EAS270, "The Atmosphere" Quiz 3 18 Nov., 2009

Professor: J.D. Wilson Time available: 15 mins Potential Value: 10%

Instructions: For all 10 questions, choose what you consider to be the best (or most logical) option, and use a pencil to mark that choice on the answer form. **Eqns/data given at back**. You may keep this quiz.

1. According to the "conveyor belt" theory of the midlatitude storm, the cold conveyor belt ____
   (a) is a cold westerly or north-westerly stream of surface air advancing behind the cold front and displacing the air in the warm sector
   (b) is a dry westerly or north-westerly upper airstream that overruns the warm front
   (c) is a cold southerly or south-easterly surface stream in the warm sector
   (d) is a cold surface easterly on the cold side of the warm front ✓✓
   (e) is a cold vertical current sinking at the centre of low pressure

2. A deep (i.e. order 1 kilometer) temperature inversion sometimes persists in winter over central Alberta because ____
   (a) snow cover reflects the weak incoming solar energy flux of the short winter day
   (b) continental winter airmasses at high latitude undergo net daily heat loss to the surface, which is itself cooling due to net radiative energy loss
   (c) winds aloft may advect milder air over the cold surface air
   (d) high humidity of the winter airmass results in its being cooled from the top by long-wave radiation
   (e) all three factors (a), (b) and (c) are pertinent ✓✓

3. The height of the Lifting Condensation Level (LCL) in an airmass is related to ____
   (a) surface temperature T
   (b) surface dewpoint T_d
   (c) surface temperature-dewpoint spread $T - T_d$ ✓✓
   (d) 1000 - 500 hPa thickness of the airmass
   (e) 850 - 500 hPa thickness of the airmass

4. A parcel moving around a northern hemisphere trough axis has ____ relative vorticity; the decay of that vorticity as the parcel moves out of the trough results in ____ aloft
   (a) cyclonic; convergence (area shrinkage)
   (b) cyclonic; divergence ✓✓
   (c) anticyclonic; convergence
   (d) anticyclonic; divergence

5. A cold front is sloped by (nominally) the ratio 1:100. If one moves perpendicularly away from the front by distance 100 km into the cold airmass, the frontal boundary is about ____ above ground

   (a) 10 m
   (b) 100 m
   (c) 1000 m ✓✓
   (d) 10 km
   (e) 100 km

6. The simplest explanatory paradigm for the existence of planetary waves (same as long waves, or Rossby waves) in the flow aloft focuses on the absolute vorticity ζ of a moving parcel. The flow pattern in the Rossby waves is such that the absolute vorticity of the parcel ____

   (a) oscillates about 3 to 7 times around the globe
   (b) equals the earth's vorticity f
   (c) is maximized
   (d) is minimized
   (e) is constant ✓✓

7. The most common summertime airmass type in central and northern Alberta is ____

   (a) cA
   (b) cP ✓✓
   (c) cT
   (d) mT
   (e) mP

8. Figure (1) is a CMC analysis for the ____ level; at Edmonton, the height (above sea level) of this surface is about ____

   (a) surface; 700 m
   (b) 850 hPa; 146 dam ✓✓
   (c) 700 hPa; 146 dam
   (d) 500 hPa; 46 dam
   (e) 250 hPa; 460 dam

9. Referring to Figure (1), warm advection is occurring at location(s) ____

   (a) A
   (b) B ✓✓
   (c) C
   (d) A & B
   (e) A & C

10. Referring to Figure (2), the ratio of the lengths L1, L2 as measured by a ruler on the map is about L1/L2 = 1/4 and the true (geographic) distance corresponding to L2 is 11×111 km. According to the Geostrophic wind equation, the wind speed at Baker lake is expected to be about ____ $\mathrm{m\,s^{-1}}$

   (a) 5
   (b) 10
   (c) 15
   (d) 30 ✓✓
   (e) 50

Equations and Data.

- one full barb on the wind vector corresponds to 5 $\mathrm{m\ s^{-1}}$, and a solid triangle corresponds to 25 $\mathrm{m\ s^{-1}}$

- $V = \frac{g}{f}\,\frac{\Delta h}{\Delta n}$

  The Geostrophic wind equation. Δh [m], the change in height of a constant pressure surface over distance Δn [m] normal to (i.e. perpendicular to) the height contours; $f = 2\Omega\ \sin\phi$ [$\mathrm{s^{-1}}$] the Coriolis parameter (where $\Omega = 2\pi/(24\text{x}60\text{x}60) = 7.27\text{x}10^{-5}\ \mathrm{s^{-1}}$ is the angular velocity of the earth, and ϕ is latitude); $g = 9.81$ [$\mathrm{m\ s^{-2}}$] acceleration due to gravity.

- $\frac{\Delta\zeta}{\Delta t} = -\,\zeta\ div$

  The Vorticity Theorem. $\Delta\zeta$ [s^{-1}], the change in the absolute vorticity ($\zeta = f + \omega_R$) of a parcel over time interval Δt; div [s^{-1}] the divergence.

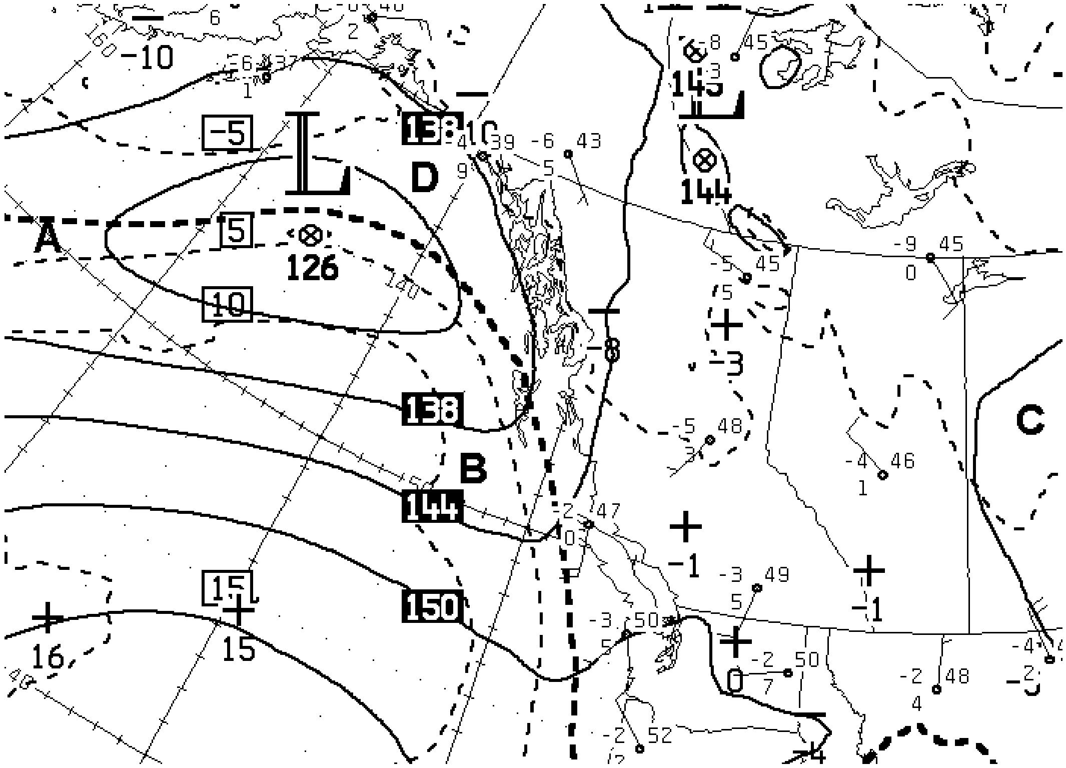

Figure 1: CMC analysis 00Z Thurs 29 Oct. 2009.

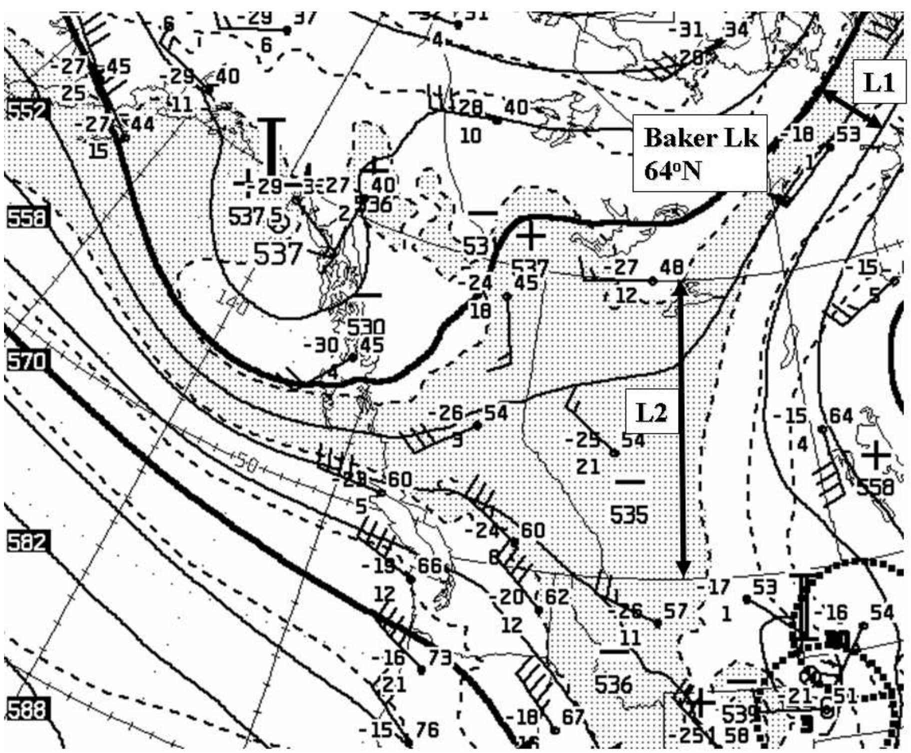

Figure 2: CMC analysis. Question 10 refers to windspeed at Baker Lake, the station at 64°N reporting $T = -18$°C.