Physics Lab - Data Analysis
ANSWER KEY

Extra Credit Data Sets
(given in x, y format)

Data Set 1		Data Set 2		Data Set 3	
P (watt)	W (kg)	T (s)	m (kg)	W (kg)	Q (cal)
1.0	0.193	0.5	0.67	5	2.38
1.5	0.434	2.5	0.142	10	1.68
2.0	0.772	3.5	0.102	15	1.38
2.5	1.210	4	0.082	20	1.19
3.0	1.740	5	0.066	25	1.06

Data Set 1 * $W = (0.193 \frac{kg}{watt^2}) P^2$

*** See sample data analysis and graphical analysis at the end of this answer key.**

Data Set 2 $m = (0.35 \text{ kg s}) \frac{1}{T}$

Data Set 3 $Q = (5.32 \text{ cal} \sqrt{kg}) \frac{1}{\sqrt{W}}$

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Individual Data Sets

Data Set 1 $v = (2.5\ \text{m})\ \frac{1}{t}$

Data Set 2 $t = (0.75\ \text{N s})\ \frac{1}{F}$

Data Set 3 $t = (2.5\ \text{s kg})\ \frac{1}{m}$

Data Set 4 $v = (6.5\ \text{L Btu})\ \frac{1}{E}$

Data Set 5 $t = (21.5\ \text{s amp})\ \frac{1}{l}$

Data Set 6 $P = (2.5\ \frac{\text{ohm}}{\sqrt{\text{km}}})\ \sqrt{h}$

Data Set 7 $V = (0.75\ \frac{\text{L}}{\sqrt{\text{min}}})\ \sqrt{t}$

Data Set 8 $m = (6.5\ \frac{\text{kg}}{\sqrt{\text{N}}})\ \sqrt{F}$

Data Set 9 $t = (12.5\ \frac{\text{min}}{\sqrt{\text{kw}}})\ \sqrt{P}$

Data Set 10 $l = (7.5)\ \sqrt{A}$

Data Set 11 $d = (0.75\ \frac{\text{in}}{\text{m}^2})\ C^2$

Data Set 12 $T = (12.5\ \frac{°\text{K}}{\text{gal}^2})\ V^2$

Data Set 13 $T = (6.5\ \frac{°\text{K}}{\text{btu}^2})\ E^2$

Data Set 14 $d = (2.5\ \frac{\text{m}}{\text{yds}^2})\ V^2$

Data Set 15 $h = (0.05\ \frac{\text{cm}}{\text{day}^2})\ t^2$

Data Set 16 $d = (12.5\ \text{cm amp}^2)\ \frac{1}{I^2}$

Data Set 17 $V = (0.75\ \text{L N}^2)\ \frac{1}{F^2}$

Data Set 18 $d = (6.5\ \text{hr}^2\ \text{cm})\ \frac{1}{t^2}$

Data Set 19 $T = (23\ \text{L}^2\ °\text{C})\ \frac{1}{V^2}$

Data Set 20 $V = (0.8\ \text{N}^2\ \text{gal})\ \frac{1}{F^2}$

Data Set 21 $Q = (12.5\ \sqrt{\text{hr}}\ \text{btu})\ \frac{1}{\sqrt{T}}$

Data Set 22 $C = (0.75\ \sqrt{\text{rad}}\ \text{cm})\ \frac{1}{\sqrt{A}}$

Data Set 23 $l = (6.5\ \sqrt{\text{hz}}\ \text{m})\ \frac{1}{\sqrt{f}}$

Data Set 24 $T = (23\ \sqrt{\text{gal}}\ °\text{K})\ \frac{1}{\sqrt{V}}$

Data Set 25 $V = (0.8\ \sqrt{\text{day}}\ \text{gal})\ \frac{1}{\sqrt{t}}$

Lab - Data Analysis - Examples

The goal is to use the data analysis to find the equation relating the two variables from the data that was input into the data analysis Excel spreadsheet. Directions on how to do this are given below the data analysis print out.

Example 1

Data Analysis

Name =	Student	x variable =	T (s)	y variable =	m (kg)

Type Data Here		Possible Proportionalities					
x variable	y variable	y/x	yx	y^2/x	y/x^2	y^2x	yx^2
1.000	3.000	3.000	3.000	9.000	3.000	9.000	3.000
2.000	6.000	3.000	12.000	18.000	1.500	72.000	24.000
3.000	9.000	3.000	27.000	27.000	1.000	243.000	81.000
4.000	12.000	3.000	48.000	36.000	0.750	576.000	192.000
5.000	15.000	3.000	75.000	45.000	0.600	1125.000	375.000
		% Differences					
# of Data Points =		0.000	90.909	66.667	-118.978	97.778	97.778
5		0.000	63.636	33.333	-9.489	82.222	82.222
		0.000	18.182	0.000	27.007	40.000	40.000
		0.000	-45.455	-33.333	45.255	-42.222	-42.222
		0.000	-127.273	-66.667	56.204	-177.778	-177.778

Directions:

1) Type in your name, the y variable symbol, and the x variable symbol in the spaces provided (yellow).
2) Type in your x,y data under the Type Data Here columns (blue).
3) Type in the number of data points. The minimum is 2 points, the maximum is 5 points.
4) Note that you can use the TAB key to jump from one field to another. Fields other than those noted above are locked and cannot be changed. Therefore you can easily TAB from one data field to another.
5) Go to FILE, PRINT.

$$\frac{y}{x} = k$$

$$\frac{m}{T} = 3\ \frac{kg}{s}$$

$$\boxed{m = (3\ kg/s)\ T}$$

$$m\ \alpha\ T$$

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Example 2

Data Analysis							
Name =	Student			x variable =	Q (cal)	y variable =	t (s)
Type Data Here		Possible Proportionalities					
x variable	y variable	y/x	yx	y^2/x	y/x^2	y^2x	yx^2
1.000	2.000	2.000	2.000	4.000	2.000	4.000	2.000
2.000	8.000	4.000	16.000	32.000	2.000	128.000	32.000
3.000	18.000	6.000	54.000	108.000	2.000	972.000	162.000
4.000	32.000	8.000	128.000	256.000	2.000	4096.000	512.000
5.000	50.000	10.000	250.000	500.000	2.000	12500.000	1250.000
		% Differences					
# of Data Points =		66.667	97.778	97.778	0.000	99.887	99.489
5		33.333	82.222	82.222	0.000	96.384	91.828
		0.000	40.000	40.000	0.000	72.542	58.631
		-33.333	-42.222	-42.222	0.000	-15.706	-30.746
		-66.667	-177.778	-177.778	0.000	-253.107	-219.203

$$\frac{y}{x^2} = k$$

$$\frac{t}{Q^2} = 2\ \frac{s}{cal^2}$$

$$\boxed{t = (2\ s/cal^2)\ Q^2}$$

$$t\ \alpha\ Q^2$$

Example 3

Data Analysis							
Name =	Student			x variable =	F (N)	y variable =	l (m)
Type Data Here		Possible Proportionalities					
x variable	y variable	y/x	yx	y^2/x	y/x^2	y^2x	yx^2
1.000	10.000	10.000	10.000	100.000	10.000	100.000	10.000
2.000	5.000	2.500	10.000	12.500	1.250	50.000	20.000
3.000	3.330	1.110	9.990	3.696	0.370	33.267	29.970
4.000	2.500	0.625	10.000	1.563	0.156	25.000	40.000
5.000	2.000	0.400	10.000	0.800	0.080	20.000	50.000
		% Differences					
# of Data Points =		-241.647	-0.020	-321.732	-321.719	-119.042	66.660
5		14.588	-0.020	47.284	47.285	-9.521	33.320
		62.077	0.080	84.412	84.396	27.132	0.080
		78.647	-0.020	93.410	93.411	45.239	-33.360
		86.334	-0.020	96.626	96.626	56.192	-66.700

y x = k

l F = 10 m N

l = (10 m N) 1/F

$$l \ \alpha \ \frac{1}{F}$$

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Example 4

Data Analysis							
Name =	Student			x variable =	P (watts)	y variable =	T (oK)
Type Data Here		Possible Proportionalities					
x variable	y variable	y/x	yx	y^2/x	y/x^2	y^2x	yx^2
1.000	10.000	10.000	10.000	100.000	10.000	100.000	10.000
2.000	14.100	7.050	28.200	99.405	3.525	397.620	56.400
3.000	17.300	5.767	51.900	99.763	1.922	897.870	155.700
4.000	20.000	5.000	80.000	100.000	1.250	1600.000	320.000
5.000	22.400	4.480	112.000	100.352	0.896	2508.800	560.000
		% Differences					
# of Data Points =		-54.815	82.276	-0.096	-184.200	90.916	95.463
5		-9.144	50.018	0.500	-0.181	63.881	74.412
		10.724	8.011	0.141	45.370	18.439	29.362
		22.593	*-41.794*	-0.096	64.475	-45.341	-45.177
		30.643	-98.511	-0.448	74.536	-127.895	-154.060

$$\frac{y^2}{x} = k$$

$$\frac{T^2}{P} = (100\ \frac{°K^2}{watts})$$

$$\boxed{T = (10\ \frac{°K}{\sqrt{watts}})\ \sqrt{P}}$$

$$T\ \alpha\ \sqrt{P}$$

Lab - Data Analysis - Homework

Use the data analysis below to find the equation relating the two given variables. Show all work.

Problem 1

Data Analysis							
Name =	Student			x variable =	U (s)	y variable =	E (m/s)
Type Data Here		Possible Proportionalities					
x variable	y variable	y/x	yx	y^2/x	y/x^2	y^2x	yx^2
0.100	40.500	405.000	4.050	16402.500	4050.000	164.025	0.405
0.200	9.850	49.250	1.970	485.113	246.250	19.405	0.394
0.300	4.400	14.667	1.320	64.533	48.889	5.808	0.396
0.400	2.480	6.200	0.992	15.376	15.500	2.460	0.397
0.500	1.550	3.100	0.775	4.805	6.200	1.201	0.388
		% Differences					
# of Data Points =		-323.448	-122.356	-383.213	-363.722	-325.158	-2.309
5		48.507	-8.159	85.709	71.805	49.703	0.470
		84.665	27.528	98.099	94.402	84.945	-0.035
		93.518	45.536	99.547	98.225	93.623	-0.237
		96.759	57.450	99.858	99.290	96.886	2.112

Directions:

1) Type in your name, the y variable symbol, and the x variable symbol in the spaces provided (yellow).
2) Type in your x,y data under the Type Data Here columns (blue).
3) Type in the number of data points. The minimum is 2 points, the maximum is 5 points.
4) Note that you can use the TAB key to jump from one field to another. Fields other than those noted above are locked and cannot be changed. Therefore you can easily TAB from one data field to another.
5) Go to FILE, PRINT.

$$y\,x^2 = k$$

$$E\,U^2 = 0.396\,\frac{m}{s}\,s^2$$

$$\boxed{E = (0.396\ m\ s)\,\frac{1}{U^2}}$$

$$E \;\alpha\; \frac{1}{U^2}$$

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Problem 2

Data Analysis							
Name =	Student			x variable =	P (kg)	y variable =	R (m)
Type Data Here		Possible Proportionalities					
x variable	y variable	y/x	yx	y^2/x	y/x^2	y^2x	yx^2
5.000	4.680	0.936	23.400	4.380	0.187	109.512	117.000
10.000	6.600	0.660	66.000	4.356	0.066	435.600	660.000
15.000	8.170	0.545	122.550	4.450	0.036	1001.234	1838.250
20.000	9.350	0.468	187.000	4.371	0.023	1748.450	3740.000
25.000	10.420	0.417	260.500	4.343	0.017	2714.410	6512.500
		% Differences					
# of Data Points =		-54.712	82.258	-0.008	-184.017	90.888	95.454
5		-9.092	49.958	0.551	-0.134	63.756	74.354
		9.971	7.082	-1.594	44.909	16.692	28.571
		22.726	-41.785	0.205	64.536	-45.481	-45.325
		31.107	-97.513	0.846	74.706	-125.854	-153.055

$$\frac{y^2}{x} = k$$

$$\frac{R^2}{P} = (4.38\ \frac{m^2}{kg})$$

$$R^2 = (4.38\ \frac{m^2}{kg})\ P$$

$$\boxed{R = (2.09\ \frac{m}{\sqrt{kg}})\ \sqrt{P}}$$

$$R\ \alpha\ \sqrt{P}$$

Data Set 1 - Sample Answer Set

1	Data Analysis							
2	Name =		Data Set 1		x variable =	P (watt)	y variable =	W (kg)
3	Type Data Here		Possible Proportionalities					
4	x variable	y variable	y/x	yx	y^2/x	y/x^2	y^2x	yx^2
5	1.000	0.193	0.193	0.193	0.037	0.193	0.037	0.193
6	1.500	0.434	0.289	0.651	0.126	0.193	0.283	0.977
7	2.000	0.772	0.386	1.544	0.298	0.193	1.192	3.088
8	2.500	1.210	0.484	3.025	0.586	0.194	3.660	7.563
9	3.000	1.740	0.580	5.220	1.009	0.193	9.083	15.660
10			% Differences					
11	# of Data Points =		50.060	90.924	90.940	0.085	98.693	96.488
12	5		25.134	69.388	69.457	0.143	90.090	82.233
13			0.121	27.396	27.519	0.085	58.191	43.814
14			-25.237	-42.246	-42.446	-0.225	-28.387	-37.600
15			-50.078	-145.462	-145.470	-0.087	-218.587	-184.934

$$\frac{y}{x^2} = k$$

$$\frac{W}{P^2} = 0.193 \ \frac{kg}{watt^2}$$

$$\boxed{W = (0.193 \ \frac{kg}{watt^2}) \ P^2}$$

$$W \ \alpha \ P^2$$

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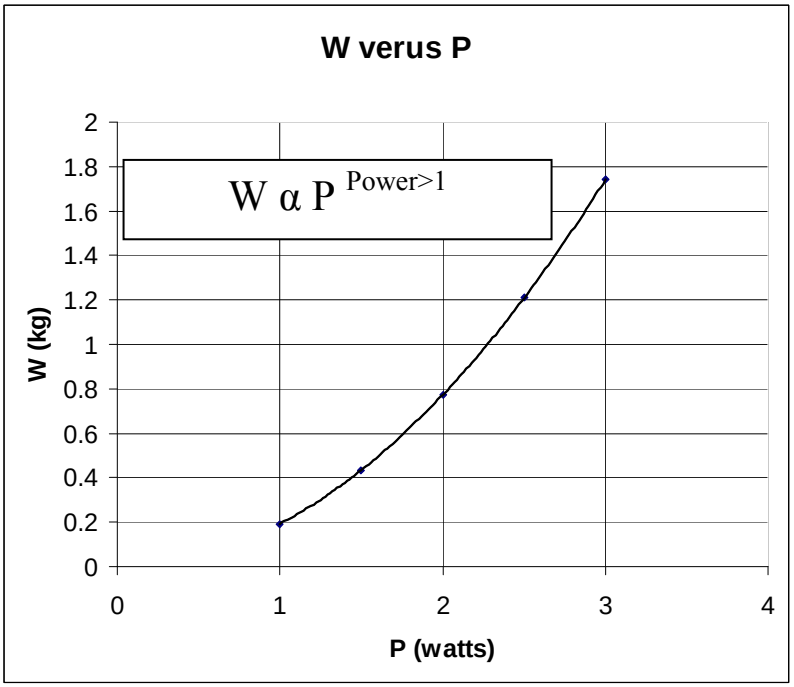
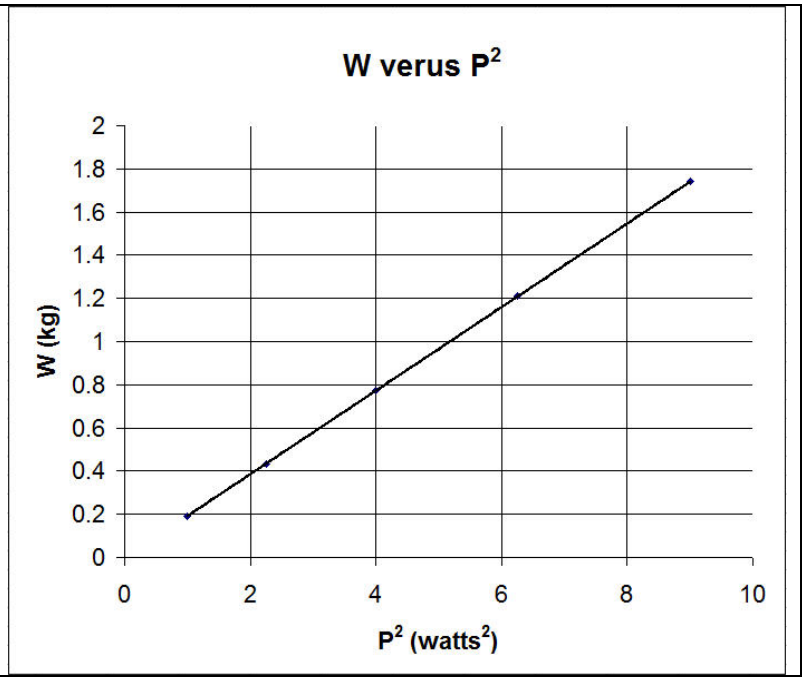
Graphical Analysis



P^2 (watts)^2	W (kg)
1.0	0.193
2.25	0.434
4.0	0.772
6.25	1.210
9	1.740

$$\text{slope} = \frac{1.7\text{ kg} - 0.2\text{ kg}}{9.2\text{ watt}^2 - 1.1\text{ watt}^2} = 0.185\,\frac{\text{kg}}{\text{watt}^2}$$

Equation:

$$W = \left(0.185\,\frac{\text{kg}}{\text{watt}^2}\right) P^2$$