2017–18 UIL Calculator Contest Solutions

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Azle ISD – 1974 to 2017

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Attention All Attendees:

Thank you for registering your attendance for **EACH SESSION**:

Each year Dr. David Bourell writes at least nine UIL high school Calculator Application contests for competition. There are 21 stated problems and 14 geometry drawings. The stated and geometry problems range in difficulty from basic arithmetic to differential and integral calculus: from simple plane and 3D-geometry to fairly complex multi-step problems. I've selected some of the problems that have appeared from the past year's competition to show how they are worked. My solutions might not be unique, and in fact they are the work of other coaches, but

If you have not purchased a copy of the "UIL Calculator Applications Contest Manual" by Dr. Bourell; **you need to do so!** The concepts covered in this manual pretty much define the knowledge the student competitors need to know in order to solve the problems on the calculator test!

In any case, I hope these particular solutions will be of help to you so that you can pass them on to the students you coach or even another coach – since there really is no sense in keeping this information to yourself.

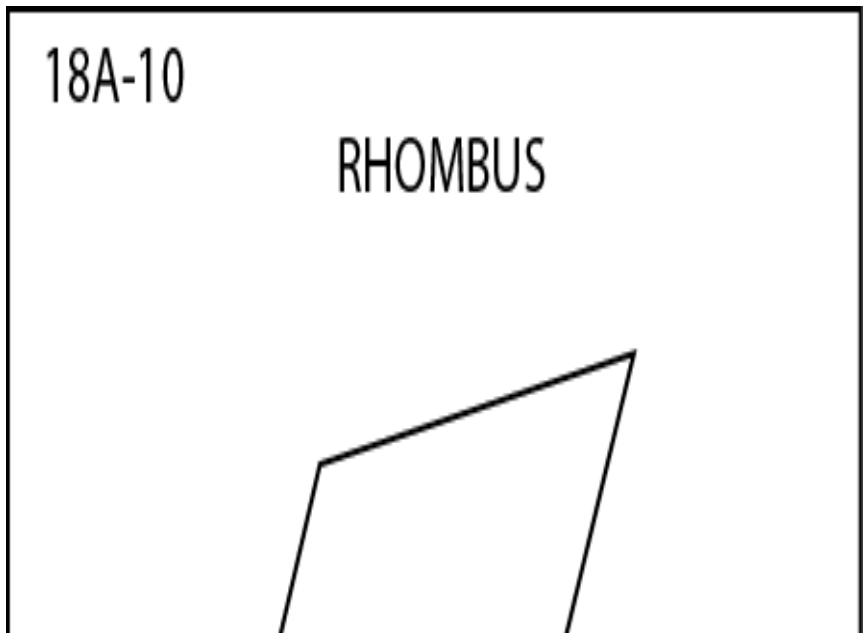
18A-7. What is the sum of the positive square root of

7.25 times 3 and the square of 0.385 plus 4.04?-----7=_____

$$\sqrt{(7.25)(3)+(.385+4.04)^2}$$ **24.2**

18A-10

RHOMBUS



$A_{Rhombus} = (s^2)\sin\theta$

$188 = (15.3^2)\sin\theta$

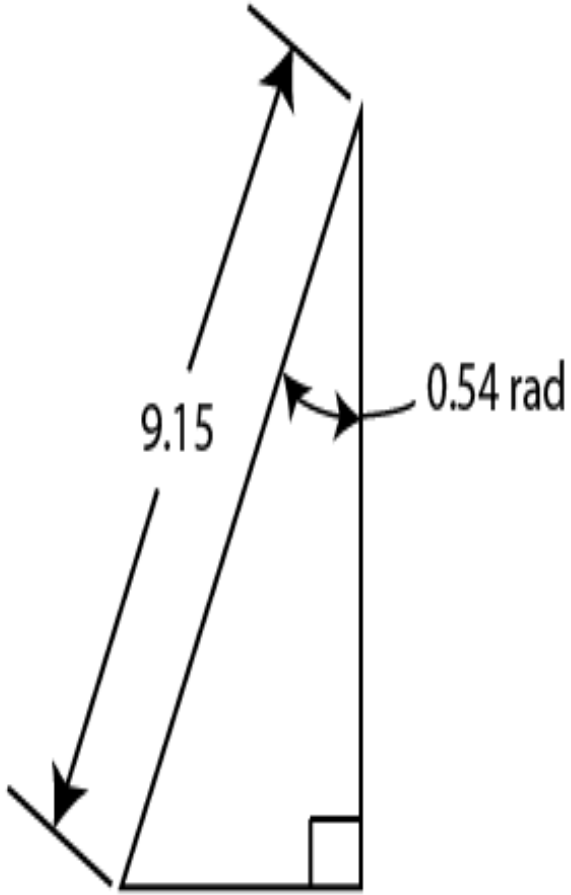
18A-16. The movie, *Guardians of the Galaxy II*, runs 2 hr 16 min, and a ticket costs $11.35. What is the movie cost per minute of run time?----------16=_____cents

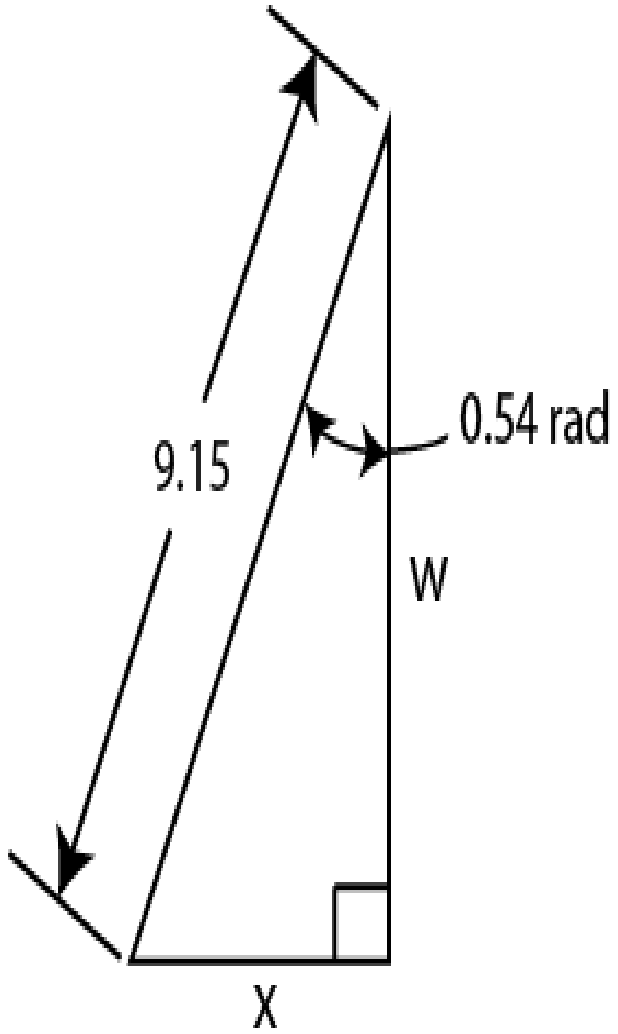
1135 / [2(60) + 16] **8.35**

18A-18. Shiprock is a mountain rising 1583 ft above the desert floor in northwestern New Mexico. What is the

18A-19

RIGHT TRIANGLE





18A-26. Deneb is the brightest star in the Northern Cross.

Its diameter is 2.82×10^{8} km. Its volume is equivalent to

how many Earth volumes?----------26=_____

$[(2.82 \times 10^{11}) / 2]$ m x (100 cm / 1 m) x (1 in / 2.54 cm) x (1 ft / 12 in)

x (1 mi / 5280 ft)

= 87,613,338.1055 mi {A}

18A-28. What is the smallest value of m for which

7.45^m >91,500?----------28=_____integer

$7.45^m > 91500$ Using Solver Function: m > 5.6886 **6**

18A-36. The half life of Phosphorus-32 is 14.26 days.

What is ι if the decay were modelled using

$N = N_o \exp(-t/\iota)$?----------36=_____dy

18A-37. A cube has a side dimension of 10 in. It shrinks at a constant volume rate equal to -20 in^3/min. At the same time, a sphere with zero initial radius starts growing with its center at the cube center. Its radius increases at 0.2in/min.

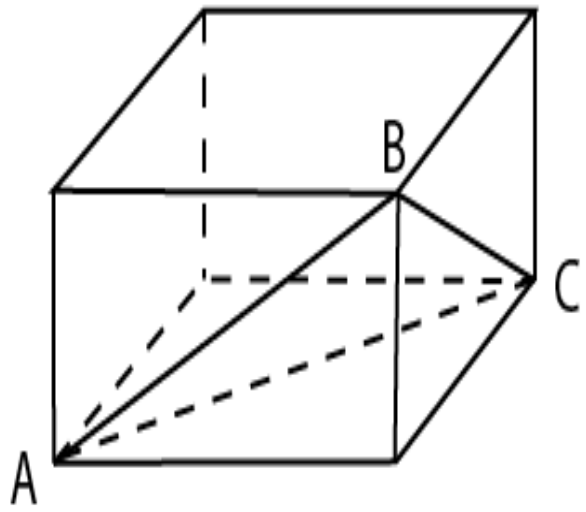
How long until the sphere contacts the cube?----------37=_____min

Let t = time to contact

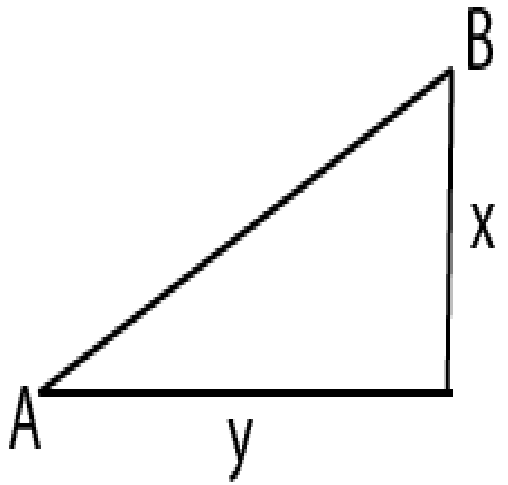
$V_c = x^3 = (2R)^3 = 8R^3$ $V_s = (4/3)\pi R^3$

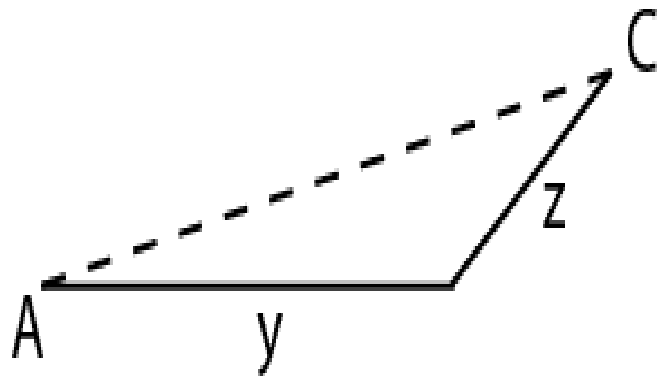
18A-30

RECTANGULAR SOLID



AB = 5.42 BC = 3.95 AC = 5.90

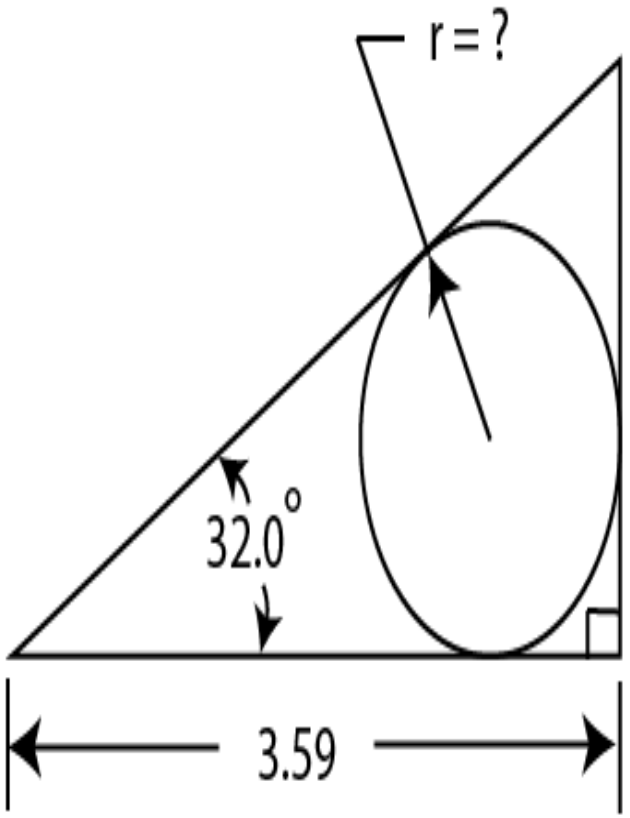


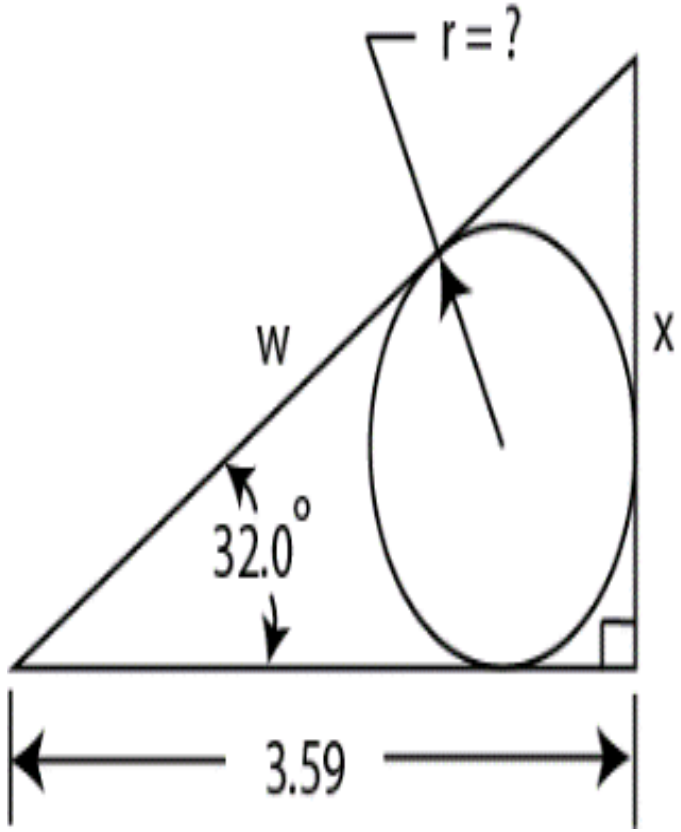


$x^2 + y^2 = 5.42^2 \rightarrow y^2 = 5.42^2 - x^2$

18A-39

RIGHT TRIANGLE AND CIRCLE



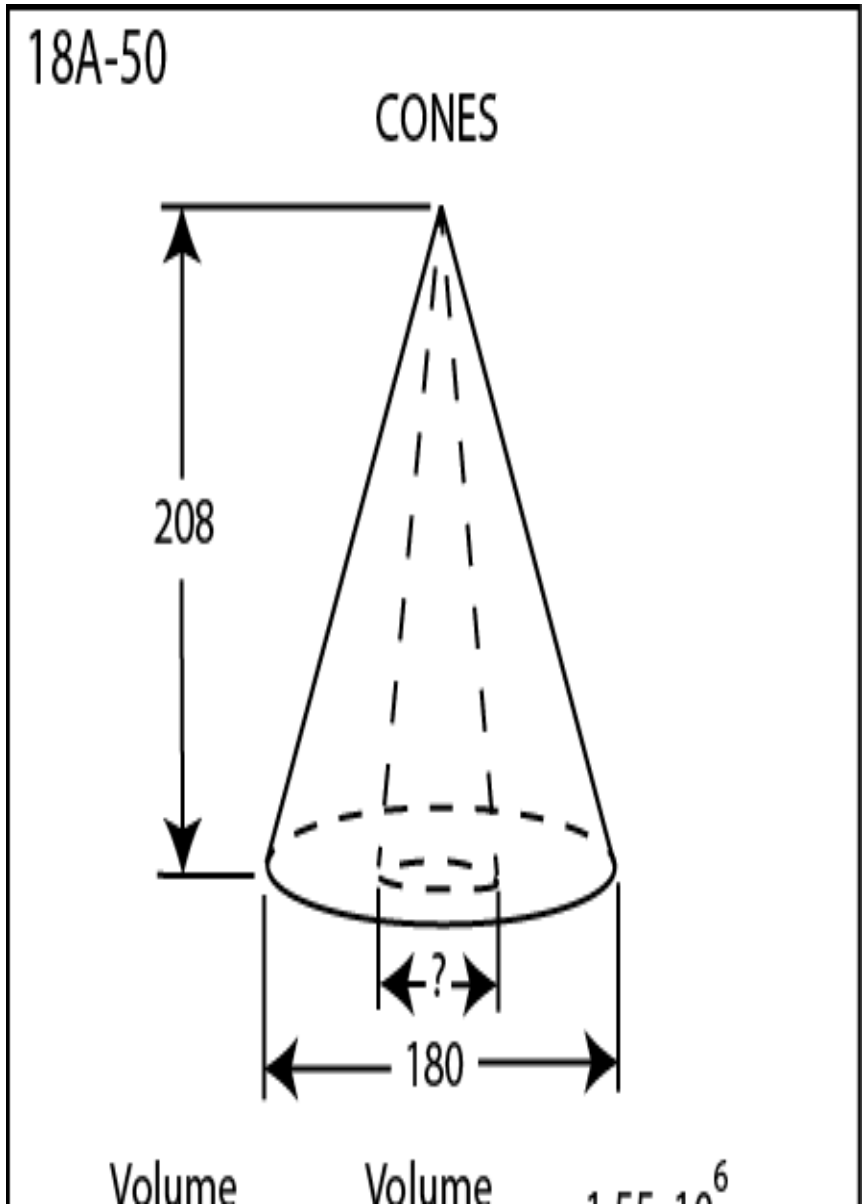


$\tan 32^\circ = x/3.59 \quad \cos 32^\circ = 3.59/w$

18A-46. A 3D printed artwork is 14 in long and weighs 4 lb 3 oz. How long is the same artwork built larger that weighs 17 lbs? ----------46=_____in

$14^3 / (4\ 3/16) = x^3/17$ **22.3**

18A-47. Calculate the correlation coefficient for these data: (1, 3.5), (2, 8), (3, 9), (4, 14), (5, 20).----------47=_____



$$(1/3)\pi\, 90^2(208) - (1/3)\pi\, R^2(208) = 1.55 \times 10^6$$

R = 31.367

2R =

62.7

18A-56. What is the y value of the point on the curve

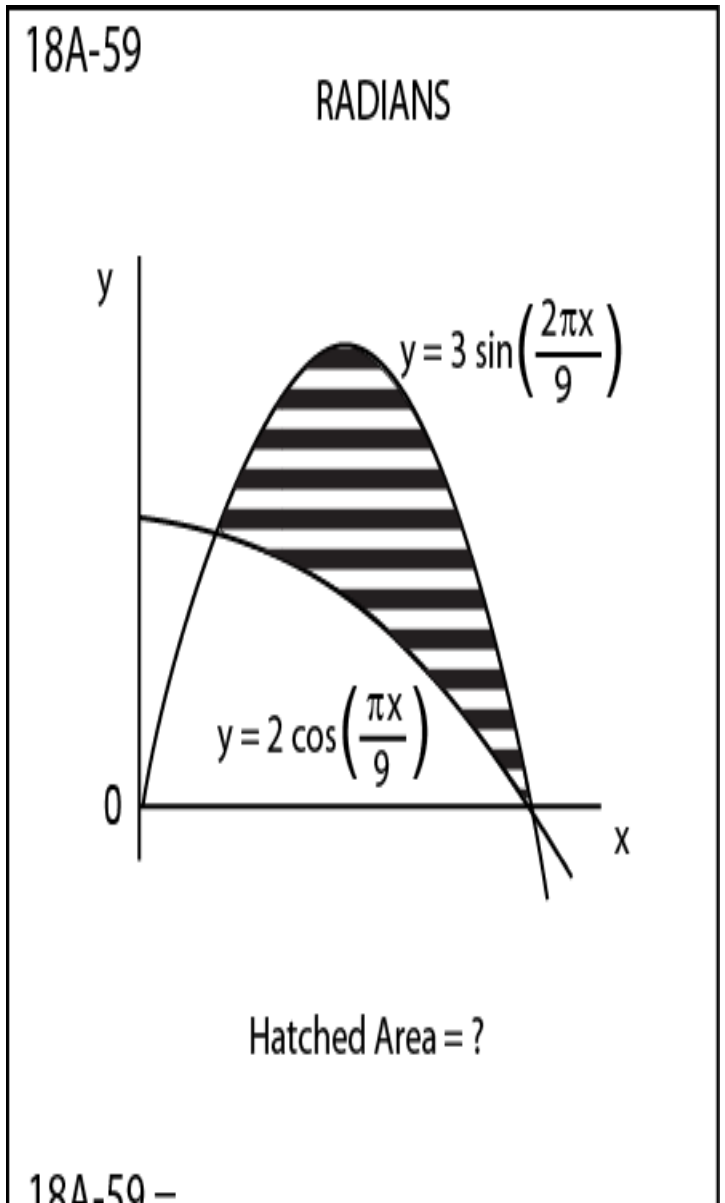
$y = 5x^2 - 17x + 200$ where the slope equals -4.5?---------56=_____

$\frac{dy}{dx}$ = y′ = (slope) at (x, y)

y′ = 10x – 17 = -4.5

18A-57. A cylindrical water tank is 50 ft tall with a diameter of 100 ft. It is initially full but must be drained using a valve at the bottom of the tank. The initial drain volume rate is -300 ft^3/s, and this rate is proportional to the instantaneous height of water remaining in the tank. How long does it take to drain 99% of the tank volume?----------57=_____hr

$\frac{dV}{dt} = kh$ $-300 = k(50)$ $k = -6$ $V = \pi R^2 h$ $V = \pi(50)^2 h$ $V = 2500\pi h$



To get limits for integration we need to get the points where the two curves intersect.

Let: $3\sin\left(\frac{2\pi x}{9}\right) = 2\cos\left(\frac{\pi x}{9}\right)$

$\therefore \quad x = .97356\ldots \quad \text{and} \quad x = 4.50$

$$\int_{.97356\ldots}^{4.5} \left[\qquad \left(\qquad \right) \qquad \left(\qquad \right) \right]$$

18A-62. What is Avogadro's number (6.022×10^{23}) raised

to the power 421?----------62=_____

$(6.022 \times 10^{23})^{421}$

$421 \log (6.022 \times 10^{23}) = 10{,}011.2708563$

$10{,}011.2708563 - 10{,}011 = .2708563$

18A-63. Vinny punted a football with a hang time of 4.1 s.

What is the maximum possible vertical distance?----------63=_____ft

$t_{total} = 4.1 \rightarrow t_{up} = t_{down} = 4.1 / 2 = 2.05$ sec

$h_{UP} = h_{DOWN} = \frac{1}{2}(32.174)(2.05)^2$ **67.6**

18A-64

RECTANGLE AND SEMICIRCLES

$34w + \frac{1}{2}\pi(5 + w)^2 - \frac{1}{2}\pi(5)^2 = 500$

Many Thanks to:

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Without the efforts of these