Introduction to Mathcad 15: Solution Manual

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Chapter 1: Mathcad: The Engineer's Scratch Pad

Problem	Mathcad File	PDF File
1.1	0101.xmcd	0101.pdf
1.2	0102.xmcd	0102.pdf
1.3	0103.xmcd	0103.pdf
1.4	0104.xmcd	0104.pdf
1.5	0105.xmcd	0105.pdf

Chapter 2: Mathcad Fundamentals

Problem	Mathcad File	PDF File
2.1	0201.xmcd	0201.pdf
2.2	0202.xmcd	0202.pdf
2.3	0203.xmcd	0203.pdf
2.4	0204.xmcd	0204.pdf
2.5	0205.xmcd	0205.pdf
2.6	0206.xmcd	0206.pdf
2.7	0207.xmcd	0207.pdf
2.8	0208.xmcd	0208.pdf
2.9	0209.xmcd	0209.pdf
2.10	0210.xmcd	0210.pdf
2.11	0211.xmcd	0211.pdf
2.12	0212.xmcd	0212.pdf
2.13	0213.xmcd	0213.pdf
2.14	0214.xmcd	0214.pdf
2.15	0215.xmcd	0215.pdf
2.16	0216.xmcd	0216.pdf
2.17	0217.xmcd	0217.pdf
2.18	0218.xmcd	0218.pdf
2.19	0219.xmcd	0219.pdf
2.20	0220.xmcd	0220.pdf

Chapter 3: Mathcad Functions

Problem	Mathcad File	PDF File
3.1	0301.xmcd	0301.pdf
3.2	0302.xmcd	0302.pdf
3.3	0303.xmcd	0303.pdf
3.4	0304.xmcd	0304.pdf
3.5	0305.xmcd	0305.pdf
3.6	0306.xmcd	0306.pdf
3.7	0307.xmcd	0307.pdf
3.8	0308.xmcd	0308.pdf
3.9	0309.xmcd	0309.pdf
3.10	0310.xmcd	0310.pdf
3.11	0311.xmcd	0311.pdf
3.12	0312.xmcd	0312.pdf
3.13	0313.xmcd	0313.pdf
3.14	0314.xmcd	0314.pdf
3.15	0315.xmcd	0315.pdf
3.16	0316.xmcd	0316.pdf
3.17	0317.xmcd	0317.pdf
3.18	0318.xmcd	0318.pdf
3.19	0319.xmcd	0319.pdf
3.20	0320.xmcd	0320.pdf

Chapter 4: Working with Matrices

Problem	Mathcad File	PDF File
4.1	0401.xmcd	0401.pdf
4.2	0402.xmcd	0402.pdf
4.3	0403.xmcd	0403.pdf
4.4	0404.xmcd	0404.pdf
4.5	0405.xmcd	0405.pdf
4.6	0406.xmcd	0406.pdf
4.7	0407.xmcd	0407.pdf
4.8	0408.xmcd	0408.pdf
4.9	0409.xmcd	0409.pdf
4.10	0410.xmcd	0410.pdf
4.11	0411.xmcd	0411.pdf
4.12	0412.xmcd	0412.pdf
4.13	0413.xmcd	0413.pdf
4.14	0414.xmcd	0414.pdf
4.15	0415.xmcd	0415.pdf

Chapter 5: Data Analysis Functions

Problem	Mathcad File	PDF File
5.1	0501.xmcd	0501.pdf
5.2	0502.xmcd	0502.pdf
5.3	0503.xmcd	0503.pdf
5.4	0504.xmcd	0504.pdf
5.5	0505.xmcd	0505.pdf
5.6	0506.xmcd	0506.pdf
5.7	0507.xmcd	0507.pdf
5.8	0508.xmcd	0508.pdf
5.9	0509.xmcd	0509.pdf
5.10	0510.xmcd	0510.pdf
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5.15	0515.xmcd	0515.pdf
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5.17	0517.xmcd	0517.pdf
5.18	0518.xmcd	0518.pdf
5.19	0519.xmcd	0519.pdf
5.20	0520.xmcd	0520.pdf

Chapter 6: Programming in Mathcad

Problem	Mathcad File	PDF File
6.1	0601.xmcd	0601.pdf
6.2	0602.xmcd	0602.pdf
6.3	0603.xmcd	0603.pdf
6.4	0604.xmcd	0604.pdf
6.5	0605.xmcd	0605.pdf
6.6	0606.xmcd	0606.pdf
6.7	0607.xmcd	0607.pdf
6.8	0608.xmcd	0608.pdf
6.9	0609.xmcd	0609.pdf
6.10	0610.xmcd	0610.pdf
6.11	0611.xmcd	0611.pdf
6.12	0612.xmcd	0612.pdf
6.13	0613.xmcd	0613.pdf
6.14	0614.xmcd	0614.pdf
6.15	0615.xmcd	0615.pdf

Chapter 7: Symbolic Math Using Mathcad

Problem	Mathcad File	PDF File
7.1	0701.xmcd	0701.pdf
7.2	0702.xmcd	0702.pdf
7.3	0703.xmcd	0703.pdf
7.4	0704.xmcd	0704.pdf
7.5	0705.xmcd	0705.pdf
7.6	0706.xmcd	0706.pdf
7.7	0707.xmcd	0707.pdf
7.8	0708.xmcd	0708.pdf
7.9	0709.xmcd	0709.pdf
7.10	0710.xmcd	0710.pdf
7.11	0711.xmcd	0711.pdf
7.12	0712.xmcd	0712.pdf
7.13	0713.xmcd	0713.pdf
7.14	0714.xmcd	0714.pdf
7.15	0715.xmcd	0715.pdf

Chapter 8: Numerical Techniques

Problem	Mathcad File	PDF File
8.1	0801.xmcd	0801.pdf
8.2	0802.xmcd	0802.pdf
8.3	0803.xmcd	0803.pdf
8.4	0804.xmcd	0804.pdf
8.5	0805.xmcd	0805.pdf
8.6	0806.xmcd	0806.pdf
8.7	0807.xmcd	0807.pdf
8.8	0808.xmcd	0808.pdf
8.9	0809.xmcd	0809.pdf
8.10	0810.xmcd	0810.pdf
8.11	0811.xmcd	0811.pdf
8.12	0812.xmcd	0812.pdf
8.13	0813.xmcd	0813.pdf
8.14	0814.xmcd	0814.pdf
8.15	0815.xmcd	0815.pdf

Chapter 9: Using Mathcad with Other Programs

Problem	Mathcad File	PDF File
9.1	0901.xmcd	0901.pdf
9.2	0902.xmcd	0902.pdf
9.3	0903.xmcd	0903.pdf
9.4	0904.xmcd	0904.pdf
9.5	0905.xmcd	0905.pdf
9.6	0906.xmcd	0906.pdf
9.7	0907.xmcd	0907.pdf

1.1 Mathcad Reference Tables: Physical Property Values at 300 K

Density of Water

Water $997.1 \cdot \frac{kg}{m^3}$

Density of Sea Water

Sea water $1025 \cdot \frac{kg}{m^3}$

Viscosity of Water

Water $0.00089 \frac{newton \cdot sec}{m^2}$

Viscosity of Kerosene

Kerosene $0.00164 \frac{newton \cdot sec}{m^2}$

Surface Tension of Water

Water $0.07197 \cdot \frac{newton}{m}$

Surface Tension of Acetone

Acetone $0.0231 \cdot \frac{newton}{m}$

1.2 Mathcad Reference Tables: Comparing Physical Property Values

Which metal has the higher thermal conductivity: copper or aluminum?

Copper	$3.98\cdot\frac{watt}{cm\cdot K}$
Aluminum	$2.37\cdot\frac{watt}{cm\cdot K}$

Answer: Copper

Which metal has the higher linear expansion coefficient: copper or iron?

Copper	16.6
Iron	12

Answer: Copper

Which metal has the lower modulus of elasticity: gold or silver?

Gold	$7.446\cdot10^{10}\cdot Pa$
Silver	$7.239\cdot10^{10}\cdot Pa$

Answer: Silver

Which metal has the lower melting point: lead or tin?

Lead	$600.7\cdot K$
Tin	$505\cdot K$

Answer: Tin

1.3 Effect of Temperature on Viscosity

$$\mu_{correct} := 0.00037 \cdot \frac{N}{sec \cdot m^2}$$ << actual viscosity at 350 K

$$\mu_{incorrect} := 0.00089 \cdot \frac{N}{sec \cdot m^2}$$ << at 300 K, not 350 K

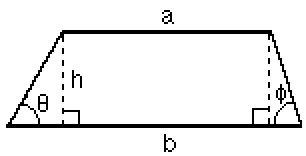
$$Percent\_Error := \frac{\mu_{correct} - \mu_{incorrect}}{\mu_{correct}} \cdot 100\%$$

$$Percent\_Error = -140.5\,\%$$

The minus sign indicates that the correct value is smaller than the incorrect value (the difference is negative).

1.4 Mathcad Reference Tables: Geometry Formulas

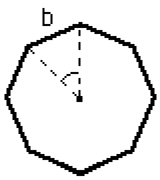
Area and perimeter of a trapezoid



Area: $\frac{1}{2} \cdot h \cdot (a + b)$

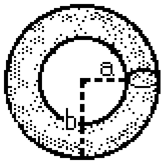
Perimeter: $a + b + h \cdot \left(\frac{1}{\sin(\theta)} + \frac{1}{\sin(\phi)} \right)$

Area of a regular polygon with "n" sides



Area: $\frac{1}{4} \cdot n \cdot b^2 \cdot \cot\left(\frac{\pi}{n} \right)$

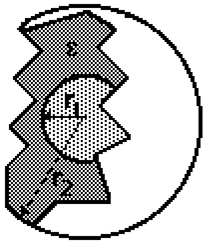
Volume of a torus (doughnut shape)



Volume:

$$\frac{1}{4} \cdot \pi^2 \cdot (a + b) \cdot (b - a)^2$$

1.5 Mathcad Reference Tables: Capacitance Formula



Capacitance:

$$\frac{4\cdot\pi\cdot\varepsilon}{\frac{1}{r_1}-\frac{1}{r_2}}$$

2.1 Unit Conversions

part a)

$a := 2.998 \cdot 10^{8} \cdot \frac{m}{sec}$ $\qquad a = 6.706 \times 10^{8} \frac{mi}{hr}$

part b)

$\rho := 62.3 \cdot \frac{lb}{ft^{3}}$ $\qquad \rho = 997.95 \frac{kg}{m^{3}}$

part c)

$\rho := 1000 \cdot \frac{kg}{m^{3}}$ $\qquad \rho = 62.428 \frac{lb}{ft^{3}}$

part d)

$\mu := 0.01 \cdot poise$ $\qquad \mu = 6.72 \times 10^{-4} \frac{lb}{ft \cdot sec}$

$\mu = 1 \times 10^{-3} \frac{kg}{m \cdot sec}$

Note: Poise is predefined in Mathcad, but cP is not. To use cP, define it in a worksheet as:

$cP := \frac{poise}{100}$

$\mu = 1\, cP$

part e)

$R_{gas} := 0.08206 \cdot \frac{L \cdot atm}{mol \cdot K}$ $\qquad R_{gas} = 8.315 \frac{joule}{mol \cdot K}$

Note: R is predefined as °R (Rankine) in Mathcad, so R_{gas} was used here to preserve the definition of R.

2.2 Volume and Surface Area of a Sphere

$r := 3 \cdot cm$

$V := \frac{4}{3} \cdot \pi \cdot r^3$ $\quad V = 1.131 \times 10^{-4}\, m^3$ $\quad V = 113.097\, cm^3$

$A := 4 \cdot \pi \cdot r^2$ $\quad A = 0.011\, m^2$ $\quad A = 113.097\, cm^2$

2.3 Volume and Surface Area of a Torus

$R := 3 \cdot cm$ $\qquad r := 1.5 \cdot cm$

$V := 2 \cdot \pi^2 \cdot R \cdot r^2$ $\qquad V = 1.332 \times 10^{-4}\, m^3$ $\qquad V = 133.24\, cm^3$

$A := 4 \cdot \pi^2 \cdot R \cdot r$ $\qquad A = 0.018\, m^2$ $\qquad A = 177.653\, cm^2$

Note: Defining "R" above overwrote the definition of °R in Mathcad's unit system. It doesn't cause any trouble here because temperature is not involved in these calculations.

2.4 Ideal Gas Behavior, I

$M := 5 \cdot gm$ $\qquad MW := 35.45 \cdot \frac{gm}{mol}$

$h := 2 \cdot cm$

$T := (25 + 273.15) \cdot K$

$n := \frac{M}{MW}$ $\qquad n = 0.141\,mol$

$P := 1 \cdot atm$

$R_{gas} := 0.08206 \cdot \frac{liter \cdot atm}{mol \cdot K}$

part a)

$V := \frac{n \cdot R_{gas} \cdot T}{P}$ $\qquad V = 3.451 \times 10^{-3}\,m^3$ $\qquad V = 3.451\,liter$

$r := \sqrt{\frac{V}{\pi \cdot h}}$ $\qquad r = 23.435\,cm$

part b)

$V_{final} := V \cdot \frac{5 \cdot cm}{2 \cdot cm}$ $\qquad V_{final} = 8.627\,liter$

$T_{final} := \frac{P \cdot V_{final}}{n \cdot R_{gas}}$ $\qquad T_{final} = 745.375\,K$ $\qquad T_{final} = 472.225\,°C$

Note: A common error when working with mass is to use the variable "m" for the mass. This would overwrite the "m" used for meters in Mathcad's unit system creating errors that can be extensive and hard to find. Here, the variable "M" is used to avoid this problem (Mathcad's variable names are case sensitive so "m" and "M" are different variable names.)

2.5 Ideal Gas Behavior, II

$r := 2.5 \cdot cm$ $\qquad h := 5 \cdot cm$

$V := \pi \cdot r^2 \cdot h$ $\qquad V = 98.175\, cm^3$

$P := 1 \cdot atm$

$T := (25 + 273.15) \cdot K$

$R_{gas} := 0.08206 \cdot \frac{liter \cdot atm}{mol \cdot K}$

part a)

$n := \frac{P \cdot V}{R_{gas} \cdot T}$ $\qquad n = 4.013 \times 10^{-3}\, mol$

part b)

$V_{final} := V \cdot \frac{2 \cdot cm}{5 \cdot cm}$ $\qquad V_{final} = 0.039\, liter$

$P_{final} := \frac{n \cdot R_{gas} \cdot T}{V_{final}}$ $\qquad P_{final} = 2.5\, atm$

2.6 Relating Force and Mass

$g_c := 1$ << unnecessary, but can be included if desired

$M := 150 \cdot kg$ << did not want to use 'm' -- it would overwrite the definition of "meters"

$g = 9.807 \dfrac{m}{s^2}$ << 'g' is a predefined variable in Mathcad

part a)

$F := M \cdot \dfrac{g}{g_c}$ $F = 1470.997\,N$

- or -

$F := M \cdot g$ $F = 1470.997\,N$

part b)

$FF := 300 \cdot N$ << allowed force per wire

$MM := FF \cdot \dfrac{g_c}{g}$ $MM = 30.591\,kg$ << kg/wire

$N_{wires} := \dfrac{M}{MM}$ $N_{wires} = 4.903$ << round UP to 5 wires