# Appendix D.1: Example Midterm Questions for Study Purposes

1. Briefly define and explain the following in the context of this course:
   a. Hadley cell
   b. $Q_E$

2. Define the concept of an isotherm line.

3. Revisit your: Lecture notes, assignments, quizzes, readings, & blackboard quizzes to the end of Week 5, and Labs 0&1, 2 & *don't forget to include the Reflection questions*, and Wx Proj skills up to & including Lab 4. Also note Lab 3 provides good review of lecture Energy Budget material but it isn't specifically tested as we've not yet completed your double submission of it.

4. What is a snow pillow?

5. Given that the radiation temperature of the Earth is about 254 K and assuming it is a black body:
   a. Calculate the flux density of radiation (Wm$^{-2}$) emitted.
   b. Report the value determined in part a. to its correct number of significant figures.
   c. Report the name and symbol used for this quantity.

6. What are: Planck's Law, Stephan-Boltzmann Law, Wien's Law? How are they related?

7. The sun is 20 degrees above the horizon.
   a. What is the zenith angle?
   b. Calculate the flux density of radiation entering the atmosphere.
   c. If the atmosphere attenuates (absorbs and reflects) 20 % of this value and Earth's albedo is 0.25, what is K*, the net short wave radiation?

8. During the course we've examined two different Q* relationships:
   a. List the two Q* equations.
   b. What controls Q*? Briefly explain your reasoning.

9. Describe how the Energy Budget ($Q^* = Q_H + Q_E + Q_G$) relates to air temperature changes from daytime to nighttime.

10. What is the incoming solar radiation (I) on Feb 14 at 8 a.m. at Prince George, assuming the latitude of Prince George is 54$^0$N and there is no atmospheric attenuation?

11. Write the letter corresponding to the correct answer in the box beside the question for the following multiple choice questions.

1) Which of the following terms refers to the horizontal transport of any atmospheric property by the wind?
   (a) radiation
   (b) advection
   (c) redistribution
   (d) conduction
   (e) convection

2) Which of the following describes how the atmospheric greenhouse effect is mainly produced?
   (a) Gases in the atmosphere absorb and re-emit ultraviolet radiation.
   (b) Clouds absorb and re-emit visible light.
   (c) Gases in the atmosphere absorb and re-emit infrared radiation.
   (d) Gases in the atmosphere absorb and re-emit visible light.
   (e) Clouds reflect solar radiation back to space.

3) At which of the following times of day does the relative humidity usually reach a maximum value?
   (a) the time when the air temperature is lowest
   (b) between midnight and dawn
   (c) the middle of the afternoon
   (d) the time when the air temperature is highest

4) Which of the following statements about water vapour is correct?
   (a) Vapour pressure decreases with increasing altitude.
   (b) A decrease in the number of water vapour molecules will increase the vapour pressure.
   (c) If air pressure falls, vapour pressure will increase.
   (d) The vapour pressure is typically higher than the partial pressure exerted by oxygen.

5) The surface pressures at the bases of warm and cold columns of air are equal. Which of the following describes the air pressure in the warm column of air compared to the air pressure in the cold column?
   (a) It increases with increasing height more slowly than in the cold column.
   (b) It increases with increasing height more rapidly than in the cold column.
   (c) It decreases with increasing height more rapidly than in the cold column.
   (d) It decreases with increasing height more slowly than in the cold column.

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> **Note: This message and the highlighting will not appear on the test equation sheet; it is provided for studying purposes only.** *The yellow highlighted formulas indicate they are definitions, and consequently the values in these formulas are considered to be exact. This should be understood when considering significant figures as these numbers do not limit your rounding of final results.*

# Midterm Constants and Formulas

*Not all are constants & formulas are used. Additional information can be provided in questions as needed.*

$K = {}^\circ C + 273.15$

$a_\lambda + r_\lambda + t_\lambda = 1$

$Q^* = K\downarrow - K\uparrow + L\downarrow - L\uparrow$

$${}^0C = \frac{5({}^0F - 32)}{9}$$

$${}^0F = \left[\left(\frac{9}{5}\right)({}^0C)\right] + 32$$

$\sigma = 5.67 \times 10^{-8}$ W m$^{-2}$ K$^{-4}$

$Q_E = L_v E_t$

$I = I_o \cos Z$

$\cos Z = \sin \phi \sin \delta + \cos \phi \cos \delta \cos h$

$Q^* = Q_H + Q_E + Q_G$

E of 1 mm h$^{-1}$ is equivalent to $Q_E$ of 680 W m$^{-2}$

Surface Area$_{(sphere)}$ = $4 \pi r^2$

Mean distance between Earth and Sun: $r = 1.500 \times 10^{11}$ m

Distance from Earth to the moon: $3.84 \times 10^8$ m

Distance from Mercury to the sun: $5.790 \times 10^{10}$ m

$E = \sigma T^4 \ \ and \ \ E = \varepsilon \sigma T^4$

$a_\lambda = \mathcal{E}_\lambda$

$$\delta = -23.4 \cos\left(\frac{360(T_J + 10)}{365}\right)$$

$$\lambda_{max} = \frac{2900}{T}$$

$$\alpha = \frac{K\uparrow}{K\downarrow}$$

Solar constant: 1361 W m$^{-2}$

$$\beta = \frac{Q_H}{Q_E}$$

$Q^* = K^* + L^*$

$P = E_t + r + \Delta S$

Note the decimal in 1000. & understand it's significance when determining significant figures.

$\rho_{water}$ = 1000. kg m$^{-3}$

$L_V = 2.450 \times 10^6$ J kg$^{-1}$

Surface Area$_{(circle)}$ = $\pi r^2$

Radius of the sun: 7.00 x$10^8$ m

Radius of the earth: $6.37 \times 10^6$ m