



## FINAL EXAMINATION: DECEMBER 2023

Course number: **ATSC 201**      Section number: 101  
Course name: Meteorology of Storms.      Duration: 90 minutes

Candidate name \_\_\_\_\_

Student number \_\_\_\_\_ Candidate signature \_\_\_\_\_

**Special instructions:** Open books, notes, laptops, iPads, and calculator. No other electronics (cell phones, ear phones). Indicate your name, student ID, Test Form (All exams this term are Test Form A), 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 name: Roland Stull**

This examination consists of 8 pages (including this cover sheet & bubble sheet). Check to ensure that it is complete. Students ARE allowed to separate all the exam sheets from each other. Students must turn in ALL pages of this exam. The bubble sheet will be marked by computer for the multiple-choice questions, and other questions involving maps or diagrams will be marked by hand. 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 UBC card 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 at the start of the examination. 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);
  - 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);
  - vi. copying, scanning, or photographing any parts of the exam to take or transmit outside of the exam room;
  - vii. use of the internet and use of search engines such as Google.
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 exam 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).

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TEST FORM

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100	(A)	(B)	(C)	(D)	(E)

**Instructions:** Put your answers on the bubble sheet, unless otherwise stated in the question. Only one best answer for each question. You may separate all the sheets from each other. Put your name on all papers and turn them in to the invigilators. There are 32 total questions. Total points = 90, which is 1 minute /point in the individual exam, 0.5 min /point in group exam. Not allowed to use Google or ChatGPT or other search engines or AI. Not allowed to communicate with other people.

For the next 15 questions, use the page of satellite photos.  
Figs A, B, C are for one time. Figs. D, E, F are for a later time.  
The 3 images for any one time are for the visible, IR, and water-vapor channels. These are colorized images, for example, in the water-vapor image, dry air is orange/brown, while juicy air is white/blue.

Question (points)

- 1 (1) Which figure is an infrared image?  
A) A                      B) B                      C) C                      D) D                      E) E
- 2 (1) A cold front is likely at location:  
A) G                      B) H                      C) I                      D) J                      E) K
- 3 (1) A warm front is likely at location:  
A) G                      B) H                      C) I                      D) J                      E) K
- 4 (2) An occluded front (not in the center of the low) is likely at location:  
A) G                      B) H                      C) I                      D) J                      E) K
- 5 (1) An extra-tropical cyclone is centered at location:  
A) G                      B) H                      C) I                      D) J                      E) K
- 6 (4) Dry air aloft is likely at location:  
A) G                      B) H                      C) I                      D) J                      E) K
- 7 (2) The clouds at location H are likely:  
A) thin cirrus                      B) mid-level (alto) clouds  
C) nimbostratus                      D) lenticular  
E) thunderstorm anvils
- 8 (2) At location "O" is likely:  
A) cumuliiform clouds in cold air  
B) cumuliiform clouds in warm air  
C) stratiform clouds in cold air  
D) stratiform clouds in warm air  
E) snow on the ground
- 9 (2) The clouds at location "M" are likely:  
A) thin cirrus                      B) mid-level (alto) clouds  
C) nimbostratus                      D) lenticular  
E) thunderstorm anvil

- 10 (5) A location "L" is likely:  
 A) a surface front B) a dry line  
 C) a sting jet D) volcanic ash cloud  
 E) an upper-level front
- 11 (1) The weather phenomenon of H, I, J, K is considered \_\_\_\_\_ scale.  
 A) planetary B) synoptic C) meso- D) micro- E) molecular
- 12 (1) The main baroclinic zone is likely aligned along  
 A) G - H B) H - I C) I - J D) J - K E) K - G
- 13 (1) The air at locations M, N, and O are at \_\_\_\_\_ latitudes.  
 A) tropical B) subtropical C) mid-  
 D) subpolar E) polar
- 14 (1) A \_\_\_\_\_ wind is likely at location "O"  
 A) northwest B) southwest C) southeast D) northeast E) near calm
- 15 (1) A likely 24-hour forecast for a ship anchored at location N is  
 A) hurricane-force winds with rapid decrease in sea-level pressure  
 B) squall line with embedded tornadic thunderstorms  
 C) lenticular clouds with mountain waves and rotor clouds  
 D) fair weather, calm conditions, and increasing temperature  
 E) increasing clouds, scattered showers, and decreasing temperature

Not on  
bubble  
sheet. (Will  
be hand marked)

- (15) For the next 3 questions, use the attached surface weather map.  
 First, analyze that map by drawing and labeling the following isobars:  
 101.0 , 100.5 , 100.0 , 99.5 , 99.0 kPa, and label any Low center with L.  
 This map will be hand marked, so be sure to submit it with your exam.

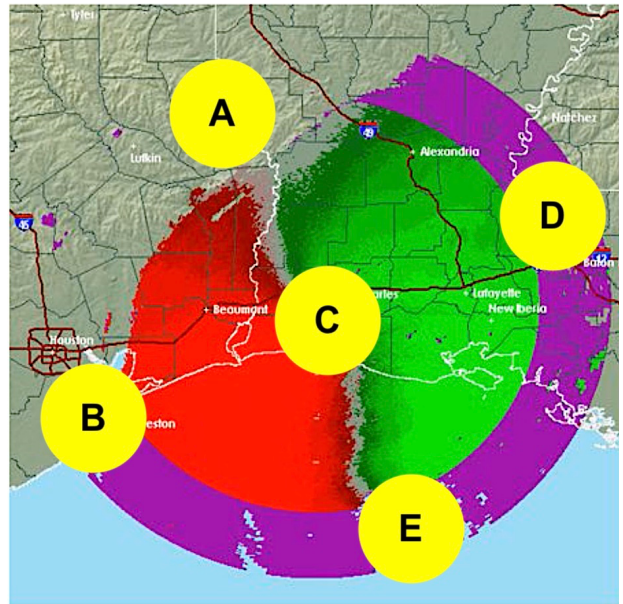
- 16 (1) There is a low-pressure center located near location:  
 A) A B) B C) C D) D E) E
- 17 (1) Northwest winds are generally near location  
 A) A B) B C) C D) D E) E
- 18 (1) Overcast conditions with calm winds  
 is generally near location  
 A) A B) B C) C D) D E) E
- 19 (1) The clouds outlined in the photo at right are  
 A) cumulonimbus B) stratocumulus  
 C) altocumulus D) cirrostratus  
 E) lenticular





- 20 (2) What drives cyclolysis in all cyclones?
- A) heavy precipitation
  - B) overcast skies
  - C) centrifugal force
  - D) cyclogenesis
  - E) boundary layer drag

- 21 (2) In the doppler radar image at right, the eye of a tropical cyclone in the Northern Hemisphere is at
- A) A      B) B
  - C) C      D) D      E) E



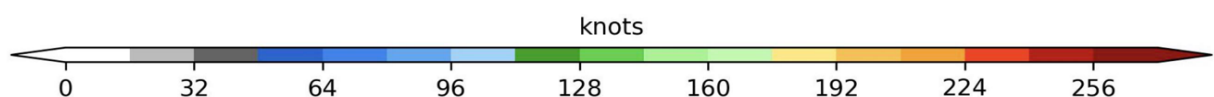
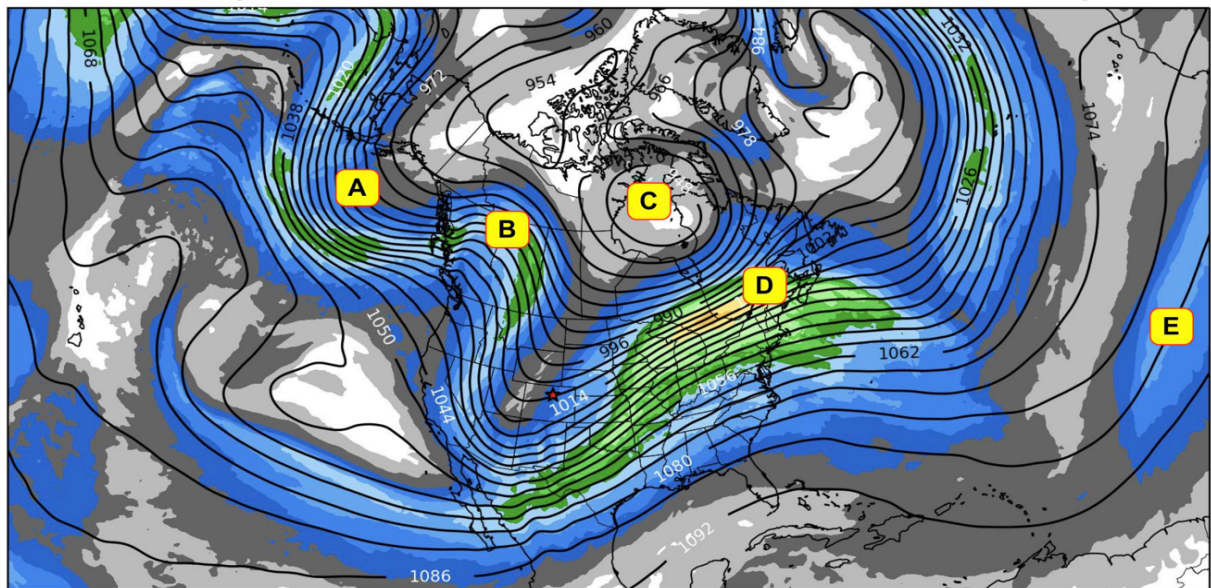
- 22 (4) Which is NOT associated with the Hadley cell?
- A) ITCZ
  - B) subtropical jet
  - C) vertical circulations
  - D) polar jet
  - E) trade winds

For the next 6 questions, use this 25 kPa map.

**GFS 0.25° 25kPa Geopotential Heights (dam) and Wind Speed (knots)**

Init: 00Z Sat 01 Jan 2022

Hour: 015 Valid: 15Z Sat 01 Jan 2022

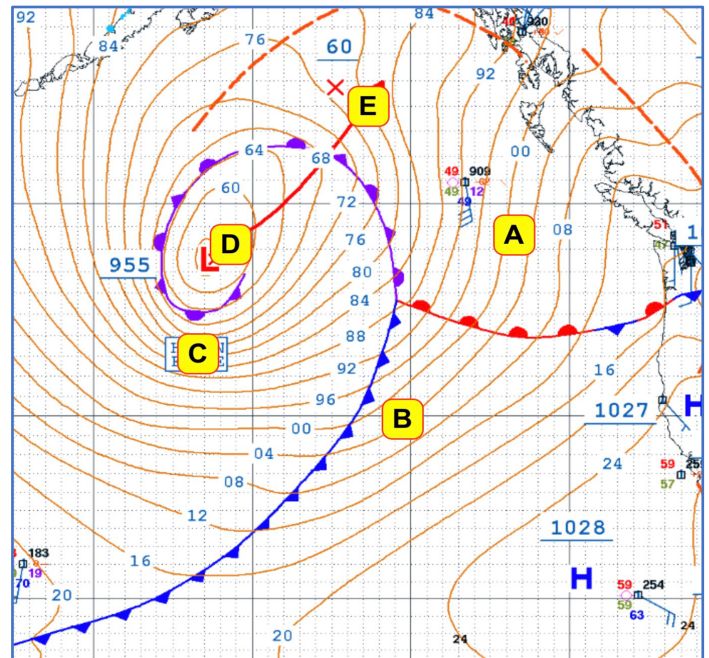


- 23 (1) Which location is NOT likely on the polar jet?
- A) A      B) B      C) C      D) D      E) E

- 24 (1) A Rossby-wave ridge is near  
A) A B) B C) C D) D E) E
- 25 (4) An Rossby-wave open trough (i.e., not a closed low) is near  
A) A B) B C) C D) D E) E
- 26 (1) The fastest jet streak in that image is near  
A) A B) B C) C D) D E) E
- 27 (4) This upper air chart corresponds to what altitude (km) above sea level?  
A) 1 B) 2 C) 5 D) 10 E) 25
- 28 (1) Wind speeds of roughly 200 knots are observed near "D".  
Assuming near zero wind at the ground, what equation would you use to estimate the average horizontal temperature gradient under "D".  
A) gradient wind eq. B) geostrophic wind eq.  
C) frontogenesis eq. D) continuity eq.  
E) thermal wind eq.

Use the surface analysis map at right for the next 3 questions.

- 29 (8) **Forecasting** for 3 hours from now, at which location do expect drizzle with embedded scattered thunderstorms, and decreasing surface pressure?  
A) A B) B C) C D) D E) E
- 30 (8) Based on this map, the fastest winds are likely at  
A) A B) B C) C D) D E) E
- 31 (1) Near location A, the surface winds are likely  
A) north B) east  
C) south D) west E) near calm
- 32 (8) If the max sea-level pressure difference between a hurricane eye and the surrounding environment outside the hurricane is 16 kPa, then what is the likely Saffir-Simpson intensity for that hurricane?  
A) 1 B) 2 C) 3 D) 4 E) 5



-- End of exam questions, but see other attachments. --



