2015 -16 Calculator Applications Study List

11I-36. A carton crushes if its impact velocity exceeds 80 mph. If the carton is thrown vertically upward from a 60-ft tall building, and it just crushes when it hits the ground, what was the initial velocity (up is positive)? -- 36=_______________mph

$v^2 = v_0^2 + 2a(y - y_0)$

$[(80)(88/60)]^2 = v_0^2 + 2(-32.17)(0 - 60)$

$v_0 =$ 99.53246 $\times$ 60/88 = **67.9**

12E-37. It takes 1.5 J (= 1 Nm) of energy to knock over a bowling pin and move it out of the way. What is the minimum velocity of a 15-lb bowling ball to bowl a strike, knocking over all 10 pins? The bowling ball energy is 0.5 mv^2 where m is the ball mass and v is its velocity. 1 N = 1 kg-m/s^2. --37=________________fps

15 lb $\rightarrow$ 6.80388… kg (HP conversion) 10(1.5) = ½ (6.80388..)v^2

v = 2.09982… m/s × 100 cm/m × 1 in/ 2.54 cm × 1 ft/12 in. = **6.89**

12F-38. Steve mixed 5 cups of milk with 6 cups flour to make crepe batter. After using 65% of the batter, he decided to make some pancakes with the rest. Since pancake batter is thicker, he needed to add more flour. If the pancake recipe calls for 1 part milk to 2 parts flour, how much flour should Steve add? --38=_______________cups

$$\frac{6(.35)+x}{11(.35)+x} = \frac{2}{3}$$

x = **1.40**

12G-36. Sam begs for bread from a local baker. The first day, Sam received a full loaf of bread. On the second and subsequent days, Sam got 40% of the preceding day's allocation. How much total bread will Sam ultimately receive? ---36=______________loaves

S = 1 / (1 -.4) S = **1.67**

12I-38. Sonya drove 30% of the distance to her destination at 56 mph. She then sped up so her total average trip velocity was 63 mph. What was her velocity on the second leg of the trip? ---38=_______________mph

Let distance = 63 mi. $\frac{.3(63)}{56} + \frac{.7(63)}{V} = \frac{63}{63}$ V = **66.6**

13C-38. A spring elongates 1 in for every 5 lbs of load. Four gallons of coconut oil (density equals 0.92 g/cm^3) are hung on the spring which is attached to a frame. However, the container has a leak, losing 10 tablespoons of coconut oil every minute. How long will it take for the container to rise 1.875 in? --38=_________________hr

.92 g x (1 kg/ 1000g) $\rightarrow$ .002028253 pounds

cm^3 x (1 ml/1cm^3) x (1 L/1000mL) $\rightarrow$ .0002641 gal 7.6777… lb/gal

F = (constant)(distance) F = kx 5 = k(1) k = 5

F = (5)(1.875 in) = 9.375 lb $\rightarrow$ 9.375 lb / 7.6777…lb/gal = 1.221057… gal

(1.221057…gal)(128 oz/gal)(2 Tbsp/oz)(1 min/10 Tbsp)(1 hr/60 min) = **.521**

13E-36. The total length of active track in the New York subway system is 842 mi. Howard starts inspecting track at 2000 ft/hr. After 800 hr inspecting, Howard still works, but Jana starts inspecting different sections at 2500 ft/hr. How many hours will Jana work if they completely finish inspecting all the track? ---36=________________hr

$r_1t_1 + r_2t_2 = J$

$2000(t + 800) + 2500t = 842(5280)$

$t = \mathbf{632}$

13I-37. A certain insect population grows exponentially. The first population estimate was 8500 and ten years later it was 136,000. Over what time period did the insect population triple? ------37=_________________yr

$A = A_0 e^{kt}$

$136{,}000 = 8500 e^{k(10)}$

$k = [\ln (1360 / 85)] / 10$

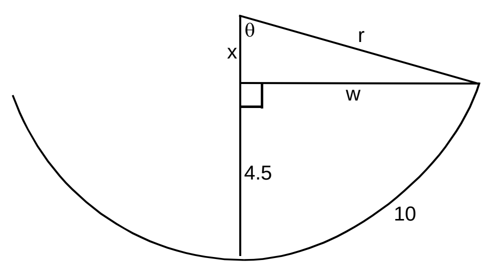
$e^{kt} = 3$ when $t = \mathbf{3.96}$

13I-38. Two runners start together running laps on a 400-meter track. The faster runner ran at 4.5 m/s, and she “lapped” the slower runner in 4 min 35 s. How far did the slower runner run? -38=_________________m

$4.5\ (275 \text{ sec}) = x + 400$

$x = \mathbf{838}$

14A-38. Two persons each hold the end of a 20 ft long jumping rope. How far apart should they stand if they hold the rope 4.5 ft off the ground, and the middle of the rope just touches the ground? Assume the arc formed by the jumping rope is circular. --------------------------------------38=__________________ft



$s = \theta r \quad 10 = \theta r \quad \cos\theta = x / r$

$r = x + 4.5 \quad 10 = \theta(x + 4.5)$

$\theta = 10 / (x + 4.5) \quad \cos\theta = x / (x + 4.5)$

$\cos(10 / (x + 4.5)) = x / (x + 4.5)$

nsolve | $x > 0$ $\quad x = 5.7586\ldots \quad \theta = .97478\ldots$

$\tan\theta = w / x \quad w = 8.48989\ldots \quad 2w = \mathbf{17.0}$

14D-37.What is the probability of a monkey typing Shakespeare’s play, *MacBeth*? The play has 99,110 characters, and there are 48 type-able keys on a keyboard. Assume the monkey presses keys randomly with equal probability, and it has the patience to type the entire play. -37=___________________

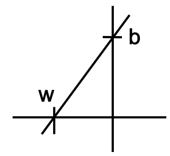
$(1/48)^{99110} \quad 99110 \log(1/48) = -166{,}627.819..$

Add: $166{,}628 + (-166{,}627.819\ldots) = .180963$

$10^{.180963} = 1.52 \rightarrow \mathbf{1.52 \times 10^{-166628}}$

14F-38. What is positive b if the right triangle formed by the x- and y-axes and the line y= 4x + b has an area of 1200? --38=__________________

$A = \frac{1}{2} wb$ $-1200 = \frac{1}{2} wb$



$b = y - 4x$ $b = 0 - 4w$ $w = b / (-4)$

$-1200 = \frac{1}{2} (b / -4)b$ $b =$ **98.0**

14H-38. An artillery shell is fired at an angle of 33° relative to horizontal but falls 300 ft short of the target. The angle is adjusted to 41° to hit the target. What is the projectile initial velocity? -38=_______________mph

$$(x - 300) = \frac{v^2 \sin 66^o}{32.174} \qquad x = \frac{v^2 \sin 82^o}{32.174}$$

$$\frac{v^2 \sin 82^o}{32.174} - 300 = \frac{v^2 \sin 66^o}{32.174}$$

Solve: $v = 354.692\ldots$ft/s $(60/88) =$ **242**

14I-36. Every Formula 1 racing car can decelerate from 100 mph to zero and then accelerate back to 100 mph, all in less than 5 s. Assuming deceleration and acceleration are equal, what minimum, positive acceleration does this represent? ---36=______________ft/s^2

$v = v_0 + at$ $a = (v - v_0) / t$ 100 mph (22/15) = 146.666… ft/s

$a = (146.66\ldots - 0) / 2.5$ s $=$ **58.7**

15A-28. A canoer on a river takes 10 min 28 sec to row a distance downstream, but he requires 35 min 40 sec to row back upstream. What is the river velocity divided by the canoer's velocity in still water? --28=__________________

$(B + W)T_1 = (B - W)T_2 \rightarrow (BT_1 / B) + (WT_1 / B) = (BT_2 / B) - (WT_2 / B)$

$T_1 + (W/B)T_1 = T_2 - (W/B)T_2 \rightarrow (W/B)(T_1 + T_2) = T_2 - T_1$

$W/B = (T_2 - T_1) / (T_1 + T_2) =$ **.546**

15A-38. A pressurized tank has a leak. The leak rate is proportional to the pressure p in the tank. With the pump off, the leak rate is 22 moles/min at 50 psi tank pressure. The pump pumps 50 moles of air into the tank each minute. What is the equilibrium tank pressure with the pump running? --38=_______________psi

$$\frac{dv}{dt} = kP \qquad \frac{dv}{dt} = 50 \qquad -22 = k(50) \qquad k = -22/50$$

$-22/50\ P = -50$ $P =$ **114**

15B-26. The amount of force F (lbs) needed to pull a post out of the ground depends on how deep it is buried. The relation to depth d (in) is F = 150d/14. If Farmer John's pulling strength is 45 lb, to what depth must he dig around the post to be able to pull it out by hand? The post is buried 18 inches in the ground. --26=__________________in

45 = 150d / 14   d = 4.2   18 – d = **13.8**

15B-38. Shannon is deciding whether to fly or drive to a destination. To fly, she spends 30 minutes getting to/from the airport, 45 minutes checking in and getting through security, 30 minutes waiting to board, 15 minutes taxing (sic) before and after the flight and 30 minutes waiting for baggage at the destination airport. An airplane averages 550 mph, and driving, she averages 55 mph. What is the break-even distance traveled where the time flying equals the time driving? -----------------38=__________________mi

30(2) + 45 + 30 + 15(2) + 30 = 195 min

d/550 + 195/60 = d/55   Solve d = **199**

15C-36. What is the distance between intersection points of $y = 0.2x^2 - 5$ and y = -2x+10? -----36=____________________

$y1(x) = .2x^2 – 5$ y2(2) = -2x + 10

Window: x min -2   x max 10   y min -10   y max 50

OR Solve y1(x) = y2(x)   x = -15 or 5   y = 40 or 0   (-15, 40) and (5, 0)

intersection: (-15, 40) and (5, 0)

$d = \sqrt{(5 - -15)^2 + (0 - 40)^2}$ = **44.7**

15C-38. Emily's car needs gas; she has only 1 gal left in her 20-gal tank. She sees a gas station that sells gas for $3.35/gal, and she can pay the same amount of money for a tankful if she drives 7 mi out of her way to a remote gas station and 7 mi back. If she gets 19 mi/gal, what is the price per gal at the remote gas station? ---38=$__________________

19(3.35) = 63.65   (19 7/19)x = 63.65   x = **3.29**

15D-37. How many minutes after 5:15 do the minute and hour hands align? ------------------------37=________________min

(15/60)(5) = 1.25   (11/12)T = 11.25   T = **12.3**

15D-38. How many oxygen molecules are in a classroom that is 25 ft by 35 ft by 12 ft? Oxygen is 20.95% of air. The classroom is at 75ºF and 15.7 psi pressure. The ideal gas law is pV = nRT where p is pressure, V is volume, n is the number of moles of gas, R equals 1.987 cal/(moleK) and T is absolute temperature. Avogadro's Number is 6.022×10^{23} molecules/mole, and a ft lb equals 0.324 cal. ---38=____________________

PV = nRT

$(15.7\ lb/in^2) \times (12\ in/ft)^2 \times (25)(35)(12)\ ft^3$ = 23,738,400 lb-ft

23,738,400 lb-ft = n [1.987 cal/ (mol-k)](273.15 + 23.888…)

23,738,400 lb-ft [.324 cal/(1 ft-lb)] = n(1.987)(297.03888…)

n = 13,031.2259… mole air

$(13,031.2259\ldots)(.2095)(6.022 \times 10^{23})$ = $\mathbf{1.64 \times 10^{27}}$

15E-36. Uriel's keys sometimes slip out of her hands. She grabs them after they have fallen 15 in. If her reaction time is 200 ms, what is the time between when they slip out of her hand and when she grabs them? --36=______________msec

$y = y_0 + v_0\, t + ½\, at^2$

$0 = (15\text{ in})/(12\text{ in/f}) + 0 + ½\,(-32.174)t^2$

t = .27875… s x (1000 ms / s) = **279**

15E-37. At what angle less than 45º relative to horizontal should an archer aim to hit a target of equal elevation 90 meters away? The arrow release velocity is 44 m/s. -----------------------------37=________________deg

$d_{h\ max} = (V^2 \sin 2\theta) / g$

n solve $90 = (44^2 \sin 2\theta) / 9.807$ when $\theta < 45$

θ = **13.6**

15F-36. Farmer Gilmore thought he had <u>25.5</u> acres of land, but a surveyor measured the rectangular plot to be <u>892.52</u> ft by <u>1285.88</u> ft. What is the percent error in the farmer's estimate? ---36=_____________%(SD)

25.5(43560) = 1,110,780 {3SD} {A}

892.52(1285.88) = 1,147,673.61760 {5SD} {B}

[(A / B) – 1] 100% → .96785… {3SD} - 1 = -.0324964… {2SD} x 100 = **-3.2**

***

{B}, {A}, % chg = **-3.2**

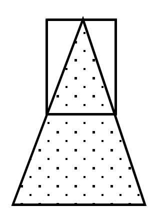
15F-37. A large cube is made up of 24^3 or 13,824 small cubes. What percent of the total number of small cubes compose the surface of the large cube? --37=_________________%

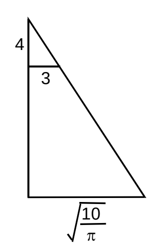
$22^2 \times 6 = 2904$ 2904 + 92 + 92 + 88 = 3176 (3176 / 13824) 100% = **23.0**

15G-37. A point light source is mounted in the middle of a 6-in diameter, 8-in tall cylindrical empty can with one open end. Neglecting reflection and refraction, how high above a table must the bottom of the can be to illuminate an area of 10ft²? The can axis is vertical. -----------------------37=__________________ft

$$\frac{h}{4} = \frac{\sqrt{10/\pi}}{3}$$

h - 4/12 = **2.05**





15G-38. 5/8 teaspoon of chlorine dioxide treat one quart of water for bacteria. How much chlorine dioxide is needed to make 2 gallons of treated water? --38=_______________tsp

$(5/8) / [32(6) + (5/8)] = x / [128(2)(6)] \quad x = \mathbf{4.98}$

15H-37. For a catalytic reaction to occur, the chemicals must be exposed to 1 m^2 of catalyst surface. A 1 in^3 block of catalyst is ground to powder. Assuming no material loss and spherical particles, what average particle diameter is needed?. --37=_______________μm

$1\ in^3 \times (2.54\ cm / in)^3 \times (1\ m / 100\ cm)^3 = .000016387\ m^3 \quad \{C\}$

$V / SA = [(4/3)\pi r^3 / 4\pi r^2] = r / 3 = C / 1$

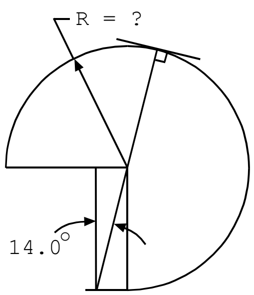
$2r = .000098322\ m \rightarrow \mathbf{98.3}$

15I-26. If boiling water converts 0.62 gal into steam per hour, how long does it take the water level in a 7.5 in diameter saucepan of boiling water to drop 1 in? --26=_______________min

$[\pi(7.5/2)^2(1)(60)] / [(231)(.62)] = \mathbf{18.5}$

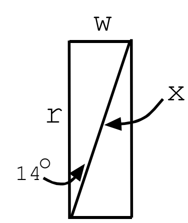
10D-60.

THREE-QUARTER CIRCLE AND RECTANGLE



Total Area = 570

10D-60 = _______________________



$w = r \tan 14°$

$\text{height} = r$

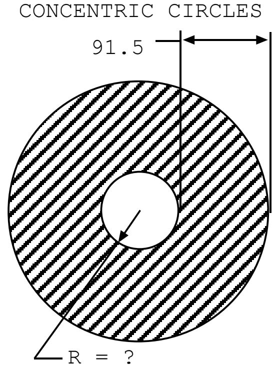
$\text{rect} = wr = r^2 \tan 14°$

$570 = ¾\pi r^2 + r^2 \tan 14°$

$r = \mathbf{14.8}$

10F-60.

CONCENTRIC CIRCLES



Hatched Area = 57,200

10F-60 = _______________________

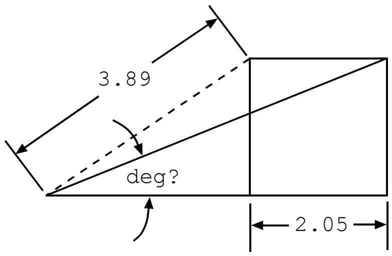
$57{,}200 = \pi R^2 - \pi(R - 91.5)^2$

$R = 145.2\ldots$

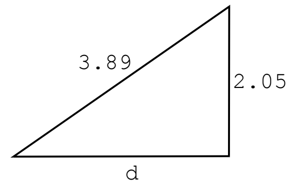
$r = 145.2\ldots - 91.5 = \mathbf{53.7}$

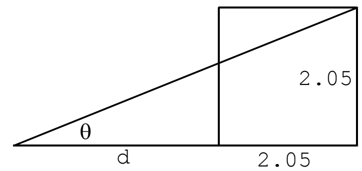
11D-60.

SQUARE AND RIGHT TRIANGLES



11D-60 = ________________________





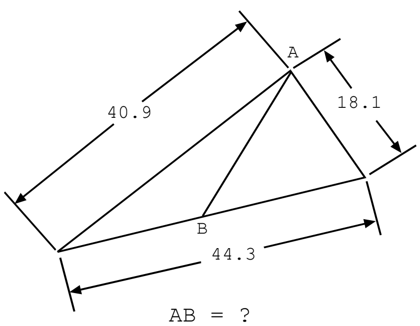
$d^2 + 2.05^2 = 3.89^2$

$d = 3.3059...$

$\tan\theta = 2.05/(2.05 + d)$ $\theta =$ **20.9°**

11I-60.

SCALENE TRIANGLES WITH EQUAL AREA



AB = ?

11I-60 = ________________________

$40.9^2 = 44.3^2 + 18.1^2 - 2(44.3)(18.1)\cos\theta$

$\theta = 67.360...$

$\sin\theta / 40.9 = \sin\alpha / 18.1$

$\alpha = 24.107...$

$\frac{1}{2}(18.1)(x)\sin\theta = \frac{1}{2}(40.9)(44.3 - x)\sin\alpha$

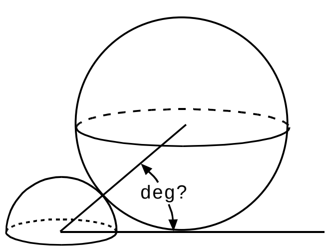
$x = 22.15$

$AB^2 = x^2 + (18.1)^2 - 2(x)(18.1)\cos\theta$

AB = **22.6**

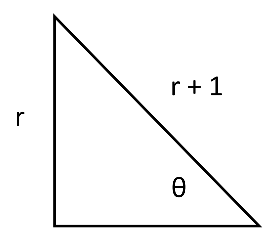
12A-49.

SPHERE AND HEMISPHERE



Volume (Sphere) =
9.56 Volume (Hemisphere)

12A-49 = ________________________



Let radius of smaller sphere = 1.

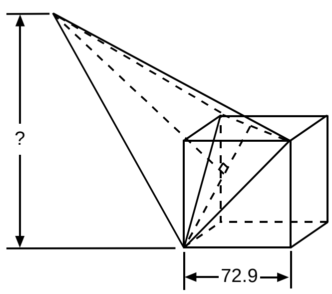
$(4/3)\pi r^3 = 9.56\ (2/3)\pi(1)^3$

$2r^3 = 9.56$ $r = 1.6845...$

$\sin\theta = r/(r+1)$ $\theta =$ **38.9**

12B-50.

CUBE AND PYRAMID WITH TRIANGULAR BASE



Cube Volume = 2[Pyramid Volume]

12B-50 = ________________________

Base is equilateral Δ

$$B = \frac{(72.9\sqrt{2})^2\sqrt{3}}{4} = 4602.414\ldots$$

$V_{cube} = 72.9^3 = 387{,}420.489$
$V_{pyramid} = ½\ V_{cube} = 193{,}710.2445 = 1/3(B)(H)$
$H = 126.266\ldots.$

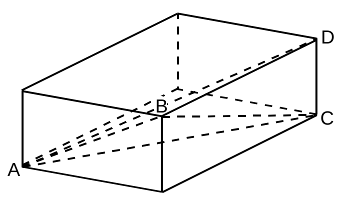
$½\,(72.9\sqrt{2})h = B \qquad h = 89.2839\ldots$

$\sin\theta = 72.9 / h \qquad \theta = 54.7356\ldots$
$\alpha = 90 - \theta = 35.264\ldots$

$2/3\ h = 59.5226\ldots \quad \{D\}$
$D\sin(\theta) + H\sin(\alpha) =$ **122**

12E-50.

RECTANGULAR SOLID



Face Diagonals
AB = 18.3, BC = 26.4, AC = 28

AD = ?

12E-50 = ________________________

1) $x^2 + y^2 = 18.3^2$

2) $x^2 + z^2 = 26.4^2$

3) $y^2 + z^2 = 28^2$

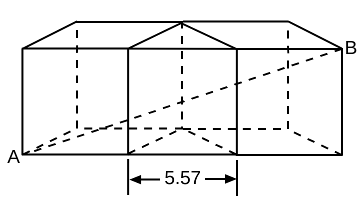
(3) – (1) $= z^2 - x^2 = 449.11$
(2) $= z^2 + x^2 = 26.4^2$

$z^2 = 573.035$
$x^2 = 123.925$
$y^2 = 210.965$

$AD = \sqrt{x^2 + y^2 + z^2} =$ **30.1**

12H-50.

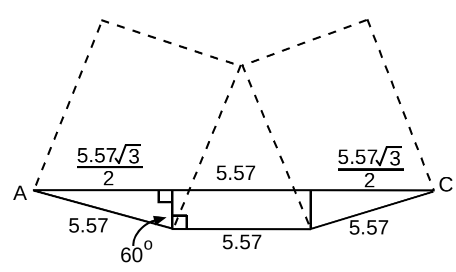
CONGRUENT CUBES AND EQUILATERAL TRIANGULAR PRISM



AB = ?

12H-50 = ________________________

Top view:



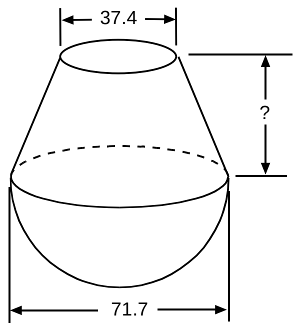
$AC = 15.217\ldots$

$AC^2 + 5.57^2 = AB^2$

$AB =$ **16.2**

13F-50.

HEMISPHERE AND FRUSTUM



Volume (Frustum) = Volume (Hemisphere)

13F-50 = ________________________

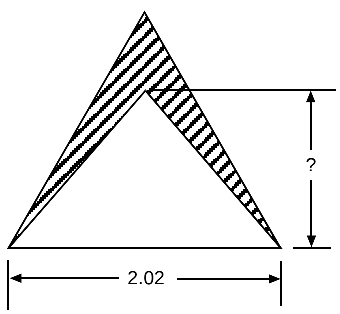
$$\frac{1}{3}\pi\left[\left(\frac{37.4}{2}\right)^2+\left(\frac{71.7}{2}\right)^2+\left(\frac{37.4}{2}\right)\left(\frac{71.7}{2}\right)\right]h$$

$$=\frac{2}{3}\pi\left(\frac{71.7}{2}\right)^3$$

h = **40.0**

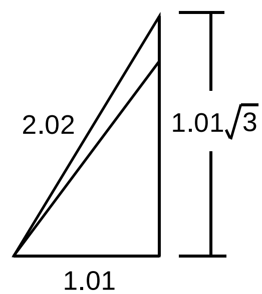
13F-60.

EQUILATERAL TRIANGLE AND TRIANGLES



Hatched Area = 0.464

13F-60 = ________________________

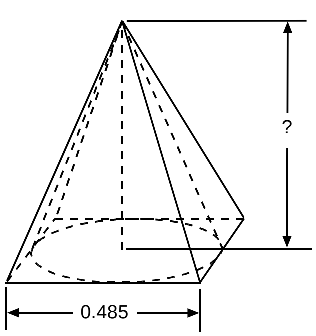


$$\frac{(2.02)^2\sqrt{3}}{4} - 1.01h = .464$$

h = **1.29**

13G-50.

CONE IN SQUARE PYRAMID



Volume(Pyramid) - Volume(Cone) = 0.00909

13G-50 = ________________________

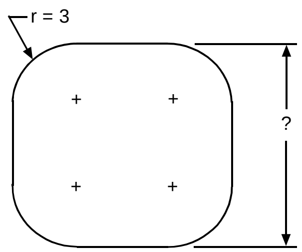
$1/3\, B_1h - 1/3\, B_2h$

$1/3(.485)^2h - 1/3\pi(.485/2)^2h = .00909$

h = **.540**

13I-60.

SQUARE WITH ROUNDED CORNERS



Area = 122

13I-60 = ________________________

4(qtr. circles) + 1 sq. + 4(rect.)

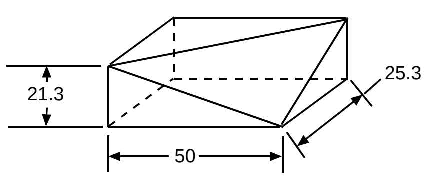
$\pi(3)^2 + x^2 + 4(3x) = 122$

$x = 5.4$

$x + 6 =$ **11.4**

14C-49.

TRUNCATED RECTANGULAR SOLID



Volume = ?

14C-49 = ________________________

$d = \sqrt{50^2 + 25.3^2} = 56.0365\ldots$

$s = \dfrac{50 + 25.3 + d}{2} = 65.6682$

$A = \sqrt{s(s-50)(s-25.3)(s-d)} = 632.499\ldots$

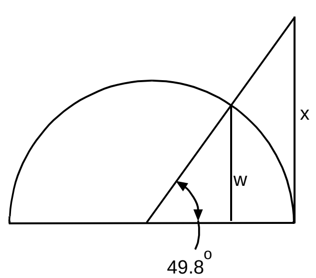
$V_1 = (1/3)A(21.3) = 4{,}490.7499\ldots$

$V_2 = 50(25.3)(21.3) = 26{,}944.5$

$V_2 - V_1 =$ **22,500**

14C-60.

SEMICIRCLE AND RIGHT TRIANGLES



x/w = ?

14C-60 = ________________________

let $r = 1$

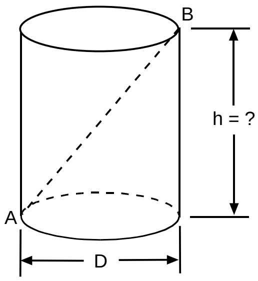
$\tan 49.8° = x/1, \quad x = \tan 49.8°$

$\sin 49.8° = w/1, \quad w = \sin 49.8°$

$x / w =$ **1.55**

14D-50.

CYLINDER



AB = 568
h>D
Volume = $4.31\text{x}10^7$

14D-50 = ________________________

$h^2 + D^2 = 568^2$

and

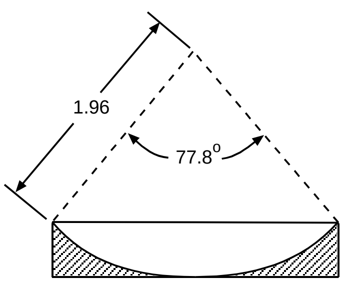
$\pi(D/2)^2\ h = 4.31\text{x}10^7$

4 solutions:

Choose h = **447** D = 350

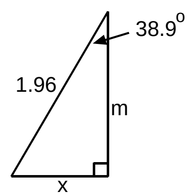
14I-60.

RECTANGLE AND SEGMENT



Hatched Area = ?

14I-60 = ________________________



$\sin 38.9^\circ = x / 1.96$
$x = 1.2308\ldots$

$\cos 38.9^\circ = m / 1.96$
$m = 1.52535\ldots$

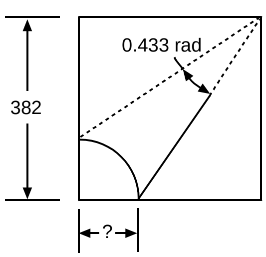
$w = 1.96 - m$ $w = .43464\ldots$

Radian mode.
Area = $(2x)w - (r^2/2)(\theta - \sin\theta)$

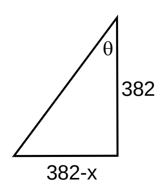
Area = **.339**

15B-60.

SQUARE AND QUARTER CIRCLE



15B-60 = ________________________



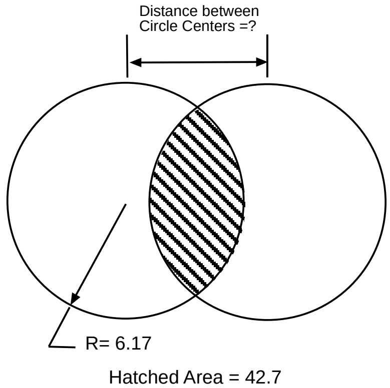
$$\frac{\pi/2 - (.433)}{2} = .56889... = \theta$$

$\tan\theta = (382 - x) / 382$

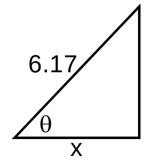
nsolve x = **138**

15C-60.

IDENTICAL CIRCLES



15C-60 = ______________________



$(6.17^2)/2\ (\theta - \sin\theta) = 42.7 / 2$

radians: solve: 2.0217…

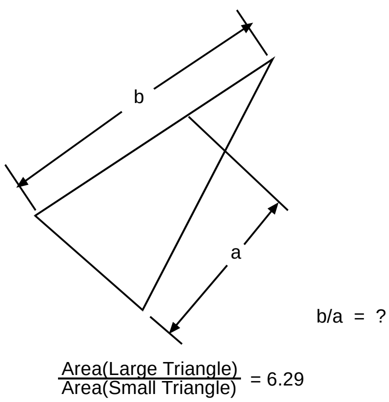
$\theta = 2.0217 / 2$

$\cos\theta = x / 6.17$

2x = **6.55**

15G-60.

ISOSCELES TRIANGLES



15G-60 = ______________________

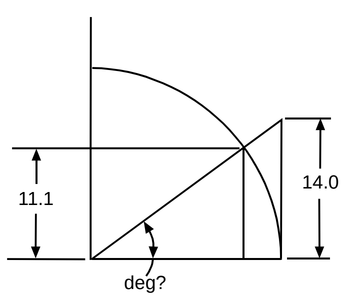
h = height of small triangle

$b / h = \sqrt{6.29} = 2.5079\ldots$ (H)

b / a = 6.29 / (6.29 – H) = **1.66**

15I-60.

RIGHT TRIANGLES AND QUARTER CIRCLE



15I-60 = ______________________

$\tan\theta = 11.1 / w$ (2) $w^2 + 11.1^2 = x^2$

$\tan\theta = 14 / x$ (1) $11.1 / w = 14 / x$

Solve system:

$\tan\theta = 11.1 / 14.44142\ldots.$

θ = **37.5**