



FINAL EXAMINATIONS: DECEMBER 2017 - INDIVIDUAL EXAM

Course number: **ATSC 201** Section numbers: 101

Course name: Meteorology of Storms

Duration: 90 minutes for the individual exam; then a 10 minute break; then 50 minute group exam in assigned groups of 4.

Candidate name _____

Student number _____ Candidate signature _____

Special instructions: Open books, notes, and calculator. No other electronics (cell phones, iPads, laptops, ear phones). Indicate your name, student ID, Test Form, and all your answers on the Bubble sheet. Each question has only one best answer. Don't leave any questions unanswered (if you don't know the answer, then guess). Good luck!

Instructor names: Roland Stull

This examination consists of 3 pages (+ this cover sheet + a bubble sheet). Check to ensure that it is complete. Students ARE allowed to separate the bubble sheet from the rest of the exam. Only the bubble sheet will be marked, but students must turn in ALL pages of this exam. Please do NOT re-staple the bubble sheet to the exam packet.

Rules governing formal examinations

1. Each examination candidate must be prepared to produce, upon the request of the invigilator or examiner, his or her UBCcard for identification.
2. Examination candidates are not permitted to ask questions of the examiners or invigilators, except in cases of supposed errors or ambiguities in examination questions, illegible or missing material, or the like.
3. No examination candidate shall be permitted to enter the examination room after the expiration of one-half hour from the scheduled starting time, or to leave during the first half hour of the examination. Should the examination run forty-five (45) minutes or less, no examination candidate shall be permitted to enter the examination room once the examination has begun.
4. Examination candidates must conduct themselves honestly and in accordance with established rules for a given examination, which will be articulated by the examiner or invigilator prior to the examination commencing. Should dishonest behaviour be observed by the examiner(s) or invigilator(s), pleas of accident or forgetfulness shall not be received.
5. Examination candidates suspected of any of the following, or any other similar practices, may be immediately dismissed from the examination by the examiner/invigilator, and may be subject to disciplinary action:
 - i. speaking or communicating with other examination candidates, unless otherwise authorized;
 - ii. purposely exposing written papers to the view of other examination candidates or imaging devices;
 - iii. purposely viewing the written papers of other examination candidates;
 - iv. using or having visible at the place of writing any books, papers or other memory aid devices other than those listed above under Special Instructions or authorized by the examiner(s); and,
 - v. using or operating electronic devices including but not limited to telephones, calculators, computers, or similar devices other than those authorized by the examiner(s)—(electronic devices other than those authorized by the examiner(s) must be completely powered down if present at the place of writing).
6. Examination candidates must not destroy or damage any examination material, must hand in all examination papers, and must not take any examination material from the examination room without permission of the examiner or invigilator.
7. Examination candidates must follow any additional examination rules or directions communicated by the examiner(s) or invigilator(s).

Write all of your answers on the bubble sheet. Both the bubble sheet and the question sheet will be marked.

This is TEST FORM "A".

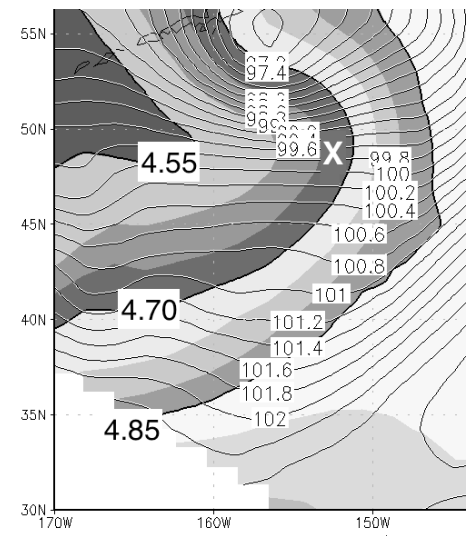
- 1) (1 points) The clouds in this photo are: A) cirrus
 B) altocumulus C) stratus D) cumulus E) nimbostratus
- 2) (1 points) These clouds likely indicate: A) (nothing)
 B) an approaching warm front C) an approaching cold front
 D) an approaching thunderstorm E) a tornado
- 3) (1 points) The polar jet stream is strongest in:
 A) Spring B) Summer C) Fall D) Winter
 E) (nearly equal strength in all seasons)



- 4) (5 points) Given a jet-stream Rossby wave of wavelength 3141.59 km, imbedded in a background flow of $U = 20$ m/s at a latitude where the average $\beta = 1.5 \times 10^{-11} \text{ m}^{-1} \text{ s}^{-1}$. Considering only barotropic effects, the trough in this wave would move at what speed relative to the ground?
 A) -16.25 B) -3.75 C) 3.75 D) 16.25 E) 20.00
- 5) (2 points) Which is true regarding geostrophic adjustment at the equator?
 A) The winds adjust to the pressure field. B) The pressure adjusts to the wind field.
 C) Both the pressure and wind fields adjust to bring the winds back to geostrophic balance.
 D) (Geostrophic adjustment does not apply at the equator, because Coriolis force is zero there.)

Given the weather map at right. The shaded contours (with large number labels) are thickness between the 100 and 50 kPa isobaric surfaces. The thin lines with small numbers are pressure (kPa) at sea level.

- 6) (2 points) The theoretical geostrophic winds at the white "X" (ignoring boundary-layer drag) are blowing from the
 A) north B) east C) south D) west E) nearly calm (no direction)
- 7) (2 points) The thermal winds at the white "X" are blowing from the
 A) north B) east C) south D) west E) nearly calm (no direction)
- 8) (1 points) Thermal winds represent or indicate ...
 A) the advection of sensible heat. B) the advection of latent heat. C) the movement of air in convective thermals. D) the rising part of the Hadley cell.
 E) the change of change of geostrophic wind with height.

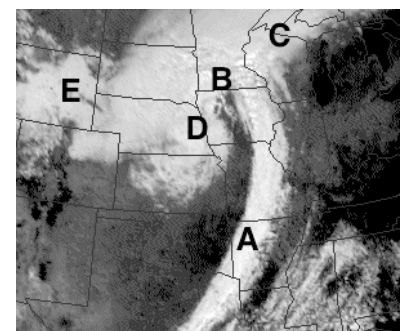


- 9) (1 points) In the visible satellite image at right, the Low center is near which letter? (hint: location is North America)

- 10) (1 points) In that same image, which letter is at a Warm Front?

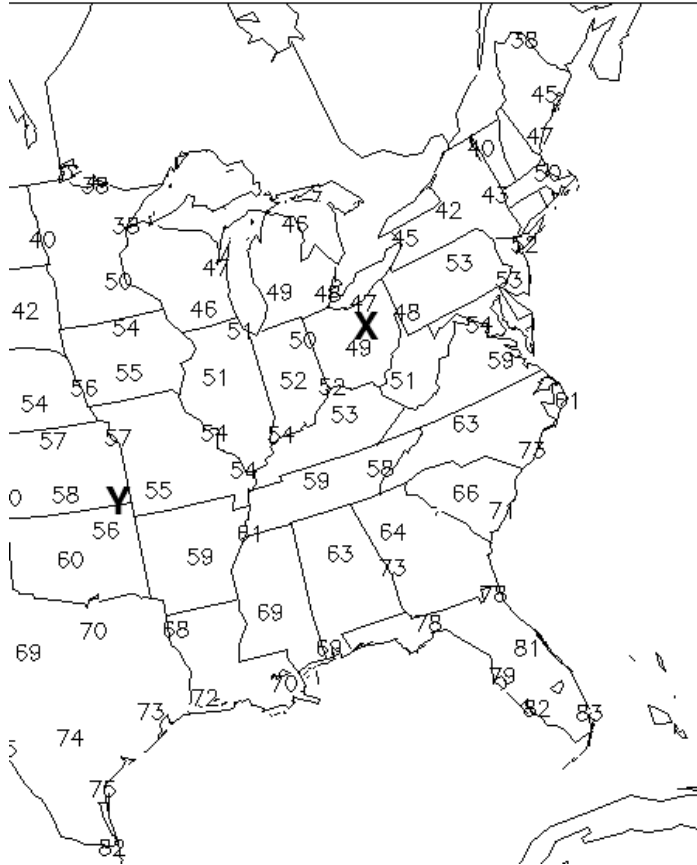
- 11) (1 points) In that same image, which letter is at a Cold Front?

- 12) (2 points) A good 3-hour forecast at point "A" in that map is:
 A) thunderstorms ending and cooling. B) becoming overcast and windy.
 C) staying overcast and cold. D) continued sunshine. E) drizzle ending and warming.

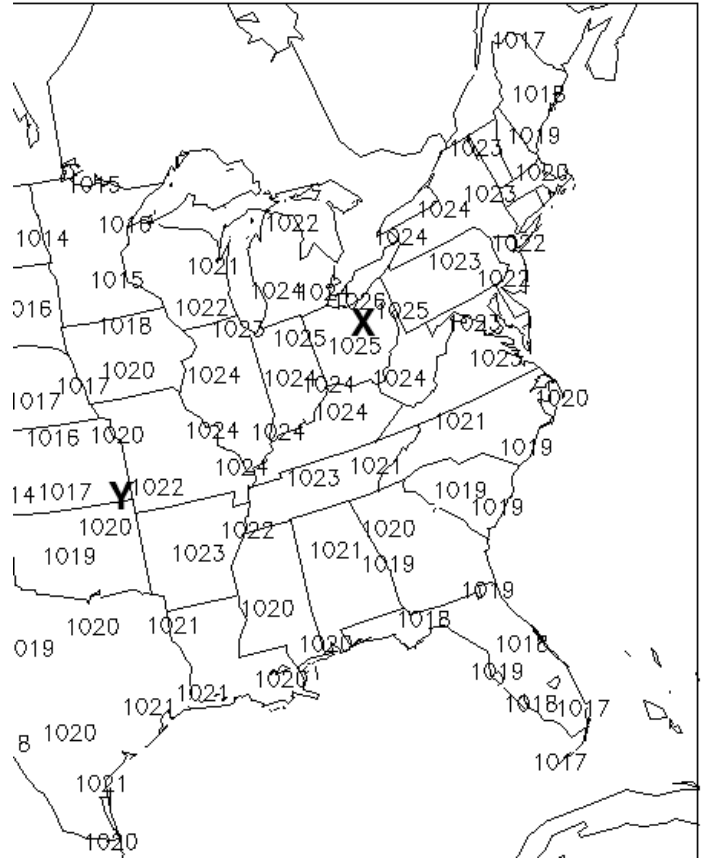


13) (10 points) Below are 2 weather maps for the same instant in time. The **left map** shows **temperatures** in deg F. Please analyze this by drawing and labeling the following isotherms: 80, 70, 60, 50, 40 degF. The **right map** shows **pressures** in hPa. Please analyze by drawing and labeling the following isobars: 1024, 1020, 1016 hPa. (recall 1000 hPa = 100.0 kPa). These analyses will help you answer the next 2 questions.

Temperatures

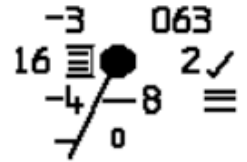


pressures



- 14) (1 points) Which weather feature is at location "X" in the maps? A) cold front B) warm front C) occluded front D) low center E) high center
- 15) (1 points) What is happening at location "Y" in the maps? A) warm air advection B) cold air advection C) warm frontal passage D) cold frontal passage E) hurricane passage
- 16) (2 points) The main reason that Vancouver gets many days of rain in the winter is because of many
 A) cold fronts coming from over the Pacific Ocean cause cumulonimbus clouds.
 B) occluded fronts coming from over the Pacific Ocean cause nimbostratus clouds.
 C) warm fronts coming from over southeastern BC cause stratus clouds.
 D) cold fronts coming from over arctic Canada cause cooling that forces condensation and rain.
 E) stationary fronts that move in from the west due to the prevailing west winds a mid latitudes.
- 17) (1 points) The "pineapple express" is another name for: A) a new fruit delivery service by Canada Post. B) a low-cost airline flying out of Hawaii. C) an atmospheric river. D) a warm front. E) the subtropical jet.
- 18) (5 points) Air with $\Delta T/\Delta z = 0^\circ\text{C}/\text{km}$ is blown by the wind at speed 20 m/s towards a mountain range. Assume an average virtual temperature of 250 K. You would likely observe: A) wake turbulence to the lee of the mountain. B) a mountain wave of wavelength 6.41 km. C) a mountain wave of zero wavelength. D) a mountain wave of infinite wavelength. E) a mountain wave of wavelength 202.7 m.

- 19) (2 points) You are in a high-pressure region with clear skies at night. Along the mountain slope you expect:
 A) anabatic winds B) katabatic winds C) gap winds D) chinook winds E) land-breeze winds
- 20) (1 points) The surface winds associated with the Hadley cell are called:
 A) westerlies B) Bermuda high C) foehn winds D) outflow winds E) trade winds
- 21) (1 points) Most of Canada is located in: A) tropics B) subtropics C) extratropics D) supertropics
 E) (none of the previous choices)
- 22) (1 points) One advantage of infrared (IR) imager channels on geostationary satellites is that they
 A) can see polar regions. B) detect water vapour in the top 1/3 of the troposphere.
 C) they are in low earth orbit, hence they return to look at every point on earth more frequently.
 D) can see in both daytime and nighttime. E) are smaller and thus less expensive to launch.
- 23) (3 points) Stratus clouds on satellite would appear as
 A) white in the visible (vis); white in the IR; and dark in the water vapour (wv) channels.
 B) dark in the vis; dark in the IR; and dark in the wv.
 C) dark in the vis; white in the IR; and white in the wv.
 D) white in the vis; white regions in the IR; and white regions in the wv.
 E) white in the vis; dark in the IR; and dark in the wv.
- 24) (2 points) Decode the weather at this weather station from the weather-map image at right. Which statement is correct? A) winds are from the north-northeast at 5 knots.
 B) T_d is -8°C . C) Sky is obscured. D) P is 90.63 kPa. E) T is -3°C .



- 25) (1 points) The airmass that forms west of Vancouver is usually: A) mP B) cP C) mT D) cP E) cA
- 26) (1 points) Why does cyclogenesis often occur east of troughs (west of ridges) in the polar jet stream?
 A) because they form at the trough and then blow downwind.
 B) because the boundary layer causes air to flow in counterclockwise in the N. Hemisphere.
 C) because of the zonal flow in the jet stream.
 D) because of divergence aloft at that location. E) because of divergence at the surface at that location.
- 27) (3 points) Suppose a column of air zonal flow over a plateau in the N. Hemisphere blows past the edge of the plateau, causing the column depth to increase. What will happen to the air flow?
 A) it will bend to the right because of conservation of relative vorticity. B) it will bend to the left because of conservation of relative vorticity. C) it will continue straight due to inertia. D) it will bend to the right because of conservation of potential vorticity. E) it will bend to the left because of conservation of potential vorticity.
- 28) (3 points) If the axis of low-pressure of a mid-latitude cyclone tilts westward with increasing height in the Southern Hemisphere, then what is likely?
 A) cyclolysis B) cyclogenesis C) no change D) anticyclogenesis E) anticyclolysis
- 29) (1 points) Hurricanes (typhoons, tropical cyclones) last for a couple ___ because the ___ extract(s) energy from the ___. A) days; cloud top; sun. B) weeks; breaking waves; ocean. C) days; sea surface; sun.
 D) weeks; eye; eye-wall thunderstorms. E) months; rotation; Coriolis force
- 30) (1 points) Hurricane strength is given by the ___ scale. A) Richter B) Fujita C) Enhance Fujita
 D) Saffir-Simpson E) Rossby-Wave