
▲ Maths100 and 180 September–December 2015

▲ Suggested homework problems

- This file updated September 14th.
- Doing the homework problems is an essential part of studying for the course.
- In addition to Webwork assignments, you should do these questions. While they are “suggested” you should attempt a sizeable fraction of them each week.
- Of course, many of the problems will be of the same “flavour” — you should make that you do a variety of different problems, not just 1 sort.
- The problems are arranged by topic rather than by week. The course divides into roughly 3 parts — Limits, Derivatives and Applications. Each of these are then broken down into subtopics.
- You should look at the [course outline](#) and your lecture notes to see what problems you should be working on. You can, of course, also get a little ahead of the schedule.

▲ Texts

Note that there is no compulsory text for this course. Instead we will take problems from the following 3 free textbooks.

- **MOOCulus:** <https://mooculus.osu.edu/handouts>
by Fowler & Snapp
The answers to every problem are given at the end, but without solutions.
- **APEX Calculus:** <http://www.apexcalculus.com/downloads/>
by Hartman, et al
Odd problems have answers at the end, without solutions.
- **Active Calculus:** <https://opencalculus.wordpress.com/about/download-active-calculus/>
by Boeklins, et al
The text does not give answers.

We recommend that you download these at the start of term.

▲ Topic 1 = Limits

▶ Tangents and velocity

- *Standard Problems:*

Active Calculus: Section 1.3, pages 30-31, problem 1

- *Challenge Problems:*

Active Calculus: Section 1.3, page 31, problem 2

- *Conceptual Problems:*

APEX Calculus: Section 2.1, page 69, problems 1, 2

- *Problems that are a little less standard:*

Active Calculus: Section 1.1, pages 7-10, problems 1-3.

▶ Introduction to limits

- *Standard Problems:*

MOOCulus: Section 1.1, page 23, problems 1-8

APEX Calculus: Section 1.4, page 36, problems 13-21

- *Challenge Problems:*

MOOCulus: Section 1.1, page 24, problem 10

- *Conceptual Problems:*

MOOCulus: Section 1.1, page 23, problems 1,8,9

APEX Calculus: Section 1.1, page 8, problems 1,3,4

APEX Calculus: Section 1.3, page 28, problems 1,2

APEX Calculus: Section 1.4, pages 35-36, problems 1-12

APEX Calculus: Section 1.5, page 45, problem 43

APEX Calculus: Section 1.6, pages 55-56, problems 1, 3, 4, 8, 11

Active Calculus: Section 1.2, pages 20-21, problem 3

- *Problems that are a little less standard:*

MOOCulus: Section 1.1, page 24, problem 10.

APEX Calculus: Section 1.3, page 28, problem 5.

▶ Limit laws

- *Standard Problems:*

MOOCulus: Section 1.3, page 35, problems 1-15

MOOCulus: Section 2.1, page 38, problems 1-10

APEX Calculus: Section 1.1, page 8, problems 6-15

APEX Calculus: Section 1.3, pages 28-29, problems 18-36

APEX Calculus: Section 1.4, page 36, problems 22-24

- *Challenge Problems:*

MOOCulus: Section 1.3, page 35, problems 6,13

- *Conceptual Problems:*

MOOCulus: Section 1.3, page 35, problems 7,15

APEX Calculus: Section 1.3, page 28, problems 5-17

• *Motivational Problems:*

Active Calculus: Section 1.2, pages 19-20, problems 1-2

►► Continuity

• *Standard Problems:*

MOOCulus: Section 2.3, page 46, problems 1-10

APEX Calculus: Section 1.5, page 45, problems 19-32, 37-40. Note that the “bisection method” is just how we found roots of continuous functions using the intermediate value theorem.

• *Conceptual Problems:*

APEX Calculus: Section 1.5, pages 44-45, problems 1-3, 5-17, 33-36

►► Limits at infinity

• *Standard Problems:*

MOOCulus: Section 2.2, page 42, problems 1-10, 12

APEX Calculus: Section 1.6, page 56, problems 19-28

• *Challenge Problems:*

MOOCulus: Section 2.2, page 42, problems 8, 11

• *Conceptual Problems:*

APEX Calculus: Section 1.6, pages 55-56, problems 1-4, 7-10, 12-14

• *Problems that are a little less standard:*

MOOCulus: Section 2.2, page 42, problem 11

• *Motivational Problems:*

MOOCulus: Section 2.2, page 42, problems 11,12.

▲ Topic 2 = Derivatives

▶ A first look at derivatives

- *Standard Problems:*

MOOCulus: Section 3.1, page 53, problems 7

- *Conceptual Problems:*

MOOCulus: Section 3.1, page 54, problems 1-5

APEX Calculus: Section 2.1, pages 69-70, problems 2, 26-30

APEX Calculus: Section 2.2, page 77, problems 1, 3-6, 8-9, 11, 15-18

- *Problems that are a little less standard:*

APEX Calculus: Section 2.2, page 77, problem 7.

APEX Calculus: Section 2.2, page 77, problems 2, 10, 12-14

Active Calculus: Section 1.5, page 50, problems 2,4

▶ A second look at derivatives

- *Standard Problems:*

MOOCulus: Section 3.1, page 53, problems 8-10

APEX Calculus: Section 2.1, pages 69-70, problems 6-12, 24

- *Challenge Problems:*

Active Calculus: Section 1.7, pages 75-76, problem 4

- *Conceptual Problems:*

MOOCulus: Section 3.1, page 54, problem 6

Active Calculus: Section 1.7, pages 74-75, problems 1-3

- *Problems that are a little less standard:*

MOOCulus: Section 3.1, page 53, problem 2 — a very nice problem.

▶ Derivatives of polynomials and exponentials

- *Standard Problems:*

MOOCulus: Section 3.2, pages 62-63, problems 1-19, 24, 27, 28

APEX Calculus: Section 2.3, page 84, problems 11-13, 15, 18

- *Challenge Problems:*

MOOCulus: Section 3.2, pages 62-63, problems 20-23, 29

- *Conceptual Problems:*

MOOCulus: Section 3.2, page 62, problems 25, 26

Active Calculus: Section 2.1, pages 94-95, problems 1-3. For problem 1(d), “local linearization” is just the tangent line. We do this in more detail later in the course.

- *Problems that are a little less standard:*

APEX Calculus: Section 3.2, page 84, problems 3,4,7.

▶ The product and quotient rules

- *Standard Problems:*

MOOCulus: Section 5.1, page 85, problems 1-6

MOOCulus: Section 5.2, page 85, problems 1-7

APEX Calculus: Section 2.4, pages 94-95, problems 17, 20-22, 34, 36, 37

• *Challenge Problems:*

APEX Calculus: Section 2.4, page 94, problems 7-14

• *Conceptual Problems:*

MOOCulus: Section 5.1, page 85, problems 8-11

MOOCulus: Section 5.2, page 85, problems 8-12

APEX Calculus: Section 2.4, pages 94-95, problems 1, 2, 5, 41

Active Calculus: Section 2.3, pages 110-111, problems 1-3. For problem 1(d), the “local linearization” is just the tangent line.

• *Problems that are a little less standard:*

MOOCulus: Section 5.1, page 85, problem 12

Active Calculus: Section 3.2, pages 111-112, problems 4, 5

► Derivatives of trig functions

• *Standard Problems:*

MOOCulus: Section 7.1, page 112, problems 2-4, 6, 9-11, 15, 18-21, 23

APEX Calculus: Section 2.3, page 84, problems 14, 16, 21

APEX Calculus: Section 2.4, pages 94-95, problems 16, 18, 19, 23-29, 35, 38-40

Active Calculus: Section 2.4, page 118, problem 3

• *Challenge Problems:*

APEX Calculus: Section 1.3, page 29, problems 37, 38, 40

• *Conceptual Problems:*

APEX Calculus: Section 2.4, page 94, problem 3

► The chain rule

• *Standard Problems:*

MOOCulus: Section 6.1, pages 95-96, problems 1-35, 37-39

APEX Calculus: Section 2.5, page 105, problems 7-15, 26-28

Active Calculus: Section 2.5, page 127, problems 1, 2

• *Challenge Problems:*

MOOCulus: Section 6.1, pages 95-96, problems 36, 40

• *Conceptual Problems:*

APEX Calculus: Section 2.5, page 105, problems 1, 6

Active Calculus: Section 2.5, page 127-128, problem 3

• *Problems that are a little less standard:*

Active Calculus: Section 2.5, page 128, problem 4

► Inverse functions

• *Standard Problems:*

APEX Calculus: Section 2.7, page 122, problems 1-4

• *Conceptual Problems:*

APEX Calculus: Section 2.7, page 122, problems 5-8

► **Implicit Differentiation**

• *Standard Problems:*

MOOCulus: Section 6.2, page 101, problems 1-8, 10-15

MOOCulus: Section 7.2, page 120, problems 2-7

APEX Calculus: Section 2.5, pages 115-116, problems 13-23, 28-35. Recall that $\frac{d^2y}{dx^2}$ is notation for the second derivative of y with respect to x . ie $\frac{d^2y}{dx^2} = y''(x)$.

Active Calculus: Section 2.6, page 138, problem 1

Active Calculus: Section 2.7, page 148, problems 1, 2

• *Challenge Problems:*

MOOCulus: Section 6.2, page 101, problem 9

• *Conceptual Problems:*

MOOCulus: Section 7.2, page 120, problem 1

APEX Calculus: Section 2.6, page 115, problems 1, 2

• *Problems that are a little less standard:*

Active Calculus: Section 2.7, page 148, problem 3

► **Logarithms and their derivatives**

• *Standard Problems:*

MOOCulus: Section 6.3, page 106, problems 1-10

APEX Calculus: Section 2.6, page 116, problems 36-41

Active Calculus: Section 2.4, page 117, problem 1

• *Conceptual Problems:*

Active Calculus: Section 2.2, page 100, problem 1

• *Problems that are a little less standard:*

MOOCulus: Section 6.3, page 106, problem 10. A good logarithmic differentiation problem

APEX Calculus: Section 2.3, page 84, problem 26

▲ Topic 3 = Applications

▶ Rates of change

• *Standard Problems:*

MOOCulus: Section 8.2, pages 134-135, problems 1-4, 7

▶ Exponential growth and decay

• *Standard Problems:*

MOOCulus: Section 8.2, page 134, problems 5,6

MOOCulus: 11.2, page 196, problems 3-6

▶ Related rates

• *Standard Problems:*

MOOCulus: Section 8.3, pages 143-145, problems 1-20

APEX Calculus: Section 4.2, pages 171-172, problems 3-15

Active Calculus: Section 3.5, pages 206-207, problems 1-4

• *Conceptual Problems:*

APEX Calculus: Section 4.2, page 171, problem 1

▶ Linear approximations

• *Standard Problems:*

MOOCulus: Section 10.1, page 165, problems 1-10

Active Calculus: Section 1.8, pages 83-84, problems 1-3

APEX Calculus: Section 4.4, page 186, problems 6-16, 30-33

• *Challenge Problems:*

Active Calculus: Section 1.8, page 85, problem 4

• *Conceptual Problems:*

APEX Calculus: Section 4.4, page 186, problems 2, 3, 5

• *Problems that are a little less standard:*

APEX Calculus: Section 4.4 pages 186-187, problems 34-38.

▶ Taylor polynomials

• *Standard Problems:*

APEX Calculus: Section 8.7, page 475, problems 5-20, 29-33. Recall that a Maclaurin polynomial is just a Taylor polynomial expanded around $x = 0$.

• *Conceptual Problems:*

APEX Calculus: Section 8.7, page 475, problems 1-4. Recall that a Maclaurin polynomial is just a Taylor polynomial expanded around $x = 0$.

Active Calculus: Section 8.5, page 518, problem 1

► Taylor's formula with remainder

•Standard Problems:

APEX Calculus: Section 8.7, page 475, problems 21-28

APEX Calculus: Section 8.8, page 487, problems 3-12, 25-30

Active Calculus: Section 8.5, page 518, problem 2

•Challenge Problems:

Active Calculus: Section 8.5, pages 518-519, problem 3

•Conceptual Problems:

APEX Calculus: Section 8.8, page 487, problems 1, 17-20

► Finding maxima and minima

•Standard Problems:

MOOCulus: Section 4.1, page 67, problems 1-11

MOOCulus: Section 9.1, page 149, problems 1-10

APEX Calculus: Section 3.1, page 130, problems 15-24

Active Calculus: Section 3.3, page 191, problem 4

•Conceptual Problems:

MOOCulus: Section 4.1, page 67, problem 12

APEX Calculus: Section 3.1, page 129, problems 1-7

Active Calculus: Section 3.3, pages 190-191, problems 1,3

•Challenge Problems:

Active Calculus: Section 3.3, page 190, problem 2

•Problems that are a little less standard:

MOOCulus: Section 4.1, page 67, problem 13. This is a nice problem.

APEX Calculus: Section 3.1, pages 129-130, problems 8-14.

► The mean value theorem

•Standard Problems:

MOOCulus: Section 10.3, page 177, problems 1-5, 10, 11

APEX Calculus: Section 3.2, page 135, problems 3-20

•Conceptual Problems:

APEX Calculus: Section 3.2, page 135, problems 1, 2

► A first look at curve sketching

•Standard Problems:

MOOCulus: Section 4.2, page 70, problems 1-7

MOOCulus: Section 4.3, page 74, problems 1-11

MOOCulus: Section 4.4, page 77, problems 1-10

APEX Calculus: Section 3.3, page 143, problems 14-23

Active Calculus: Section 1.6, pages 62-64, problems 1, 3, 4

Active Calculus: Section 3.1, page 172-173, problems 1, 2, 4

•Conceptual Problems:

APEX Calculus: Section 3.3, page 143, problems 1-5

Active Calculus: Section 3.1, page 172, problem 3
Active Calculus: Section 3.2, pages 181-182, problems 1, 2

• *Challenge Problems:*

Active Calculus: Section 3.2, page 182, problem 3

• *Problems that are a little less standard:*

MOOCulus: Section 4.2, page 70, problem 8

►► More curve sketching

• *Standard Problems:*

MOOCulus: Section 4.5, page 81, problems 1-8

APEX Calculus: Section 3.5, page 158, problems 12-25

• *Challenge Problems:*

APEX Calculus: Section 3.5, page 158, problems 26-29

Active Calculus: Section 1.6, page 63, problem 2

Active Calculus: Section 2.8, page 159, problem 2

►► Optimisation problems

• *Standard Problems:*

MOOCulus: Section 9.2, pages 157-160, problems 1-32

APEX Calculus: Section 4.3, page 179, problems 3-17

Active Calculus: Section 3.4, page 197, problems 1-4

• *Conceptual Problems:*

APEX Calculus: Section 4.3, page 179, problem 1

• *Problems that are a little less standard:*

MOOCulus: Section 9.2, pages 159-160, problems 24,31

APEX Calculus: Section 4.3, page 179, problem 10

►► 4.4 L'Hopital's Rule

• *Standard Problems:*

MOOCulus: Section 8.1, pages 128-129, problems 1-49

APEX Calculus: Section 6.7, pages 331-332, problems 8-52

Active Calculus: Section 2.8, page 159, problem 3

• *Conceptual Problems:*

APEX Calculus: Section 6.7, page 331, problems 3, 4, 6, 7

Active Calculus: Section 2.8, page 159, problem 1

• *Problems that are a little less standard:*

Active Calculus: Section 2.8, page 159, problem 4. This is a very good problem using L'Hospital to figure out relative orders of magnitude for common functions.

►► Antiderivatives

• *Standard Problems:*

MOOCulus: Section 11.1, page 185, problems 1-10

APEX Calculus: Section 5.1, pages 197-198, problems 8-26, 28-38

• *Challenge Problems:*

MOOCulus: Section 11.1, pages 185-186, problems 11-34

• *Conceptual Problems:*

APEX Calculus: Section 5.1, page 197, problems 1-7, 27

Active Calculus: Section 4.1, page 221, problem 1