系所別：地球物理研究所　科目：地球物理學

1. 地震學中所謂的 b 值，其意為何？其於地體構造上又有何啟示？(10%)

2. (a) P 波和 S 波的速度與地質材料之體積模數(bulk modulus)、剪切模數(shear modulus)以及密度有關，請寫下它們之間的關係式。(5%)
(b) In the simple self-compression model, the density structure for the whole earth could be obtained by using the well-known Adams-Williamson equation:

$$\frac{d\rho}{dr} = -GM_r\rho(r)/r^2\Phi$$

where ρ is the density, G the gravitational constant, M_r the mass within the radius r, and Φ is equal to $V_p^2 - \frac{4}{3}V_s^2$. Please derive the Adams-Williamson equation. (10%)

3. (a) What dose the 'P-wave shadow zone' mean? (5%) And what is its cause? (5%)
(b) An important seismic phase naming PKIKP was identified by a Danish seismologist, Inge Lehmann, in 1936. What does the code of PKIKP of a seismic phase mean? (5%) Could you explain why it is important for investigating the interior of the Earth? (10%)

4. (a) *geoid* 與 *reference ellipsoid* 是何意義？(10%)
(b) Calculate the depths and densities beneath a 5 km high mountains chain in isostatic equilibrium with a 35 km thick, $2.8\text{x}10^3$ kg/m^3 continental crust and a $3.3\text{x}10^3$ kg/m^3 mantle by using the hypothesis of (a) Pratt (5%) and (b) Airy (5%). Illustrate these two hypotheses with simple diagrams in your calculation (5%).

5. (a) Why is the Earth's main magnetic field not possible to be produced by magnetic materials such as magnetite inside the Earth? (5%)
(b) The model which best explains the main field is called the *geomagnetic dynamo* or *geodynamo*. In such dynamo models, the convective liquid metal in the outer core plays a fundamental role in generating the magnetic field. Then, what drives or powers the convection in the outer core? (10%)

6. 下列關於地球的各種物理量，請寫出其數量級之大小（或數值範圍）與對應之單位：(a) 地心溫度；(b) 地球的平均密度；(c) Moho 的深度；(d) 地心壓力；(e) 板塊的移動速率。(10%)