Geophysics 210 - Physics of the Earth

Mid-term exam

Section   GEOPH 210 Lecture A01
Instructor   Dr. Martyn Unsworth
Date   Tuesday October 23rd 2007
Time allowed   11:00 a.m. – 12:20p.m.

Total = 70 points

*Please attempt **ALL** questions.*

*Notes and books may **NOT** be used during the exam.*

Calculators are permitted.

Show all working, as credit will be given for your method as well as the final answer.

All questions should be directed to the invigilator.

Please hand in this exam, with your answer booklet

Name _____

Question 1 – Tides and rotation of the Earth

Use equations and data on formula sheet to answer (a) and (b)

(a) What is the acceleration of gravity on the surface of the Earth due to the Sun?
(3 points)

(b) What is the acceleration of gravity on the surface of the Earth due to the Moon?
(3 points)

(c) Why are tides caused by the Moon **larger** than those caused by the Sun?
(3 points)

(d) Describe **two observations** that show that the length of day is increasing. **(4 points)**

(e) The Earth-Moon separation is increasing. Explain why with the aid of a diagram.
(4 points)

(Q1 Total = 17 points)

Question 2 – Gravitation

(a) List **three factors** that cause the acceleration of gravity (g) to vary from the Pole to the Equator. Briefly explain each factor and state if $g_P > g_E$ or $g_P < g_E$
(9 points)

(b) Describe **two** ways that gravity be measured from an satellite? **(5 points)**

(c) Define the **geoid**. Sketch the shape of the geoid over a region where there is an increase in density (excess mass) **(5 points)**

(Q2 Total = 19 points)
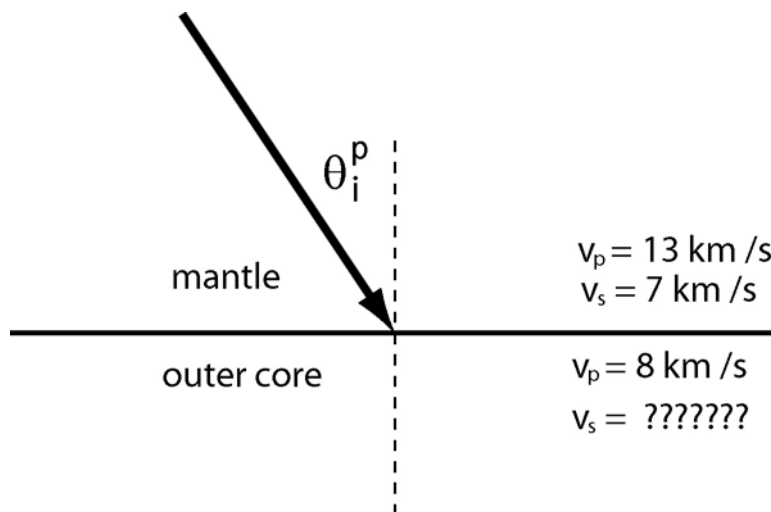
Question 3 – Isostacy

An iceberg is 400 m thick and is floating in the ocean.
The ice has a density of 920 kg m^{-3} The seawater has a density of 1030 kg m^{-3}

What will be the height (h) of ice surface above the ocean surface?

(Q3 Total = 6 points)

Question 4 – Seismic waves

A P-wave strikes the core-mantle boundary at an angle $\theta_i^p = 35°$ to the normal.
P-wave and S-wave velocities are as shown.

What is v_s in the outer core?

Sketch the P-waves and S-waves that are generated, and calculate the angles at which they travel.

(Q4 Total = 8 points)

Question 5 - Earthquakes

(a) The following **fault plane solutions** were determined for three separate earthquakes.

- Draw a sketch map and/or cross section showing (a) the direction of the fault, and (b) the direction of slip during the earthquake

- If multiple answers are possible, describe each one.
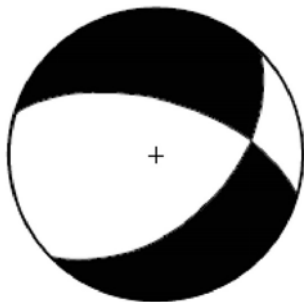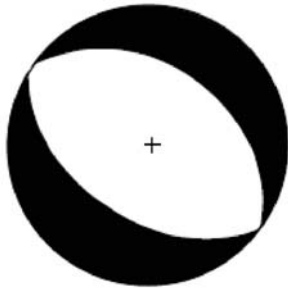
(12 points)

(b) What is the Gutenberg-Richter Law? Illustrate with a sketch.

(3 points)

(c) Sketch a figure of a subduction zone.

Indicate the locations of megathrust earthquakes, intermediate depth earthquakes and deep earthquakes.

Include a depth scale. **(5 points)**

Q5 Total = 20 points