

2026 UIL / TMSCA JUNIOR HIGH CALCULATOR CONTEST – GRADE 8 CHAMPIONSHIP – OFFICIAL ANSWERS

CANONICAL ANSWERS (3 SIGNIFICANT DIGITS) • SCIENTIFIC NOTATION • GRADING TOLERANCES [PAGE 1 OF 5]

#	OFFICIAL CONTEST ANSWER (3 SIG FIGS)	SCIENTIFIC NOTATION	ACCEPTANCE INTERVAL (±2 UNITS)
1	6120 [INT]	6.12×10^3	[6120]
2	4.00×10^5	4.00×10^5	$[3.98, 4.02] \times 10^5$
3	1500 [INT]	1.50×10^3	[1500]
4	49 [INT]	4.90×10^1	[49]
5	53200 [INT]	5.32×10^4	[53200]
6	4.00×10^8	4.00×10^8	$[3.98, 4.02] \times 10^8$
7	0.188	1.88×10^{-1}	[0.185, 0.190]
8	1.82×10^6	1.82×10^6	$[1.80, 1.84] \times 10^6$
9	499 [INT] s	4.99×10^2	[499]
10	1.12×10^7	1.12×10^7	$[1.10, 1.15] \times 10^7$
11	39 [INT]	3.90×10^1	[39]
12	27.4	2.74×10^1	[27.2, 27.6]
13	37 [INT]	3.70×10^1	[37]
14	16.7	1.67×10^1	[16.5, 16.9]
15	23.3	2.33×10^1	[23.1, 23.5]
16	9.47	9.47×10^0	[9.45, 9.49]
17	14.1	1.41×10^1	[13.9, 14.3]
18	22.6	2.26×10^1	[22.4, 22.8]
19	21.2 m	2.12×10^1	[21.0, 21.4]
20	4.40 m	4.40×10^0	[4.38, 4.42]
21	60 [INT]	6.00×10^1	[60]
22	30.5	3.05×10^1	[30.3, 30.7]
23	52 [INT]	5.20×10^1	[52]
24	34.6	3.46×10^1	[34.4, 34.8]
25	19.2	1.92×10^1	[19.0, 19.4]

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CANONICAL ANSWERS (3 SIGNIFICANT DIGITS) • SCIENTIFIC NOTATION • GRADING TOLERANCES [PAGE 2 OF 5]

#	OFFICIAL CONTEST ANSWER (3 SIG FIGS)	SCIENTIFIC NOTATION	ACCEPTANCE INTERVAL (±2 UNITS)
26	17.0	1.70×10^1	[16.8, 17.2]
27	17 [INT]	1.70×10^1	[17]
28	21.2	2.12×10^1	[21.0, 21.4]
29	30.6 ft	3.06×10^1	[30.4, 30.8]
30	32.2 m	3.22×10^1	[32.0, 32.4]
31	$1.88 \times 10^3 \text{ cm}^3$	1.88×10^3	$[1.86, 1.90] \times 10^3$
32	$4.88 \times 10^3 \text{ m}^3$	4.88×10^3	$[4.86, 4.90] \times 10^3$
33	382 cm ³	3.82×10^2	[380, 384]
34	$1.60 \times 10^3 \text{ m}^3$	1.60×10^3	$[1.58, 1.62] \times 10^3$
35	$1.77 \times 10^3 \text{ cm}^3$	1.77×10^3	$[1.75, 1.79] \times 10^3$
36	$7.24 \times 10^3 \text{ m}^3$	7.24×10^3	$[7.22, 7.26] \times 10^3$
37	792 cm ²	7.92×10^2	[790, 794]
38	908 m ²	9.08×10^2	[906, 910]
39	$1.28 \times 10^4 \text{ ft}^3$	1.28×10^4	$[1.26, 1.30] \times 10^4$
40	$4.02 \times 10^3 \text{ m}^3$	4.02×10^3	$[4.00, 4.04] \times 10^3$
41	6.92	6.92×10^0	[6.90, 6.94]
42	3 [INT]	3.00×10^0	[3]
43	58.5	5.85×10^1	[58.3, 58.7]
44	24 [INT]	2.40×10^1	[24]
45	7.84 g/cm ³	7.84×10^0	[7.82, 7.86]
46	10.8	1.08×10^1	[10.6, 11.0]
47	251	2.51×10^2	[249, 253]
48	242 mi	2.42×10^2	[240, 244]
49	100 [INT] mi	1.00×10^2	[100]
50	456 [INT] mph	4.56×10^2	[456]

STACKCALC32 RPM BENCHMARK: 385 KEYSTROKES vs. 509 ALGEBRAIC (SAVING 124 KEYS, 24.4% FASTER)

GRADER 1 INITIALS: _____ GRADER 2 INITIALS: _____ CONTEST DIRECTOR: _____

SCORING RULE: +5 points for each correct answer; -4 points for each error or skipped question up to last attempted.

PART II: DETAILED WORD PROBLEM & GEOMETRY WORKED SOLUTIONS

Formal Mathematical Modeling, Formula Setups & StackCalc RPN Keystroke Workflows

PROBLEM 9 • SCIENTIFIC NOTATION: RP2040 CYCLES & MICROSCOPIC DENSITY**ANSWER: 499 [INT] s**

An RP2040 embedded microcontroller executes 1.496×10^6 instructions during a benchmark run. If a coprocessor executes instructions at 3.00×10^6 instructions per second, how many seconds would the coprocessor require to execute that same workload?

GOVERNING MODEL: Total Quantity = Rate/Density $\times$ Total Volume/Time

NUMERICAL SETUP: Total = $(a \times 10^m) \times (b \times 10^n)$

STEP-BY-STEP MATHEMATICAL REASONING:

Use scientific exponent rules: multiply coefficients and add exponents of ten. On StackCalc, enter numbers directly using the [EXP] key.

CALCULATOR FLOW: [1.496] [EE] [8] [ENTER] [3] [EE] [5] [÷] -> 499 [INT] s

PROBLEM 10 • SCIENTIFIC NOTATION: RP2040 CYCLES & MICROSCOPIC DENSITY**ANSWER: 1.12×10^7**

A high-density solder paste contains 4.50×10^4 microscopic alloy solder spheres per milliliter. How many total solder spheres are contained in a 250 milliliter laboratory dispenser flask?

GOVERNING MODEL: Total Quantity = Rate/Density $\times$ Total Volume/Time

NUMERICAL SETUP: Total = $(a \times 10^m) \times (b \times 10^n)$

STEP-BY-STEP MATHEMATICAL REASONING:

Use scientific exponent rules: multiply coefficients and add exponents of ten. On StackCalc, enter numbers directly using the [EXP] key.

CALCULATOR FLOW: [4.5] [EE] [4] [ENTER] [250] [×] -> 1.12×10^7

PROBLEM 19 • SQUARE ROOT GEOMETRY: MAGNETIC PEI BUILD PLATE**ANSWER: 21.2 m**

A square magnetic PEI build plate for a 3D printer has a surface area of 450 square meters. Calculate the side length of the build plate in meters.

GOVERNING MODEL: Side Length = $\sqrt{\text{Surface Area}}$

NUMERICAL SETUP: $s = \sqrt{\text{Area}}$

STEP-BY-STEP MATHEMATICAL REASONING:

For a square build plate, area is $A = s^2$. Therefore side length is the principal square root of area: $s = \sqrt{A}$. Press [$\sqrt{x}$] on the area.

CALCULATOR FLOW: [450] [$\sqrt{x}$] -> 21.2 m

PROBLEM 20 • CUBE ROOT GEOMETRY: MODULAR LEARNING BLOCK ENCLOSURE**ANSWER: 4.40 m**

A cubic modular learning block enclosure has an internal volume of 85.0 cubic meters. Determine the edge length of the cube in meters.

GOVERNING MODEL: Edge Length = $\text{cbrt}(\text{Volume})$

NUMERICAL SETUP: $s = \text{cbrt}(\text{Volume}) = \text{Volume}^{(1/3)}$

STEP-BY-STEP MATHEMATICAL REASONING:

For a cubic block enclosure, volume is $V = s^3$. The edge length is cube root of volume: $s = V^{(1/3)}$. Enter volume, enter 3, and evaluate cube root.

CALCULATOR FLOW: [85] [ENTER] [3] [1/x] [y^x] -> 4.40 m

PROBLEM 29 • PYTHAGOREAN HEIGHT: OVERHEAD SPOOL SUPPORT STRUT**ANSWER: 30.6 ft**

An articulated support strut for a 3D printer overhead spool rack is 32.0 feet long with its base placed 9.50 feet from the vertical frame. What vertical height in feet does the top of the strut reach?

GOVERNING MODEL: $h = \sqrt{(\text{Strut_Length})^2 - (\text{Base_Offset})^2}$

NUMERICAL SETUP: $h = \sqrt{[(\text{L_strut})^2 - (\text{d_base})^2]}$

STEP-BY-STEP MATHEMATICAL REASONING:

The articulated support strut forms a right triangle with the vertical frame and level base. By the Pythagorean theorem, vertical reach is $h = \sqrt{L^2 - d^2}$. Square strut length, square base distance, subtract on the stack, and press $\sqrt{x}$.

CALCULATOR FLOW: [32] [x²] [9.5] [x²] [-] [√x] -> 30.6 ft

PROBLEM 30 • ORTHOGONAL VS. DIAGONAL PCB TRACE ROUTING DIFFERENCE**ANSWER: 32.2 m**

A high-speed differential signal trace crosses a rectangular PCB ground plane measuring 85.0 meters long and 42.0 meters wide along the straight diagonal path. How many meters shorter is the diagonal path than routing along both orthogonal edges?

GOVERNING MODEL: $\text{Savings} = (\text{Length} + \text{Width}) - \sqrt{(\text{Length})^2 + (\text{Width})^2}$

NUMERICAL SETUP: $\text{Delta} = (L + W) - \sqrt{[(L)^2 + (W)^2]}$

STEP-BY-STEP MATHEMATICAL REASONING:

Routing along orthogonal PCB axes requires total distance $(L + W)$. The straight diagonal hypotenuse path is $\sqrt{L^2 + W^2}$. Subtract diagonal length from orthogonal perimeter distance on the stack to find length saved.

CALCULATOR FLOW: [85] [ENTER] [42] [+] [85] [x²] [42] [x²] [+] [√x] [-] -> 32.2 m

PROBLEM 39 • SPHERICAL ACOUSTIC CHAMBER VOLUME**ANSWER: $1.28 \times 10^4 \text{ ft}^3$**

A spherical acoustic resonance chamber in a custom 3D printed speaker enclosure has an internal radius of 14.5 feet. Calculate the storage capacity of the chamber in cubic feet.

GOVERNING MODEL: $V = (4/3) \times \pi \times r^3$

NUMERICAL SETUP: $V = (4/3) \times \pi \times (\text{Radius})^3$

STEP-BY-STEP MATHEMATICAL REASONING:

Volume of a spherical chamber is four-thirds π times radius cubed: $V = 4/3 \cdot \pi \cdot r^3$. Cube radius r , multiply by 4, multiply by π , and divide by 3.

CALCULATOR FLOW: [14.5] [ENTER] [3] [y^x] [π] [×] [4] [×] [3] [÷] -> $1.28 \times 10^4 \text{ ft}^3$

PROBLEM 40 • COMPOSITE 3D VOLUME: PELLET HOPPER & CHAMBER**ANSWER: $4.02 \times 10^3 \text{ m}^3$**

An industrial 3D printing pellet hopper consists of a vertical cylinder with radius 8.00 meters and height 18.5 meters, topped by a conical funnel of the same radius and height 4.50 meters. Determine the total internal volume in cubic meters.

GOVERNING MODEL: $V = (\pi \times r^2 \times h) + (2/3 \times \pi \times r^3)$

NUMERICAL SETUP: $V = [\pi \times r^2 \times h] + [(2/3) \times \pi \times r^3]$

STEP-BY-STEP MATHEMATICAL REASONING:

The 3D printer pellet hopper combines a vertical cylinder with a hemispherical base. Sum cylinder volume $\pi \cdot r^2 \cdot h$ and hemisphere volume $2/3 \cdot \pi \cdot r^3$ on the stack.

CALCULATOR FLOW: [8] [x²] [18.5] [×] [π] [×] [8] [x²] [4.5] [×] [π] [×] [3] [÷] [+] -> $4.02 \times 10^3 \text{ m}^3$

PROBLEM 49 • 3D PRINT SERVICE BUREAU BREAK-EVEN ANALYSIS**ANSWER: 100 [INT] mi**

3D Print Bureau A quotes custom enclosures for \$39.95 plus \$0.45 per unit. Bureau B charges \$49.95 plus \$0.35 per unit. At how many units produced is the fabrication cost identical for both bureaus?

GOVERNING MODEL: $\text{Fixed}_A + \text{Rate}_A \times n = \text{Fixed}_B + \text{Rate}_B \times n \Rightarrow n = (\text{Fixed}_B - \text{Fixed}_A) / (\text{Rate}_A - \text{Rate}_B)$

NUMERICAL SETUP: $\text{Units} = (\text{Cost}_{\text{Base}_B} - \text{Cost}_{\text{Base}_A}) / (\text{Rate}_A - \text{Rate}_B)$

STEP-BY-STEP MATHEMATICAL REASONING:

Set the two bureau total cost functions equal to find break-even unit volume n . Subtract fixed tooling fees, subtract marginal rates, and divide difference in fixed costs by difference in rates.

CALCULATOR FLOW: [49.95] [ENTER] [39.95] [-] [0.45] [ENTER] [0.35] [-] [÷] -> 100 [INT] mi

PROBLEM 50 • AUTONOMOUS ROBOTICS & AGV KINEMATICS**ANSWER: 456 [INT] mph**

An autonomous delivery drone carrying sensor payloads flies 1,280 miles with a steady tailwind in 2.50 hours. On the return flight against the same wind, the flight takes 3.20 hours. Calculate the speed of the drone in still air in miles per hour.

GOVERNING MODEL: $\text{Closing Speed} = v_1 + v_2$; $\text{Time} = \text{Distance} / \text{Closing Speed}$

NUMERICAL SETUP: $t = \text{Distance} / (v_1 + v_2)$ [or $\text{Separation} = (v_1 + v_2) \times t$]

STEP-BY-STEP MATHEMATICAL REASONING:

For autonomous robotic shuttles or gantry carriages moving relative to each other, closing velocity is $v_{\text{rel}} = v_1 + v_2$. Divide initial distance by closing speed to find encounter time, or multiply combined speed by time for separation distance.

CALCULATOR FLOW: [1280] [ENTER] [2.5] [÷] [1280] [ENTER] [3.2] [÷] [+] [2] [÷] -> 456 [INT] mph