EAS270, "The Atmosphere" Quiz 3 17 Nov., 2006

Professor: J.D. Wilson Time available: 25 mins Potential Value: 10%

Instructions: For all 16 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. The concept of "airmass weather" refers to _____
 - (a) a period of unsettled, stormy weather
 - (b) a period of settled, rather constant weather $\checkmark \checkmark$
 - (c) weather that occurs during frontal passage
 - (d) cloudy weather in which the diurnal temperature wave has reduced amplitude
 - (e) the weather associated with airmass thunderstorms
- 2. Of the four most common airmass types, that which is considered the most stable in relation to convection is _____
 - (a) mT
 - (b) cT
 - (c) mP
 - (d) cP $\checkmark \checkmark$
 - (e) maritime cT
- 3. The polar jet stream is _____ and should be most easily identifiable on the _____
 - (a) associated with the polar front; CMC 250 mb analysis $\checkmark \checkmark$
 - (b) associated with the polar front; CMC 850 mb analysis
 - (c) localized at 60° N (or S) and circles the globe; Edmonton sounding
 - (d) localized at 60° N (or S) and circles the globe; CMC 850 mb analysis
 - (e) a strong current at 500 mb that passes over the poles; CMC 500 mb analysis
- 4. When a weather forecast map for the 850 mb surface is created from the gridded data fields of a numerical weather model, by mapping contours of height and temperature fitted to the gridpoint data, the signal of a front would be _____
 - (a) an occlusion
 - (b) a belt of very strong winds
 - (c) a warm sector
 - (d) thunderstorms
 - (e) a belt of closely-spaced isotherms $\checkmark \checkmark$

- 5. If upper-level divergence over a surface low exceeds surface convergence, the central pressure of the low will _____
 - (a) remain steady
 - (b) oscillate
 - (c) initially fall, then rise
 - (d) decrease $\checkmark \checkmark$
 - (e) increase
- 6. The Coriolis parameter $f = 2\Omega \sin \phi$ (where Ω is the earth's rotation rate, and ϕ is latitude) has units _____ and is numerically equal to _____
 - (a) $m s^{-1}$; Coriolis force
 - (b) s; Coriolis force
 - (c) s⁻¹; earth vorticity $\checkmark \checkmark$
 - (d) $m s^{-1}$; earth vorticity
 - (e) s^{-1} ; relative vorticity
- 7. The simplest explanatory paradigm for a Rossby wave is that as a parcel moves _____
 - (a) its motion is adiabatic
 - (b) its absolute vorticity $\zeta = \text{const.} \quad \checkmark \checkmark$
 - (c) its longtitude $\theta = \text{const.}$
 - (d) its relative vorticity $\omega_r = \text{const.}$
 - (e) its latitude $\phi = \text{const.}$
- 8. In a region of the 500 mb surface where the (horizontal) divergence *div* is positive _____
 - (a) shear vorticity exists
 - (b) surface pressure rises
 - (c) surface pressure falls
 - (d) area shrinkage is occurring
 - (e) area expansion is occurring $\checkmark \checkmark$
- 9. If the pressure on the axis of a tornado $P_0 = 940$ mb and the pressure outside the tornado is P = 980 mb, a good guess for the peak tangential windspeed associated with the tornado would be about _____
 - (a) 40 kph
 - (b) 40 m s^{-1}
 - (c) 60 kph
 - (d) 60 m s⁻¹ $\checkmark \checkmark$
 - (e) 120 m s^{-1}

- 10. Upper level divergence _____ ascent, and is more likely to be found in a longwave trough _____ region
 - (a) induces; entry
 - (b) suppresses; entry
 - (c) induces; exit $\checkmark \checkmark$
 - (d) suppresses; exit
 - (e) cancels; baroclinic
- 11. Most often the two contributions to horizontal divergence, viz. speed divergence and diffluence, _____
 - (a) partially compensate by having opposite signs $\checkmark \checkmark$
 - (b) reinforce each other by having the same sign
 - (c) combine to produce the mesocyclone within a supercell storm
 - (d) combine to produce a quasi-stationary front
 - (e) result in an increase of earth vorticity
- 12. Fig.(1) is the product of a _____ satellite, and the field represented is _____
 - (a) geostationary; ocean surface pressure
 - (b) geostationary; windspeed near the ocean surface
 - (c) polar orbiting; windspeed near the ocean surface $\checkmark\checkmark$
 - (d) polar orbiting; ocean surface pressure
 - (e) polar orbiting; ocean surface temperature
- 13. Which of the following generic distinctions between the attributes (low; hurricane) of a northern hemisphere mid-latitude storm and a northern hemisphere hurricane is *false*?
 - (a) cold core; warm core
 - (b) fastest winds aloft; fastest winds near surface
 - (c) frontal structure at surface; relatively uniform low-level temperature
 - (d) cyclonic wind pattern; roughly equal frequencies of occurrence of cyclonic and anticyclonic surface winds $~\surd\checkmark$
 - (e) updraft at core; downdraft at core

For the remaining questions, please refer to the attached analyses.

- 14. On Fig.(2) the thermal feature at 850 mb in southern Alberta and Montana is a _____ while the 850 mb height contours define a _____
 - (a) quasi-stationary front; cyclone
 - (b) trowal; lee trough $\checkmark\checkmark$
 - (c) lee trough; trowal
 - (d) freezing contour; quasi-stationary front
 - (e) capping inversion; Rossby wave trough
- 15. On Fig.(2) at 700 mb the slot in the stippling (ie. zone without stippling) in southwestern Alberta implies the probability of _____ likely due to _____
 - (a) a slot of clear or clearer skies; adiabatic compression of flow down the lee slopes $\checkmark \checkmark$
 - (b) a shield of cloud; adiabatic compression of flow down the lee slopes
 - (c) a shield of cloud; adiabatic expansion of flow down the lee slopes
 - (d) a trowal; adiabatic expansion of flow down the lee slopes
 - (e) cyclogenesis; clear skies
- 16. Bearing in mind that there are many peaks with altitudes of the order of 3 kilometers in the Alberta and B.C. Rockies, the winds at 850 mb over the Rockies can be regarded as

- (b) running parallel to the height contours
- (c) obeying the geostrophic wind model
- (d) being a geostrophic (ie. not geostrophic), due to the influence of friction $\checkmark\checkmark$
- (e) obeying the gradient wind model

⁽a) calm

Equations and Data.

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

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

• $P - P_0 \approx \rho U^2$

Tornado force balance. LHS gives the pressure difference from the axis of the tornado to its exterior, ρ is air density, and U is the tangential windspeed.



Figure 1: Satellite image, 2138 GMT Nov. 14, 2006



Figure 2: CMC analyses, 12Z Nov.28, 2003