

SIO 15 (FQ 2024) – Homework #2 Due October 15, 2024

Maximum score: 20 points + 2 bonus point

Homeworks submitted late (after due date) are subject to a 2-point reduction.

Divide by 4 for contribution to total cumulative

ANSWERSHEET

Topics 5 - 7

1) Flyer 2, lecture notes:

- a) How often do high and low tides occur? (0.5 pt)
 - b) How often do spring tides occur? (0.5 pt)
 - c) What is/are the associated moon phase(s)? (0.5 pt)
 - d) What is a blue moon? (0.5 pt)
- (2 points total)

a) daily

also accepted: once a day; twice a day; 1-2 times a day

b) at least twice a month

also accepted: twice a month

-0.25 pt for “monthly”

c) full and new moon

-0.25 pt if one is missing

d) a second full moon in a month

also accepted: forth full moon in a season; a 13th full moon in a year

2) Flyer 3, lecture notes:

- a) What is the current deviation of Earth’s magnetic dipole axis relative to the rotation axis? (0.5 pt)
 - b) What is the depth of Earth’s deepest earthquakes? (0.25 pt)
 - c) Where do these earthquakes occur? (0.25 pt)
 - d) How many earthquake occur on Earth each day? Why do people not feel most of these? (0.5 pt)
 - e) At which speeds do the Nazca and the Cocos plate move? What is the normal speed of plate drift? (0.5 pt)
- (2 points total)

a) 9.5°

b) 670 km

c) in (down-going slab of) subduction zones

+0.25 pt if both subduction zones AND down-going slab is mentioned

d) 3.5 million; most are too small to be felt

-0.25 pt if one is missing

e) 10 cm/year; a few cm/year

-0.25 pt if one is missing

- 3) a) On which of the three principal types of plate boundary (not zone!) do the largest earthquakes occur? (0.25 pt)
b) Provide an example of such an earthquake in the U.S.. (0.25 pt)
c) In subduction zones, which type of plate sinks into the mantle? (0.5 pt)
d) In a subduction zone setting, describe all locations where shallow earthquakes occur. Include plates and relative location to the trench. (0.5 pt)
e) Relate the three types of plate boundary to the types of earthquake. (0.5 pt)
(2 points total)

a) convergent

no credit for: subduction zone

b) 1964 (Prince Williams Sound), Alaska (Good Friday) earthquake

also accepted: 1965 Rat Islands, Alaska earthquake; 1957 Andreanov Islands, Alaska earthquake

c) oceanic plate

d) two locations: on subducting plate on the sea side (in front of the trench); on the over-riding plate behind the trench

-0.25 pt if one location is missing, or the descriptions are missing

e) normal earthquakes relate to divergent plate boundaries

reverse earthquakes relate to convergent plate boundaries

strike-slip earthquakes relate to transform boundaries

- 4) a) What are the three depth ranges for earthquakes? Include names and depths with units. (0.5 pt)
b) Where do we find the Wadati-Benioff zone? (0.5 pt)
c) Follow the link to the Wadati-Benioff zone on Wikipedia. A graph color-codes the earthquakes in the Kuril Islands subduction zone. Into which of the three depth categories do the blue earthquakes fall? (0.5 pt)
d) On which two subduction zones did Hugo Benioff's research initially focus? (0.5 pt)
(2 points total)

a) shallow: 0 – 100 km

intermediate: 100 – 300 km

deep: 300+ km

b) in a subduction zone

+0.25 pt if also mentioned that the zone is in the subducting slab

c) intermediate

d) Kermadec-Tonga and South American

-0.25 pt if only one is mentioned

- 5) a) In a given year, and on average, how many magnitude 6.6-6.9 earthquakes occur worldwide? (0.5 pt)
 b) Compute the recurrence time of a magnitude 6.6-6.9 earthquake. Choose a reasonable time unit so that there is no zero before the decimal point (e.g. years may not be adequate). (0.5 pt)
 c) What is the recurrence time of a magnitude 5.0-5.9 earthquake? Choose a reasonable time unit! It may be different from the one in 5b). (0.5 pt)
 d) What is the recurrence time, in hours, of a magnitude 2.3-2.7 earthquake in Southern California? (0.5 pt)
 (2 points total)

a) 56

b) 6.5 days

no credit for 0.018 years;

also no credit for 0.9 weeks because of the zero leading the decimal

-0.25 pt if number is right but unit is missing

c) 11 h

also accepted: 10.95 h

d) 4.5 h

NB: there are 37 events per week, or 168 h

- 6) a) As given in the class notes, which three processes can generate tsunami? (0.5 pt)
 b) What is the approximate speed of a tsunami that travels across an ocean? (0.5 pt)
 c) Using the chart in the book or the lecture notes, and being as precise as possible (include units!), how long does it take for a tsunami to travel from Alaska to Hawaii? (0.5 pt)
 d) If I stand on the beach, how do I know whether the receding water is the tide going out or the sign of an approaching tsunami? (0.5 pt)
 e) If a tsunami-genic quake in Alaska occurred at 8 am (PDT) is it ok to go back to the beach in Hawaii at 4 pm (PDT)? Explain your answer. (0.5 pt)
 (2.5 points total)

a) earthquakes, volcanoes, landslides

+0.25 pt if reverse and normal are mentioned for earthquakes

b) accepted: any value between 700 and 850 km/h; 230m/s; 515 mph;

-0.25 pt if unit is missing

c) 6.5 h

-0.25 pt if unit is missing

no credit: 6 h; 7 h

d) the water recedes much faster before and incoming tsunami (in matter of minutes) than between high and low tides (6 h)

e) no; because subsequent tsunami waves continue to come in for several hours after the first tsunami; 4 pm would be only 1.5 h after the arrival of the initial wave

-0.25 pt if explanation missing or insufficient

- 7) a) How do asperities prevent continuous slip along an earthquake fault? (0.5 pt)
 b) Name the force generated by asperities. Which force do they counteract? (0.5 pt)
 c) Which of the four seismic waves is fastest, which causes the most damage? (0.5 pt)
 d) What is induced seismicity? (0.5 pt)
 e) Provide two general examples for induced seismicity. (0.5 pt)
 (2.5 points total)

a) protrusions lock a fault

also accepted: asperities increase friction

- b) friction; stress
-0.25 pt if one is missing
- c) p waves; Rayleigh waves
-0.25 pt if one is missing
- d) human-caused earthquakes
- e) any two of the following:
pumping water into fault zones
building larger reservoirs
hydro-fracking
also accepted (though not strictly an earthquake): nuclear explosions
-0.25 pt if one is missing

8) News Clip September 25, 2024

- a) Where did an earthquake cause a small tsunami? (0.5 pt)
 - b) How much damage did the quake and tsunami cause? How tall was it at its greatest height? (0.5 pt)
 - c) When was the initial tsunami warning lifted? (0.5 pt)
 - d) Given its magnitude, discuss the chance that this quake generated a large tsunami? (0.5 pt)
- (2 points total)
- a) accepted: Japan; Japanese islands
 - b) no damage; 1 m
-0.25 pt if only one answer correct
 - c) about 3 h later;
also accepted because of misleading instructions in HW video, even though this answer is wrong: 30 min later
-.25 pt if unit missing
no credit for any other answer
 - d) this earthquake was too small to generate a large tsunami

9) Earth Watch September 30, 2024

- a) Which of the three hurricanes that week affected the U.S.? (0.5 pts)
 - b) Follow the link: Compared to other hurricanes to strike Florida's Big Bend, how strong was this hurricane? (0.5 pt)
 - c) In terms of fatalities, how does this hurricane compare to the two (!) other most recent deadliest Atlantic hurricanes? (be as specific as possible) (0.5 pt)
 - d) How long did it take for this hurricane to go from a category 1 to a category 4 hurricane? Be as precise as possible (if adequate, describe the time in hours) (0.5 pt)
 - e) As what (which type of storm) did this hurricane affect Tennessee? Did this storm cause any fatalities in Tennessee? (0.5 pt)
- (2.5 points total)
- a) Hurricane Helene
 - b) strongest hurricane on record to strike the Big Bend region
 - c) deadliest Atlantic hurricane since 2017 Hurricane Maria;
deadliest to strike U.S. mainland since 2005 Hurricane Katrina
-0.25 pt if one answer is missing
 - d) between 1 and 2 days
also accepted: less than 2 days

-0.25 pt for: a little more than 1 day

NB: it became a hurricane early on 9/25, it reached category 4 late on 9/26

e) post-tropical cyclone; yes

-0.25 pt if one answer is missing

+0.25 pt if number of fatalities given (15)

10) Google Earth: INCLUDE UNITS WHERE APPROPRIATE

Find the Salton Sea, California. Zoom out if necessary.

a) Measure the length and largest width of Salton Sea (include units! Error margins: 4 km for length; 2 km for width) (0.5 pt)

b) Using the polygon tool, determine the area of the Salton Sea. (include units! Error margins: -100 sqkm to +50 sqkm) (0.5 pt)

c) Which larger city along route 111 (and just south of 78) is south of Salton Sea? (0.5 pt)

d) Search for that city and open the corresponding box: according to census data, what was the population in 2000? (0.25 pt)

e) What was the population in 2010? (0.25 pt)

f) Using the 2000 value as baseline, calculate the percentage change between 2000 and 2010 (include + for increase/-for decrease). (0.5 pt)

(2.5 points total)

a) length: 54 km (allowed range 50 – 58 km); width: 23 km (allowed range 21 – 25 km)

NB: Wikipedia states length and width at 56 by 24 km. But this does not mean that the those numbers are more accurate than what is measured in Google Earth.

-0.25 pt if only one answer correct

-0.25 pt if units are missing

b) 841 sqkm (allowed range 741 – 891 sqkm)

-0.25 pt if unit are missing

c) Brawley

d) 22, 052

e) 24,953

f) +13%

also accepted: +13.155%; +12.16%; “increase” instead of the ‘+’

-0.25 pt if ‘+’/increase is missing