Remote Sensing Answer Key

1. B
2. B
3. E
4. A
5. C
6. A
7. -89°C/-129°F in Vostok, Antarctica
8. Warm/Cold

11. D

12. area of strong upward vertical motion with attendant surface pressure falls

13a. water vapor

13b. As the temperature of the atmosphere rises, more water is evaporated from ground storages (rivers, oceans, reservoirs, soil). Because the air is warmer, the absolute humidity can be higher (the air is able to 'hold' more water when it's warmer), leading to more water *vapor* in the atmosphere. As a greenhouse gas, the higher concentration of water vapor is then able to absorb more thermal IR energy radiated from the Earth, further warming the atmosphere. The warmer atmosphere can then hold more water vapor and so on. Huge scientific uncertainty exists in defining the extent and importance of this feedback loop. As water vapor increases in the atmosphere, more of it will eventually also condense into clouds, which reflect incoming solar radiation (allowing less energy to reach the Earth's surface and heat it up).

14a. Hydrologic Cycle

14b. climate conditions

14c. Precipitation and runoff

14d. Run off and groundwater flow- The oceans supply most of the evaporated water found in the atmosphere. Of this evaporated water, only 91% of it is returned to the ocean basins by way of precipitation. The remaining 9% is transported to areas over landmasses where climate factors induce the formation of precipitation. The resulting imbalance between rates of evaporation and precipitation over land and ocean is corrected by runoff and groundwater flow to the oceans.

15. CO_2 in the atmosphere and dissolved in water (forming HCO_3^-); carbonate rocks (limestone and coral = $CaCO_3$); deposits of coal, petroleum, and natural gas derived from once-living things; dead organic matter (ex: humus in soil)
16. Primarily through photoautotroph, like plants and algae, that use the energy of light to convert carbon dioxide to organic matter and to a small extent, chemoautotrophs — bacteria and archaea that do the same but use the energy derived from an oxidation of molecules in their substrate.
17. respiration (as CO_2) ; burning; decay (producing CO_2 if oxygen is present, methane (CH_4) if it is not.
18. As part of photosynthesis, trees absorb carbon dioxide. They are reservoirs of carbon because when a tree dies (by rotting, burning, etc) they release it back into the atmosphere.
19. Greenhouse effect
20. Biomass
21. Fossil Fuel
22. Pixel

23a. albedo— the fraction of Sun's radiation reflected from a surface. It is quantified as the proportion, or percentage of solar radiation of all wavelengths reflected by a body or surface to the amount incident upon it. An ideal white body has an albedo of 100% and an ideal black body, 0%. Visually we can estimate the albedo of an object's surface from its tone or color. This method suggests that albedo becomes higher as an object gets lighter in shade.

23b. eccentricity of a satellite's orbit = ratio of the satellite orbit's focus length (c) to the orbit's semi-major axis (average orbit radius) (a). It defines how elliptical the orbit is and the orbit height at the apogee and perigee points. The eccentricity of an orbit is a unitless value that ranges from 0 (perfectly circular) to 1 (parabolic). All of Earth's artificial satellites have orbit eccentricities of between 0 and 1. Within a TLE (Two Line Element) file, the decimal point is not present, but is always assumed to be placed before the first number, even if it is a zero

23c. obliquity— the angle between a planet's orbital angular momentum and its rotational angular momentum. It is an important factor in determining its climate and habitability.

23d. precession- change in the orientation of the rotation axis of a rotating body

24. Elliptical

25. Elliptical—Satellites don't always stay the same distance from Earth. The closest point a satellite comes to Earth is called its perigee. The farthest point is the apogee.

26. **Changes in orbital eccentricity**

Changes have varied with time from a circular orbit to maximum eccentricity, when the values of incoming solar radiation may have varied by as much as 30 % between perihelion and aphelion. The periodicity of this cycle is 95,800 years, during which time the Earth alternates from a circular orbit to a highly eccentric orbit and back again to a circular orbit. Changes in orbital eccentricity don't change the amount of solar radiation reaching the Earth during summer or winter, nor the total annual heat received by the hemispheres. The effect is to increase the contrast in seasonality in one hemisphere and reduce it in the other. It was believed that when this contrast was at its maximum it would cause increased snowfall in the northern hemisphere during winter. The increased global albedo resulting in a widespread snow cover— might modify the climate of the succeeding seasons and, in this way, initiate ice ages.

Changes in obliquity

Changes have varied between extreme values of 21.39° and 24.36° (present value is 23.44°) with a periodicity of 41,000 years. Increases in axial tilt result in lengthening of the period of winter darkness in polar regions. They also result in changes in the seasonal range of latitude in which the Sun occurs overhead. Changes therefore cause significant changes in the amount of solar radiation received at high latitudes but don't greatly affect the amount of incoming solar radiation at low latitudes. The resulting changes in incoming solar radiation are the same in both hemispheres

27. B

28. D

29. B

30. B

31. A

32. B

33. a) is a true color image, while b) is a false color image. These images are created by using 3 different bands to represent the 'Red', 'Green', and 'Blue' bands in a digital image. A true color image is one where the three bands selected are the same wavelength range that RGB bands are located within (2pts). These images provide scientists valuable information in regions of the electromagnetic spectrum humans cannot 'see' (2pts).

34. Advantages: provides very accurate elevation data with one pass, active sensor means data can be collected at any time of day, estimate fire fuel densities, determine forest structural age
Disadvantage: information limited to elevation, thus applicability to gather biophysical and physiological information is limited, not as effective in high density environments, canopy height typically shorter than photogrammetry and field measurements.
The image shows a clearing/shrub vegetation around ~100-500m but otherwise the canopy is relatively stable/age of forest is similar. Slope is relatively flat though it is acceptable to say that slope decrease slightly from 500-2500m

35. C

36. D

37. C

38. A

39. B

40. While there are regions of deforestation, on a whole, forest density has been increasing during this time period. Yes the forest managers can increase the density of the forest in the green area from the 2002 levels