Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Block \_\_\_\_ Binder Page # \_\_\_\_

***\_\_\_\_\_ / \_20\_ pts***

***P-Wave and S-Wave Travel Time Practice (Tutorial)***

**1) Travel Time** of a P-wave or S-wave, given the distance.

 (a) Find distance on X-axis, go up to the correct curve

(b) Go over to the Y-axis and find **travel time**

Ex 1. How long does it take a P-wave to travel 4,000 km? \_\_\_\_\_\_\_\_ Minutes \_\_\_\_\_\_\_\_ seconds

Ex 2. How long does it take an S-wave to travel 4,000 km? \_\_\_\_\_\_\_\_ Minutes \_\_\_\_\_\_\_\_ seconds

Ex 3. How long does it take a P-wave to travel 8,000 km? \_\_\_\_\_\_\_\_ Minutes \_\_\_\_\_\_\_\_ seconds

Ex 4. How long does it take an S-wave to travel 8,000 km? \_\_\_\_\_\_\_\_ Minutes \_\_\_\_\_\_\_\_ seconds

**2) Epicenter Distance** a P-wave or S-wave traveled, given travel time

 (a) Go to travel time on Y-axis and go over to correct curve

(b) Go down to X-axis to determine distance

Ex 5. How far can an S-wave travel in 9 minutes? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ km

Ex 6. How far can a P-wave travel in 9 minutes? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ km

Ex 7. How far can an S-wave travel in 6 minutes 40 seconds? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ km

Ex 8. How far can a P-wave travel in 6 minutes 40 seconds? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ km

**3) Arrival Time** of earthquake, given epicenter distance and origin time…

1. Determine **travel time** of the wave (see #1-4)
2. ***Add* travel time** to the **origin time** given

Ex 9. If an earthquake occurs at 08:50:40, what time did the P-wave arrive at a seismic station 2,600 km away?

 \_\_\_\_\_\_\_\_:\_\_\_\_\_\_\_\_\_:\_\_\_\_\_\_\_\_\_

 + \_\_\_\_\_\_\_\_:\_\_\_\_\_\_\_\_\_:\_\_\_\_\_\_\_\_\_

 \_\_\_\_\_\_\_\_ : \_\_\_\_\_\_\_\_ : \_\_\_\_\_\_\_\_

Ex 10. If an earthquake occurs at 02:11:20, what time did the S-wave arrive at a seismic station 9,000 km away?

 \_\_\_\_\_\_\_\_:\_\_\_\_\_\_\_\_\_:\_\_\_\_\_\_\_\_\_

 + \_\_\_\_\_\_\_\_:\_\_\_\_\_\_\_\_\_:\_\_\_\_\_\_\_\_\_

 \_\_\_\_\_\_\_\_ : \_\_\_\_\_\_\_\_ : \_\_\_\_\_\_\_\_

**4) Origin Time** (the time the earthquake occurred)….

1. Determine **travel time** of the given wave (see #1-4)
2. ***Subtract* arrival time given** minus **travel time**

Ex 11. If a P-wave arrives at a station 8,000 km away at 12:15:00, what time did the earthquake originate?

 \_\_\_\_\_\_\_\_:\_\_\_\_\_\_\_\_\_:\_\_\_\_\_\_\_\_\_

 - \_\_\_\_\_\_\_\_:\_\_\_\_\_\_\_\_\_:\_\_\_\_\_\_\_\_\_

 \_\_\_\_\_\_\_\_ : \_\_\_\_\_\_\_\_ : \_\_\_\_\_\_\_\_

Ex 12. If an S-wave arrives at a station 4,400 km away at 07:45:00, what time did the earthquake originate?

 \_\_\_\_\_\_\_\_:\_\_\_\_\_\_\_\_\_:\_\_\_\_\_\_\_\_\_

* \_\_\_\_\_\_\_\_:\_\_\_\_\_\_\_\_\_:\_\_\_\_\_\_\_\_\_

 \_\_\_\_\_\_\_\_ : \_\_\_\_\_\_\_\_ : \_\_\_\_\_\_\_\_

**5) Difference in Arrival Time** between P-waves and S-waves, given the epicenter **distance**

1. Line up paper vertically on the distance given
2. Mark paper where S and P waves intersect

(c) Line up paper on Y-axis, P wave on 0 minute mark

(d) S-wave mark indicates the difference in arrival time

Ex 13. An epicenter station is 5,000 km away. How long after the first P-wave did the first S-wave arrive?

 \_\_\_\_\_\_\_\_ Minutes \_\_\_\_\_\_\_\_ seconds

Ex 14. An epicenter station is 7,600 km away. How long after the first P-wave did the first S-wave occur?

 \_\_\_\_\_\_\_\_ Minutes \_\_\_\_\_\_\_\_ seconds

6) Determine the **Arrival Time of an S-wave**, given the **clock time** for the arrival of the P-wave, and given **distance**.

 (a) Find difference in arrival time between P-wave and S-wave at the given epicenter distance.

 (b) Add the difference in arrival time to the clock time of the P-wave

Ex 15. A P-wave arrived at a seismic station 3,200 km away at 06:10:00. What time did the first S-wave arrive at the station?

 \_\_\_\_\_\_\_\_:\_\_\_\_\_\_\_\_\_:\_\_\_\_\_\_\_\_\_

 + \_\_\_\_\_\_\_\_:\_\_\_\_\_\_\_\_\_:\_\_\_\_\_\_\_\_\_

 \_\_\_\_\_\_\_\_ : \_\_\_\_\_\_\_\_ : \_\_\_\_\_\_\_\_

Ex 16. A P-wave arrived at a seismic station 4,000 km away at 01:25:00. What time did the first S-wave arrive at the station?

\_\_\_\_\_\_\_\_:\_\_\_\_\_\_\_\_\_:\_\_\_\_\_\_\_\_\_

 + \_\_\_\_\_\_\_\_:\_\_\_\_\_\_\_\_\_:\_\_\_\_\_\_\_\_\_

 \_\_\_\_\_\_\_\_ : \_\_\_\_\_\_\_\_ : \_\_\_\_\_\_\_\_

**7) Determine the Arrival Time of a P-wave,** given the **clock time** for the arrival of the S-wave, and given **distance**.

(a) Find difference in arrival time between P-wave and S-wave at the given epicenter distance.

 (b) Subtract the difference in arrival time to the clock time of the P-wave

Ex 17. An S-wave arrived at a seismic station 6,200 km away at 04:48:00. What time did the first P-wave arrive at the station?

\_\_\_\_\_\_\_\_:\_\_\_\_\_\_\_\_\_:\_\_\_\_\_\_\_\_\_

* \_\_\_\_\_\_\_\_:\_\_\_\_\_\_\_\_\_:\_\_\_\_\_\_\_\_\_

 \_\_\_\_\_\_\_\_ : \_\_\_\_\_\_\_\_ : \_\_\_\_\_\_\_\_

Ex 18. A S-wave arrived at a seismic station 1,400 km away at 09:20:40. What time did the first P-wave arrive at the station?

\_\_\_\_\_\_\_\_:\_\_\_\_\_\_\_\_\_:\_\_\_\_\_\_\_\_\_

* \_\_\_\_\_\_\_\_:\_\_\_\_\_\_\_\_\_:\_\_\_\_\_\_\_\_\_

 \_\_\_\_\_\_\_\_ : \_\_\_\_\_\_\_\_ : \_\_\_\_\_\_\_\_

**8) Epicenter Distance using the difference in arrival time of P-wave and S-wave**

 (a) Find difference in clock time between P-wave and S-wave by subtracting the given times

 (b) Use Y-axis (time travel) and scrap paper to mark the time difference

 (c) Slide scrap paper along graph to find location where the interval is touching both the P and S wave line

 (d) Find epicenter distance by going down to the X-axis

Ex 19. The first P-wave arrived at a seismic station at 10:00:00. The first S-wave arrived at the same seismic station at 10:08:40. How far is this seismic station from the epicenter?

\_\_\_\_\_\_\_\_:\_\_\_\_\_\_\_\_\_:\_\_\_\_\_\_\_\_\_

 - \_\_\_\_\_\_\_\_:\_\_\_\_\_\_\_\_\_:\_\_\_\_\_\_\_\_\_

 \_\_\_\_\_\_\_\_ : \_\_\_\_\_\_\_\_ : \_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ km

Ex 20. The first P-wave arrived at a seismic station at 06:32:20. The first S-wave arrived at the same seismic station at 06:30:20. How far is this seismic station from the epicenter?

\_\_\_\_\_\_\_\_:\_\_\_\_\_\_\_\_\_:\_\_\_\_\_\_\_\_\_

 - \_\_\_\_\_\_\_\_:\_\_\_\_\_\_\_\_\_:\_\_\_\_\_\_\_\_\_

 \_\_\_\_\_\_\_\_ : \_\_\_\_\_\_\_\_ : \_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ km

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