San Francisco State University   Name _____
Department of Earth & Climate Sciences

ERTH 260 Spring 2018

Homework 2 Key

Due Friday 9 February 2018

Please answer on back or on separate sheets, in complete sentences where appropriate.

1. How is the rectangular (or cartesian) coordinate system defined? (15 pts)

   Most generally, our horizontal coordinates are given by *x*, referring to the east-west direction, *y*, referring to the north-south direction, and *z*, referring to the up-down/vertical direction.. The positive *x*-axis always points to the east, the positive *y*-axis always points to the north, and the positive *z*-axis points up. The *x*-*y*-*z* coordinate system is commonly referred to as the Cartesian coordinate system. Constant height surfaces at low altitudes above sea level often intersect the Earth's surface, particularly in mountainous regions.

2. How is the natural coordinate system defined? (15 pts)

   A natural coordinate system is one defined not based upon the geography and/or geometry of the Earth but, rather, based upon the local air flow (e.g., wind). In a natural coordinate system, there exist two horizontal coordinates: *s*, following the flow (streamwise), and *n*, perpendicular (normal) to the flow and *z*, referring to the up-down/vertical direction.The positive *s*-axis is defined in the direction to which the wind is blowing, while the positive *n* axis is defined perpendicular and to the left of the positive *s*-axis. The positive *z*-axis points up so that upward motion is positive and downward motion is negative.

3. What are the symbol(s) for the horizontal wind components in the rectangular coordinate system? (10 pts)

   u, v

4. What are the symbol(s) for the horizontal wind components in the natural coordinate system? (10 pts)

   V

5. What is the meaning of w= -15 cm/s ?   Please draw this as a vector on the graph paper attached, with the x and z axes shown. (15 pts)

   This means that the vertical wind is moving in the negative direction (downward) on the z-axis at a speed of 15 cm/s. This is called subsidence.

6. What is the meaning of u= -6 m/s?   Please draw this as a vector on the graph paper attached, with the x and z axes shown. (15 pts)

   This means that the wind speed on the x-axis is directed from east to west, or there is an east wind at 6 m/s.

7.

A

9

Actual wind vector

B

9

C
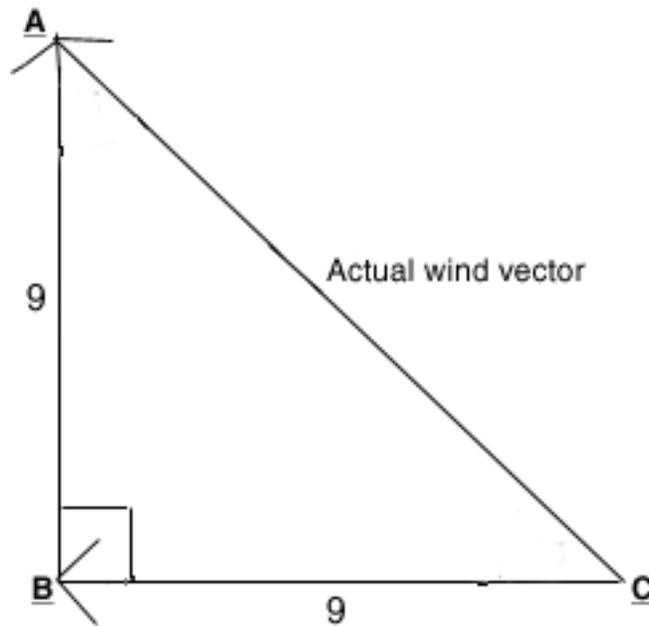
Examine the diagram above. The actual horizontal wind vector depicts a southeast wind at around 13 mph. The actual horizontal wind vector can be broken down into its two components. Which of the following choices is correct? (10 pts)

i) u= 9 mph, v= -9mph
ii) u= 9 mph, v= -9mph
iii) u= 9 mph, v= 9mph
iv) u= -9 mph, v= 9mph

8. A meteorologist reports the wind at a station as a v= -10 mph. (10 pts)This means that the wind at the station is
i) A south wind at 10 mph.
ii) A north wind at 10 mph.
iii) An east wind at 10 mph.
iv) A west wind at 10 mph

z-axis

20 cm/s

15 cm/s

10 cm/s

5 cm/s

x-axis

5 cm/s

10 cm/s

15 cm/s

Problem #5

20 cm/s

z-axis

6 m/s   1 m/s   1 m/s   6 m/s

x-axis

Problem #6