Solutions for *Elementary Mathematical Analysis*

You'll need to create a new file for the solution of each problem in the solutions subdirectory. Also, if you rename your main file, change TextbookExample in this document (two places) to your new name.

Contents

Chapter 1

Solutions

1.1 Introduction

1.2 Functions

1.2.1 1.1 - Patterns All Around Us

L1 (0101LabPick)

Answer vary. Ex. "I am choosing to model ceiling tiles in my classroom, directly above my head." or "I choose to count fence posts on the picket-fence in the hallway."

L2 (0101LabMeasure)

Individual results will vary.

L3 (0101LabVar)

It makes the most sense for length to be dependent upon the number of items, not the other way around. We can freely choose the number of item we want to measure, so that is independent.

L4 (0101LabPlot)

Individual results will vary.

L5 (0101LabFunction)

$L(n) = m \cdot n$, where m is the length of 1 item.

L6 (0101LabDR)

The upper end is very situation-specific, the minimum means they should both begin: [0,...

L7 (0101LabExtra)

'Intra' means 'within' and 'extra' means 'outside'. Interpolation is finding a new data point between existing ones. Extrapolating is going beyond existing data to project new possibilities, such as 100 items.

L8 (0101LabPoint)

Individual results with vary.

1.2.2 1.4 - Through the Looking Glass

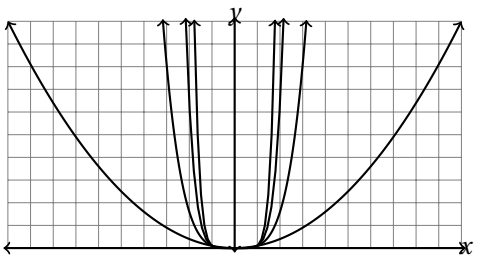
L1 (0104LabTable)

e.g. 2^4 is positive, 2^3 is positive, $(-2)^4$ is positive, and $(-2)^3$ is negative.

L2 (0104LabSquared)

see next

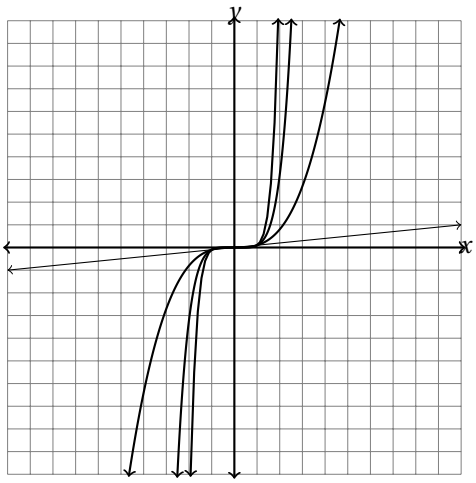
L3 (0104LabEven)



L4 (0104LabCubed)

see next

L5 (0104LabOdd)



L6 (0104LabDescribe)

Even graphs are symmetric across the x-axis, while odd graphs are symmetric across the origin.

L7 (0104LabSentences)

Even: $f(x) = f(-x)$. Odd: $f(x) = -f(-x)$.

L8 (0104LabBeauty)

Individual results vary. Often, evenly symmetrical objects appear more human, while odd and rotational symmetries appear impersonal. Human faces and bodies are even.

L9 (0104LabPoint)

Individual results vary.

1.2.3 Section 1.5 Exercises

P1 (0105Quad1)

a. $y \approx 1.09578x^2 - 2.69643x + 1.13637$

b. $y \approx -1.48736x^2 + 5.86598x - 8.11229$

P2 (0105Quad2)

a. $y \approx -0.57142x^2 + 2.2x + 1.94286$

b. $y \approx -1.48736x^2 + 5.86598x - 8.11229$

P3 (0105Arch)

a. $23.557x - 24.427$

b. 1248 cm

P4 (0105ModelDay)

From day 28 to 314, hence 286 days.

P5 (0105Hourly)

a. insert graphic

b. $y \approx .4089x + 9.8601$

c. 98.6%. It would seem so...

d. $0.0124x^2 + .2473x + 10.1241$

e. 99.8%. Yes, more so than the linear.

f. Individual results will vary.

P6 (0105traffic)

a. $y \approx -0.00746x^2 + 1.14821 + 4.80714$

b. 47.9 ft

P7 (0105LM1)

a. $\frac{2}{5}x + \frac{5}{2} = y$

b. $0 = y$

c. $\frac{23}{11}x - \frac{27}{22} = y$

d. $\frac{9}{23}x - \frac{19}{5} = y$

P8 (0105LM2)

a. $-\frac{5}{4}x - \frac{3}{4} = y$

b. $x = y$

c. $-4x + \frac{11}{3} = y$

d. $-\frac{484}{225} + \frac{7894}{5625} = y$

P9 (0105high)

NY $y \approx 25.61 \cdot \sin(.5090x - 2.0685) + 56.8797$

DC $y \approx 22.7410 \cdot \sin(.4946x - 1.9503) + 65.3889$

TX $y \approx 17.742 \cdot \sin(.5043x - 2.0110) + 79.1803$

They will never intersect.

P10 (0105sun)

a. $y \approx 32.2267 \sin(.3993x - .5706) + 26.9744$

b. 40.3

P11 (0105newton)

a. insert graphic

b. r^2=99.98%

c. $T(x) \approx 118.0705 \cdot .9511^x + 72.$

d. It seems exceedingly close to the data.

1.3 Limits

1.3.1 2.1 - Removing the Hole

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L9 (lab:L9)

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L10 (lab:L10)

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L11 (lab:L11)

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1.3.2 Section 2.1 Exercises

P1 (0201Remove1)

a. 5

b. $\frac{1}{6}$

c. 5

d. $\frac{11}{12}$

e. $-\frac{1}{9}$

f. $-\frac{1}{2}$

P2 (0201Remove2)

a. 3

b. $\frac{3}{2}$

c. 0

d. $\frac{3}{7}$

e. $-\frac{4}{5}$

f. $\frac{1}{8}$

1.3.3 2.5 - Extremely Average

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1.4 Parents

1.4.1 3.1 - In Pieces

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1.4.2 Section 3.1 Exercises

P1 (0301ParaPerpA)

a. a) $y = -x - 1$ b) $y = x + 5$

b. a) $y = -\frac{5}{3}x + \frac{53}{24}$ b) $y = \frac{3}{5}x + \frac{9}{40}$

c. a) $x = 2$ b) $y = 5$

d. a) $y = 1$ b) $x = 2$

e. a) $y = -3x - 13.1$ b) $y = \frac{1}{3}x - 0.1$

P2 (0301ParaPerpB)

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P3 (0301GrapherA)

a is parallel to c and b is perpendicular to them both

P4 (0301GrapherB)

No Solution File Found

P5 (0301GrapherC)

a is parallel to b and c is perpendicular to both

P6 (0301:GrapherD)

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P7 (0301TFA)

False. Steepness is measured by the absolute value of the slope/derivative.

P8 (0301TFB)

False. They do not have opposite-reciprocal slope.

P9 (0301TFC)

True.

P10 (0301TFD)

True.

1.4.3 3.2 - Zoomed Straight

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1.4.4 3.3 - Another Definition of Parabolas

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1.4.5 3.4 - Classic Ladder Problem

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1.5 Transformations

1.5.1 4.1 - I'm Batman

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L4 (lab:L4)

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1.5.2 Section 4.1 Exercises

P1 (0401ClassA)

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P2 (0401ClassB)

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P3 (0401X)

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P4 (0401Para)

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P5 (0401Cube)

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P6 (0401Sym)

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P7 (0401Football)

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P8 (0401Chain)

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1.5.3 4.2 - x, y, ...t?

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1.5.4 4.4 - “Upside Down”

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1.6 Powers

1.6.1 5.1 - Work Smarter, Not Harder

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L10 (lab:L10)

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L11 (lab:L11)

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1.6.2 Section 5.1 Exercises

P1 (0501xA)

a. $-\frac{125}{114}$

b. $-\frac{3}{76}$

c. $-\frac{222}{725}$

d. $\frac{51}{125}$

e. $-\frac{220}{12201}$

P2 (0501xB)

a. $\frac{119}{925}$

b. $-\frac{149450}{1955239}$

c. $-\frac{161168}{95227}$

d. $\frac{2662}{1593}$

e. $-\frac{564}{295}$

1.6.3 5.2 - The Power of Powers

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1.6.4 5.3 - With Great Power

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1.6.5 5.4 - Truth to Power

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1.7 Polynomials

1.7.1 6.1 - In the End

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1.7.2 6.3 - Twists and Turns

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1.8 Logarithms

1.8.1 7.1 - 3-in-1

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1.8.2 Section 7.1 Exercises

P1 (0701Identity)

a. identity

b. conditional

c. identity

d. conditional

e. false

P2 (0701Graph)

a. $y = x^3$

b. ${}^{3}_{y}\triangle_{x}$

c. Swap the position of x and y.

1.8.3 7.2 - Money Matters

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1.8.4 7.3 - Triangular Tables

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1.8.5 Section 7.3 Exercises

P1 (0703All6)

a. graphs

b. yup

c. infinite, infinite, infinite, two, infinite, two

d. roots and powers, logs and exponents, the other two

e. $9^y = x$ and $x^y = 9$

P2 (0703:LogProofs)

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P3 (0703SolveLogs)

a. 3 or -2

b. 999,999,999

P4 (0703SimplifyLogs)

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P5 (0703DescribeDifference)

Graphs up 2 vs left 2. ${}_5\triangle_x+2$ vs. ${}_5\triangle_{x+2}$

P6 (0703DescribeCalclog)

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1.8.6 7.4 - Log Infection

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1.9 Infinities

1.9.1 8.1 - Magic Number

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1.9.2 8.2 - It Don't Stop

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1.9.3 Section 8.2 Exercises

P1 (0802Hotel)

a. have each of the existing guests move to their room number plus n

b. many solutions. ex. have each existing guest move to 2 times his or her room number. The new guests can fill in the odds

c. many solutions. ex. having numbered each bus with a prime number starting with 3 (call it P_n), and having numbered each person the bus with a number (call it m), assign each new guest a room number P_n^m. Have all the existing guests move from their room (call it q) to 2^q.

d. many solution

P2 (0802BFF)

$1+x+x^2+x^3+x^4+x^5+\ldots$. Many answers, ex. by six terms it resembles the original from $-1/2$ to $1/2$. Even with vastly large numbers, it still only works from (-1,1).

P3 (0802Grandi)

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P4 (0802Gabriel)

Infinite surface, finite area. The surface never stops, so the painting would never stop. But the area sums to a finite number.

P5 (0802Primes)

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P6 (0802Power)

Make a table of booleans (T/F) for whether a number is included or not.

P7 (0802Aleph2)

Most functions and relations map the real numbers onto the real numbers. Like a power set, all possible combinations of the reals should yield a higher cardinality than the reals.

1.9.4 8.3 - Inverse of e

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L4 (lab:L4)

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1.9.5 8.4 - Limits by Derivative

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1.9.6 8.5 - To Infinity, and Beyond

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1.10 Circles

1.11 Identities

1.11.1 10.3 - Cosine, cosine, sine, sine

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L11 (lab:L11)

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1.12 Triangles

1.13 Polar

1.14 Regressions

1.15 Probabilities

1.16 Sequences

1.17 Radices

1.17.1 Section 16.1 Exercises

P1 (probP1)

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P2 (probP2)

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P3 (probP3)

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1.18 Prerequisites

1.18.1 Section A.1 Exercises

P1 (AASet1)

(i) x : x is an even natural numbers less than 12
(ii) x : x is a prime numbers less than 12
(iii) x : x is a month whose name starts with letter J
(iv) x : x is a vowel in English alphabets
(v) x : x is a day of the week whose name starts with letter T
(vi) x : x is a perfect square natural number up to 25
(vii) x : x is a natural number up to 30 and divisible by 5

P2 (AASet2)

(i) A = x | x is an odd number less than 10.
(ii) B = x | x is a perfect square natural number between 15 and 65
(iii) C = x | x is a vowel in English small alphabet.
(iv) D = x | x is a color in rainbow.
(v) E = x | x is a month having 31 days.

1.18.2 Section A.2 Exercises

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1.18.3 Section A.3 Exercises

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1.18.4 Section A.4 Exercises

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1.18.5 Section A.6 Exercises

P1 (AA06CubeDifference)

There are three prisms left over, when a cube is taken out of a larger cube. Their dimensions are $(a-b)(a)(a)$, $(a-b)(a)(b)$, and $(a-b)(b)(b)$. This can be factored into $a^3-b^3=(a-b)(a^2+ab+b^2)$.

P2 (AA06CubeSum)

Because the difference of cubes is $a^3-b^3=(a-b)(a^2+ab+b^2)$, we might guess that the sum of cubes would be mostly opposite, $(a+b)(a^2-ab-b^2)$, but that produces $a^3-2ab^2-b^3$. The correct formula is $a^3+b^3=(a+b)(a^2-ab+b^2)$.

P3 (AA06CS)

$$\begin{aligned} x^2+bx+c&=0\\ x^2+bx&=-c\\ x^2+bx+\frac{b^2}{4}&=\frac{b^2}{4}-c\\ \left(x+\frac{b}{2}\right)^2&=\frac{b^2-4c}{4}\\ x+\frac{b}{2}&=\pm\frac{\sqrt{b^2-4c}}{2}\\ x&=\frac{-b\pm\sqrt{b^2-4c}}{2} \end{aligned}$$

P4 (AA06QF)

$$\begin{aligned} ax^2+bx+c&=0\\ a(x^2+\frac{b}{a}x&=-c\\ x^2+bx+\frac{b^2}{4}&=\frac{b^2}{4}-\frac{c}{a}\\ \left(x+\frac{b}{2}\right)^2&=\frac{b^2-4ac}{4a}\\ x+\frac{b}{2}&=\pm\frac{\sqrt{b^2-4ac}}{2}\\ x&=\frac{-b\pm\sqrt{b^2-4ac}}{2} \end{aligned}$$

P5 (AA06Root)

Because $504=2^3\cdot3^2\cdot7$, we can "take out" one of each pair. That is $2\cdot3\sqrt{2\cdot7}$ or $6\sqrt{14}$.

P6 (AA06Factor)

a. 15,5

b. 9,-5

c. -8,-10

d. -7,-9

P7 (AA06Split)

a. $(2r-11)(2r+7)$

b. $(2x-13)(2x+5)$

c. $(3k-4)(3k+10)$

d. $2(2y-5)(2y+1)$

P8 (AA06Hard)

a. $\frac{-5\pm4\sqrt{30}}{5}$

b. $2\pm i\sqrt{2}$

c. $10\pm\sqrt{29}$

P9 (AA06Disc)

Because the term b^2-4ac is under the radical, there are three cases. If it is a perfect square, then there will be two rational solutions. If it is otherwise positive, there will be two irrational solutions. If it is negative, there will be two imaginary solutions.

1.19 Matrices

1.20 Vectors

1.21 Conics

1.21.1 D.1 - Mirror, Mirror, in R3

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1.22 Solutions

1.23 Bibliography