The Open University of Sri Lanka

B.Sc. Degree Programme (Level 05) 2011/12

Final Examination – Fundamentals of Geophysics

PYU3168/PYE5168

Date: 30th November 2012

Duration: 2 Hours
(1.30 pm - 3.30 pm)

Answer ***FOUR (04)*** questions. **SHORT ANSWERS ARE PREFERRED.** Answers should be illustrated with sketch maps and diagrams where appropriate. Each question is allocated 25 points, and the marking scheme is given in brackets. Non-programmable calculators are permitted. Supplementary page is given for question No.3.

1 (i) Sketch the internal structure of the Earth, showing and describing very briefly only its major subdivisions. *(5 points)*

(ii) Sketch a graph to show how the seismic body wave velocities S and P vary as a function of depth from Earth's surface. *(10 points)*

(iii) Explain the risk of Earthquakes on that part of the tectonic plate where Sri Lanka is located using your knowledge in plate tectonics. *(5 points)*

(iv) What is your explanation of the recently occurred earth tremors in the South, Uva and Eastern parts of Sri Lanka? *(5 points)*

2. A Resistivity profiling was carried out using Schlumberger array at point 'P' (center point). The distance from 'P' to any current electrode (L/2) and the distance from 'P' to any potential electrode (l /2) is given in the Table below. Calculate

(i) the geometric constant (K) and resistivity values (ρ) for each electrode separation and construct the resistivity curve. *(15 points)*

(ii) According to the results of above (i), how many subsurface layers are present in the profiling area? *(10 points)*

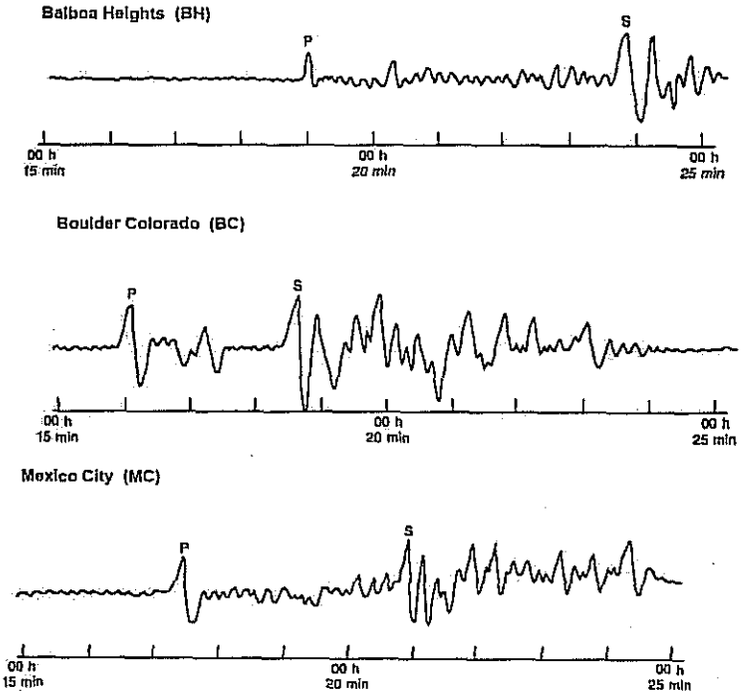
L /2 (m)	l /2 (m)	K (m)	R(Ω)	ρ(Ωm)
1.5	0.5		79.62	
2	0.5		39.05	
3	0.5		13.10	
4.5	0.5		1.91	
6	0.5		0.53	
8	0.5		0.17	
10	0.5		0.10	
12.5	2		0.23	
15	2		0.14	
20	2		0.08	
25	2		0.05	

(The geometric constant for the Schlumberger array is given as, $K = \frac{\pi(L^2 - l^2)}{4l}$)

3. (i) Define focus and epicentre of an earthquake. *(5 points)*

(ii) How do you determine the earthquake epicentre from seismic waves? *(5 points)*

(iii) Three seismic monitoring stations [Balboa Heights (BH), Boulder Colorado (BC) and Mexico City(MC)] located in USA have reported the first P – and S wave signals from an earthquake, which are shown in the graphs below.



(a) Calculate the S-P time difference of each station with respect to each seismo-meters using above graphs. *(5 points)*

(b) Use time-travel Graph given to you in the supplementary sheet to find the distance of each station from the epicentre of the earthquake. *(5 points)*

(c) Refer to the map on the supplementary page. Use a compass, ruler and the given map scale to construct a circle around each of the three cities. Locate and label the epicentre of the earthquake (please detach supplementary page from the question paper and attach with the answer paper). *(5 points)*

(4) (i) Define Free Air and Bouguer anomalies. What is the significance of each term in the definitions? *(5 points)*

(ii) Given that $G=6.672 \times 10^{-11} m^2 kg^{-1} s^{-2}$, that $g = 9.8\ m/s^2$, and that the radius of the earth is 6,367.467 km, calculate the mass of the earth. *(5 points)*

(iii) At 45 degrees latitude, the radius of GRS67 normal ellipsoid is 6,367,467 m. What is the normal gravity of this latitude?

1967 geodetic reference system formula (GRS67)
$G_N = 978.031846\ (1 + 0.005278895\ \sin^2\phi + 0.000023462\ \sin^4\phi)$

(15 points)

5. (i) Describe two commonly used Global Coordinate Systems for navigation and positioning. *(10 points)*

(ii) Describe the technical theory behind the functioning of NAVSTAR GPS system. *(5 points)*

(iii) Discuss general and special features of NAVSTAR GPS constellation. *(5 points)*

(iv) Describe the technique known as Differential GPS (DGPS). *(5 points)*

6. (i) Diffentiate seismic refraction and reflection surveys *(5 points)*

(ii) Describe the four basic modes (or "seismic rays") used in seismic investigations. *(5 points)*

(iii) Derive travel-time equation of reflected seismic wave arrivals (two-layer case, horizontal interface): $T(x) = \sqrt{\left(X/V_1\right)^2 + \left(2d/V_1\right)}$ *(10 point)*

(iv) Explain the procedure for interpretation of travel time graph (two layers) in seismic reflection method. *(5 points)*

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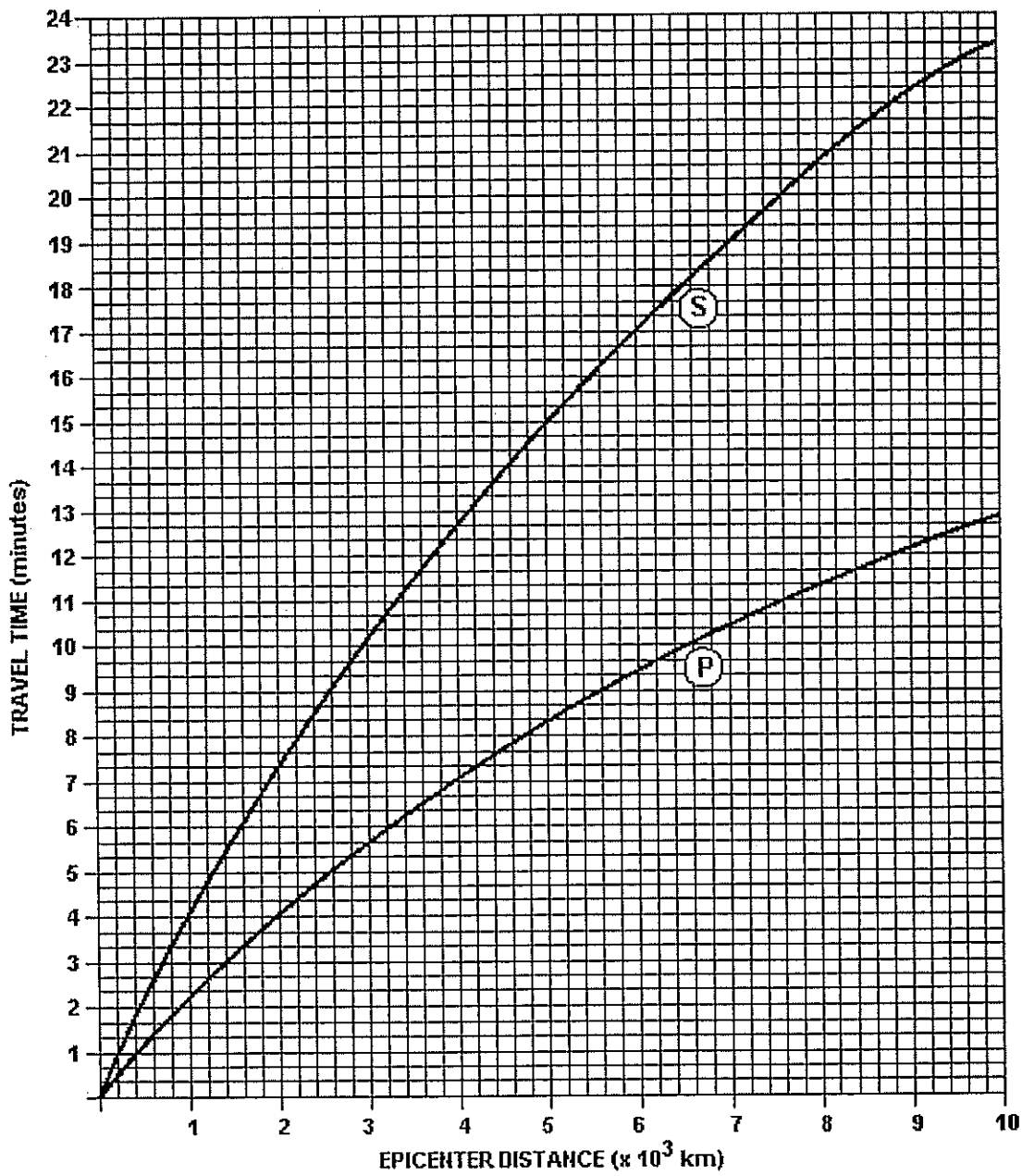
Supplementary page for question 3



Seismograph Location	S-P Time Difference (min)	Distance to Epicenter (km)
1. Balboa Heights		
2. Boulder Colorado		
3. Mexico City		

Location	Distance (km)
1. Balboa Heights	
2. Boulder Colorado	
3. Mexico City	