0$$

$$x = \frac{-500 \pm \sqrt{500^2 - 4(1)(-25)}}{2(1)}$$

$$x = 0.05 \text{ ft.}$$

$$x = 0.05 \text{ ft.} \times \frac{12 \text{ in}}{1 \text{ ft.}} = 0.60 \text{ in.}$$

**Note: The solution -500.05 ft. is extraneous.**

43. The cooling system in a certain car holds 10 liters of a solution that is 50% antifreeze and 50% water. The maintenance manual says that this ratio will protect the car to  $-34^\circ\text{F}$ . The owner of the car is planning to move further north where the temperatures drop lower than  $-34^\circ\text{F}$  for extended periods of time. The owner's mechanic suggests a 65% antifreeze to 35% water ratio. Because the volume of fluid must stay at 10 L, some of the fluid must be drained and replaced with pure antifreeze. What volume of the 50-50 solution should the mechanic drain and replace with pure antifreeze to achieve the 65-35 ratio?  
- Suggested Time Limit: 3 minutes

	Amount Soln.	%Antifreeze	Amount Antifreeze
<b>Beginning</b>	10 L.	0.5	5.0 L.
<b>Removed</b>	$x$ L.	0.5	$0.5x$
<b>Added</b>	$x$ L.	1	$x$
<b>Final</b>	10 L.	0.65	6.5 L

**Use last column to set up an equation and solve for  $x$ .**

$$5 + 0.5x + x = 6.5$$

$$5 + 1.5x = 6.5$$

$$1.5x = 1.5$$

$$x = 1 \text{ L.}$$

**Remove 1 liter of the 50-50 mixture and replace with 1 liter pure antifreeze to give a final mixture that is 65-35.**

44. Advertisements in FloDar Magazine sell for \$125 per column inch. How much will the advertisement below cost? - Suggested Time Limit: 3 minutes



$$\text{Cost} = 2 \text{ columns} \times 3.75 \text{ in.} \times \frac{\$125}{1 \text{ column-inch}} = \$937.50$$

45. A quart bottle contains a mixture that is  $\frac{1}{10}$  sulfuric acid and  $\frac{9}{10}$  water. A half-gallon bottle contains a mixture that is  $\frac{2}{5}$  sulfuric acid and  $\frac{3}{5}$  water. The contents of the two bottles are poured into a gallon jug. Write, as a fraction, the ratio of sulfuric acid to water in the jug. – *Suggested Time Limit: 5 minutes*

Prepare a table for the above data. Here are the results.

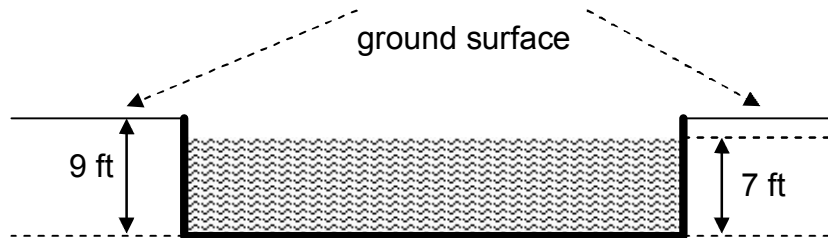
Container	Amount Contents	Amount Sulfuric Acid	Amount Water
Qt. bottle	32 oz.	3.2 oz.	28.8 oz.
Half-gallon bottle	64 oz.	25.6 oz.	38.4 oz.
Jug (combined)	96 oz.	28.8 oz.	67.2 oz.

$$\text{Ratio of sulfuric acid to water} = \frac{28.8 \text{ oz.}}{67.2 \text{ oz.}} = \frac{288}{672} = \frac{3}{7}$$

46. A concrete swimming pool is 50 feet by 100 feet in plan view. The bottom of the concrete is at a depth of 9 feet below the ground's surface. The groundwater table is 2 feet below the ground's surface. The weight of the pool is 550,000 lbs. The uplift water pressure at the bottom of the pool is 7 feet by 63 lbs/ft<sup>3</sup> = 441

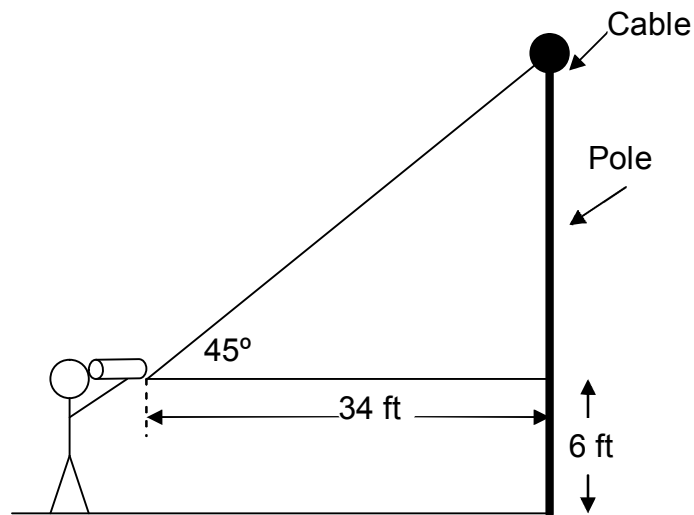
lb/ft<sup>2</sup>. Given the following formula: *Uplift force = water pressure X the plane surface area of the pool*

Determine the uplift force and whether the pool would float upward if the water inside the pool were removed. - *Suggested Time Limit: 5 minutes*



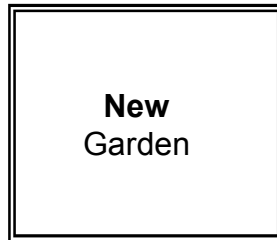
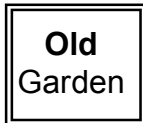
$$\text{Uplift force} = 441 \frac{\text{lbs.}}{\text{ft.}^2} \times (50 \times 100) \text{ ft.}^2 = 2,205,000 \text{ lbs.}$$
 Yes, the pool would float upward if the water inside the pool were removed.

47. A field surveyor sets his hand level at 45° to find the height of a high voltage cable on a pole. The surveyor's eye level is 6 feet above the ground and the distance from the surveyor to the pole is 34 feet. What is the height of the cable?  
- *Suggested Time Limit: 5 minutes*



The triangle in the drawing is an isosceles right triangle with a vertical height of 34 ft. The height of the cable is the same as the height of the pole which is (34+6) ft. or 40 ft.

48. Farmer Brown has a rectangular garden that measures 40 ft by 50 ft. The garden is fenced and requires 60 pounds of fertilizer each spring. Farmer Brown decides to enlarge the garden to 80 ft by 100 ft. He will move his existing fence and add to it as needed. How much additional fence must he purchase, and how many pounds of fertilizer will he need for his new garden? - *Suggested Time Limit: 3 minutes*



$$P_{\text{old garden}} = 180 \text{ ft.}$$

$$P_{\text{new garden}} = 360 \text{ ft.}$$

$$\text{Extra fence needed} = 360 - 180 = 180 \text{ ft.}$$

$$A_{\text{old garden}} = 2000 \text{ ft.}^2$$

$$A_{\text{new garden}} = 8000 \text{ ft.}^2$$

Let  $x$  equal amount of fertilizer needed for new garden.

$$\frac{x \text{ lbs.}}{60 \text{ lb.}} = \frac{8000 \text{ ft.}^2}{2000 \text{ ft.}^2}$$

$$x = 240 \text{ lbs.}$$

49. The time required to drive a certain distance varies inversely as the speed. If it takes 4 hours to drive the distance at 65 miles per hour, how long will it take to drive the same distance at 45 miles per hour? Give your answer as a mixed number. - *Suggested Time Limit: 3 minutes*

**Let  $t$  equal the time and  $r$  equal the speed. The relationship can be**

**expressed as:**  $t = \frac{k}{r}$

$$4 \text{ hr.} = \frac{k}{65 \text{ mph}}$$

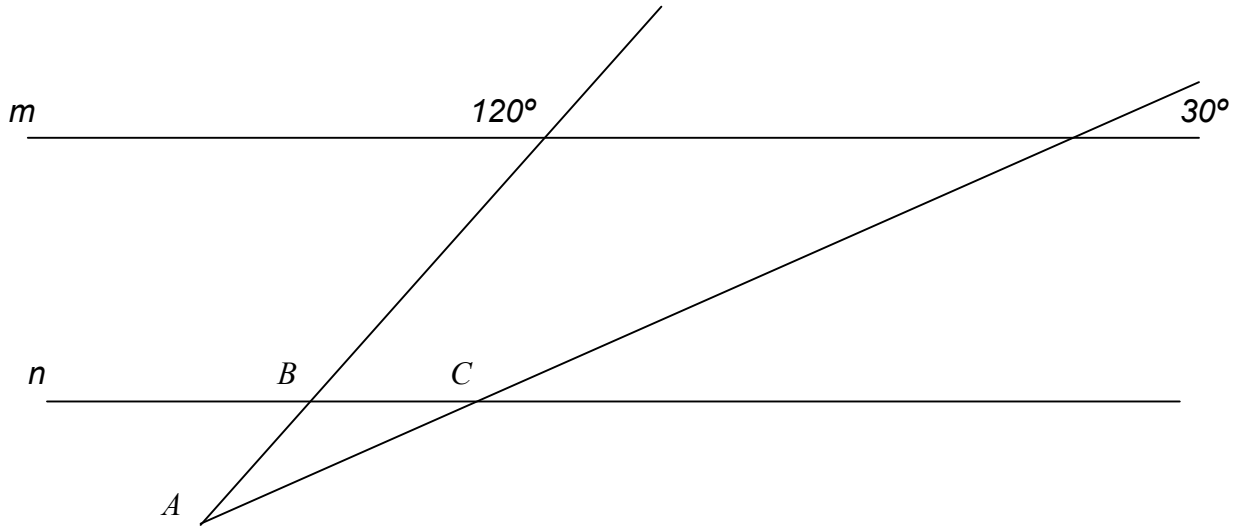
**If  $t$  is 4 hr. when  $r$  is 65 mph, then  $k = 260 \text{ mi.}$**

**The equation for this problem is**  $t = \frac{260 \text{ mi.}}{r}$

$$t = \frac{260 \text{ mi.}}{45 \text{ mph}} = \frac{52}{9} \text{ hr. or } 5\frac{7}{9} \text{ hr.}$$

Therefore when  $r$  is 45 mph:

50. Find the measure of side  $\overline{AC}$  rounded to the nearest 10<sup>th</sup> unit.  $m \parallel n$ .  $\overline{BC}$  has length 14 m. - Suggested Time Limit: 3 minutes



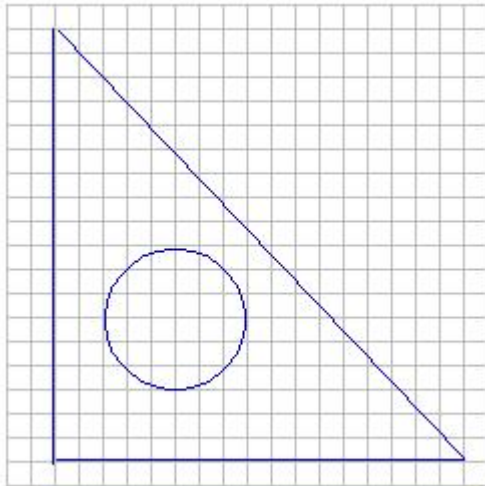
$$m\angle ABC = 120^\circ, m\angle BCA = 30^\circ$$

Use law of sines to find length of  $\overline{AC}$ .

$$\frac{AC}{\sin(120^\circ)} = \frac{14 \text{ m}}{\sin(30^\circ)}$$

$$AC = \frac{14 \times \sin(120^\circ)}{\sin(30^\circ)} = 24.2 \text{ m}$$

51. The squares in the grid below are 0.25" on a side. The drawing is to scale with 0.1 inches representing 7 m. Find the area of the region between the triangle and the circle. Read measurements to the nearest whole number of grids and give your answer to the nearer tenth of a meter. -*Suggested Time Limit: 3 minutes*



**The base of the triangle is 17 units. The height is 18 units. The diameter of the circle is 6 units.**

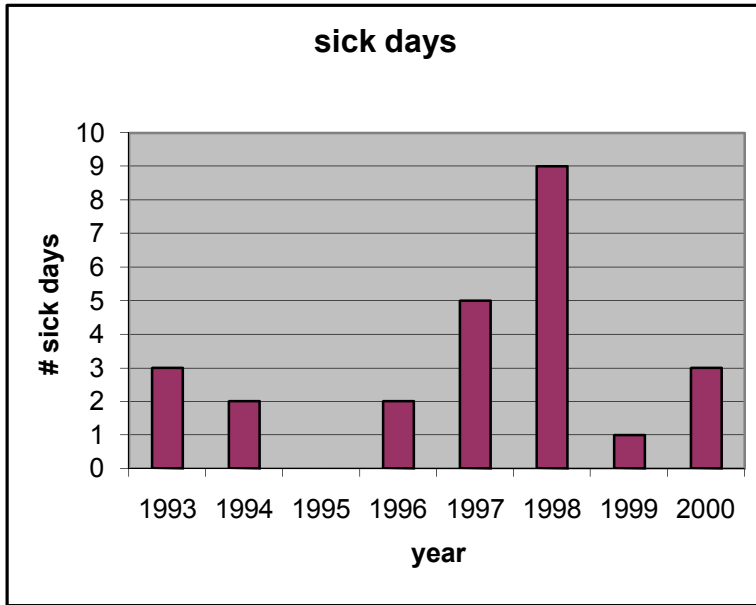
$$b = 17 \text{ units} \times \frac{0.25 \text{ in.}}{1 \text{ unit}} \times \frac{7 \text{ m}}{0.1 \text{ in.}} = 297.5 \text{ m}$$

$$h = 18 \text{ units} \times \frac{0.25 \text{ in.}}{1 \text{ unit}} \times \frac{7 \text{ m}}{0.1 \text{ in.}} = 315 \text{ m}$$

$$r = \frac{d}{2} = \frac{6 \text{ units}}{2} \times \frac{0.25 \text{ in.}}{1 \text{ unit}} \times \frac{7 \text{ m}}{0.1 \text{ in.}} = 52.5 \text{ m}$$

$$A = A_{\text{triangle}} - A_{\text{circle}} = \frac{(297.5 \times 315)}{2} \text{ m}^2 - \pi(52.5 \text{ m})^2$$

$$A = 38,197.2 \text{ m}^2$$



52. The chart below shows the number of sick days an employee took each year for the last eight years. - *Suggested Time Limit: 3 minutes*

a.) Find the mean number of sick days per year taken by the employee. Round your answer to the nearer tenth of a day.

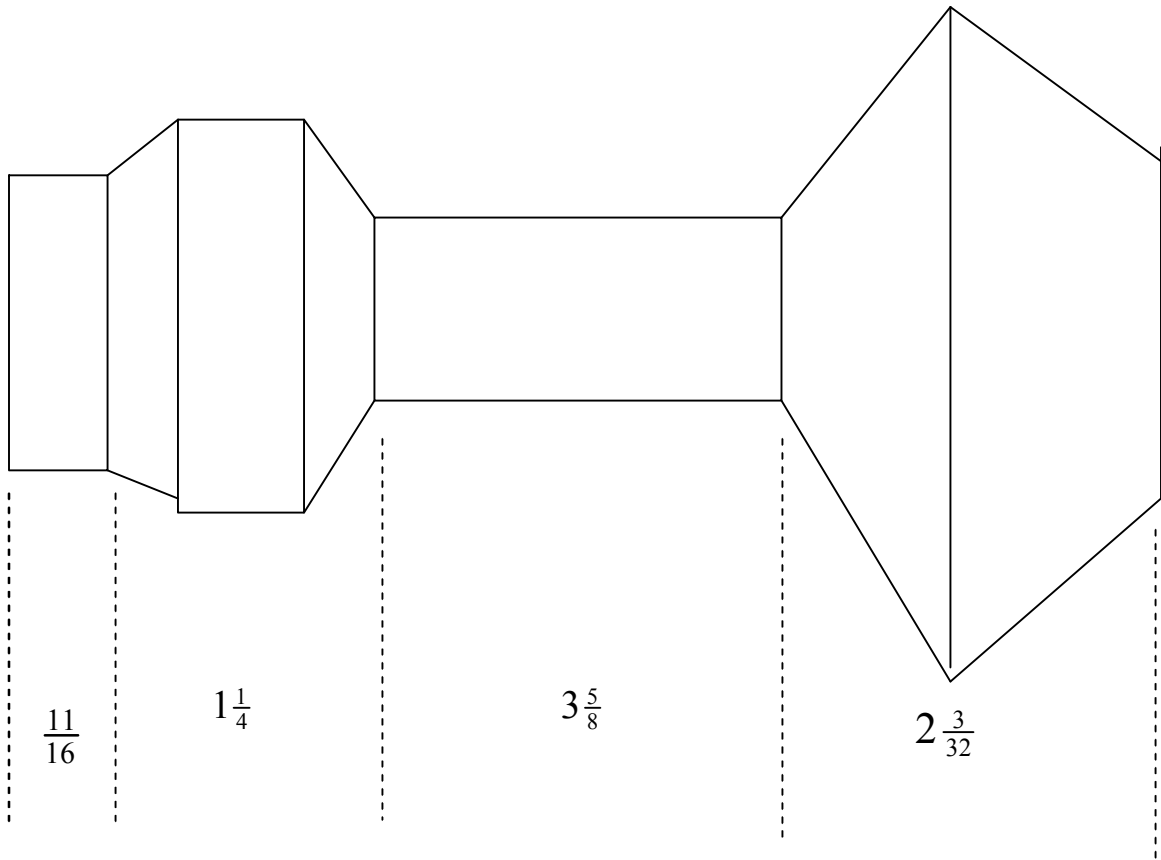
$$\bar{x} = \frac{3+2+0+2+5+9+1+3}{8} = \frac{25}{8} = 3.1 \text{ days}$$

b.) Find the median number of sick days per year taken by the employee.

**Arrange the data in ascending order: 0, 1, 2, 2, 3, 3, 5, 9**

$$\text{Median} = \frac{4th + 5th}{2} = \frac{2+3}{2} = 2.5 \text{ days}$$

53. Compute the overall length of the bevel gear blank shown below. Give your answer as a reduced mixed number. - *Suggested Time Limit: 3 minutes*



$$\begin{aligned}
 \text{overall length} &= \frac{11}{16} + 1\frac{1}{4} + 3\frac{5}{8} + 2\frac{3}{32} \\
 &= \frac{22}{32} + 1\frac{8}{32} + 3\frac{20}{32} + 2\frac{3}{32} \\
 &= 6\frac{53}{32} \\
 &= 7\frac{21}{32} \text{ units}
 \end{aligned}$$