

Name _____

Ocean Tides Lab

April 2020 tides for San Diego

May 2020 tides for San Diego

US HARBORS
 San Diego, CA - Apr 2020

www.USHarbors.com

Date	High				Low				Rise	Set	Moon
	AM	ft	PM	ft	AM	ft	PM	ft			
1 Wed	2:57	4.5	7:15	3.3	11:21	0.4	10:39	3.1	6:34	7:10	
2 Thu	4:42	4.7	7:25	3.8			12:22	-0.1	6:32	7:11	
3 Fri	5:58	5.1	7:48	4.3	12:04	2.6	1:08	-0.5	6:31	7:11	
4 Sat	6:57	5.6	8:14	4.8	1:00	1.8	1:47	-0.8	6:30	7:12	
5 Sun	7:48	6.0	8:44	5.3	1:48	1.1	2:24	-1.0	6:29	7:13	
6 Mon	8:37	6.1	9:15	5.8	2:33	0.3	3:00	-0.9	6:27	7:13	
7 Tue	9:24	6.0	9:49	6.2	3:18	-0.3	3:35	-0.6	6:26	7:14	
8 Wed	10:12	5.7	10:24	6.5	4:05	-0.8	4:10	-0.2	6:25	7:15	
9 Thu	11:02	5.2	11:00	6.5	4:52	-1.0	4:46	0.4	6:24	7:16	
10 Fri	11:56	4.5	11:40	6.2	5:43	-0.9	5:22	1.1	6:22	7:16	
11 Sat			1:00	3.8	6:39	-0.7	6:00	1.8	6:21	7:17	
12 Sun	12:24	5.8	2:23	3.4	7:45	-0.3	6:47	2.4	6:20	7:18	
13 Mon	1:18	5.3	4:33	3.3	9:04	0.0	8:09	2.9	6:19	7:18	
14 Tue	2:33	4.8	6:21	3.6	10:33	0.1	10:22	3.0	6:17	7:19	
15 Wed	4:10	4.5	7:07	4.0	11:50	0.1			6:16	7:20	
16 Thu	5:37	4.5	7:36	4.3	12:04	2.6	12:44	0.0	6:15	7:21	
17 Fri	6:40	4.7	7:59	4.6	1:01	2.1	1:24	0.0	6:14	7:21	
18 Sat	7:27	4.8	8:19	4.9	1:40	1.6	1:55	0.1	6:13	7:22	
19 Sun	8:06	4.9	8:38	5.1	2:13	1.1	2:21	0.2	6:12	7:23	
20 Mon	8:40	4.9	8:58	5.3	2:42	0.7	2:45	0.3	6:10	7:23	
21 Tue	9:13	4.8	9:19	5.5	3:12	0.4	3:08	0.5	6:09	7:24	
22 Wed	9:47	4.6	9:41	5.7	3:42	0.1	3:31	0.8	6:08	7:25	
23 Thu	10:21	4.4	10:04	5.8	4:13	-0.1	3:53	1.1	6:07	7:26	
24 Fri	10:58	4.1	10:28	5.8	4:46	-0.2	4:15	1.4	6:06	7:26	
25 Sat	11:39	3.8	10:53	5.7	5:22	-0.2	4:36	1.8	6:05	7:27	
26 Sun	12:29 PM	3.4	11:23	5.5	6:04	-0.1	4:55	2.2	6:04	7:28	
27 Mon			1:37	3.1	6:53	0.1	5:16	2.5	6:03	7:29	
28 Tue	12:00	5.3	3:20	3.0	7:57	0.2	5:42	2.9	6:02	7:29	
29 Wed	12:55	5.0	5:24	3.3	9:14	0.3	7:54	3.2	6:01	7:30	
30 Thu	2:24	4.7	6:05	3.7	10:30	0.1	10:27	3.0	6:00	7:31	

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10 Sun	1:03 PM	3.8	11:55	6.0	6:27	-1.1	5:37	2.3	5:51	7:38	
11 Mon			2:22	3.6	7:26	-0.6	6:32	2.8	5:50	7:39	
12 Tue	12:47	5.4	4:01	3.6	8:32	-0.2	7:57	3.1	5:50	7:40	
13 Wed	1:55	4.8	5:24	3.9	9:43	0.1	9:53	3.1	5:49	7:40	
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16 Sat	6:00	4.1	7:09	4.8	12:34	2.1	12:27	0.6	5:47	7:42	
17 Sun	6:55	4.1	7:31	5.1	1:17	1.6	1:01	0.7	5:46	7:43	
18 Mon	7:40	4.2	7:53	5.4	1:52	1.1	1:30	0.9	5:46	7:44	
19 Tue	8:21	4.2	8:16	5.7	2:24	0.6	1:57	1.1	5:45	7:45	
20 Wed	9:00	4.1	8:40	6.0	2:56	0.1	2:24	1.3	5:44	7:45	
21 Thu	9:38	4.1	9:05	6.1	3:28	-0.2	2:51	1.5	5:44	7:46	
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25 Mon	12:37 PM	3.5	11:09	6.0	5:57	-0.6	4:45	2.5	5:42	7:49	
26 Tue	1:40 PM	3.4	11:53	5.7	6:45	-0.5	5:26	2.8	5:41	7:49	
27 Wed			2:53	3.5	7:40	-0.3	6:33	3.0	5:41	7:50	
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31 Sun	5:03	4.4	6:19	5.4	11:34	0.3			5:40	7:52	

Tidal curve

Using graph paper and the data in the tide tables, make a **tidal curve** for the days indicated by your instructor. Put your tidal curve (3-hole punched) in your lab book with this exercise.

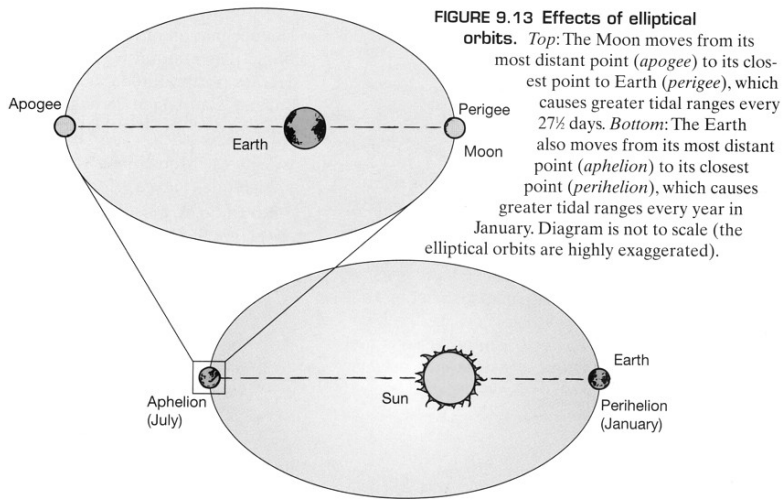
Questions

1. How does the tidal range change during the days you plotted (does the range increase or decrease)? Why does the range change this way? Relate your answer to the phases of the moon show on the tide table.

2. Looking at the tide tables, find the date(s) of the highest high tides and lowest low tides this month.
- a. What day of the month has the greatest tidal range (the greatest difference between high tide and low tide)?
 - b. Write the height and time of the highest high tide on this date: _____
 - c. Write is the height and time of the lowest low tide on this date: _____
 - d. What is the tidal range on this date? (Remember to account for the negative value.) _____ feet
 - e. What phase of the Moon (new, first quarter, full, or third quarter) occurs on or near this date?
 - f. Looking one week ahead or one week behind the date in a. above, how does the tidal range compare? What phase of the Moon (new, first quarter, full, or third quarter) occurs on or near these dates?
 - g. Looking two weeks ahead or two weeks behind the date in a. above, how does the tidal range compare? What is phase of the Moon occurs on or near this date?
3. Considering your answers above, explain how the phases of the Moon control the tidal range, referring in your answer back to the related question on the pre-lab exercise, and using the terms **spring tide** and **neap tide** in your explanation.

Your answer to 3. above shows how the tidal range is controlled, in part, by the relative position (alignment) of the Moon and the Sun relative to the Earth. Another factor that controls the tidal range is how far away the Earth is from either the Sun or the Moon.

The diagrams below illustrate how the orbit of the Moon around the Earth, and the orbit of the Earth around the Sun, are not circles but ellipses. The elliptical nature of the orbits means that sometimes the objects are closer together, while at other times they are farther apart. Since gravitational attraction is inversely proportional to the square of the distance between two objects, small changes in the distance between the Earth and the Moon, or between the Earth and the Sun, translate to relatively large changes in gravitational attraction—with associated changes in the sizes of the tidal bulges, and thus the tidal range.



From Trujillo and Thurman, Essentials of Oceanography

4. Combining the tidal effects of the elliptical orbits of **both** the Moon (around the Earth) and the Earth (around the Sun), when would you expect to see the largest tidal ranges? When would you expect to see the smallest tidal ranges? Study the diagrams.

5. Considering your answers to both questions 3. and 4. above, what combination of factors do you think would produce the absolutely highest high tides and lowest low tides during the year? Consider the combined effects of the lunar phases (question 3) and the elliptical orbits of Moon around Earth and Earth around Sun (question 4).

6. The most extreme coastal flooding and coastal erosion in southern California usually happen in January. There are two main reasons for this. One reason is related to question #4 above, while the other reason has nothing to do with tides. List both reasons and explain.

Amphidromic Points and Tidal Circulation along the U.S. West Coast

In this part of the lab, we will acquire tide information at four sites along the west coast of the U. S., from southern California north to Washington State. Based on the data, we will then draw some conclusions about how the tide processes in the northern Pacific Ocean operate. The internet site we will use is the WWW Tide and Current Predictor for U.S. West Coast sites (North to South), located at http://tbone.biol.sc.edu/tide/sites_uswest.html

Location #1 (southern California)

Location Name: _____

Time and height of first HIGH tide of the day: _____

Time and height of following LOW tide: _____

Tidal range (the difference between high tide and low tide; be sure to account for any negative value): _____

Location #2 (central or northern California)

Location Name: _____

Time and height of first HIGH tide of the day: _____

Time and height of following LOW tide: _____

Tidal range: _____

Location #3 (northern California or Oregon)

Location Name: _____

Time and height of first HIGH tide of the day: _____

Time and height of following LOW tide: _____

Tidal range: _____

Location #4 (northern Oregon or Washington)

Location Name: _____

Time and height of first HIGH tide of the day: _____

Time and height of following LOW tide: _____

Tidal range: _____

Questions

1. Of the four locations above, which has the earliest tide? (Note: you must be comparing highs versus highs, or lows versus lows, between locations in order to get this one right.)
2. Which location has the latest tide? (Again, you must compare highs to highs, or lows to lows.)
3. Given the nature of co-tidal lines and amphidromic points, which direction (clockwise or counter-clockwise) does the tidal wave in the North Pacific rotate? Explain your answer.
4. Of the four locations, which has the lowest range of tides (the least difference between high and low)?
5. Which location has the highest range of tides (the greatest difference between high and low)?
6. Based on this, which location is closest to, and which location is furthest from, the amphidromic point that affects the tides in this area of the Pacific? Explain your answer.