

Geophysics 210 - Physics of the Earth

Mid-term exam

Section	GEOPH 210 Lecture A01
Instructor	Dr. Martyn Unsworth
Date	Tuesday October 14 th 2008
Time allowed	11:00 a.m. – 12:20p.m.

Total = 55 points

Please attempt ALL FIVE 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 the formula sheet to answer (1a) and (1b)

(1a) What is the acceleration of gravity at the centre of the Earth due to the Sun?
(2 points)

(1b) What is the acceleration of gravity at the centre of the Earth due to the Moon?
(2 points)

(1c) Why are tides caused by the Moon **larger** than those caused by the Sun?
Comment on (1a) and (1b) in your answer. (3 points)

(1d) Describe **two distinct** pieces of evidence that the length of day is increasing.
(4 points)

(Q1 Total = 11 points)

Question 2 – Gravitation

The gravity anomaly at a location in Alberta was measured at -205.0 milligals.

The location was 560 m above sea-level.

(2a) Apply Free Air and Bouguer corrections and compute the Bouguer anomaly corrected to **sea level**. Show **all** the steps in your calculation (5 points)

(2b) Describe **two** ways that gravity can be measured from an satellite? (4 points)

(2c) Consider the following statements. Explain how they can both be true.

- The sea-surface is a gravitational equipotential surface.
- A gravity survey was conducted along a beach at sea-level. The acceleration of gravity was found to vary with distance along the beach.

(Hint : Latitude changes are not the answer!)

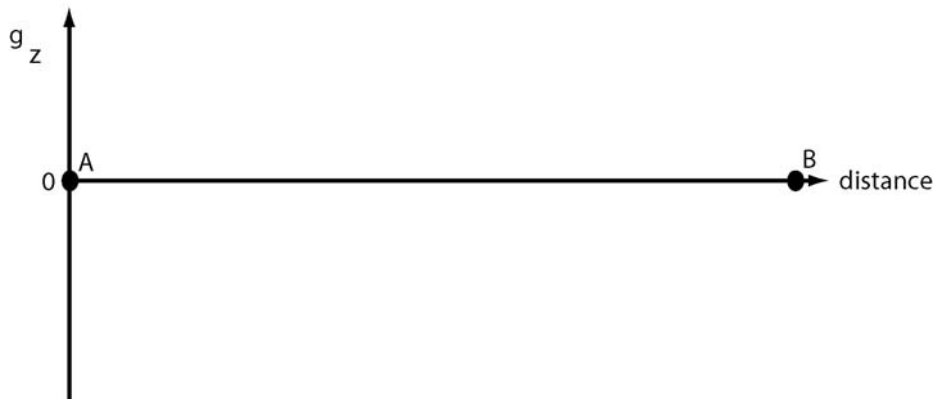
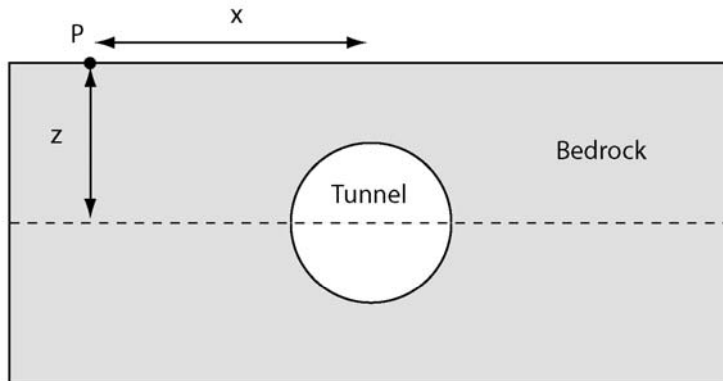
(4 points)

(Q2 Total = 13 points)

Question 3 – Gravity anomalies

A geophysicist is using gravity data to locate a **flooded tunnel**. The tunnel has a radius of 2 m and the centre is at a depth of 4 m below the surface.

The tunnel is located in bedrock with a density 2600 kg m^{-3} and filled with water of density 1000 kg m^{-3}



(3a) Compute the value of g_z directly above the tunnel **(2 points)**

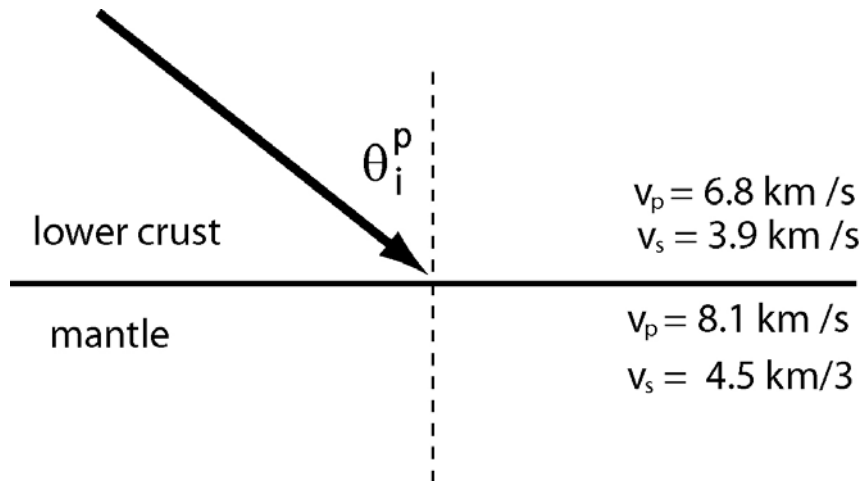
(3b) Sketch the gravity anomaly that will be produced at the surface. Assume that $g_z = 0$ at points A and B. Indicate the half-width of the anomaly **(4 points)**

(3c) A survey has vertical locations measured to a precision of 0.1 m. Will it be possible to detect the tunnel? **(3 points)**

(Q3 Total = 9 points)

Question 4 – Seismic waves

A P-wave strikes the crust-mantle boundary at an angle $\theta_i^p = 60^\circ$ to the normal. P-wave and S-wave velocities in the crust and mantle are shown on the figure.



(4a) List the body waves that are generated, and
Calculate the angles at which they travel (measured from the normal)
(8 points)

(4b) Explain Huyghen's principle.

Use it to explain the concept of diffraction from a corner (with a diagram!)
(4 points)

(Q4 Total = 12 points)

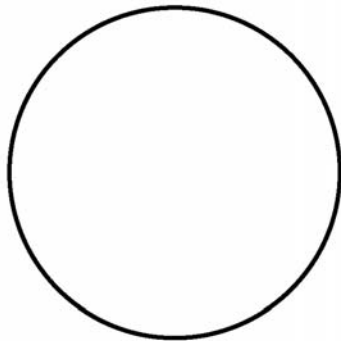
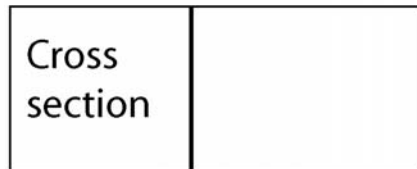
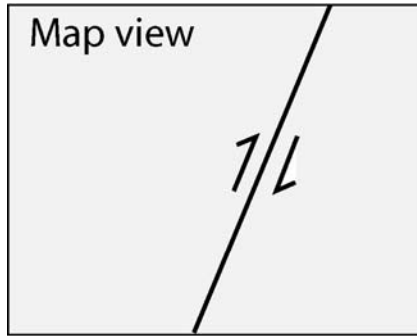
Question 5 - Earthquakes

(5a) Earthquakes occur on the two faults shown below.

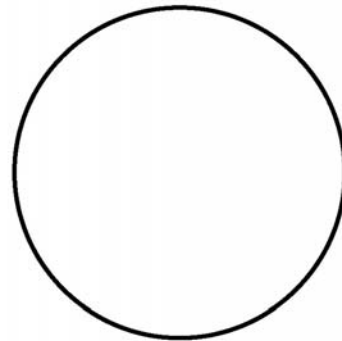
Left = strike-slip

Right = normal faults

Sketch the focal mechanism for each in the space provided.



Focal mechanism



Focal mechanism

(6 points)

(5b) What is the Gutenberg-Richter Law? Illustrate with a sketch graph.

(4 points)

(Q5 Total = 10 points)