

2026 TMSCA / UIL MIDDLE SCHOOL CHAMPIONSHIP EXAM – OFFICIAL SCORING KEY

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	95.0	9.50×10^1	[94.8, 95.2]
2	129	1.29×10^2	[127, 131]
3	6.10	6.10×10^0	[6.08, 6.12]
4	34.8	3.48×10^1	[34.6, 35.0]
5	0.0957	9.57×10^{-2}	[0.0955, 0.0959]
6	40.9	4.09×10^1	[40.7, 41.1]
7	42.9	4.29×10^1	[42.7, 43.1]
8	1.82×10^3	1.82×10^3	$[1.80, 1.84] \times 10^3$
9	\$38.97	3.90×10^1	[38.8, 39.2]
10	139 ft	1.39×10^2	[137, 141]
11	7.19	7.19×10^0	[7.17, 7.21]
12	10.4	1.04×10^1	[10.2, 10.6]
13	101	1.01×10^2	[98.9, 103]
14	11.1	1.11×10^1	[10.9, 11.3]
15	7.02	7.02×10^0	[7.00, 7.04]
16	0.00762	7.62×10^{-3}	[0.00760, 0.00764]
17	20.9	2.09×10^1	[20.7, 21.1]
18	9.38	9.38×10^0	[9.36, 9.40]
19	1.51 hrs	1.51×10^0	[1.49, 1.53]
20	661 m ²	6.61×10^2	[659, 663]
21	498	4.98×10^2	[496, 500]
22	37.4	3.74×10^1	[37.2, 37.6]
23	54.7	5.47×10^1	[54.5, 54.9]
24	0.400	4.00×10^{-1}	[0.398, 0.402]
25	5.31	5.31×10^0	[5.29, 5.33]

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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	115	1.15×10^2	[113, 117]
27	4.15	4.15×10^0	[4.13, 4.17]
28	55.5	5.55×10^1	[55.3, 55.7]
29	98.2 min	9.82×10^1	[98.0, 98.4]
30	25.2 ft	2.52×10^1	[25.0, 25.4]
31	13.6	1.36×10^1	[13.4, 13.8]
32	1 [INT]	1.00×10^0	[1]
33	58.1	5.81×10^1	[57.9, 58.3]
34	38.2	3.82×10^1	[38.0, 38.4]
35	3.83	3.83×10^0	[3.81, 3.85]
36	495 [INT]	4.95×10^2	[495]
37	336 [INT]	3.36×10^2	[336]
38	0.967	9.67×10^{-1}	[0.965, 0.969]
39	25.8 cm	2.58×10^1	[25.6, 26.0]
40	103 m ²	1.03×10^2	[101, 105]
41	3.76	3.76×10^0	[3.74, 3.78]
42	35.3	3.53×10^1	[35.1, 35.5]
43	2.30	2.30×10^0	[2.28, 2.32]
44	5.81	5.81×10^0	[5.79, 5.83]
45	25.0	2.50×10^1	[24.8, 25.2]
46	4.28	4.28×10^0	[4.26, 4.30]
47	1.46	1.46×10^0	[1.44, 1.48]
48	24.0	2.40×10^1	[23.8, 24.2]
49	655 cm ³	6.55×10^2	[653, 657]
50	1.95×10^3 cm ³	1.95×10^3	$[1.93, 1.97] \times 10^3$

STACKCALC32 RPM BENCHMARK: 356 KEYSTROKES vs. 693 ALGEBRAIC (SAVING 337 KEYS, 48.6% 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 • TEST BENCH TOOL DISCOUNT & SALES TAX**ANSWER: \$38.97**

A modular electronics component organizer case priced at \$45.00 is discounted by 20%. With 8.25% sales tax, find the total purchase cost.

GOVERNING MODEL: Final Cost = Original Price $\times$ (1 - Discount Rate) $\times$ (1 + Tax Rate)

NUMERICAL SETUP: Final Cost = $P_0 \times (1 - d) \times (1 + t)$

STEP-BY-STEP MATHEMATICAL REASONING:

Calculate net purchase price after lab equipment discount: $P_{\text{net}} = P_0 \cdot (1 - d)$. Then apply sales tax: $P_{\text{final}} = P_{\text{net}} \cdot (1 + t)$. In competition scoring, currency answers [\$] are rounded to the nearest cent.

CALCULATOR FLOW: [45] [ENTER] [0.80] [$\times$] [1.0825] [$\times$] -> \$38.97

PROBLEM 10 • METRIC TO IMPERIAL GUIDE RAIL CONVERSION**ANSWER: 139 ft**

A 3D printer linear guide rail travel length is 42.5 meters. Convert this length to feet (1 meter = 3.28084 feet).

GOVERNING MODEL: Measurement (ft) = Measurement (m) $\times$ Conversion Factor

NUMERICAL SETUP: Length (ft) = Length (m) $\times$ 3.28084 ft/m

STEP-BY-STEP MATHEMATICAL REASONING:

Multiply linear guide rail length in meters by standard conversion factor 3.28084 feet per meter.

CALCULATOR FLOW: [42.5] [ENTER] [3.28084] [$\times$] -> 139 ft

PROBLEM 19 • PARALLEL PROCESSING & VACUUM CHAMBER EVACUATION**ANSWER: 1.51 hrs**

3D printer A can print a full batch of modular math blocks in 2.50 hours, while 3D printer B requires 3.80 hours. How many hours will it take to print the batch working together?

GOVERNING MODEL: $1/t_{\text{total}} = 1/t_A + 1/t_B \Rightarrow t_{\text{total}} = 1 / (1/t_A + 1/t_B)$

NUMERICAL SETUP: $t_{\text{total}} = 1 / [(1 / t_A) + (1 / t_B)]$

STEP-BY-STEP MATHEMATICAL REASONING:

Each degassing pump, printer, or resin dispenser operates at rate $1/t$. Running concurrently, their combined rate is $R = 1/t_A + 1/t_B$. Time to complete is reciprocal $1 / R$. In RPN: enter t_A , press $[1/x]$, enter t_B , press $[1/x]$, add $[+]$, and invert with $[1/x]$.

CALCULATOR FLOW: [2.5] $[1/x]$ [3.8] $[1/x]$ $[+]$ $[1/x]$ -> 1.51 hrs

PROBLEM 20 • CIRCULAR PRINT BED SURFACE AREA**ANSWER: 661 m²**

A circular 3D printer rotating print bed has a radius of 14.5 meters. Determine the total surface area of the print bed in square meters.

GOVERNING MODEL: Area = $\pi \times r^2$

NUMERICAL SETUP: Area = $\pi \times (\text{Radius})^2$

STEP-BY-STEP MATHEMATICAL REASONING:

Surface area of a circular 3D printer bed is π times radius squared: $A = \pi \cdot r^2$. Square the radius and multiply by π .

CALCULATOR FLOW: [14.5] [$\times^2$] [π] [$\times$] -> 661 m²

PROBLEM 29 • AUTONOMOUS ROBOTICS & AGV KINEMATICS**ANSWER: 98.2 min**

Two educational mobile robotics carts 45.0 miles apart travel toward each other at speeds of 12.0 mph and 15.5 mph. In how many minutes will they meet?

GOVERNING MODEL: Closing Speed = $v_1 + v_2$; Time = Distance / Closing Speed

NUMERICAL SETUP: $t = \text{Distance} / (v_1 + v_2)$ [or 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: [45] [ENTER] [12] [ENTER] [15.5] [+] [+] [60] [×] -> 98.2 min

PROBLEM 30 • PYTHAGOREAN HEIGHT: OVERHEAD SPOOL SUPPORT STRUT**ANSWER: 25.2 ft**

An articulated support strut for a 3D printer overhead spool rack is 26.0 feet long with its base placed 6.50 feet away on level ground. How high up the frame does the top of the strut reach in feet?

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: [26] [$\times^2$] [6.5] [$\times^2$] [-] [$\sqrt{x}$] -> 25.2 ft

PROBLEM 39 • RIGHT TRIANGLE TRIGONOMETRY**ANSWER: 25.8 cm**

RIGHT TRIANGLE: In the right triangle below, hypotenuse $c = 48.0$ cm and angle $\theta = 32.5^\circ$. Find opposite leg a .

GOVERNING MODEL: $a = c \times \sin(\theta)$ or $b = c \times \cos(\theta)$

NUMERICAL SETUP: $a = 48.0 \times \sin(32.5^\circ)$

STEP-BY-STEP MATHEMATICAL REASONING:

In a right triangle, the opposite leg equals hypotenuse c multiplied by $\sin(\theta)$. With $c = 48.0$ and acute angle $\theta = 32.5^\circ$, calculate in Degree mode and round non-integers to 3 significant figures.

CALCULATOR FLOW: [DEG] [48.0] [ENTER] [32.5] [SIN] [×] -> 25.8 cm

PROBLEM 40 • CIRCULAR SECTOR AREA**ANSWER: 103 m²**

CIRCULAR SECTOR: For the sector diagrammed below, radius $r = 14.0$ m and central angle $\theta = 60.0^\circ$. Determine the sector area in square meters.

GOVERNING MODEL: Area = $\pi \times r^2 \times (\theta / 360^\circ)$

NUMERICAL SETUP: Area = $\pi \times (14.0)^2 \times (60.0^\circ / 360^\circ)$

STEP-BY-STEP MATHEMATICAL REASONING:

A circular sector represents a fraction ($\theta / 360^\circ$) of a full circle. Square radius $r = 14.0$, multiply by angle $\theta = 60.0^\circ$, multiply by π , and divide by 360.

CALCULATOR FLOW: [14.0] [$\times^2$] [60.0] [×] [π] [×] [360] [÷] -> 103 m²

PROBLEM 49 • RIGHT CIRCULAR CONE VOLUME**ANSWER: 655 cm³**

RIGHT CIRCULAR CONE: A cone has base radius $r = 6.50$ cm and height $h = 14.8$ cm. Find the volume in cubic centimeters.

GOVERNING MODEL: $V = (1/3) \times \pi \times r^2 \times h$

NUMERICAL SETUP: $V = (1/3) \times \pi \times (6.5)^2 \times (14.8)$

STEP-BY-STEP MATHEMATICAL REASONING:

The cone volume equals one-third base area times vertical height. Square base radius $r = 6.5$, multiply by vertical height $h = 14.8$, multiply by π , and divide by 3.

CALCULATOR FLOW: [6.5] [x^2] [14.8] [x] [π] [x] [3] [+] -> 655 cm³

PROBLEM 50 • RECTANGULAR ELECTRONICS ENCLOSURE VOLUME**ANSWER: 1.95 x 10³ cm³**

A 3D printed electronics project enclosure measures 18.5 cm long, 12.4 cm wide, and 8.50 cm high. Determine its internal volume in cubic centimeters.

GOVERNING MODEL: Volume = Length × Width × Height

NUMERICAL SETUP: $V = L \times W \times H$

STEP-BY-STEP MATHEMATICAL REASONING:

Internal volume of the rectangular electronics enclosure equals length times width times height: $V = L \cdot W \cdot H$. Multiply dimensions sequentially.

CALCULATOR FLOW: [18.5] [ENTER] [12.4] [x] [8.5] [x] -> 1.95 x 10³ cm³