Name: **Answer Key**   Score: **100**/100

Remote Sensing Intro Test -- ANSWER KEY

Tiebreaker: 1. Part V Score 2. Part IV Score 3. Part III Score 4. Part II Score 5. Part I Score 6. Time

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Part I. Acronyms: Write out the full name of each of these acronyms. Each acronym is worth 1 point.

1. AMSR-E **Advanced Microwave Scanning Radiometer for Earth Observing System**
2. CERES **Clouds and the Earth's Radiant Energy System**
3. MODIS **Moderate Resolution Imaging Spectrometer**
4. CALIPSO **Cloud-Aerosol Light Image Detection and Ranging and Infrared Pathfinder Satellite Observations**
5. CLOUD-SAT **Cloud Cover Statistical Analysis Program**
6. OCO-2 **Orbiting Carbon Observatory 2**
7. AURA **Aura**
8. LiDAR **Lidar Image Detection and Ranging**
9. RADAR **Radio Detection and Ranging**
10. WiFS **Wide Field Sensor**

Part II. Satellite Trivia: Answer each satellite question. ==**Each question is worth 2 points.**==

11. What was the first satellite launched in space called? **Sputnik 1**
12. When did the AMSR-E spin down to 0 rpm? **0545 EDT on Friday, December 4, 2015.**
13. How is LiDAR mechanistically different from RADAR? **LiDAR uses a laser light, not radio waves.**
14. What is another name for LiDAR? **Laser scanning or 3D scanning.**
15. In which year was MODIS first launched into orbit? **1999**
16. How many A-Train satellites are currently active? **4 satellites**
17. Formally define remote sensing. **The science of acquiring data without being in contact with it.**
18. What is a composite, in the context of remote sensing? **An image where multiple satellite images have been combined to produce a new, often more detailed, image.**
19. What is the difference between active and passive sensing? **Active sensing is when the satellite produces radiation on its own then senses the backscatter to create an image, while passive sensing senses naturally available radiation to make a picture.**
20. Allie shines a special flashlight and determines that the light combing out of her flashlight has a frequency of 10^{14} hz. What type of light is Allie's flashlight emitting? Be as specific as possible! Near-**infrared light (fun fact: this is really good for vegetation)**
2 Point Bonus Question! If you made a remote sensing image using the type of light coming out of Allie's flashlight, what would the image be most useful at showing? **Plants or Vegetation**

Part III. Physics of Remote Sensing: Answer each question on the physics of remote sensing. Each question is worth 5 points. Partial credit is available.

21. Assume that LAN is an example of a perfect blackbody radiator. Assume that the wavelength of LAN is $4.0 * 10^{-7}$ m. Determine the temperature at the surface of this star.
Use Wein's Law, which states that: $\lambda = b/T$.
Since we want to find T, $T = b/\lambda = (2.90*10^{-3})/(4*10^{-7}) = 7250°$ K.

+1 writing the equation of Wein's Law, +1 for knowing the value of b, +1 for manipulating the equation to find T, +1 for plugging λ and b into the equation, and +1 for getting the correct answer with the correct units and 2 significant figures.

22. Consider our Sun, which has a surface temperature of 5,530 degrees Celsius. Determine the total intensity of the Sun. Express your answer in $J/(s*m^2)$.
$5,530° C + 273° = 5,800° K$
Use the Stefan-Boltzmann Law, which states that the total energy given off per second by a hot source is directly proportional to the temperature to the fourth power, or $I = \sigma*T^4$. It is known that σ is a constant that equals $5.67 * 10^{-8}$.
Therefore, $I = (5.67*10^{-8}) * (5,800 K)^4$
$= 6.42 * 10^7 J/(s*m^2)$

+1 for converting Celsius into Kelvin, +1 for writing the equation for the Stefan-Boltzmann Law, +1 for knowing the value of σ, +1 for plugging the temperature and σ into the equation, +1 for getting the correct answer with the correct units and 3 significant figures.

Part IV. Climate Change Concepts: Answer each question on the impacts of climate change. Each question is worth 2 to 4 points.

23. List and write the corresponding chemical formulas for each of the four major greenhouse gases, excluding ozone. (4 pts) **Water vapor (H2O), Carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O). (1 pt each for formula and name, 0.5 pt for formula or name)**
24. Define albedo. (2 pts) **The fraction of solar energy reflected from the Earth back into space.**
25. What percentage of total world production of carbon dioxide do the developed countries contribute? (2 pts) **D. about 75%**
26. Which of the following best describes the mechanism of the greenhouse effect in Earth's atmosphere? (2 pts) **C. Infrared radiation from Earth's surface is absorbed by gases in the atmosphere.**

Part V. Map Reading: Read each image then answer the questions that follow. The questions about each image are worth a total of 10 points, but may not be equally weighted.

Image 1
27. Which satellite took this image? (2 pts) **Aqua**

28. What type of sensor took this image? **AMSR-E** (2 pts)

29. What does the white part in the image represent? (2 pts) **A hurricane**

30. What do the orange and red in the image represent? (4 pts) **Warmer areas [over 82° F]**

Image 2
31. What instrument took this image? (2 pts) **CERES**

32. What do the red areas represent? (2 pts) **Areas where net radiation is positive**

33. What do the blue areas represent? (2 pts) **Areas where net radiation is negative**

34. What season was the Northern Hemisphere in when this picture was taken? (2 pts) **Winter (December)**

35. Name one factor that could cause an area of the map to become more blue. (2 pts) **Cloud cover, type of surface, albedo.**

Image 3

36. What instrument took this image? (2 pts) **MODIS**

37. What kind of image is this? (1 pt) **True-color image**

38. What country is depicted in the image? [Hint: the image might not show all of the country] (2 pts) **United States of America**

39. What could the dark green represent? (1 pt) **The Everglades or a forest**

40. What is responsible for the greenish color of some of the water in the image? (2 pts) **Sediment and phytoplankton**

41. What does the white in the upper right corner of the image represent? (2 pts) **Clouds**

Image 4

42. What satellite took this image? (1 pt) **Aqua**

43. What does this image represent? (2 pts) **A tropical storm, hurricane, cyclone; or, a sideways view of clouds**

44. What do the blue areas towards the top of this image represent? (2 pts) **Cloud ice**

45. What do the red colors in the image represent? (1 pt) **The most intense reflected solar energy.**

46. What would you physically find if you flew a plane through the areas in the red? (1 pt) **Large amounts of water and heavy rainfall.**

47. This image relates to the radiative effect. Briefly explain what the radiative effect is. (3 pts) **The radiative effect is when clouds trap and radiate heat back to the ground, which prevents ice from freezing again and leaves more ice exposed, exacerbating the rate that sea ice melts.**

Image 5

48. What satellite took this image? (2 pts) **OCO-2**

49. What was measured by the satellite that took this remote sensing image? (2 pts) **Carbon Dioxide Levels**

50. Why is much of southern Africa red? (2 pts) **Burning of savannas and forests raised Carbon Dioxide levels there.**

51. Why is much of northern China red? (2 pts) **An abundance of factories and the wintertime burning of wood has led to higher Carbon Dioxide levels there.**

52. Why are some areas of the map shaded black and gray? (2 pts) **The satellite did not retrieve CO2 data from those areas of the map.**