Earthquake Epicenter
Task Information

Subject: Earth Science

Content:

- NYS Earth Science Syllabus (1970 ed.) - Topic XII - Dynamic Crust B-2
- Earth Science Syllabus (Pro. Mod.) - Unit 3-Dynamic Crust A-2,4
- Framework - Standard 4 - Science - Many of the phenomena we observe on Earth involve interactions among air, water, and land components.
- Middle Level Science Block D - Processes II Changes in Earth's surface - B-1:d.

Format: Paper/pencil

Purpose: To determine if the student can locate an epicenter of an earthquake, given the P & S wave data for 3 stations.

Skills:

Primary: Measuring, generalizing/inferring,
Secondary: Interpreting data

Time: 20 minutes

Materials:

per Student	Teacher
• compass	• extra supply of compasses
• calculator	

Preparation: Make sure the compasses have a metric scale.

Safety: Advise students how to handle the compasses appropriately.

Extensions/Modifications:

Consider the addition of identified cities to predict earthquake arrival times.
Consider questions about earthquake preparedness.

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NSF Grant #MDR-9154506

Earthquake Epicenter

Task: Using data in the chart below, the student will determine the location of the epicenter of an earthquake.

Background:

When an earthquake occurs, scientists need to determine the location of its epicenter as soon as possible. The epicenter is the point on the surface of the Earth directly above the earthquake. Measurements from at least three seismographic stations allow scientists to locate the epicenter.

Materials:

- calculator
- compass

Directions:

The data in the table are the delay times between the S and P waves from an earthquake to three stations (A, B, and C.)

Station	Delay Time Between S and P Wane Arrivals	Distance from Earthquake (km)	Distance on Map (cm)
A	5 minutes, 20 seconds		
B	1 minute, 40 seconds		
C	3 minutes, 20 seconds		

1. Find the distance of each station from the earthquake using the delay times between the S and P waves and the graph on the next page. Record these distances in the table.
2. Locate the epicenter of the earthquake on the map on the last page. Calculate and record your map distances in the table. Indicate the epicenter location with the letter **X.** The scale of the map is 1 cm = 300 kilometers.
3. In the space below, describe 3 procedures you used to locate the epicenter of the earthquake. Answer in complete sentences.

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April 30, 1996

Earthquake Epicenter - Scoring Rubric

Maximum score - 13 points

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1. Data Table — 8 points total

Standard: The student will determine the distance from the earthquake

Criteria:

Distance from earthquake
Answers: A = 3700 km, B = 900 km, C = 2000 km.

- Allow 2 points for each correct distance recorded within +\ - 200 km
- Allow 1 point for each correct distance recorded within +\ - 400 km
- Allow 0 points for distances recorded +\ - > 400 km

Distance on map
Answers: A = 12.3 cm, B = 3.0 cm, C = 6.7 cm.

- Allow 2 points if 3 of the distances recorded are within +\ - 1.0 cm
- Allow 1 point if 2 distances are within +\ - 1.0 cm
- Allow 0 points for 1 or less distances within range.

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2. Location of Epicenter — 2 points total

Standard: By using the triangulation method, the student will identify the epicenter.

Criteria:

- Allow 2 points for the correct placement of the letter "X" at the intersection of the 3 lines or a small triangle.
- Allow 1 point for the correct placement of the letter "X" without the intersecting lines.
- Allow 0 points for the omission of the letter "X"

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3. Procedures — 3 points total

Standard: Using complete sentences, the student will describe 3 procedures used to find the epicenter.

Criteria:

- Allow 3 points if the student's response has three (3) logical and reasonable descriptions. The answers must be in complete sentences.
- Allow 2 points if there are 2 logical and reasonable descriptions in complete sentences.
- Allow 1 point for 1 logical and reasonable response in a complete sentence.
- Allow 1 point for logical and reasonable answers not in complete sentences.

Highest possible score - 13 points

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Student ID _____ **Earthquake Epicenter - Scoring Form**

Male / Female

Circle the student's score for each question. Add the points for each question and write the total score at the bottom of the scoring form.

1. A. Data table					
1. distance from A	0	1	2		
2. distance from B	0	1	2		
3. distance from C	0	1	2		
B. Distance on Map	0	1	2		
2. Location of Epicenter on map	0	1	2		
3. Procedures student followed	0	1	2	3	

TOTAL SCORE _____

Total possible score - 13 points

Student ID _____ **Earthquake Epicenter - Scoring Form**

Male / Female

Circle the student's score for each question. Add the points for each question and write the total score at the bottom of the scoring form.

1. A. Data table					
1. distance from A	0	1	2		
2. distance from B	0	1	2		
3. distance from C	0	1	2		
B. Distance on Map	0	1	2		
2. Location of Epicenter on map	0	1	2		
3. Procedures student followed	0	1	2	3	

TOTAL SCORE _____

Total possible score - 13 points

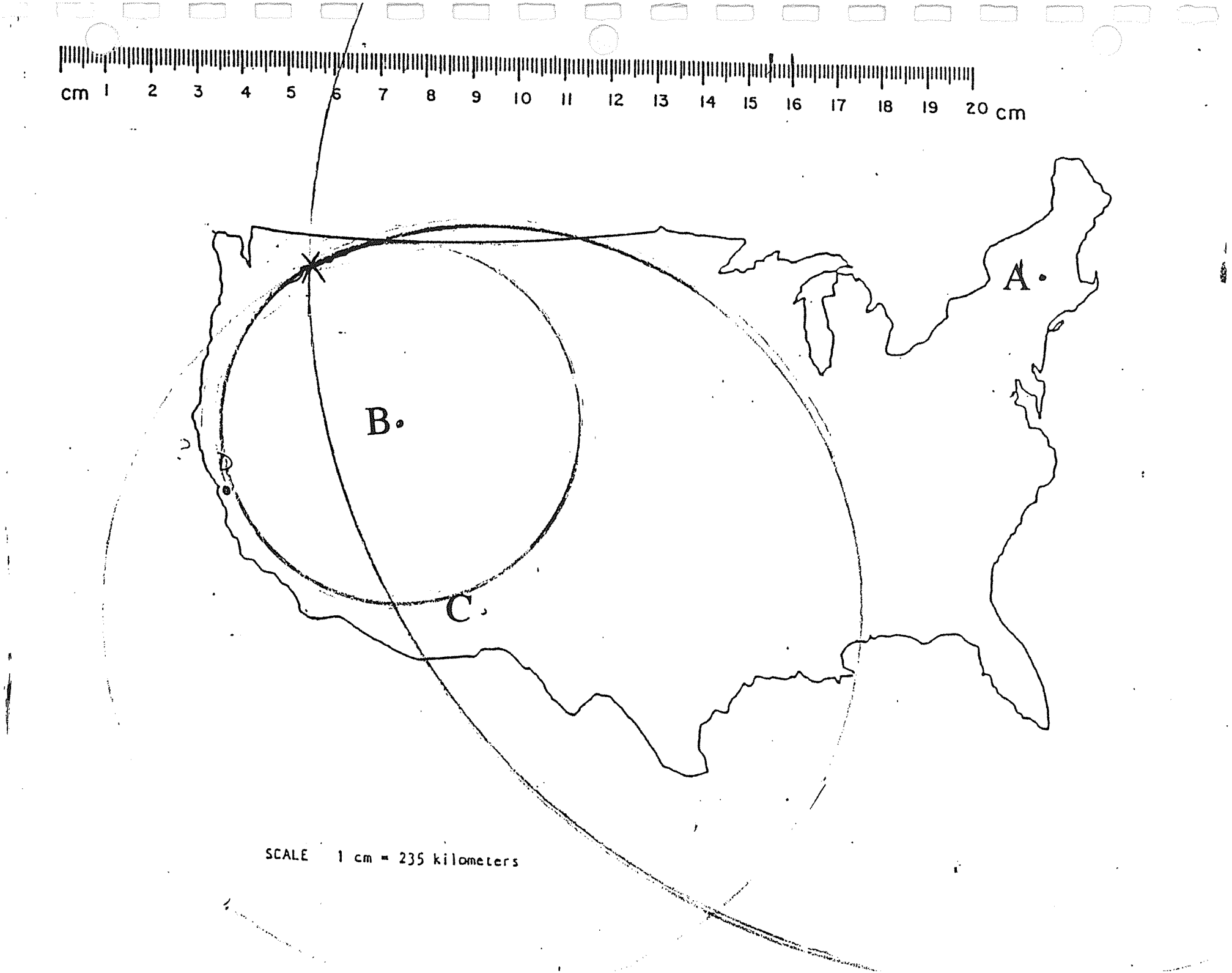
Student ID ESEE #2 **Scoring Form - Earthquake Epicenter-**

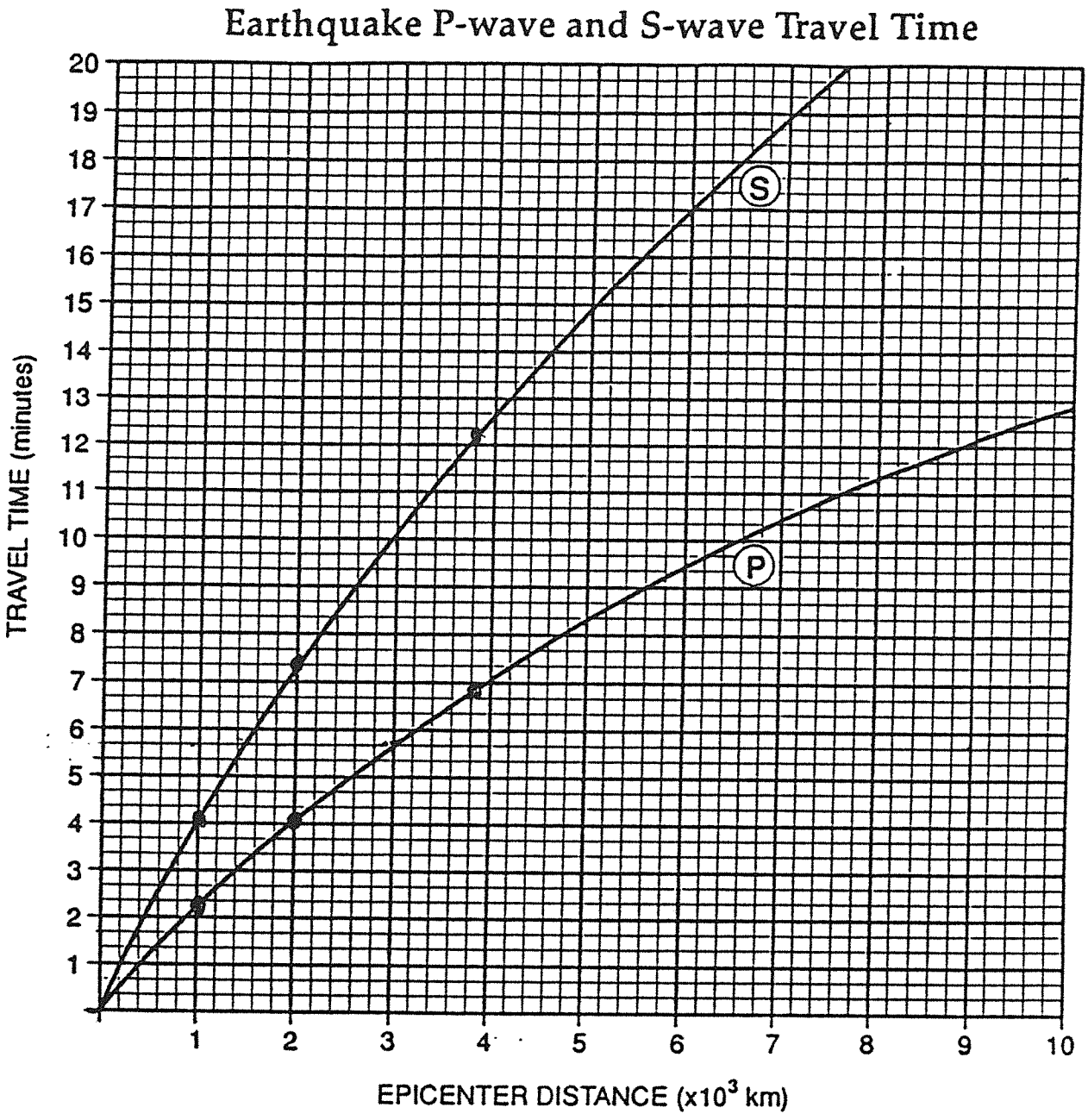
Male / Female

Circle the student's score for each question. Add the points for each question and write the total score at the bottom of the scoring form.

1. A. Data table			
1. distance from A	0	1	(2)
2. distance from B	0	1	(2)
3. distance from C	0	1	(2)
B. Distance on Map	~~0~~	1	(2)
2. Location of Epicenter on map	0	(1)	2
Procedures student followed	0	1	2 (3)

TOTAL SCORE 12
(Total possible score - 13 points)


cm 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 cm
A.
B.
C.
SCALE 1 cm = 235 kilometers


Earthquake P-wave and S-wave Travel Time
TRAVEL TIME (minutes)
20
19
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
S
P
1
2
3
4
5
6
7
8
9
10
EPICENTER DISTANCE (x10³ km)

Student ID ES EE#4 **Scoring Form - Earthquake Epicenter**

(Male) / Female

Circle the student's score for each question. Add the points for each question and write the total score at the bottom of the scoring form.

1. A. Data table				
1. distance from A	(0)	1	2	
2. distance from B	0	1	(2)	
3. distance from C	0	1	(2)	
B. Distance on Map	0	(1)	2	
2. Location of Epicenter on map	(0)	1	2	
3. Procedures student followed	0	(1)	2	3

TOTAL SCORE 6
(Total possible score - 13 points)

Earthquake Epicenter

Task: Using data in the chart below, the student will determine the location of the epicenter of an earthquake.

Background:

When an earthquake occurs, scientists need to determine the location of its epicenter as soon as possible. The epicenter is the point on the surface of the Earth directly above the earthquake. Measurements from at least three seismographic stations allow scientists to locate the epicenter.

Materials:

- calculator
- compass

Directions:

The data in the table are the delay times between the S and P waves from an earthquake to three stations (A, B, and C.)

Station	Delay Time Between S and P Wane Arrivals	Distance from Earthquake (km)	Distance on Map (cm)
A	5 minutes; 20 seconds	3,060	10.2
B	1 minute, 40 seconds	800	2.7
C	3 minutes, 20 seconds	2000	6.7

1. Find the distance of each station from the earthquake using the delay times between the S and P waves and the graph on the next page. Record these distances in the table.
2. Locate the epicenter of the earthquake on the map on the last page. Calculate and record your map distances in the table. Indicate the epicenter location with the letter X. The scale of the map is 1 cm = 300 kilometers.
3. In the space below, describe 3 procedures you used to locate the epicenter of the earthquake. Answer in complete sentences.

Find the distance, connect the circles, know the time the earthquake started.

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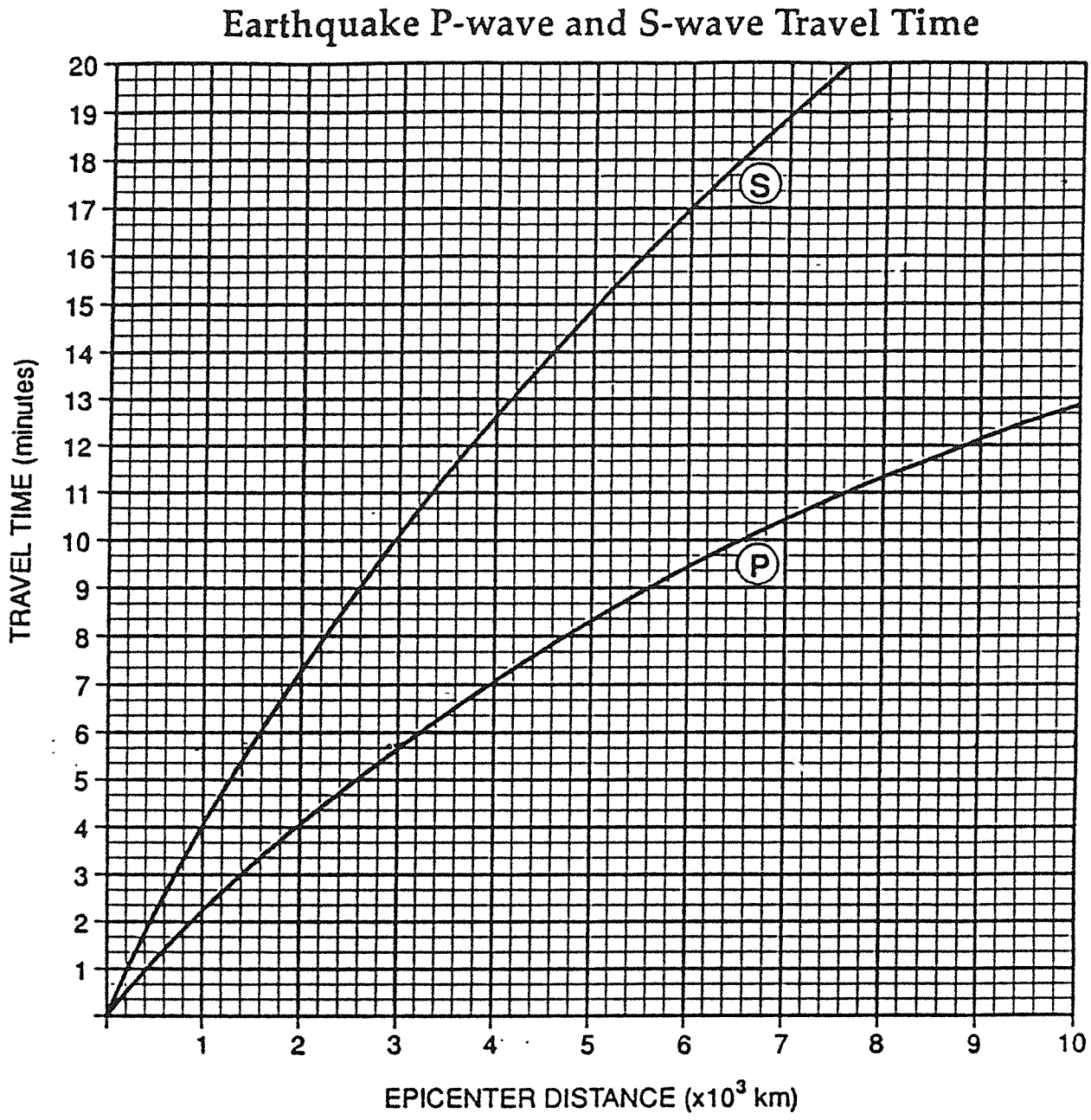
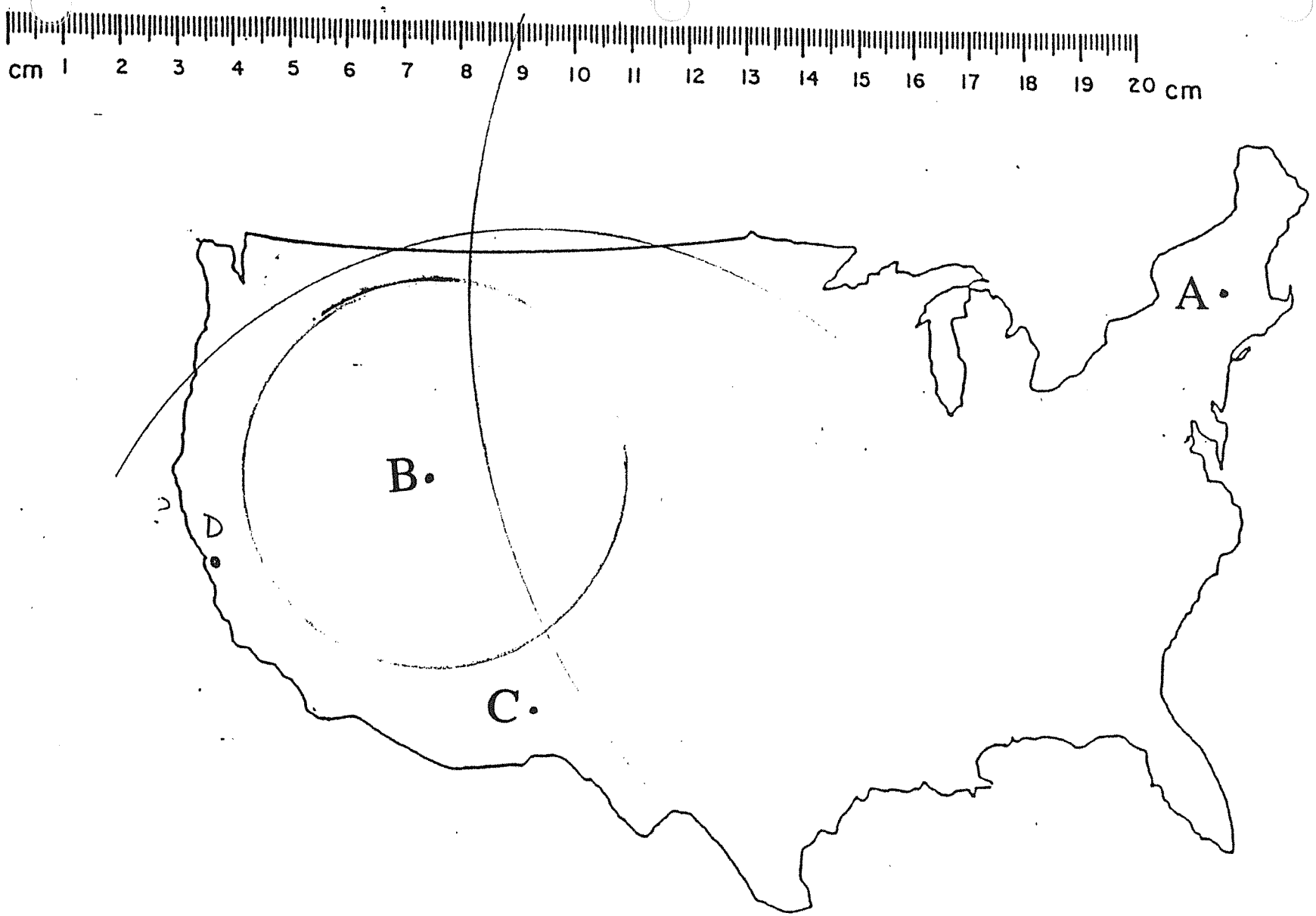

Earthquake P-wave and S-wave Travel Time
TRAVEL TIME (minutes)
20
19
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
S
P
1
2
3
4
5
6
7
8
9
10
EPICENTER DISTANCE (x10³ km)



SCALE 1 cm = 235 kilometers