

ATOC 1060 section 001: Oct. 28, 12:30pm-1:45pm, 2010

Exam 2

No books or notes are allowed. Choose the correct answers (A, B, C, or D) on the answer sheet using a no. 2 pencil. Please make sure that you completely darken the appropriate bubble. **There is only one correct answer for each question (please fill only one bubble).** Each question is 2.5 points.

1. Figure 1 shows surface air pressure distribution in Boulder, Colorado. The pressure gradient force at point A is
- A. southward;
  - B. eastward;
  - C. northward;
  - D. westward.

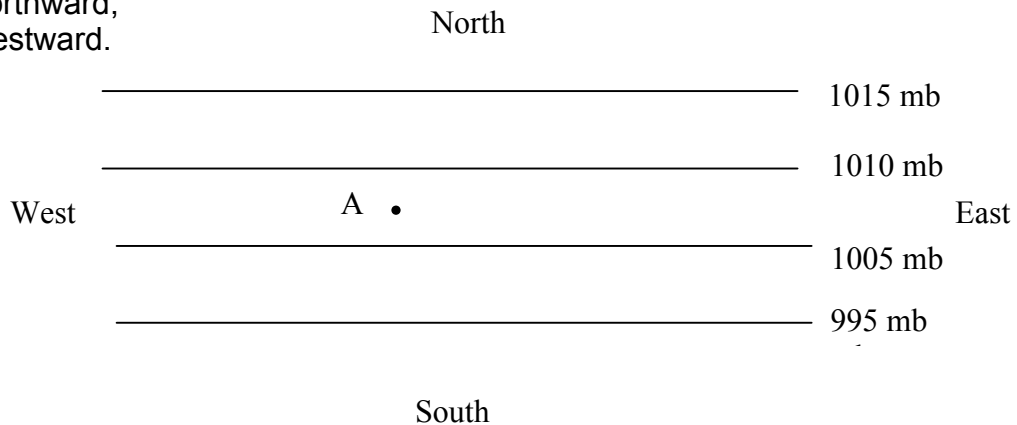


Figure 1. Surface Pressure Distribution in Boulder, Colorado.

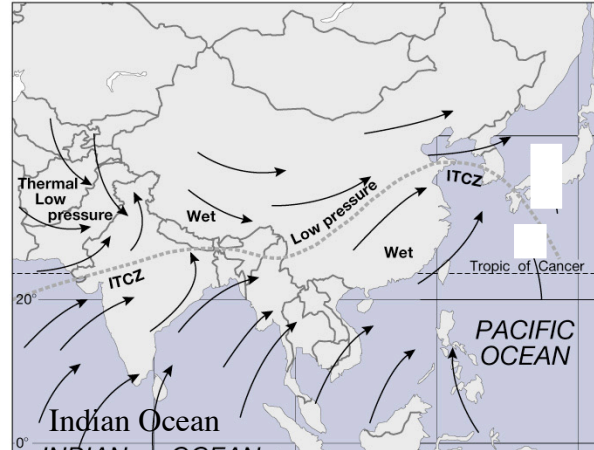
2. Assume geostrophy holds In Figure 1. The Coriolis force at point A is:
- A. northward;
  - B. eastward;
  - C. westward;
  - D. southward.
3. In Figure 1, the geostrophic wind blows toward:
- A. the north;
  - B. the east;
  - C. the west;
  - D. the south.

4. Seasonal variability of atmospheric circulation results mainly from
- A. seasonal variation of solar insolation;
  - B. seasonal variation of Coriolis force;
  - C. changes of Coriolis force with latitude;
  - D. seasonal change of ocean currents.
5. Seasonal variation of solar insolation is caused primarily by
- A. the Earth's rotational rate;
  - B. the Earth's obliquity (tilt);
  - C. changes of Coriolis force with latitude;
  - D. direction of the Earth's rotation.
6. Choose the correct statement.
- A. Land surface quickly transfers heat downward by convection;
  - B. Heat from the land surface can be quickly transferred upward by atmospheric convection;
  - C. Land surface slowly transfers heat downward by thermal conduction;
  - D. Both B and C.
7. Choose the correct statement.
- A. Ocean surface transfers heat downward mainly by thermal conduction;
  - B. Land surface transfers heat downward mainly by thermal conduction;
  - C. Ocean surface transfers heat downward quickly by turbulent mixing;
  - D. Both B and C.
8. Choose the correct statement.
- A. Ocean has a much larger heat capacity than the atmosphere;
  - B. Atmosphere has a larger heat capacity than the ocean;
  - C. Ocean and atmosphere have similar heat capacities;
  - D. none of the above.
9. Because of the land-ocean heat capacity contrasts, seasonal variability of temperature
- A. is the greatest in the tropical ocean and smallest in the interior of large continental masses;
  - B. is the smallest in the tropical ocean and largest in the interior of large continental masses;
  - C. has similar amplitudes over land and ocean;
  - D. is the largest in the tropical ocean and smallest in high latitude continent.

10. Figure 2 shows the observed surface winds (arrows) over Southeast Asia, Indian Ocean, and western Pacific Ocean during Northern Hemisphere summer. The winds over the Indian Ocean are referred to as:

- A. southeasterly trades;
- B. southwest monsoon;
- C. northeast monsoon;
- D. southwesterly trades.

Figure 2



June-July

11. In Figure 2, winds over the Indian Ocean are caused by:

- A. Indian Ocean summer heating;
- B. Indian Ocean summer cooling;
- C. Both land/ocean heating contrast and the influence of Coriolis force;
- D. Land and ocean summertime surface heating.

12. Sea breeze (wind blows from the sea to land) occurs during:

- A. Day time;
- B. Night time;
- C. Both day time and night time;
- D. None of the above.

13. Water in the Earth's system is stored in:

- A. the ocean;
- B. the land surface and subsurface;
- C. the atmosphere;
- D. all of the above.

14. Because the phase changes of water are associated with energy release or absorption, they are important for energy exchange among atmosphere, ocean, and land. Energy is released when

- A. water vapor in the atmosphere condenses to form cloud;
- B. sea water evaporates to become atmospheric water vapor;
- C. sea ice melts to become liquid water;
- D. Both B and C.

15. In figure 3, the curve shows the temperature and vapor pressure at which the air becomes saturated. For an air parcel at point P, which has a temperature of about 15°C and vapor pressure of about 8mb, it is

- A. saturated;
- B. unsaturated;
- C. supersaturated;
- D. none of the above.

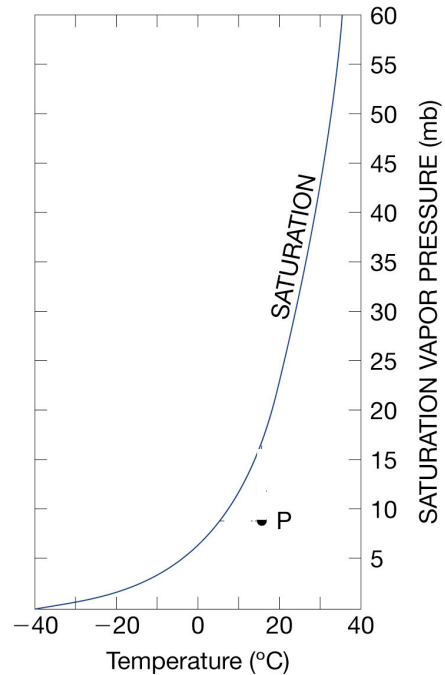


Figure 3.

16. Which of the following processes can make the air parcel at point P form a cloud?

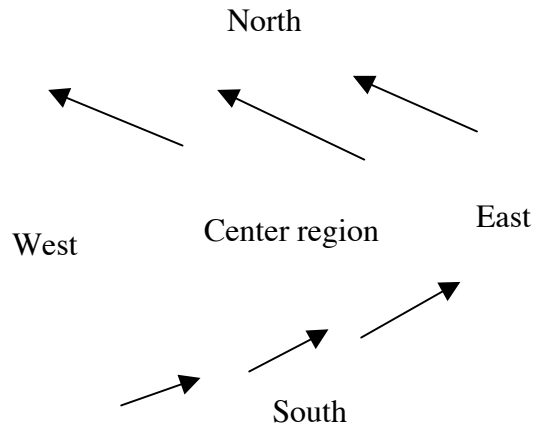
- A. lift the air parcel up so that its temperature decreases;
- B. reduce its vapor pressure;
- C. push the air parcel downward toward the Earth's surface so that its temperature increases;
- D. keep its vapor pressure but increase its temperature.

17. Due to the uplifting effects, strong precipitations are generally observed in the vicinity of

- A. ITCZ, subtropical high pressure region, and leeward (downwind) slopes of the mountains;
- B. Polar front zone, subtropical high pressure region, and windward slopes of mountains;
- C. the ITCZ, polar front zone, and windward (upwind) slopes of mountains;
- D. ITCZ, polar front zone, and subtropical high pressure regions.

18. Deserts are located in the vicinity of
- A. ascending arms of the Hadley cells;
  - B. descending arms of the Hadley cells;
  - C. windward slopes of mountains;
  - D. ITCZ.
19. Along the coasts of southwest Africa, the driest desert (Namib Desert) is observed. This type of desert is called “littoral” or “alongshore” desert. It is due to
- A. the alongshore cold currents warm the air and increase evaporation, and thus inhibit convection;
  - B. the alongshore cold currents cool the air and reduce evaporation, and thus inhibit convection;
  - C. the alongshore warm currents increase evaporation;
  - D. none of the above.
20. Surface circulations of the *subtropical oceans* are dominated by
- A. Antarctic Circumpolar Currents;
  - B. eastward currents;
  - C. Subtropical Gyres;
  - D. westward currents.
21. In the subtropical oceans, surface circulation in the eastern and western basins are
- A. symmetric; western boundary currents and eastern boundary currents have similar strengths;
  - B. asymmetric; western boundary currents are much slower than eastern boundary currents;
  - C. asymmetric; the western boundary currents are much stronger, wider, and shallower than the eastern boundary currents;
  - D. asymmetric; the western boundary currents are much stronger, narrower, and deeper than the eastern boundary currents.
22. In the Southern Hemisphere subtropical gyre (STG) region, the prevailing winds are mid-latitudes westerlies and tropical easterlies (arrows in figure 4 below).
- A. Ekman transports diverge from the center of the STG;
  - B. Ekman transports converge to the STG region;
  - C. There are no convergence or divergence in the STG;
  - D. Ekman transports converge in the west and diverge in the east.

Figure 4.  
Southern Hemisphere



23. Sea surface height in the STG region of figure 4 is
- A. lower than its surrounding areas because of the surface Ekman divergence;
  - B. higher than its surrounding areas because of the surface Ekman convergence;
  - C. lower than its surrounding areas because of the surface Ekman convergence;
  - D. the same as that of its surrounding areas because there is no Ekman convergence or divergence in the center of the STG.
24. In areas of surface Ekman convergence,
- A. sea level drops and upwelling occurs;
  - B. sea level rises and upwelling occurs;
  - C. sea level rises and downwelling occurs;
  - D. sea level drops and downwelling occurs.
25. In areas of surface Ekman divergence,
- A. downwelling occurs and sea surface temperature (SST) decreases;
  - B. upwelling occurs and SST decreases;
  - C. downwelling occurs and SST increases;
  - D. upwelling occurs and SST increases.
26. Coastal upwelling is important for fishery, because
- A. upwelling decreases salinity;
  - B. upwelling increases SST;
  - C. upwelling causes convergence;
  - D. upwelling brings the nutrient rich water from deeper layers to the surface, where sufficient light supports life.
27. In ocean observations, we often obtain CTD data that are conducted using CTD bottles on board scientific cruises. CTD stands for
- A. Current, temperature, and density;
  - B. Conductivity (which measures salinity), temperature, and depth;
  - C. Current, temperature, and depth;
  - D. none of the above.

28. Figure 5 shows the observed SST and surface wind stress in the eastern tropical Pacific. Figure 5 demonstrates that

- A. surface water is warm in the eastern equatorial Pacific, because the equatorial Ekman convergence causes downwelling;
- B. surface water is cold in the eastern equatorial Pacific, because the equatorial Ekman divergence causes upwelling;
- C. surface water is cold in the eastern equatorial Pacific because of the equatorial Ekman convergence;
- D. surface water is warm in the eastern equatorial Pacific because of the equatorial Ekman divergence.

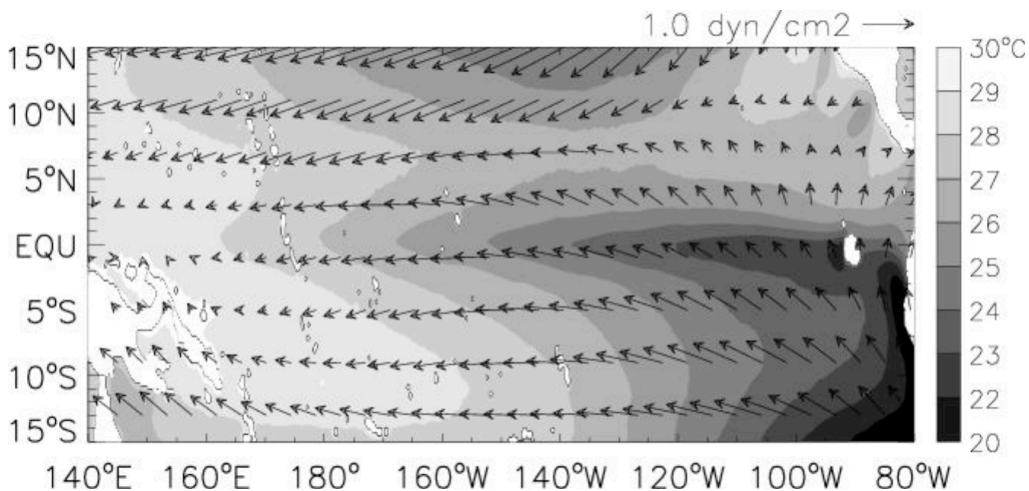


Figure 5. Observed sea surface temperature (SST) and surface windstress in the eastern equatorial Pacific.

29. Figure 5 shows that SST along the west coast of South America (the eastern boundary in the southern hemisphere) is very cold. This is because

- A. Offshore (away from the coast) Ekman transport caused by the winds induces coastal downwelling;
- B. Offshore Ekman transport caused by the winds induces coastal upwelling;
- C. Onshore (toward the coast) Ekman transport induces coastal downwelling;
- D. Onshore Ekman transport induces coastal upwelling.

30. The western boundary current of the North Atlantic is referred to as

- A. The Gulf Stream;
- B. The Kuroshio;
- C. The Antarctic Circumpolar Current;
- D. The north Atlantic drift.

31. The salt contained in seawater results mostly from the breakdown of crustal rocks (or weathering) on land. When rivers flow over or through the rocks, they remove and carry the soluble materials to the ocean.
- A. The oceans are getting saltier with time;
  - B. The oceans are getting fresher with time;
  - C. When averaged over geological timescales (millions of years), salts are removed from seawater at a rate that essentially equals the rate of input;
  - D. The oceanic salinity remains constant; it does not change with time and location.
32. Choose the correct statement.
- A. Circulation of the deep ocean results mainly from thermohaline circulation;
  - B. Circulation of the deep ocean results mainly from wind-driven circulation;
  - C. Circulation of the deep ocean is induced by the westward intensification;
  - D. Circulation of the deep ocean is induced by strong surface precipitation.
33. In the upper 50m~100m of the ocean, oceanic variables (such as temperature, salinity, and density) vary little with depth. This layer is referred to as
- A. thermocline;
  - B. halocline;
  - C. surface mixed layer;
  - D. pycnocline.
34. The pycnocline refers to the region of the ocean where
- A. salinity increases rapidly with the increase of depth;
  - B. temperature decreases rapidly with the increase of depth;
  - C. density increases rapidly with the increase of depth;
  - D. temperature increases rapidly with the increase of depth.
35. Formation of the North Atlantic Deep Water (NADW) is suggested to be mainly due to
- A. increased salinity because of evaporation exceeding precipitation;
  - B. wintertime surface cooling and sea-ice formation;
  - C. strong winds cause deep ocean currents;
  - D. strong fresh water input from rivers.
36. Choose the correct statement.
- A. The warmer, and fresher Mediterranean Sea water flows into the North Atlantic;
  - B. The warmer, and saltier Mediterranean Sea water flows into the North Atlantic;
  - C. The colder, fresher Mediterranean Sea water flows into the North Atlantic;
  - D. The colder, saltier Mediterranean Sea water flows into the North Atlantic.



37. The thermohaline conveyor belt is a significant feature of the Earth system because
- A. it plays an important role in recycling the ocean nutrients, and thus is important in affecting marine life; but it does not affect the global climate;
  - B. It is important for global heat balance and thus has a major impact on global climate;
  - C. it plays a dominant role in recycling of ocean nutrients and thus affect marine life;
  - D. Both B and C.

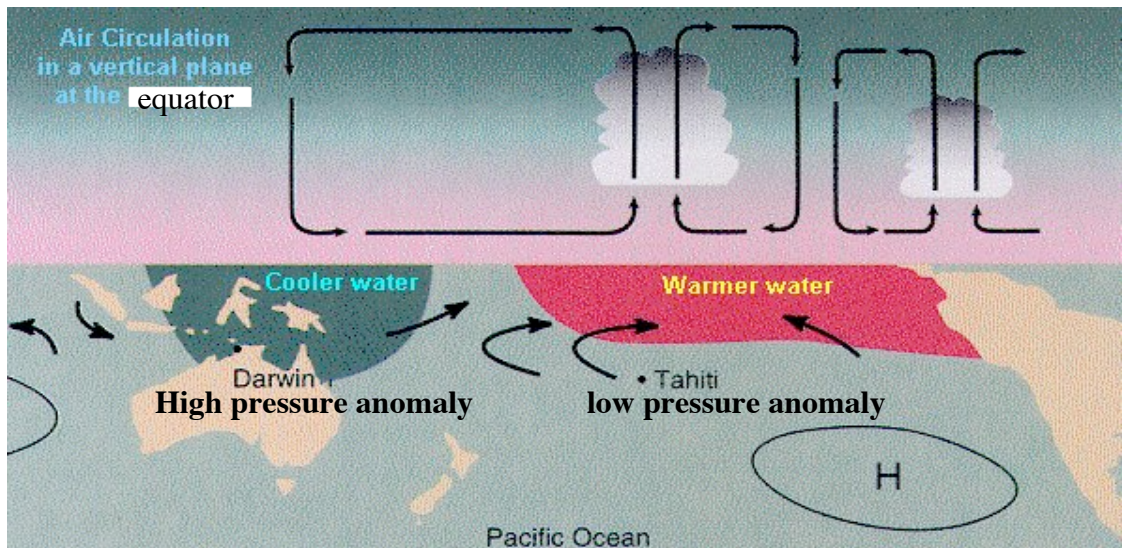


Figure 6. Schematic diagram showing atmospheric circulation in a vertical plane at the equator, together with anomalies of sea level pressure and SST.

38. Atmospheric and oceanic conditions shown in Figure 6 are associated with
- A. Normal condition;
  - B. El Nino;
  - C. Warm phase (or El Nino phase) of the Southern Oscillation;
  - D. Both B and C.
39. During an El Nino year,
- A. fish industry in Peru and Chile booms;
  - B. fish industry in Peru and Chile declines; landslides often occur;
  - C. enhanced rainfall occurs in Indonesia and Australia;
  - D. both B and C.

40. During an El Niño year,
- A. Indonesia (western Pacific) experiences flood;
  - B. Northern Australia experiences flood;
  - C. Peru and Chile (eastern Pacific) experience drought;
  - D. Asian summer monsoon generally weakens.