

Last name _____

First name _____

LARSON—MATH 255—CLASSROOM WORKSHEET 05
Lists—Calculus

1. Log in to your Sage Cloud account.
 - (a) Start the Chrome browser.
 - (b) Go to `http://cloud.sagemath.com` and sign in.
 - (c) You should see an existing Project for our class. Click on that.
 - (d) Click “New”, call it **c05**, then click “Sage Worksheet”.
 - (e) For each problem number, label it in the Sage cell where the work is. So for Problem 1, the first line of the cell should be `#Problem 1`.

Lists in Sage

A *list* is a basic *data structure* in Python and Sage. They are represented by square brackets with comma separated numbers, strings, etc., between them (like `[2, 5, 9]` or `["red", "blue"]`). We have already seen lists in our use of both the `solve()` and `line()` commands which used, respectively, a list of equations and a list of points.

2. Lists can be given names. Evaluate `L=[2,3,5,9]`. Then evaluate `L`.
3. Lists are indexed starting with 0. Evaluate each of `L[0]`, `L[1]`, `L[2]`, and `L[3]`.
4. Lists can be combined with “+”. Evaluate `[2,3,5,9]+[3,4,5]`. (Note: any common elements are repeated.)
5. Let `M=[3,4,5]`. Evaluate `L+M`.
6. If you want all the integers from x to y you can use the shorthand notation `[x..y]`. Evaluate `[3..7]`.
7. If you want a list with m n 's you can use the shorthand notation `[n]*m`. Evaluate `[0]*7`.
8. You can have a list of lists. Evaluate `L=[[0,1],[2,3],[4,5]]`. Now evaluate `L[1]`. Then evaluate `L[1][0]`. What do you think the value of `L[0][1]` is?
9. You can use `map()` to apply a function to each term of a list. Let `f(x)=x**2`. Evaluate `map(f(x), [2,5,9])`.
10. What could you write to produce a *list* of all the cubes of the integers from 2 to 17?
11. You can also use *list comprehension* to get the same behavior as `map()`. Evaluate `[x**2 for x in [2,5,9]]`.
12. Use list comprehension to produce a list of the cubes of all the integers from 2 to 17.

13. List comprehension can also be used to *filter* the numbers in a list. Evaluate `[x for x in [2,5,9] if x%2==0]`. What did this do?
14. Evaluate `[x for x in [2,5,9] if x%2==1]`. What did this do?

Calculus in Sage

15. Find the derivatives for x^2 , $2x^4$, $\log(x)$, $\sin(x)$, e^{2x} , and x^x using the command `diff(f(x),x)` (put each function in for `f(x)`).
16. Find the 2nd derivatives for x^2 , $2x^4$, $\log(x)$, $\sin(x)$, e^{2x} , and x^x using the command `diff(f(x),x,2)` (put your function in for `f(x)`).
17. Let $g(x) = x^x$. Sketch the graph of $g(x)$. Let `gprime(x)=diff(g(x),x)`. Evaluate `gprime(1)` and `gprime(0)`. Explain.
18. Sketch the graph of $gprime(x)$. Solve when $gprime(x) = 0$.
19. Evaluate `derivative(g(x))`. (`diff()` is just shorthand for `derivative()`).
20. Find `g(x).derivative()`.
21. Let $h(x,y)=xy$. Find $\frac{\partial h}{\partial x}$ the partial derivative of $h(x)$ with respect to x by hand. Then evaluate $h(x,y)=xy$, and `diff(h(x,y),x)`.
22. Let $h(x,y)=xy$. Find `diff(h(x,y),x)`.
23. Find $\frac{\partial h^2}{\partial x \partial y}$. Now try `diff(h(x,y),x,y)`
24. Find $\frac{\partial h^2}{\partial x \partial x}$.
25. Try `h.derivative()`. Explain what you get.
26. Find $\int 3x \, dx$ by hand. Check with `integral(3*x,x)`
27. Let $f(x)=3x$. Let `fint=integral(3*x,x)`. Check that `diff(fint,x)=f(x)`.
28. Find $\int_1^2 f(x) \, dx$ by hand. Check using `integral(f(x),x,1,2)`.
29. Sketch $g(t) = t^{20}e^t$ on $(0, 3)$.
30. Find $\int t^{20}e^t \, dt$.
31. Find $\int_2^3 t^{20}e^t \, dt$.
32. Find a numerical approximation for $\int_2^3 t^{20}e^t \, dt$.
33. Try `numerical_integral(t^{20}e^t, 2, 3)`.
34. Find out what the second number of your answer means.