The University of British Columbia
Christen / GEOB 300 / October 15, 2010

Midterm Examination

Name	Student #	
Signature	*for marking only* Score	Grade

Write answers directly into space provided. Additional pages are not allowed and will not be marked. There are 7 pages. Make sure you have all. Marks are indicated in square brackets. Total possible marks are 100 (Part A: 32, Part B: 28, Part C: 40). Time allowed - 50 min.

Part A: Multiple choice questions

Solve all multiple choice questions. Check only one answer per question. If you check none or multiple answers, your answer will be invalid.

1. Which sensor does measure only direct-beam solar irradiance (S) [4]

   ◯ Pyrheliometer ◯ Diffusometer ◯ Pyrgeometer ◯ Pyranometer

2. Under which sky condition is the bulk atmospheric emissivity ε_a lowest? [4]

   ◯ Fog ◯ High cirrus coulds ◯ Significant haze (forest fires) ◯ Clear and unpolluted sky

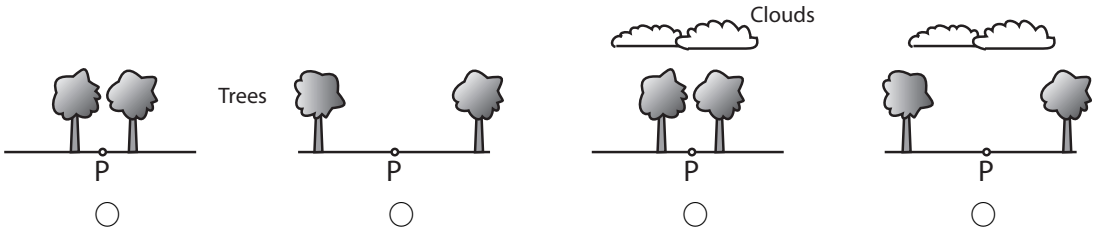
3. How is spectral reflectivity α_λ defined? [4]

   ◯ Radiation emitted divided by radiation reflected of a specific wavelength.
   ◯ Radiation reflected divided by radiation transmitted and absorbed of a specific wavelength.
   ◯ Radiation reflected divided by total incident radiation of a specific wavelength.
   ◯ Radiation absorbed divided by radiation reflected of a specific wavelength.

4. The climatological instrument shown below creates a voltage output that is proportional to the ... [4]

   ◯ Soil heat flux density ◯ Soil volumetric water content
   ◯ Soil heat capacity ◯ Soil moisture potential

5. In the following diagrams, P is a point on the surface. During night, in which of the four situations do you expect Q^* to be lowest (i.e. most negative) - if everything else is kept constant? [4]



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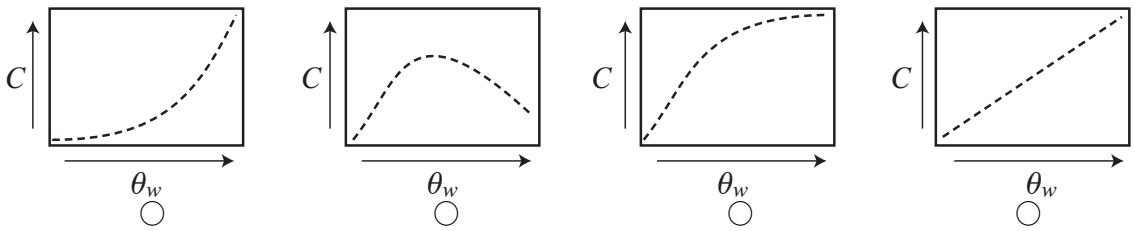
6. How does heat capacity C change with soil volumetric water content θ_w? [4]



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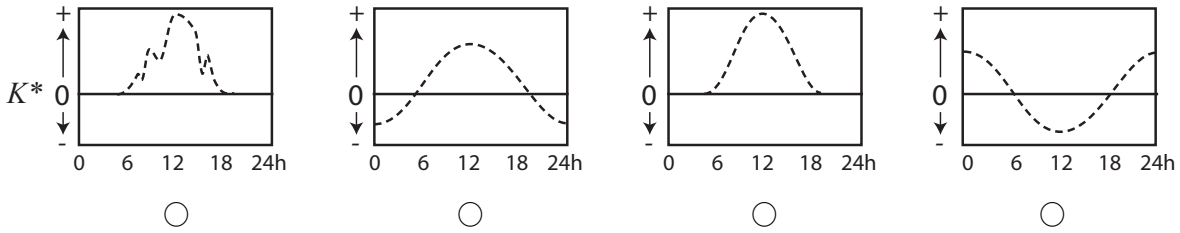
7. Which of the following graphs shows measurements of net shortwave radiation K^* from a summer clear-sky day measured on Totem Field in Vancouver? [4]



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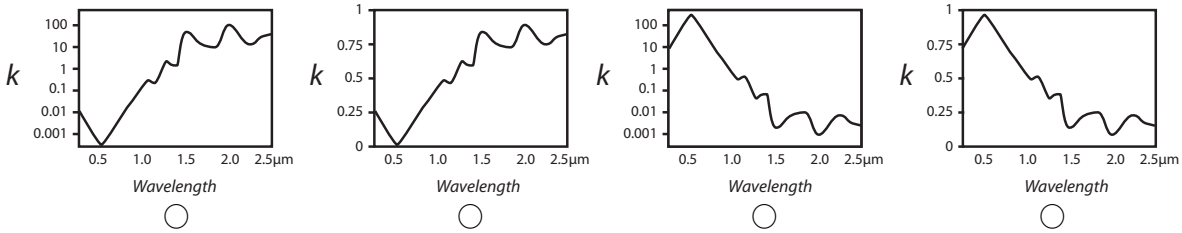
8. For water, how does the extinction coefficient k change with wavelength? [4]



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Part B: Short answer questions.

Answer only four out of these five short answer questions. Note: the first four questions with any answer written into the space provided will be marked, hence solving more than four questions is not to your advantage.

1. Briefly explain the difference between *PAR* and *NIR*. [7]

2. Briefly explain the difference between a *cold* and a *wet snowpack* from an energetic point of view. [7]

3. Briefly explain the difference between *local mean solar time* (LMST) and *local apparent time* (LAT). [7]

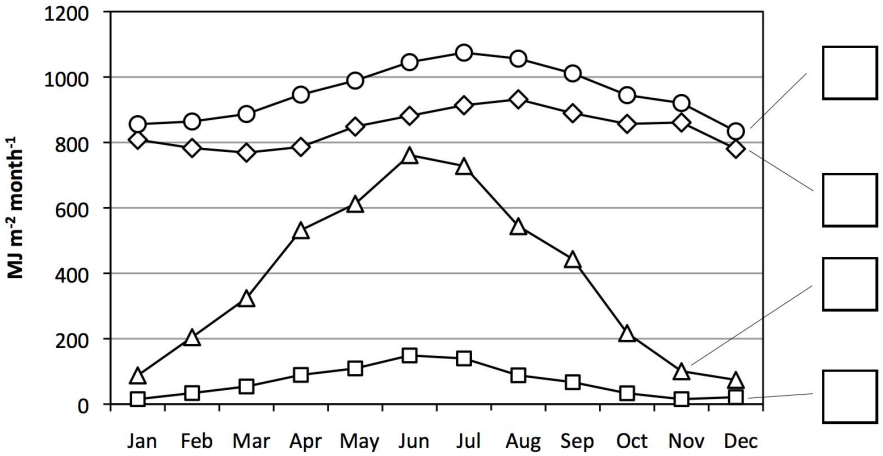
4. Briefly explain the difference between *frequency* (ν) and *wavelength* (λ) of radiation. [7]

5. Under a given situation, the atmospheric thermal admittance μ_a is five times larger than the soil thermal admittance μ_s. If the soil heat flux density is $Q_G = 50\,\mathrm{W\,m^{-2}}$, calculate the turbulent sensible heat flux Q_H. [7]

Part C: Problem questions

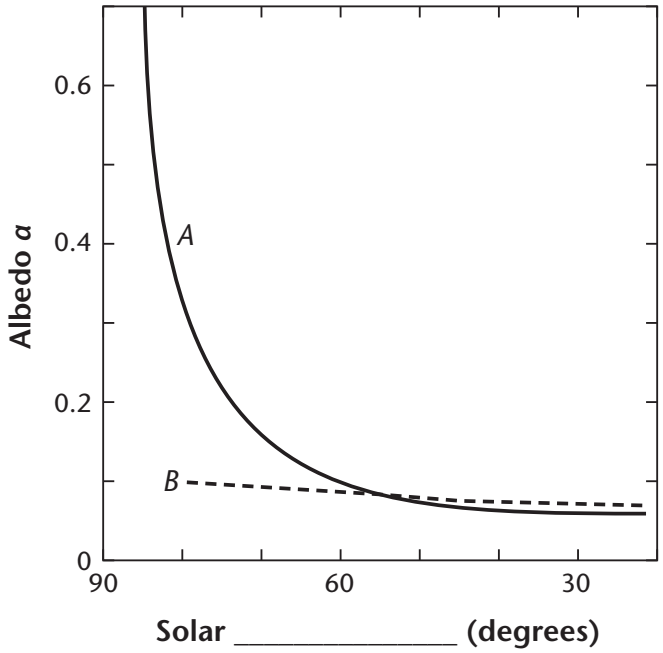
Answer only four out of the following six questions. Again: the first four questions with any answer written into the space provided will be marked, hence solving more than four questions is not to your advantage.

1. The following graph shows magnitudes of measured monthly totals $K_\downarrow$, $K_\uparrow$, $L_\downarrow$ and $L_\uparrow$ measured in Vancouver (Year 2008). (a) Label the boxes (curves) with $K_\downarrow$, $K_\uparrow$, $L_\downarrow$ or $L_\uparrow$. (b) Determine if the yearly totals of each K^*, L^*, and Q^* are positive or negative. (c) Determine in which month Q^* is highest. [10]

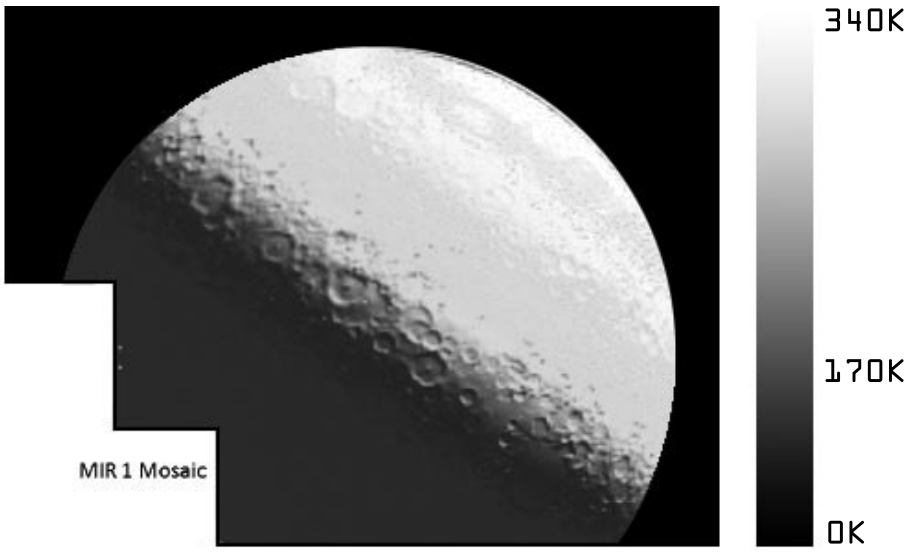


2. In mid-latitude climates, farmers are often keen to retain a deep snow cover over their land during the winter and early spring. List two reasons why this could be an advantage from an agricultural perspective. [10]

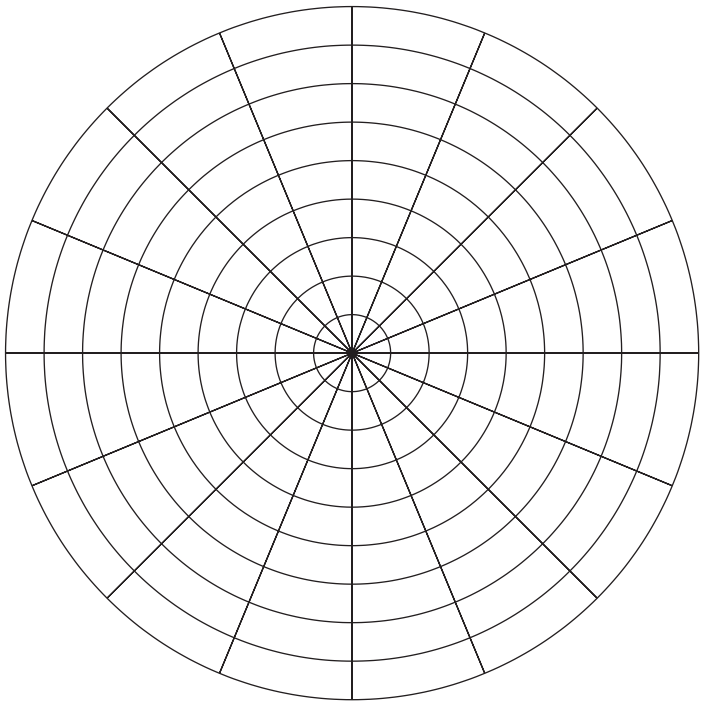
3. The graph below shows the measured change of albedo α of a calm water body (lake) as a function of relative solar geometry. (a) Label the x-axis of the graph and briefly justify your choice, (b) The two curves A and B refer to different sky conditions. Label those and briefly justify your choice. (c) Sketch into the diagram two additional curves that show A and B under a situation when the lake's surface experiences waves. Briefly explain your curves. [10]



4. The figure below shows a mosaic of thermal images from the far-side of the moon taken from a spaceship by NASA on June 23, 2009. These are the first thermal images of the far-side of the moon. The grey-scale represents measured lunar surface temperatures, with white being the hottest (+340 K) and the dark being the coldest (lowest lunar temperature 170K). (a) Briefly explain how a spaceship can remotely measure lunar surface temperatures. (b) The warmest temperatures (+340K = +65°C) are warmer than most surface temperatures on Earth, while the coldest are much lower. Briefly speculate why. (c) Argue why we see topographic features in a band along the centre of the image but not in the upper right or the lower left of the moon (craters are found all across the lunar surface). [10]



5. Draw into the graph below a sun-path diagram valid at the latitude of Vancouver (49° North) for the dates of the equinoxes. Indicate select hours of the day (6h, 12h and 18h in LAT). Label solar altitude and solar azimuth axes and provide units. [10]



6. What is special about the the atmosphere in the waveband between 8 and 13 μm of the electromagnetic spectrum? Explain why this is of relevance for the operation of Infrared Thermometers (IRTs)? [10]

END OF EXAM