

DETECTOR BUILDING C – RESULTS

CAMAS SCIENCE OLYMPIAD INVITATIONAL TOURNAMENT 2021

NOTES

1	This document is a results summary of the Detector Building event at the Camas Invitational hosted on December 12, 2020, by Camas High School in Camas, Washington. This tournament was run in mini SO format with testing conducted via the Scilympiad platform. As such, many questions of the test were structured and/or worded for the online format.
2	The test for this event was written by George Sun, a graduate of the University of Washington in Seattle.

TOPIC BREAKDOWN

Topic	Questions	Points	Percentage
i. Relationships between resistance, voltage, and temperature	1, 2, 3, 4, 5, 6, 7, 19	27.00	20%
ii. Theory of LEDs, working principles, and applications	8, 9, 10, 11, 12, 14, 18	31.00	23%
iii. The process of calibration - working with raw data and determining real world relationships	15, 20, 27, 28, 29, 30, 31, 32, 33	32.00	24%
iv. Operational knowledge of basic Device components	13, 16, 17, 21, 22, 23, 24, 25, 26	42.00	32%

SCORING METHODOLOGY

Fill in the Blank: All fill-in-the-blank questions were manually regraded with points awarded without penalty for misspelled answers. For some questions, points were awarded for similar answers. Responses were penalized if instructions were not followed, e.g. not rounding numbers as requested, including units when told not to, answering with more words than requested.

Multiple Answer: All multiple answer questions were regraded such that a proportionate fraction of the points possible were awarded for each answer choice response that matched the key, e.g. for a five point question with five answer choices, one point was awarded for each choice correctly selected and one point was awarded for each choice correctly not selected. Note this is different from Scilympiad's default scoring for this question type.

Short Answer: To ensure consistency in grading, all responses to short answer questions were graded together. After scoring all responses, grading was reviewed for grading consistency.

Multiple Choice and True/False: Multiple choice and true/false questions were graded for exact matches; no partial credit was awarded for these questions.

Tiebreakers: Tiebreaker questions were included in each team's total score. The questions selected for tiebreakers were identified on the test made available to students. In the event of a tie, a comparison of the scores from each of these tiebreakers was used in order until the tie was broken.

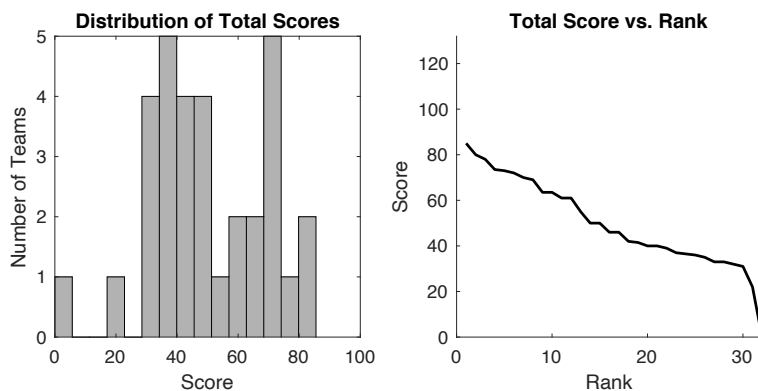
RESULTS SUMMARY

Submitted: 31/32
Possible Points: 132
Average: 49.8
Minimum: 22
Maximum: 85

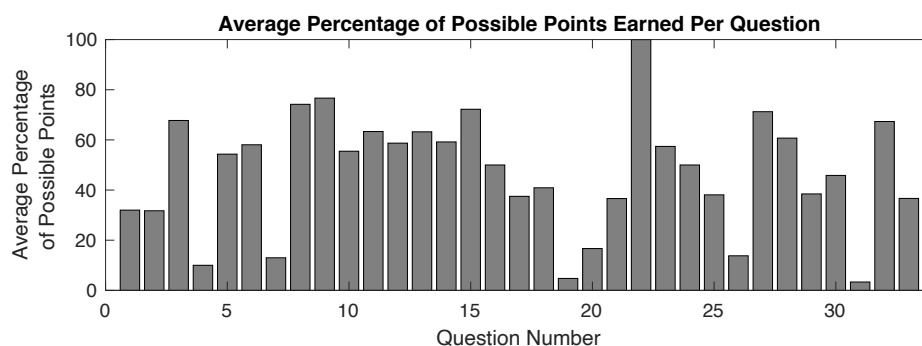
A histogram of total scores, line plot of scores by rank, bar graph of percentage points earned for question on average, and statistics for each question are included starting on the following page.

RESULTS SUMMARY (CONTINUED)

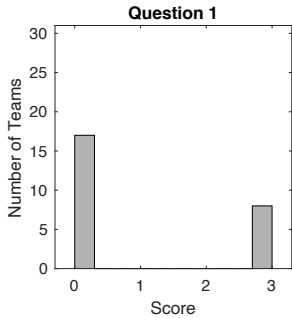
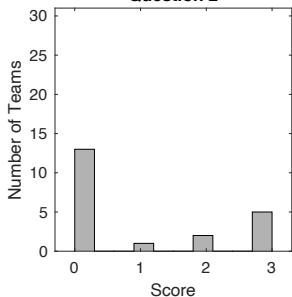
The histogram and line plot below show the distribution of total scores and total score vs. rank, respectively.



The bar graph below shows the percentage of possible points earned on average for each question, which can be used as an indication for which questions were most difficult for students. Note that question 22 was worth zero points.



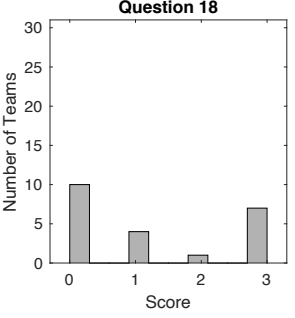
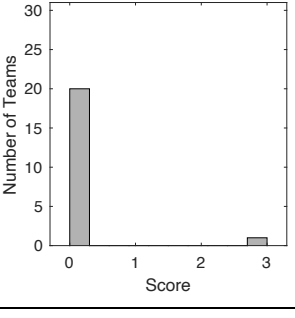
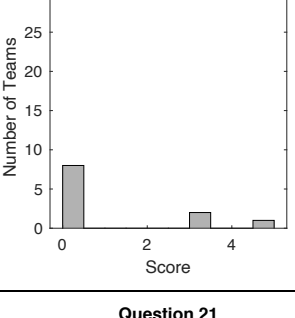
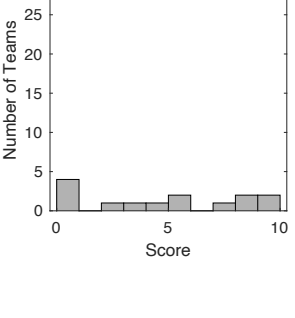
RESULTS BY QUESTION

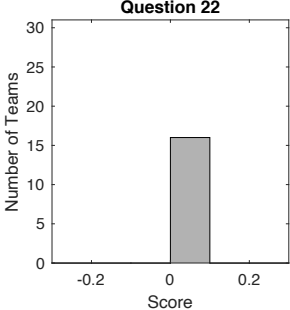
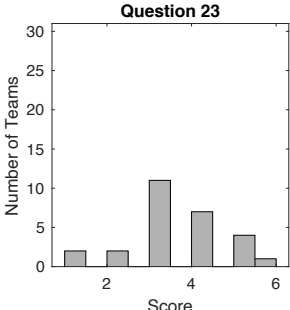
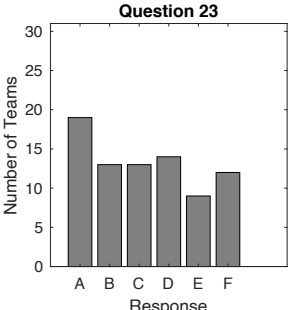
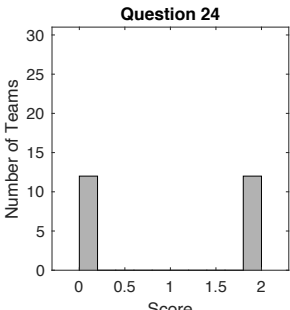
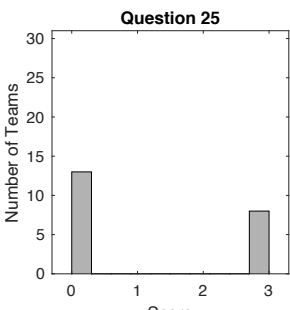
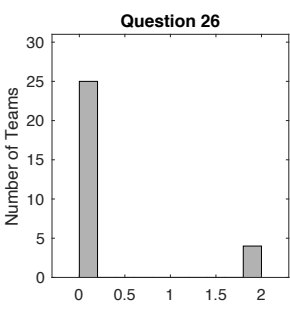
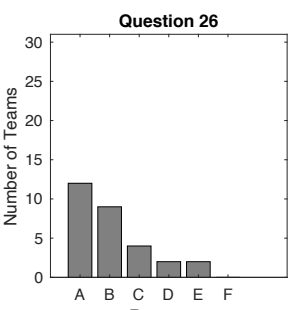
Question	Comments	Statistics
1	Fill in the Blank 	Answered: 25/31 Possible: 3 Average: 1.0 Minimum: 0 Maximum: 3
2	Fill in the Blank  Partial credit was awarded for responses that were near the correct answer (e.g. 1.8 V) or the result of an intermediate step toward calculating the correct answer (e.g. 7.1 V, the voltage across the resistor).	Answered: 21/31 Possible: 3 Average: 1.0 Minimum: 0 Maximum: 3

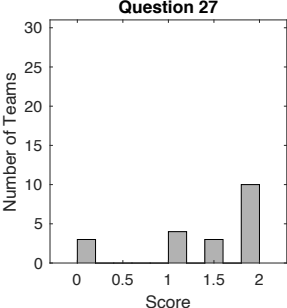
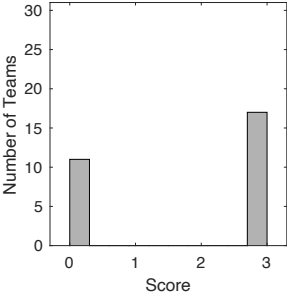
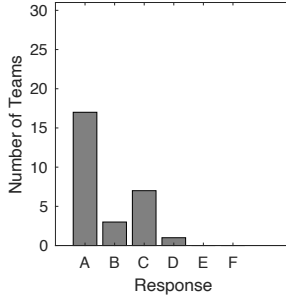
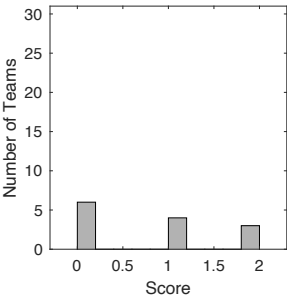
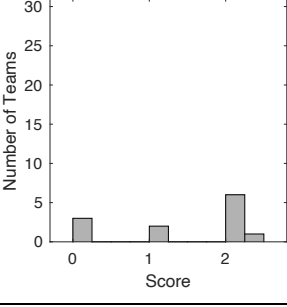
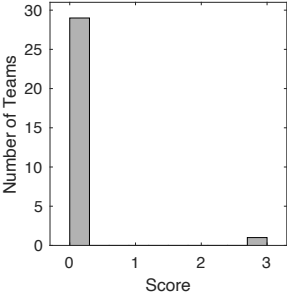
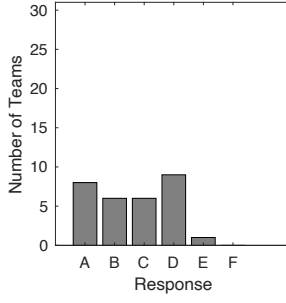
RESULTS BY QUESTION (CONTINUED)		
Question	Comments	Statistics
3	Multiple Choice	<p>Question 3</p> <p>Number of Teams</p> <p>Score</p> <p>Question 3</p> <p>Number of Teams</p> <p>Response</p> <p>Correct answer: A</p>
		<p>Answered: 31/31 Possible: 3 Average: 2.0 Minimum: 0 Maximum: 3</p>
4	Fill in the Blank	<p>Question 4</p> <p>Number of Teams</p> <p>Score</p> <p>Partial credit was awarded for 236 °C, which is the result if the negative sign on $\Delta T = -211.3\text{ }^\circ\text{C}$ is accidentally ignored when ΔT is added to the initial temperature, 25 °C.</p>
		<p>Answered: 22/31 Possible: 5 Average: 0.5 Minimum: 0 Maximum: 5</p>
5	Fill in the Blank	<p>Question 5</p> <p>Number of Teams</p> <p>Score</p> <p>Partial credit was awarded for 337, which is the answer in units Kelvin, instead of the specified units, degrees Celsius.</p>
		<p>Answered: 27/31 Possible: 3 Average: 1.6 Minimum: 0 Maximum: 3</p>
6	Multiple Choice	<p>Question 6</p> <p>Number of Teams</p> <p>Score</p> <p>Question 6</p> <p>Number of Teams</p> <p>Response</p> <p>Correct answer: B</p>
		<p>Answered: 31/31 Possible: 2 Average: 1.2 Minimum: 0 Maximum: 2</p>
7	Fill in the Blank	<p>Question 7</p> <p>Number of Teams</p> <p>Score</p> <p>This was a difficult question that required being familiar with both the β parameter equation and the Steinhart-Hart equation, specifically the case of $C = 0$ where the two equations are approximations of each other.</p> <p>Partial credit was awarded for answers that were incorrectly rounded or close to the correct answer.</p>
		<p>Answered: 20/31 Possible: 5 Average: 0.7 Minimum: 0 Maximum: 5</p>

RESULTS BY QUESTION (CONTINUED)		
Question	Comments	Statistics
8	Multiple Answers	<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>Question 8</p> <p>Number of Teams</p> <p>Score</p> </div> <div style="text-align: center;"> <p>Question 8</p> <p>Number of Teams</p> <p>Response</p> </div> </div> <p>Correct answer(s): A</p> <p>Incorrect answer(s): B, C, D, E</p>
9	Fill in the Blank	<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>Question 9</p> <p>Number of Teams</p> <p>Score</p> </div> <div> <p>Most teams answered this question correctly, and most teams that answered the question incorrectly reversed the order of colors.</p> </div> </div> <p>Answered: 30/31 Possible: 3 Average: 2.3 Minimum: 1 Maximum: 3</p>
10	Multiple Answers	<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>Question 10</p> <p>Number of Teams</p> <p>Score</p> </div> <div style="text-align: center;"> <p>Question 10</p> <p>Number of Teams</p> <p>Response</p> </div> </div> <p>Correct answer(s): E</p> <p>Incorrect answer(s): A, B, C, D</p>
11	Multiple Answers	<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>Question 11</p> <p>Number of Teams</p> <p>Score</p> </div> <div style="text-align: center;"> <p>Question 11</p> <p>Number of Teams</p> <p>Response</p> </div> </div> <p>Correct answer(s): B, D</p> <p>Incorrect answer(s): A, C</p>
12	Multiple Answers	<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>Question 12</p> <p>Number of Teams</p> <p>Score</p> </div> <div style="text-align: center;"> <p>Question 12</p> <p>Number of Teams</p> <p>Response</p> </div> </div> <p>Correct answer(s): A, B, C</p> <p>Incorrect answer(s): D, E</p>

RESULTS BY QUESTION (CONTINUED)		
Question	Comments	Statistics
13	Multiple Answers	<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>Question 13</p> <p>Score</p> </div> <div style="text-align: center;"> <p>Question 13</p> <p>Response</p> </div> </div> <p>Correct answer(s): D</p> <p>Incorrect answer(s): A, B, C, E</p>
14	Multiple Answers	<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>Question 14</p> <p>Score</p> </div> <div style="text-align: center;"> <p>Question 14</p> <p>Response</p> </div> </div> <p>Correct answer(s): A, B, E, F</p> <p>Incorrect answer(s): C, D</p>
15	Multiple Answers	<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>Question 15</p> <p>Score</p> </div> <div style="text-align: center;"> <p>Question 15</p> <p>Response</p> </div> </div> <p>Correct answer(s): B, E</p> <p>Incorrect answer(s): A, C, D, F</p>
16	Multiple Answers	<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>Question 16</p> <p>Score</p> </div> <div style="text-align: center;"> <p>Question 16</p> <p>Response</p> </div> </div> <p>Correct answer(s): B, D, F</p> <p>Incorrect answer(s): A, C, E</p>
17	Short Answer	<div style="display: flex;"> <div style="flex: 1;"> <p>Question 17</p> <p>Score</p> </div> <div style="flex: 2;"> <p>I was impressed by the detailed descriptions many teams provided for how they would incorporate the sensor into their selected application. Printers were the most popular application, and many teams used the sensor to detect if paper was present, either from a copy being made or in the storage tray. A handful of teams misunderstood the function of the sensor and therefore received few or no points.</p> </div> </div>

RESULTS BY QUESTION (CONTINUED)			
Question	Comments	Statistics	
18	Fill in the Blank	 <p>Partial credit was awarded for responses that were near the correct answer.</p>	Answered: 22/31 Possible: 3 Average: 1.2 Minimum: 0 Maximum: 3
19	Fill in the Blank	 <p>This question involves a basic calculation for what value of resistor should be paired with an LED given its voltage and current requirements, one every team should have completed in the process of building their device.</p>	Answered: 21/31 Possible: 3 Average: 0.1 Minimum: 0 Maximum: 3
20	Short Answer	 <p>Many teams wrote responses too specific to the sensor on the datasheet without speaking in general terms, which was asked by the question. Many of these teams focused their discussion on electrical properties (power, current, etc.) which seemed to distract them from the goal of the question.</p>	Answered: 11/31 Possible: 6 Average: 1.0 Minimum: 0 Maximum: 5
21	Short Answer	 <p>About only a third of the teams attempted this coding question. While approaches to detecting signal stability were varied, the most common approach was checking if the difference between two recent readings was within a specified difference threshold (e.g. <code>abs(current_reading - previous_reading) < 0.1</code>).</p> <p>Responses were graded according to the rubric. Many teams forgot to convert voltage values to temperature measurements.</p> <p>Almost no teams implemented a noise reduction step which is important because without noise reduction, the specified difference threshold needs to be large to recognize the readings as stabilized but then the computed and displayed temperature readings would still be fluctuating within several degrees, which would not appear stabilized.</p>	Answered: 14/31 Possible: 12 Average: 4.4 Minimum: 0 Maximum: 10

RESULTS BY QUESTION (CONTINUED)			
Question	Comments	Statistics	
22	Fill in the Blank 	This was a follow-up question (to the previous coding question) that was worth zero points. Answered: 16/31 Possible: 0 Average: 0.0 Minimum: 0 Maximum: 0	
23	Multiple Answers  	Correct answer(s): A, B, D Incorrect answer(s): C, E, F	Answered: 27/31 Possible: 6 Average: 3.4 Minimum: 1 Maximum: 6
24	Fill in the Blank 	Answered: 24/31 Possible: 2 Average: 1.0 Minimum: 0 Maximum: 2	
25	Fill in the Blank 	Answered: 21/31 Possible: 3 Average: 1.1 Minimum: 0 Maximum: 3	
26	Multiple Choice  	Correct answer: C	Answered: 29/31 Possible: 2 Average: 0.3 Minimum: 0 Maximum: 2

RESULTS BY QUESTION (CONTINUED)		
Question	Comments	Statistics
27 Short Answer	<p>Question 27</p>  <p>A number of teams described the relationship as linear when it was not; however, this was not penalized. Common mistakes were mentioning both variables without describing their relationship or only mentioning a relationship (e.g. "it's linear") without mentioning what variables were involved. A few responses mentioned true observations that were not conclusions that could be made from the data provided.</p>	<p>Answered: 20/31 Possible: 2 Average: 1.4 Minimum: 0 Maximum: 2</p>
28 Multiple Choice	<p>Question 28</p>  <p>Question 28</p>  <p>Correct answer: A</p>	<p>Answered: 28/31 Possible: 3 Average: 1.8 Minimum: 0 Maximum: 3</p>
29 Short Answer	<p>Question 29</p>  <p>A common mistake was applying a valid linearization operation but to the wrong variable (e.g. squaring LED voltage instead of photoresistor voltage).</p> <p>Teams that thought the relationship was already linear did not attempt any linearization steps and therefore were not awarded points for this question.</p>	<p>Answered: 13/31 Possible: 2 Average: 0.8 Minimum: 0 Maximum: 2</p>
30 Short Answer	<p>Question 30</p>  <p>The most common mistake was not specifying units for coefficients or constants in the equation. Grading for this question was lenient; teams that did not attempt to linearize in the previous question were still graded on whether the equation they provided was linear, had defined variables, and had units.</p>	<p>Answered: 12/31 Possible: 3 Average: 1.4 Minimum: 0 Maximum: 2.5</p>
31 Multiple Choice	<p>Question 31</p>  <p>Question 31</p>  <p>Correct answer: E</p>	<p>Answered: 30/31 Possible: 3 Average: 0.1 Minimum: 0 Maximum: 3</p>

RESULTS BY QUESTION (CONTINUED)																												
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32	Multiple Answers	<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <p>Question 32</p> <table border="1"> <caption>Question 32 Score Distribution</caption> <thead> <tr><th>Score</th><th>Number of Teams</th></tr> </thead> <tbody> <tr><td>1</td><td>1</td></tr> <tr><td>2</td><td>5</td></tr> <tr><td>3</td><td>9</td></tr> <tr><td>4</td><td>12</td></tr> <tr><td>5</td><td>3</td></tr> </tbody> </table> </div> <div style="width: 45%;"> <p>Question 32</p> <table border="1"> <caption>Question 32 Response Distribution</caption> <thead> <tr><th>Response</th><th>Number of Teams</th></tr> </thead> <tbody> <tr><td>A</td><td>11</td></tr> <tr><td>B</td><td>20</td></tr> <tr><td>C</td><td>7</td></tr> <tr><td>D</td><td>19</td></tr> <tr><td>E</td><td>2</td></tr> <tr><td>F</td><td>0</td></tr> </tbody> </table> </div> </div> <p>Correct answer(s): B</p> <p>Incorrect answer(s): A, C, D, E</p>	Score	Number of Teams	1	1	2	5	3	9	4	12	5	3	Response	Number of Teams	A	11	B	20	C	7	D	19	E	2	F	0
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