

**EXAM NUMBER** \_\_\_\_\_

**NATS 101, Section 4, Spring 2009  
Midterm Examination #2  
March 13, 2009**

Name: \_\_\_\_\_

SID: S \_\_\_\_\_

**Instructions:**

- **Write your name and student ID on ALL pages of the exam.**
- In the multiple-choice/fill in the blank section, please write-in only **ONE** answer (unless directions state otherwise). **Tear off the multiple exam answer sheet at the end of the exam packet and write your answers on this sheet. Turn this sheet in separately when you hand in your exam.**
- In the short answer section, please make sure to read each question carefully and show your work where it is required. Should you need more room to answer your questions, you can use the other side, and indicate it with the answer.
- You **CANNOT** use a calculator for the short calculation questions.
- You are **NOT** allowed to use your book or notes on this exam.
- You are **NOT** allowed to talk about or look at anyone else's exam. If you commit such an offense, you will be awarded a **0** and the offense will be noted in accordance to **The Code of Academic Integrity**.
- Good luck!

**Score:**

**Multiple Choice Section:** \_\_\_\_\_ / 30 points

**Short Answer Section:** \_\_\_\_\_ / 15 points

**Bonus Questions:** \_\_\_\_\_ / 5 points

**Total:** \_\_\_\_\_ / 45 points

**VERSION A**

**Midterm Examination #2**  
**NATS 101, Section 4, Spring 2009**  
**Introduction to Weather and Climate**  
**Multiple Choice, One Word Answer Section**

**Scoring:** Each question is worth 1 point in this section.

1. In a Chinook wind, what happens to the air after it crosses the continental divide in the Rocky Mountains and descends into the Great Plains?
  - a) The air cools by adiabatic expansion.
  - b) The air cools by adiabatic compression.
  - c) The air warms by adiabatic expansion.
  - d) The air warms by adiabatic compression.
  - e) None of the above.
  
2. In the mid-latitudes, where would the formation of clouds and precipitation be most likely with respect to the position of an upper-level trough?
  - a) To the west of the upper-level trough
  - b) To the east of the upper-level trough
  - c) To the north of the upper-level trough.
  - d) To the south of the upper-level trough.
  - e) At the location of the upper-level trough itself.
  
3. Ice crystals in the presence of supercooled water drops in a cloud will \_\_\_\_\_ because the saturation vapor pressure of water is \_\_\_\_\_ than that of ice.
  - a) Shrink; higher
  - b) Shrink; lower
  - c) Grow; higher
  - d) Grow; lower
  - e) Neither shrink nor grow; the same.
  
4. The atmosphere is \_\_\_\_\_ when a positively buoyant, moist air parcel is \_\_\_\_\_ than its surrounding environment due to condensation of liquid water and the environmental lapse rate is 7 degrees Celsius per kilometer.
  - a) Absolutely stable; colder
  - b) Absolutely stable; warmer
  - c) Absolutely unstable; colder
  - d) Absolutely unstable; warmer
  - e) Conditionally unstable; colder
  - f) Conditionally unstable; warmer
  
5. In a coastal area like Florida, typically during the day air \_\_\_\_\_ over the land and the winds blow \_\_\_\_\_.
  - a) Sinks; onshore
  - b) Sinks; offshore
  - c) Rises; onshore
  - d) Rises; offshore
  - e) None of the above

**VERSION A**

6. Newton's Second Law of Motion states that
- a) The acceleration that an object experiences is proportional to the net force applied to it.
  - b) The acceleration that an object experiences is inversely proportional to the net force applied to it
  - c) The acceleration that an object experiences is not proportional to the net force applied to it.
  - d) The acceleration that an object experiences is proportionally squared to the net force applied to it.
  - e) None of the above
7. In what direction does energy flow in a single cell model of the general circulation?
- a) From the midlatitudes to the poles.
  - b) From the poles to the equator.
  - c) From the equator to the poles
  - d) From the poles to the midlatitudes.
  - e) None of the above.

For questions 8-14, write the name of the cloud that corresponds to the description given

8. Thunderhead with an anvil.
9. Lens shaped
10. Streaky in appearance with "mare's tails"
11. Have flat bases, and lumpy tops. Look like cotton balls.
12. A low-lying cloud just above the ground.
13. Small, rounded puffy clouds that cause a "mackerel sky"
14. Associated with large areas of steady light to moderate precipitation.
15. Given a constant pressure gradient, air flowing around the base of an upper-level trough is in \_\_\_\_\_ balance and therefore the wind speed will be relatively \_\_\_\_\_ at this point.
- a) Geostrophic; faster.
  - b) Geostrophic; slower.
  - c) Gradient; faster.
  - d) Gradient; slower
  - e) Cyclostrophic; faster
  - f) Cyclostrophic; slower.
16. What is the process that best explains the rapid growth of cloud drops into precipitating raindrops?
- a) Collision and coalescence
  - b) Condensation
  - c) Accretion
  - d) Aggregation.
  - e) Bergeron process
  - f) None of the above
17. The dry adiabatic lapse rate is approximately \_\_\_\_\_ degrees Celsius per kilometer.

**VERSION A**

18. Before the crash of BOAC flight 911 on Mt. Fuji on March 5, 1966, what clouds were observed by other aircraft that are typically indicative of severe mountain lee wave turbulence?
- Cirrus clouds
  - Cumulonimbus clouds
  - Lenticular clouds
  - Billow clouds
  - All of the above.
  - None of the above.
19. The atmosphere is \_\_\_\_\_ when a positively buoyant, dry air parcel is \_\_\_\_\_ than its surrounding environment and the environmental lapse rate is 11 degrees Celsius per kilometer.
- Absolutely stable; colder
  - Absolutely stable; warmer
  - Absolutely unstable; colder
  - Absolutely unstable; warmer
  - Conditionally unstable; colder
  - Conditionally unstable; warmer
20. Which type of cloud is indicative of the most instability in the atmosphere?
- Cirrus
  - Lenticular
  - Fair weather cumulus
  - Nimbostratus
  - Cumulus congestus
  - None of the above because all these clouds occur in a stable atmosphere.
21. The elevation that defines the base of a cumulus cloud is called \_\_\_\_\_.
- The equilibrium level
  - The lifting condensation level
  - The convection condensation level
  - The level of free convection
  - None of the above
22. Water draining down a sink in the southern hemisphere will \_\_\_\_\_ because the Coriolis force \_\_\_\_\_.
- Always rotate clockwise; acts to the left of the direction of motion.
  - Always rotate clockwise; acts to the right of the direction of motion.
  - Always rotate counterclockwise; acts to the left of the direction of motion.
  - Always rotate counterclockwise; acts to the right of the direction of motion.
  - Rotate either counterclockwise or clockwise; is negligible.
23. Sea surface temperatures in the eastern tropical Pacific tend to be \_\_\_\_\_ than average during El Niño and \_\_\_\_\_ than average during La Niña.
- Colder; warmer
  - Colder; colder.
  - Warmer; colder.
  - Warmer; warmer.
  - None of the above because the sea surface temperatures are about average during both El Niño and La Niña.
24. Friction causes the surface wind to \_\_\_\_\_ and \_\_\_\_\_.
- Slow down; curve towards surface low pressure.
  - Speed up; curve towards surface low pressure
  - Slow down; curve away from surface low pressure
  - Speed up; curve away from surface low pressure

**VERSION A**

25. During an El Niño winter precipitation in the Southwestern U.S. is typically \_\_\_\_\_ average and winter precipitation in the Pacific Northwest is typically \_\_\_\_\_ average.
- a) Above; above.
  - b) Above; below.
  - c) Below; above.
  - d) Below; below.
  - e) None of the above.
26. This form of precipitation is formed by snow crystals falling through warmer air, then refreezing before they hit the ground
- a) Rain
  - b) Snow
  - c) Sleet
  - d) Hail
  - e) None of the above
27. The atmosphere is \_\_\_\_\_ when a negatively buoyant, dry parcel of air is \_\_\_\_\_ than its surrounding environment and the environmental lapse rate is 5 degrees Celsius per kilometer.
- a) Absolutely stable; colder
  - b) Absolutely stable; warmer
  - c) Absolutely unstable; colder
  - d) Absolutely unstable; warmer
  - e) Conditionally unstable; colder
  - f) Conditionally unstable; warmer
28. In the cloud in the bottle experiment shown in class, a cloud forms in the flask due to adiabatic \_\_\_\_\_ of the air and \_\_\_\_\_ nucleation.
- a) compression; homogeneous
  - b) compression; heterogeneous
  - c) expansion; homogeneous
  - d) expansion; heterogeneous
29. Vertical motion associated with buoyancy in the atmosphere is caused by \_\_\_\_\_.
- a) Horizontal convergence and divergence.
  - b) Friction
  - c) Centripetal acceleration
  - d) Horizontal temperature differences.
  - e) All of the above.
  - f) None of the above
30. Which type of precipitation occurs if the air temperature is below freezing throughout the entire depth of the troposphere?
- a) Rain
  - b) Snow
  - c) Sleet
  - d) Freezing rain
  - e) None of the above
  - f) All of the above

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**Midterm Examination #2**  
**NATS 101, Section 4, Spring 2009**  
**Introduction to Weather and Climate**  
**Short Answer Section**

**Scoring:** Each question is worth points as indicated.

31. Explain why Arizona is a desert. In your explanation, emphasize the role of the general circulation. You are encouraged to use a sketch in your answer. **(4 points)**

**VERSION A**

32. Sketch and physically explain the atmospheric vertical temperature profile through the lower troposphere necessary for the following types of precipitation: a) rain, b) sleet, c) freezing rain, and d) snow. You should have four different sketches corresponding to each precipitation type. **(6 points)**

**VERSION A**

33. You are flying from Tucson to Denver. Give two different reasons why would you expect to have a bumpy flight, irrespective of what season it is? You are encouraged to use illustrations in answering this question. **(5 points)**

**VERSION A**



BONUS QUESTION: A Galileo thermometer (as displayed on the overhead projector) is used to measure temperature in the range of approximately 60-85°F. Explain why, near room temperature, some of the glass balls filled with colored liquid sink to the bottom of the cylinder while others float at the top. *Hint: Each of the glass balls filled with colored liquid has approximately the same mass. Attached to the balls are metal tags, each with a slightly different mass.*

**(5 Points Extra Credit)**

**VERSION A**

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**MIDTERM EXAM #2 ANSWER SHEET**  
**Mark answers TO RIGHT of question number.**

<u>Question</u>	<u>Answer</u>	<u>Question</u>	<u>Answer</u>
<b>1</b>		<b>19</b>	
<b>2</b>		<b>20</b>	
<b>3</b>		<b>21</b>	
<b>4</b>		<b>22</b>	
<b>5</b>		<b>23</b>	
<b>6</b>		<b>24</b>	
<b>7</b>		<b>25</b>	
<b>8</b>		<b>26</b>	
<b>9</b>		<b>27</b>	
<b>10</b>		<b>28</b>	
<b>11</b>		<b>29</b>	
<b>12</b>		<b>30</b>	
<b>13</b>			
<b>14</b>			
<b>15</b>			
<b>16</b>			
<b>17</b>			
<b>18</b>			

**VERSION A**